U.S. Department of Transportation

Federal Railroad Administration

Maintenance-of-Way (MOW) Employee Safety System – Phase 1: Appendices A Through C

Office of Research, Development and Technology
Washington, DC 20590

DOT/FRA/ORD-19/15 June 2019

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	June 2019	Appendix 06/08/17–08/31/18

4. TITLE AND SUBTITLE
Maintenance-of-Way (MOW) Employee Safety System – Phase 1: Appendices A Through C

5. FUNDING NUMBERS
Task Order 0056

Contract Number
DTFR5311D00008L

6. AUTHOR(S)
Matthew Holcomb, Nate Stoehr, Aaron Ramos, Thomas Nast

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Transportation Technology Center, Inc.
55500 DOT Road
Pueblo, CO 81001

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Department of Transportation
Federal Railroad Administration
Office of Railroad Policy and Development
Office of Research, Development and Technology
Washington, DC 20590

10. SPONSORING/MONITORING AGENCY REPORT NUMBER
DOT/FRA/ORD-19/15

11. SUPPLEMENTARY NOTES
COR: Richard Orcutt

12a. DISTRIBUTION/AVAILABILITY STATEMENT
This document is available to the public through the FRA website.

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)
Appendices A through C contains operational use cases, a preliminary hazard analysis, and the full suite of MOWESS applications detailed in the CONOPS.

14. SUBJECT TERMS
Maintenance-of-Way Employee Safety System, MOWESS, North American railroad, maintenance-of-way, MOW, safety improvements, worker protection

15. NUMBER OF PAGES
272

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	

Appendix A.
MOWESS Operational Use Cases

Maintenance of Way Employee Safety System (MOWESS)

Baseline Use Cases

Rev 1.0

Prepared by:

Transportation Technology Center, Inc.

1. Introduction

The objective of the overall Maintenance of Way Enhanced Safety System (MOWESS) project is to create a concept of operation and system level specification for a system that enhances railroad maintenance of way (MOW) worker safety. The functions performed by the MOWESS will be determined based on the outcome of analysis to identify the most significant hazards encountered by MOW workers in the operational railroad environment.

The purpose of the MOW worker baseline use cases is to describe current railroad operating practices and scenarios associated with establishing and maintaining roadway worker protection. This set of use cases represents the base case for hazard analysis.

2. Reference Documents

1. GCOR, Seventh Edition, April 1, 2015
2. NORAC Operating Rules, Tenth Edition, November 6, 2011
3. 49 CFR Part 214

3. Abbreviations and Acronyms

CFR	Code of Federal Regulations
CP	Control Point
CTC	Centralized Traffic Control
DBO	Dispatch Back Office
EIC	Employee in Charge
EOA	Exclusive Occupancy Authority
GCOR	General Code of Operating Rules
ITD	Individual Train Detection
JO	Joint Occupancy
JOP	Joint Occupancy Protection
LW	Lone Worker
MA	Movement Authority
MOW	Maintenance of Way
MOWESS	Maintenance of Way Enhanced Safety System
NORAC	Northeast Operating Rules Advisory Committee
PTC	Positive Train Control
RR	Railroad
RWP	Railroad Worker Protection
TB	Track Bulletin
TC	Train Crew
TW	Track Warrant
TWC	Track Warrant Control
UC	Use Case
WL	Working Limits

WLP	Watchman Lookout Protection
WM	Watchman

4. Use Case Description

The use cases are grouped into sets, as shown in Table 1, to aid in organization. Each use case is assigned an identifier that includes set membership.

Table 1. Use Case Sets

Use Case Set	Set Title	Description
UC-RWP-100	Lone Worker	These use cases describe on-track protection for a lone worker who does not have formal exclusive track authority from a dispatcher.
UC-RWP-200	Watchman Lookout	These use cases describe on-track protection for a group of roadway workers who do not have formal exclusive track authority from a dispatcher.
UC-RWP-300	Acquisition of Exclusive Authority to Access Track	These use cases describe how an MOW worker, or gang of MOW workers gain exclusive or joint authority to access track from a dispatcher.
UC-RWP-400	Train Coordination	These use cases describe roadway worker on-track protection when an exclusive track authority is ceded by train crew to a roadway worker in charge.
UC-RWP-500	MOW Worker Exclusive Track Occupancy – Track Warrant Control Territory.	These use cases describe on-track protection of MOW workers when MOW workers have exclusive occupancy authority in Track Warrant Control Territory
UC-RWP-600	MOW Worker Exclusive Track Occupancy – Centralized Traffic Control Territory	These use cases describe on-track protection of MOW workers when MOW workers have exclusive occupancy

		authority in Centralized Traffic Control Territory.
UC-RWP-700	Track Bulletin	These use cases describe protection of MOW workers while working within limits of an active Track Bulletin.
UC-JOP-800	Joint Occupancy	These use cases describe protection of MOW workers accessing track of which another group of workers hold exclusive occupancy authority.

Use cases in this document are described using a common format as shown in Table 2.

Table 2. Use Case Format

Field Name	Description
ID	Unique use case identifier
Title	Name of use case
Description	Brief description of processes involved in the operating scenario.
Method of Operation	Indication of applicable railroad method of operation(s) rules. (e.g., CTC, TWC)
RR Personnel (Human Actors)	List of railroad personnel involved in the scenario, such as Employee in Charge, MOW Worker, train crew, dispatcher, etc.
RR Systems (Machine Actors)	List of railroad systems involved in scenario, such as train, PTC onboard, DBO, etc.
Reference Track Configuration	Generic track arrangement of the use case.
Initial Condition	Description of the setup situation at the start of the scenario. Include state of RR systems, authorities in place, location of RR personnel, location of trains, etc.
Trigger Event	The action and actor that initiates the described scenario. Each step should be atomic.
Scenario Steps	Description of steps/actions/events of the scenario in sequential order, and what actor performs each action.
End State (Happy Path)	Description of the final disposition of actors and when scenario is successfully completed.

References	Identification of documents or sections of documents used to define use case.

4.1. Reference Track Configurations

Reference track configurations define a basic set of use case track arrangements. Reference track configurations are intended to streamline use case definition by predefining generic track arrangements used. Additional details related to scenario conditions, such as position and movement of trains are defined within the use case descriptions. Conditions that contribute to errors or hazardous situations are examined in the hazard analysis and are not included in the use cases.

In scenarios with Exclusive Occupancy Authorities, the work zone is bounded by work limits (WL) that are defined by:

- Mile posts, stations, switches, or other clearly identifiable location in TWC, and
- Absolute signals, interlockings or control points, in CTC.

When a switch, interlocking, or CP is referenced as a WL bound, the switch is not included within the work limits unless otherwise noted in the use case description. Additionally, in multi-track territory, it is assumed that track centers are less than 20 feet unless otherwise stated in the use case description.

4.1.1. Single Track

Single mainline track with no switches within the scenario's work zone. A schematic for this case is shown in Figure 1.

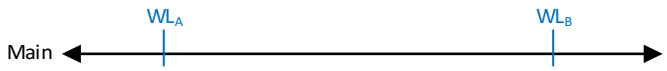


Figure 1. Single Track

4.1.2. Single Track with Uncontrolled Spur Track

Same as single track, but with a mainline switch providing access to uncontrolled (non-dispatched) spur track as shown in Figure 2.

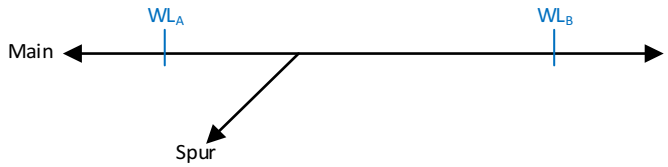


Figure 2. Single Track with Spur

4.1.3. Single Track with Diverging Mainline

Same as single track, but with a mainline switch providing access to a diverging, and dispatched, mainline track as shown in Figure 3.

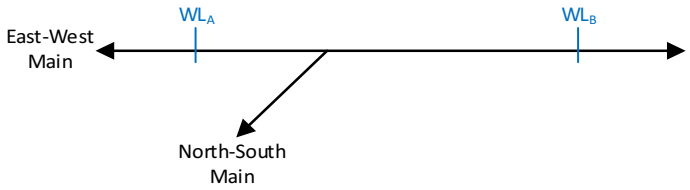


Figure 3. Single Track with Mainline Divergence

4.1.4. Single Track with Siding

Same as single track, but with two mainline switches bounding the work zone and providing access to a siding as shown in Figure 4 and Figure 3.

Figure 4. Single Track with Siding

4.1.5. Double Track

Two parallel mainline tracks with no switches within the scenario's work zone. A schematic for this case is shown in Figure 5.

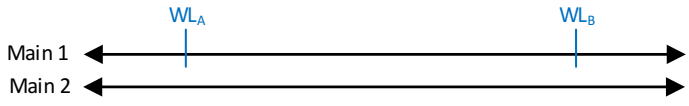


Figure 5. Double Track

4.1.6. Double Track with Crossovers

Same as double track, but with two mainline switches bounding the work zone and providing access to a second Main track as shown in Figure 6.

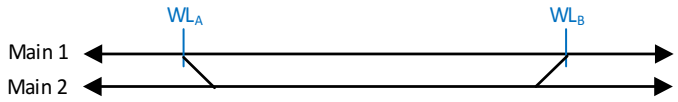


Figure 6. Double Track with Crossovers

4.1.7. Double Tack with Universal Crossovers

Same as double track, but with four mainline switches, two sets in 'V' configuration, bounding the work zone and providing access to a second Main track as shown in Figure 7.

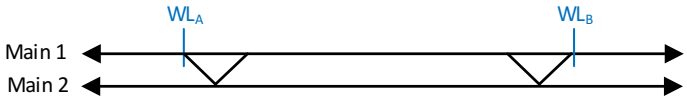


Figure 7. Double Track with Universal Crossovers

4.1.8. Triple Track

Three parallel mainline tracks, with two tracks to one side of the track defined to have a work zone, with no switches within the work area. A schematic for this case is shown in Figure 8.

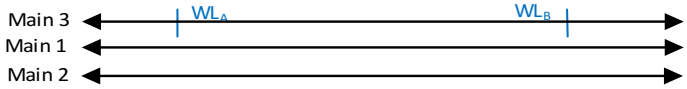


Figure 8. Triple Track

4.1.9. Quad Track

Four parallel mainline tracks, one or two tracks on either side of the track defined to have a work zone, with no switches within the work area. A schematic for this case is shown in 9.

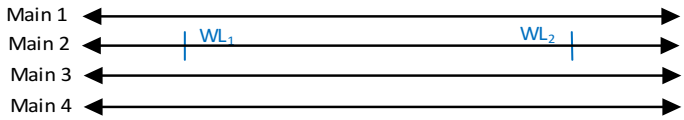


Figure 9. Quad Track

4.2. Rules for Use Case Development

Each use case is written at a specific level of system detail, and with a certain set of rules in mind. They are summarized as follows:

1) Initial conditions describe actors, actions, and circumstances that occur prior to the initiation of the scenario event. While initial conditions are not part of the scenario events, they are essential for the complete understanding of the scenario. Each initial

condition description is atomic; defining a single condition, actor, and action. Each initial condition description is complete; defining a single actor/action pair, or location/condition.

2) The trigger event defines the circumstance that initiates the scenario. The trigger event description defines the actor, action, and location of the trigger event.
3) Scenario steps define the scenario actions of the use case in the sequence in which those actions occur. Each scenario step description is atomic; defining a single actor and action. Each scenario step description is complete; defining a single actor/action pair.
4) Mechanical actors within a use case are defined at the segment level or above. For example, "Dispatch Back Office (DBO)" is used to reference the set of functions associated with dispatching and track bulletin generation, and "PTC Onboard" is used instead of a specific product name. This allows use cases to be defined at a level that is not dependent upon vendor specific product implementation.
5) The use case activities, objects, and actors shall be described in a generic manner, especially with respect to a specific railroad's operating rules and practices. For example, "Maintenance-of-Way (MOW) worker has bulletin authority to access track." will be used instead of "MOW worker has Form B." This allow uses cases to be defined in a manner that is independent of terminology or nomenclature that is specific to a railroad or set of operating rules.
6) Use cases define scenarios in which processes are executed without error and system failures have not occurred. Possible process errors, system failures, and their effects will be explored in a preliminary hazard analysis.

5. Use Cases

Assume for all adjacent tracks that track centers are less than 20 feet unless otherwise stated in scenario description.

5.1. Lone Worker Use Cases

The lone worker use case set (UC-RWP-100) describes how a lone worker, who does not have exclusive track occupancy authority from a dispatcher, performs and maintains on-track protection.

Under lone worker method of on-track protection, a single workman is responsible for spotting approaching trains with sufficient time to clear from the track. Requirements of lone worker protection are:

- Lone worker is trained and qualified to perform his/her tasks.
- Lone worker must have sight distance along track to provide a minimum warning time equal to the time required for self, and any equipment, to be clear of the track plus fifteen seconds.

- Lone worker must be working in a location where his/her ability to hear and see approaching trains and other on-track equipment is not impaired by background noise, lights, precipitation, fog, passing trains, or any other physical conditions.
- Lone worker must not engage in any activities that may distract them from his/her duties.

Table 3 provides a list of use cases in this series.

Table 3. Lone Worker Use Cases

Use Case ID	Use Case Title
UC-RWP-101	Lone Worker – Single Track
UC-RWP-102	Lone Worker – Single Track with Uncontrolled Spur Track
UC-RWP-103	Lone Worker – Single Track with Diverging Mainline
UC-RWP-104	Lone Worker – Single Track with Siding
UC-RWP-105	Lone Worker – Double Track
UC-RWP-106	Lone Worker – Double Track with Crossovers
UC-RWP-107	Lone Worker – Double Track with Universal Crossovers
UC-RWP-108	Lone Worker – Triple Track
UC-RWP-109	Lone Worker – Quad Track

5.1.1. Lone Worker – Single Track

ID	UC-RWP-101
Title	Lone Worker – Single Track
Description	LW must foul Main track to perform inspection or minor adjustment/repair. Road Train on Main track approaches work area.
Method of Operation	Any
RR Personnel	LW, TC
RR Systems	Road Train
Reference Track Configuration	Single track per Section 4.1.1.
Initial Condition	1) LW determines maximum train speed. 2) LW determines clear time. 3) LW determines site distance available. 4) LW determines site distance required. 5) Track to be accessed by LW is unoccupied. 6) LW accesses track and begins work if ITD is adequate.
Trigger Event	Road Train approaches track segment occupied by LW.
Scenario Steps	1) LW observes road train approaching. 2) TC blows whistle. 3) LW clears track.

	4) TC proceeds through track segment.
End State (Happy Path)	1) LW cleared track. 2) Road Train proceeded.
References	49 CFR 214.337, 49 CFR 214.339, GCOR 5.8

5.1.2. Lone Worker – Single Track with Uncontrolled Spur

ID	UC-RWP-102
Title	Lone Worker – Single Track with Uncontrolled Spur Track
Description	LW must foul Main track to perform inspection or minor adjustment/repair. Road train on uncontrolled spur approaches work area.
Method of Operation	Any
RR Personnel	LW, TC
RR Systems	Road Train
Reference Track Configuration	Single track with uncontrolled spur per Section 4.1.2.
Initial Condition	1) LW determines maximum train speed. 2) LW determines clear time. 3) LW determines site distance available, including spur track. 4) LW determines site distance required. 5) Track to be accessed by LW is unoccupied. 6) LW accesses track and begins work if ITD is adequate.
Trigger Event	Road train on spur track approaches track segment occupied by LW.
Scenario Steps	1) LW observes road train approaching. 2) TC blows whistle. 3) LW clears track. 4) TC proceeds through track segment.
End State (Happy Path)	1) LW cleared track. 2) Road train proceeded.
References	49 CFR 214.337, 49 CFR 214.339, GCOR 5.8

5.1.3. Lone Worker – Single Track with Diverging Mainline

ID	UC-RWP-103
Title	Lone Worker – Single Track with Diverging Mainline
Description	LW must foul East-West Main track to perform adjustments and/or minor repairs. Road train on North- South Main track approaches work area.
Method of Operation	Any
RR Personnel	LW, TC
RR Systems	Road Train
Reference Track Configuration	Single track with diverging mainline per Section 4.1.3.
Initial Condition	1) LW determines maximum train speed. 2) LW determines clear time. 3) LW determines site distance available, to include diverging mainline. 4) LW determines site distance required. 5) Track to be accessed by LW is unoccupied. 6) LW accesses East- West Main track and begins work.
Trigger Event	Road train on North-South Main approaches track segment occupied by LW.
Scenario Steps	1) LW observes road train approaching. 2) TC blows whistle. 3) LW clears track. 4) TC proceeds through track segment.
End State (Happy Path)	1) LW cleared track. 2) Road train proceeded.
References	49 CFR 214.337, 49 CFR 214.339, GCOR 5.8

5.1.4. Lone Worker – Single Track with Siding

ID	UC-RWP-104
Title	Lone Worker – Single Track with Siding
Description	LW must foul siding track to perform inspection or minor adjustment/repair. Road train on Main track approaches work area.
Method of Operation	Any
RR Personnel	LW, TC
RR Systems	Road Train
Reference Track Configuration	Single track with siding per Section 4.1.4.
Initial Condition	1) LW determines maximum train speed. 2) LW determines clear time. 3) LW determines site distance available, to include siding. 4) LW determines site distance required. 5) Siding track to be accessed by LW is unoccupied. 6) LW accesses siding track and begins work if ITD is adequate.
Trigger Event	Road train on mainline approaches siding track segment occupied by LW.
Scenario Steps	1) LW observes road train approaching. 2) TC blows whistle. 3) LW clears track. 4) TC proceeds on mainline past siding track segment.
End State (Happy Path)	1) LW cleared track. 2) Road train proceeded.
References	49 CFR 214.337, 49 CFR 214.339, GCOR 5.8

5.1.5. Lone Worker – Double Track

ID	UC-RWP-105
Title	Lone Worker – Double Track
Description	Lone worker must foul track Main 1 to perform inspection or minor adjustment/repair. Road train on track Main 2 approaches work area.
Method of Operation	Any
RR Personnel	LW, TC
RR Systems	Road Train
Reference Track Configuration	Double track per Section 4.1.5.
Initial Condition	1) LW determines maximum train speed. 2) LW determines clear time. 3) LW determines site distance available. 4) LW determines site distance required. 5) Track Main 1 to be accessed by LW is unoccupied. *6)* LW accesses track Main 1 and begins work if ITD is adequate.
Trigger Event	Road train on track Main 2 approaches track segment occupied by LW.
Scenario Steps	1) LW observes road train approaching. 2) TC blows whistle. 3) LW clears track Main 1. 4) TC proceeds through track Main 2 segment.
End State (Happy Path)	1) LW cleared track. 2) Road train proceeded.
References	49 CFR 214.337, 49 CFR 214.339, GCOR 5.8

5.1.6. Loan Worker – Double Track with Crossovers

ID: UC-RWP-106

Reference Track Configuration: Double Track with Crossovers per section 4.1.6.

- Handle in accordance with use case 5.1.5.

References: 49 CFR 214.337, 49 CFR 214.339, GCOR 5.8.2

5.1.7. Lone Worker – Double Track with Universal Crossovers

ID: UC-RWP-107

Reference Track Configuration: Double Track with Universal Crossovers per Section 4.1.7.

- Handle in accordance with use case 5.1.5.

References: 49 CFR 214.337, 49 CFR 214.339, GCOR 5.8

5.1.8. Lone Worker – Triple Track

ID	UC-RWP-108
Title	Lone Worker – Triple Track
Description	Lone worker must access track Main 3 to perform inspection or minor adjustment/repair. Road train on track Main 2 approaches work area.
Method of Operation	Any
RR Personnel	LW, TC
RR Systems	Road Train
Reference Track Configuration	Triple track per Section 4.1.8.
Initial Condition	1) LW determines maximum train speed. 2) LW determines clear time. 3) LW determines site distance available. 4) LW determines site distance required. 5) Track Main 3 to be accessed by LW is unoccupied. 6) LW accesses track Main 3 and begins work if ITD is adequate.
Trigger Event	Road train on track Main 2 approaches track segment occupied by LW. *Note: Scenario is the same as double track if train is approaching on same track or track adjacent to track occupied by LW.*
Scenario Steps	1) LW observes road train approaching. 2) TC blows whistle. 3) LW observes road train on track Main 2. 4) LW does not clear track Main 1.
End State (Happy Path)	1) LW continued work. 2) Road train proceeded.
References	49 CFR 214.337, 49 CFR 214.339, GCOR 5.8

5.1.9. Lone Worker –Quad Track

ID	UC-RWP-109
Title	Lone Worker – Quad Track
Description	Lone worker must foul track Main 2 to perform inspection or minor adjustment/repair. Road train on track Main 4 approaches work area.
Method of Operation	Any
RR Personnel	LW, TC
RR Systems	Road Train
Reference Track Configuration	Quad track per Section 4.1.9.
Initial Condition	1) LW determines maximum train speed. 2) LW determines clear time. 3) LW determines site distance available. 4) LW determines site distance required. 5) Track Main 2 to be accessed by LW is unoccupied. 6) LW accesses track Main 2 and begins work if ITD is adequate. 7) Road train is occupying track Main 4 and parallel to LW work area.
Trigger Event	Road train on track Main 4 approaches track segment occupied by LW. *Note: Scenario is the same as double track if train is approaching on same track or track adjacent to track occupied by LW.*
Scenario Steps	1) LW observes road train approaching. 2) TC blows whistle. 3) LW clears track in direction of track Main 1 (LW must cross track Main 1). 4) TC proceeds through track segment.
End State (Happy Path)	1) LW cleared track. 2) Road train proceeded.
References	49 CFR 214.337, 49 CFR 214.339, GCOR 5.8

5.2. Watchman Lookout Use Cases

The watchman lookout use case set (UC-RWP-200) describes how one or more watchmen provide protection for a group of MOW workers, who do not have exclusive track occupancy authority from a dispatcher.

Under watchman lookout method of on-track protection, one or more watchmen are responsible for spotting approaching trains and notifying roadway workers with sufficient time to clear from the track. Requirements of watchman protection are:

- Watchmen are trained and qualified to perform their tasks.
- Watchmen must have sight distance along track to provide a minimum warning time to MOW workers equal to the time required for workers, and any equipment, to be clear of the track plus fifteen seconds.
- Watchmen must have effective means to communicate with MOW workers.
- Watchmen must not engage in any activities that may distract them from their duties.

Table 4 provides a list of use cases in this series.

Table 4. Watchman Lookout Use Cases

Use Case ID	Use Case Title
UC-RWP-201	Watchman Lookout – Single Track
UC-RWP-202	Watchman Lookout – Single Track with Uncontrolled Spur Track
UC-RWP-203	Watchman Lookout – Single Track with Diverging Mainline
UC-RWP-204	Watchman Lookout – Single Track with Siding
UC-RWP-205	Watchman Lookout – Double Track
UC-RWP-206	Watchman Lookout – Double Track with Crossovers
UC-RWP-207	Watchman Lookout – Double Track with Universal Crossovers
UC-RWP-208	Watchman Lookout – Triple Track
UC-RWP-209	Watchman Lookout – Quad Track

5.2.1. Watchman Lookout – Single Track

ID	UC-RWP-201
Title	Watchmen Lookout Protection– Single Track
Description	MOW worker(s) under same WLP must foul Main track to perform adjustments and/or minor repairs. Road train on Main track approaches work area.
Method of Operation	Any
RR Personnel	WM, MOW Worker(s), TC
RR Systems	Road Train
Reference Track Configuration	Single track per Section 4.1.1.
Initial Condition	1) WM determine maximum train speed for approaches to work area. 2) WM obtain clear time estimate from MOW worker(s). 3) WM determine site distance available. 4) WM determine site distance required. 5) WM briefs MOW worker(s) on conditions (i.e. train speed, clear-to location(s), etc.) 6) WM to get in appropriate position to watch for trains and alert MOW worker(s) of approaching train. 7) Main track to be accessed by MOW worker(s) is unoccupied by train or other vehicles. 8) MOW worker(s) access track and begin work.
Trigger Event	Road train approaches track segment occupied by MOW worker(s).
Scenario Steps	1) WM observes road train approaching. 2) TC observes MOW worker(s) and blows whistle. 3) WM alerts MOW worker(s) of approaching road train. 4) MOW worker(s) clear track, to include any tools that may be in the foul. 5) Road train proceeds through track segment.
End State (Happy Path)	1) WM and MOW worker(s) cleared track. 2) Road train proceeds.
References	49 CFR 214.339, 49 CFR 214.349, GCOR 5.8

5.2.2. Watchman Lookout – Single Track with Uncontrolled Spur Track

ID	UC-RWP-202
Title	Watchmen Lookout Protection – Single Track with Uncontrolled Spur Track
Description	MOW worker(s) under same WLP must foul Main track to perform adjustments and/or minor repairs. Road train on spur track approaches work area.
Method of Operation	Any
RR Personnel	WM, MOW Worker(s), TC
RR Systems	Road Train
Reference Track Configuration	Single track with uncontrolled spur per Section 4.1.2.
Initial Condition	1) WM determine maximum train speed for approaches to work area, including spur track. 2) WM obtain clear time estimate from MOW worker(s). 3) WM determine site distance available. 4) WM determine site distance required. 5) WM briefs MOW worker(s) on conditions (i.e. train speed, clear-to location(s), etc.) 6) WM to get in appropriate position to watch for trains and alert MOW worker(s) of approaching train. 7) Main track to be accessed by MOW worker(s) is unoccupied by train or other vehicles. 8) MOW worker(s) access Main track and begin work.
Trigger Event	Road train on spur track approaches track segment occupied by MOW worker(s).
Scenario Steps	1) WM observes road train approaching on spur track. 2) TC observes MOW worker(s) and blows whistle. 3) WM alerts MOW worker(s) of approaching road train. 4) MOW worker(s) clear track, to include any tools that may be in use. 5) TC proceeds through track segment.
End State (Happy Path)	1) WM and MOW worker(s) cleared track. 2) Road train proceeds.
References	49 CFR 214.339, 49 CFR 214.349, GCOR 5.8

5.2.3. Watchman Lookout – Single Track with Diverging Mainline

ID	UC-RWP-203
Title	Watchmen Lookout Protection – Single Track with Diverging Mainline

Description	MOW worker(s) under same WLP must foul East-West Main track to perform adjustments and/or minor repairs. Road train on North- South Main track approaches work area.
Method of Operation	Any
RR Personnel	WM, MOW Worker(s), TC
RR Systems	Road Train
Reference Track Configuration	Single track with diverging mainline per Section 4.1.3.
Initial Condition	1) WM determine maximum train speed for approaches to work area, including diverging mainline. 2) WM obtain clear time estimate from MOW worker(s). 3) WM determine site distance available. 4) WM determine site distance required. 5) WM briefs MOW worker(s) on conditions (i.e. train speed, clear-to location(s), etc.) 6) WM to get in appropriate position to watch for trains and alert MOW worker(s) of approaching train. 7) Track segment to be accessed by MOW worker(s) is unoccupied by train or other vehicles. 8) MOW worker(s) access East-West Main track and begin work.
Trigger Event	Road train on North-South Main approaches track segment occupied by MOW worker(s).
Scenario Steps	1) WM observes road train approaching. 2) TC observes MOW worker(s) and blows whistle. 3) WM alerts MOW worker(s) of approaching road train. 4) Mow worker(s) clear track, to include any tools that may be in use. 5) TC proceeds on East-West Main.
End State (Happy Path)	1) WM and MOW worker(s) cleared track. 2) Road train proceeds.
References	49 CFR 214.339, 49 CFR 214.349, GCOR 5.8

5.2.4. Watchman Lookout – Single Track with Siding

ID	UC-RWP-204
Title	Watchmen Lookout Protection – Single Track with Siding
Description	MOW worker(s) under same WLP must access siding to perform adjustments and/or minor repairs. Road train on Main track approaches work area.
Method of Operation	Any
RR Personnel	WM, MOW Worker(s), TC
RR Systems	Road Train
Reference Track Configuration	Single track with siding per Section 4.1.4.
Initial Condition	1) WM determine maximum train speed for approaches to work area. 2) WM obtain clear time estimate from MOW worker(s). 3) WM determine site distance available. 4) WM determine site distance required. 5) WM briefs MOW worker(s) on conditions (i.e. train speed, clear-to location(s), etc.) 6) WM to get in appropriate position to watch for trains and alert MOW worker(s) of approaching road train. 7) Siding track segment to be accessed by MOW worker(s) is unoccupied by train or other vehicles. 8) MOW Worker(s) access siding track and begin work.
Trigger Event	Road train on Main track approaches siding track segment occupied by MOW worker(s).
Scenario Steps	1) Train approaches track segment occupied by MOW worker(s). 2) WM observes train approaching. 3) TC observes MOW worker(s) and blows whistle. 4) WM alerts MOW worker(s) of approaching train. 5) MOW worker(s) clear track, to include any tools that may be in use. 6) Road train on Main track proceeds past siding track segment.
End State (Happy Path)	1) WM and MOW worker(s) cleared track. 2) Road train proceeds.
References	49 CFR 214.339, 49 CFR 214.349, GCOR 5.8

5.2.5. Watchman Lookout – Double Track

ID	UC-RWP-205
Title	Watchmen Lookout Protection – Double Track
Description	MOW worker(s) under same WLP must foul track Main 1 to perform adjustments and/or minor repairs. Road train on track Main 2 approaches work area.
Method of Operation	Any
RR Personnel	WM, MOW Worker(s), TC
RR Systems	Road Train
Reference Track Configuration	Double track per Section 4.1.5
Initial Condition	1) WM determine maximum train speed for approaches to work area. 2) WM obtain clear time estimate from MOW worker(s). 3) WM determine site distance available. 4) WM determine site distance required. 5) WM briefs MOW worker(s) on conditions (i.e. train speed, clear-to location(s), etc.) 6) WM to get in appropriate position to watch for trains and alert MOW worker(s) of approaching train. 7) Track Main 1 to be accessed by MOW worker(s) is unoccupied by train or other vehicles. 8) MOW worker(s) access track Main 1 and begin work.
Trigger Event	Road train on track Main 2 approaches track segment adjacent to track Main 1 occupied by MOW worker(s).
Scenario Steps	1) WM observes road train approaching. 2) TC observes MOW worker(s) and blows whistle. 3) WM alerts MOW worker(s) of approaching road train. 4) MOW worker(s) clear track, to include any tools that may be in use. 5) Road train on track Main 2 proceeds past track Main 1 track segment.
End State (Happy Path)	1) WM and MOW worker(s) cleared track. 2) Road train proceeds.
References	49 CFR 214.339, 49 CFR 214.349, GCOR 5.8

5.2.6. Watchman Lookout – Double Track with Crossovers

ID: UC-RWP-206
Reference Track Configuration: Double Track with Crossovers per Section 4.1.6.

- Handle in accordance with use case 5.2.5.

References: 49 CFR 214.349, 49 CFR 214.349, GCOR 5.8

5.2.7. Watchman Lookout – Double Track with Universal Crossovers

ID: UC-RWP-207
Reference Track Configuration: Double Track with Universal Crossovers per Section 4.1.7.

- Handle in accordance with use case 5.1.5.

References: 49 CFR 214.339, 49 CFR 214.349, GCOR 5.8

5.2.8. Watchman Lookout – Triple Track

ID	UC-RWP-208
Title	Watchmen Lookout Protection – Triple Track
Description	MOW worker(s) under same WLP must foul track Main 3 to perform adjustments and/or minor repairs. Road train on track Main 2 approaches work area.
Method of Operation	Any
RR Personnel	WM, MOW Worker(s), TC
RR Systems	Road Train
Reference Track Configuration	Triple track per Section 4.1.8.
Initial Condition	1) WM determine maximum train speed for approaches to work area. 2) WM obtain clear time estimate from MOW worker(s). 3) WM determine site distance available. 4) WM determine site distance required. 5) WM briefs MOW worker(s) on conditions (i.e. train speed, clear-to location(s), etc.) 6) WM to get in appropriate position to watch for trains and alert MOW worker(s) of approaching train. 7) Track Main 3 to be accessed by MOW worker(s) is unoccupied by train or other vehicles. 8) MOW worker(s) access track Main 3 and begin work.
Trigger Event	Road train on track Main 2 approaches track segment occupied by MOW worker(s). *Note: Scenario is the same as double track if train is approaching on same track or track adjacent to track occupied by LW.*
Scenario Steps	1) WM observes road train approaching. 2) TC observes MOW worker(s) and blows whistle. 3) WM determines road train not on same track or adjacent track. 4) MOW worker(s) do not clear track. 5) Road train proceeds past work area track segment.
End State (Happy Path)	1) WM and MOW worker(s) continue work. 2) Road train proceeds.
References	49 CFR 214.339, 49 CFR 214.349, GCOR 5.8

5.2.9. Watchman Lookout – Quad Track

ID	UC-RWP-209
Title	Watchmen Lookout Protection – Quad Track

Description	MOW worker(s) under same WLP must foul track Main 2 to perform adjustments and/or minor repairs. Road train on track Main 1 approaches work area.
Method of Operation	Any
RR Personnel	WL, MOW Worker(s), TC
RR Systems	Road Train
Reference Track Configuration	Quad track per Section 4.1.9.
Initial Condition	1) WM determine maximum train speed for approaches to work area. 2) WM obtain clear time estimate from MOW worker(s). 3) WM determine site distance available. 4) WM determine site distance required. 5) WM briefs MOW worker(s) on conditions (i.e. train speed, clear-to location(s), etc.) 6) WM to get in appropriate position to watch for trains and alert worker(s) of approaching train. 7) Segment of track Main 2 to be accessed by MOW worker(s) is unoccupied by train or other vehicles. 8) Train or other vehicles are occupying track Main 4 9) MOW worker(s) access track Main 2 and begin work.
Trigger Event	Road train on track Main 1 approaches track segment occupied by MOW worker(s). *Note: Scenario is the same if train is approaching on same track or track adjacent to track occupied by LW.*
Scenario Steps	1) WM observes road train approaching. 2) TC observes MOW worker(s) and blows whistle. 3) WM alerts MOW worker(s) of approaching road train. 4) MOW worker(s) clear track, to include any tools that may be in use, in direction of track Main 1 (worker(s) must cross track Main 1). 5) Road train proceeds past work area track segment.
End State (Happy Path)	1) WM and worker(s) cleared track. 2) Road train proceeds.
References	49 CFR 214.339, 49 CFR 214.349, GCOR 5.8.2

5.3. Acquisition of Authority to Access Track Use Cases

The Acquisition of Authority to Access Track (UC-RWP-300) use case set describes the processes and communication exchange by which a TC, or EIC of a work gang, obtains exclusive occupancy of a track from a dispatcher, or by a track bulletin. Acquisition of exclusive authority cases,

themselves, do not describe how MOW workers are protected on track; rather, these cases are referenced by the UC-RWP-400 and UC-RWP-500 series use case initial conditions.

Table 5 provides a list of use cases in this series.

Table 5. Acquisition of Exclusive Authority Use Cases

Use Case ID	Use Case Title
UC-RWP-301	Acquisition of Exclusive Occupancy Authority Track Warrant Control (49 CFR 214.321, NORAC 400, GCOR 14)
UC-RWP-302	Acquisition of Exclusive Occupancy in Centralized Traffic Control (49 CFR 214.321, NORAC 400, GCOR 10)
UC-RWP-303	Acquisition of Exclusive Occupancy in Territory Governed by Block System Rules (49 CFR 214.321, NORAC 400, GCOR 9)
UC-RWP-304	Acquisition of Joint Occupancy Track Warrant (49 CFR 214.319, 49 CFR 214.321, GCOR 14)
UC-RWP-305	Acquisition of Joint/Overlapping Track and Time (49 CFR 214.321, GCOR 10.3.3)
UC-RWP-306	Acquisition of Joint/Overlapping Authority Track Permit (CFR 214.321, GCOR 9.15)
UC-RWP-307	Accessing Track Under Exclusive Occupancy Authority Held by Another Employee (49 CFR 214.319, 49 CFR 214.321, GCOR 14)
UC-RWP-308	Acquisition of Track Bulletin Protection (49 CFR 214.321, GCOR 15)

5.3.1. Acquisition of Exclusive Occupancy Authority in TWC Territory

ID	UC-RWP-301
Title	Acquisition of Exclusive Occupancy Authority Track Warrant Territory
Description	EIC of work gang, or TC, requests from dispatch, an EOA (TW) to access track TWC territory.
Method of Operation	TWC
RR Personnel	EIC (or TC), Dispatcher
RR Systems	DBO
Reference Track Configuration	Any
Initial Condition	1) Main track(s) between WL_A and WL_B (track segment AB) to be accessed by MOW gang is unoccupied. 2) No TWs providing authority to occupy track segment AB established.
Trigger Event	EIC (or TC) contacts dispatcher to request access to Main track between points A and B.
Scenario Steps	1) Dispatcher verifies, via DBO, track segment AB has no effective TW. 2) Dispatcher creates TW request via DBO. 3) Dispatcher reads TW to EIC (or TC). 4) EIC (or TC) copies TW. 5) EIC (or TC) reads back TW to Dispatcher. 6) Dispatcher verifies TW and gives OK time to EIC (or TC).
End State (Happy Path)	EOA in effect providing EIC (or TC) authority to access Main track between WL_A and WL_B.
References	49 CFR 214.321, NORAC 400, GCOR 14

5.3.2. Acquisition of Exclusive Occupancy in CTC Territory (Track and Time)

Note: Per GCOR 10.3, Track and Time does not authorize occupancy of track(s) within interlocking limits.

ID	UC-RWP-302
Title	Acquisition of Exclusive Occupancy in CTC (Track and Time)
Description	EIC of work gang, or TC, requests from dispatch, an exclusive track occupancy (Track and Time) to access track in CTC territory.
Method of Operation	CTC
RR Personnel	EIC (or TC), Dispatcher
RR Systems	DBO
Reference Track Configuration	Any
Initial Condition	1) Main track between CP WL_A and CP WL_B (track segment AB) to be accessed by MOW gang is unoccupied at the requested time. 2) No other EOA for requested track(s) over segment AB established for the requested time.
Trigger Event	EIC (or TC) contacts dispatcher to request access to Main track(s) between CP A and CP B.
Scenario Steps	1) Dispatcher verifies, via DBO, track segment AB has no effective EOA for requested time. 2) Dispatcher creates Track and Time and applies blocking of Main track(s) at CP WL_a and CP WL_b via DBO. 3) Dispatcher reads Track and Time to EIC (or TC). 4) EIC (or TC) copies Track and Time. 5) EIC (or TC) reads back Track and Time to Dispatcher. 6) Dispatcher verifies Track and Time and acknowledges accuracy to EIC (or TC).
End State (Happy Path)	EOA in effect providing EIC (or TC) authority to access Main track between WL_A and WL_B.
References	49 CFR 214.321, NORAC 400, GCOR 10

5.3.3. Acquisition of Exclusive Occupancy in Territory Governed by Block System Rules (Track Permit)

Note: Per GCOR 9.15 Track Permit limits, designated by a switch, extend only to the signal governing movement over the switch, unless otherwise designated.

Note: The primary difference between Track Permit and Track and Time is:

1) *Track Permit is effective immediately upon completion of issuing process.*
2) *Track and Time has defined start time that may or may not be the time of completion of issuance, and end time.*

ID	UC-RWP-303
Title	Acquisition of Exclusive Occupancy in Territory Governed by Block System Rules (Track Permit)
Description	EIC of work gang, or TC, requests from dispatch, an exclusive track occupancy (Track Permit) to access track in Block System Rules governed territory.
Method of Operation	Block System Rules
RR Personnel	EIC (or TC), Dispatcher
RR Systems	DBO
Reference Track Configuration	Any
Initial Condition	1) Main track between CP WL_A and CP WL_B (track segment AB) to be accessed by MOW gang is unoccupied. 2) No other EOA for requested track(s) over segment AB established.
Trigger Event	EIC (or TC) contacts dispatcher to request access to Main track(s) between CP A and CP B.
Scenario Steps	1) Dispatcher verifies, via DBO, track segment AB has no effective EOA for requested time. 2) Dispatcher creates Track Permit and applies blocking of Main track(s) at CP WL_a and CP WL_b via DBO. 3) Dispatcher reads Track Permit to EIC (or TC). 4) EIC (or TC) copies Track Permit. 5) EIC (or TC) reads back Track Permit to Dispatcher. 6) Dispatcher verifies Track Permit and acknowledges accuracy to EIC (or TC).
End State (Happy Path)	EOA in effect providing EIC (or TC) authority to access Main track between WL_A and WL_B.
References	49 CFR 214.321, NORAC 400, GCOR 9

5.3.4. Acquisition of Joint/Overlapping Occupancy Track Warrant

ID	UC-RWP-304
Title	Acquisition of Joint/Overlapping Occupancy Track Warrant
Description	EIC of work gang, or TC, requests from dispatch, a track warrant to access track segment which overlaps TW issued to a train, vehicle, or other employees.
Method of Operation	Any
RR Personnel	EIC (or TC), Dispatcher
RR Systems	DBO
Reference Track Configuration	Any
Initial Condition	1) Main track between WL_A and WL_B (track segment AB) to be accessed by MOW gang is occupied by other trains, vehicles, or employees. 2) TW(s) providing authority to (another) train to occupy track segment AB already established.
Trigger Event	EIC (or TC) contacts dispatcher to request access to Main track between points A and B.
Scenario Steps	1) Dispatcher identifies, via DBO, existing unidirectional TW for Road Train overlapping track segment AB. 2) Dispatcher informs EIC (or TC) of overlapping limits with Road Train's TW (men/equipment not to occupy track ahead of Road Train). 3) Dispatcher creates TW request via DBO (including information on joint TW). 4) Dispatcher reads TW to EIC (or TC), noting that other trains, vehicles, or employees are occupying track. 5) Dispatcher informs other TW holders that other trains, vehicles, or employees are occupying track. 6) EIC (or TC) copies TW. 7) EIC (or TC) reads back TW to Dispatcher. 8) Dispatcher verifies TW and gives OK time to EIC (or TC).
End State (Happy Path)	Joint TW in effect providing EIC (or TC) authority to access Main track between WL_A and WL_B.
References	49 CFR 214.319, 49 CFR 214.321, GCOR 14

5.3.5. Acquisition of Joint/Overlapping Track and Time

Note: Per GCOR 10.3, Track and Time does not authorize occupancy of track(s) within interlocking limits.

ID	UC-RWP-305
Title	Acquisition of Joint/Overlapping Track and Time
Description	EIC of work gang, or TC, requests from dispatch, a track occupancy authority (Track and Time) to access track in CTC territory which overlaps authority issued to a train, vehicle, or other employees.
Method of Operation	CTC
RR Personnel	EIC (or TC), Dispatcher
RR Systems	DBO
Reference Track Configuration	Any
Initial Condition	1) Main track between CP WL_A and CP WL_B (track segment AB) to be accessed by MOW gang is unoccupied at the requested time. 2) Track and time or track permit providing authority to (other) train, vehicles, or employees to occupy track segment AB already established.
Trigger Event	EIC (or TC) contacts dispatcher to request access to Main track between CP A and CP B.
Scenario Steps	1) Dispatcher verifies, via DBO, track segment AB has no effective EOA for requested time. 2) Dispatcher creates Track and Time and applies blocking of Main track(s) at CP WL_a and CP WL_b via DBO. 3) Dispatcher reads Track and Time to EIC (or TC), noting that other trains, vehicles, or employees are occupying track. 4) Dispatcher informs other track occupancy authority holders that other trains, vehicles, or employees are occupying track. 5) EIC (or TC) copies Track and Time. 6) EIC (or TC) reads back Track and Time to Dispatcher. 7) Dispatcher verifies Track and Time and acknowledges accuracy to EIC (or TC).
End State (Happy Path)	Joint Track and Time authority effect providing EIC (or TC) authority to access Main track between WL_A and WL_B.
References	49 CFR 214.321, GCOR 10.3.3

5.3.6. Acquisition of Joint/Overlapping Authority Track Permit

Note: Per GCOR 9.15 Track Permit limits, designated by a switch, extend only to the signal governing movement over the switch, unless otherwise designated.

Note: The primary difference between Track Permit and Track and Time is:

3) *Track Permit is effective immediately upon completion of issuing process.*
4) *Track and Time has defined start time that may or may not be the time of completion of issuance, and end time.*

ID	UC-RWP-306
Title	Acquisition of Joint/Overlapping Authority Track Permit
Description	EIC of work gang, or TC, requests from dispatch, track occupancy (Track Permit) to access track in Block System Rules governed territory that is occupied by another train, vehicle, or other employees.
Method of Operation	Block System Rules
RR Personnel	EIC (or TC), Dispatcher
RR Systems	DBO
Reference Track Configuration	Any
Initial Condition	1) Main track between CP WL_A and CP WL_B (track segment AB) to be accessed by MOW gang is occupied by other trains, vehicles, or employees occupying track. 2) No other EOA for requested track(s) over segment AB established.
Trigger Event	EIC (or TC) contacts dispatcher to request access to Main track(s) between CP A and CP B.
Scenario Steps	1) Dispatcher verifies, via DBO, track segment AB has no effective EOA for requested time. 2) Dispatcher creates Track Permit and applies blocking of Main track(s) at CP WL_a and CP WL_b via DBO. 3) Dispatcher reads Track Permit to EIC (or TC); noting that other trains, vehicles, or employees are occupying track. 4) Dispatcher informs other track permit holders that other trains, vehicles, or employees are occupying track. 5) EIC (or TC) copies Track Permit. 6) EIC (or TC) reads back Track Permit to Dispatcher. 7) Dispatcher verifies Track Permit and acknowledges accuracy to EIC (or TC).
End State (Happy Path)	Track Permit in effect providing EIC (or TC) authority to access Main track between WL_A and WL_B.
References	CFR 214.321, GCOR 9.15

5.3.7. Accessing Track Under Exclusive Occupancy Authority Held by Another Employee

ID	UC-RWP-307
Title	Accessing Track Under Exclusive Occupancy Authority Held by Another Employee
Description	EIC-1 of primary work gang, or TC, requests from dispatch, an EOA (TW) to access track TWC territory per UC-RWP-301 or UC-RWP-302 as appropriate.
Method of Operation	TWC, CTC
RR Personnel	EIC-1 (or TC-1), EIC-2 (or TC-2)
RR Systems	None
Reference Track Configuration	Any
Initial Condition	1) Main track(s) between WL_A and WL_B (track segment AB) to be accessed by secondary MOW gang is unoccupied. 2) Portion of track to be accessed by secondary MOW gang is away from portion of track occupied by primary MOW gang.
Trigger Event	EIC-2 (or TC-2) contacts EIC-1 (or TC-1) and requests JO under established TW.
Scenario Steps	1) EIC-1 (or TC-1) reads TW to EIC-2 (or TC-2). 2) EIC-2 (or TC-2) copies TW. 3) EIC-2 (or TC-2) reads back TW to EIC-1 (or TC-1). 4) EIC-1 (or TC-1) verifies TW and gives OK time to EIC-2 (or TC-2).
End State (Happy Path)	EOA in effect providing EIC-2 (or TC-2) authority to access Main track between WL_A and WL_B.
References	49 CFR 214.319, 49 CFR 214.321, GCOR 14

5.3.8. Acquisition of Track Bulletin Protection

ID	UC-RWP-308
Title	Acquisition of Track Bulletin Protection
Description	Track bulletin defining work zone is established in advance of EIC of work gang accessing track to perform work tasks.
Method of Operation	Any
RR Personnel	EIC (or TC), for foreman/manager of MOW, Dispatcher
RR Systems	DBO (or bulletin system)
Reference Track Configuration	Any
Initial Condition	1) EIC or manager of MOW, 24 hours or more (per RR operating practices) prior to scheduled work, enters bulletin data into RR bulletin system defining date, time, subdivision, EIC, location of work (Main track between WL_A and WL_B (track segment AB), etc.
Trigger Event	Start of day track bulletin is effective.
Scenario Steps	1) Track bulletin distributed to all trains that will operate on subdivision in which track bulletin is effective. 2) TC of each train receives track bulletin at initial station, or from prior TC. 3) TC members compare copies of track bulletin to verify. 4) TC contacts dispatch and verifies track bulletin prior to entry to subdivision.
End State (Happy Path)	Track bulletin in effect providing EIC authority to access Main track between WL_A and WL_B.
References	49 CFR 214.321, GCOR 15

5.4. Train Coordination Use Cases

The train coordination use case set (UC-RWP-400) describes how the crew of a train, which has exclusive occupancy authority over a segment of track, cedes control of that authority to an EIC who manages on-track protection through coordination of the activities of MOW workers and the train.

Under train coordination method of on-track protection, working limits are established within a segment of track(s) upon which only one train holds exclusive authority to move. Requirements of train coordination are:

- Train is visible to EIC establishing work limits.
- Train is stopped.
- Movement of train within work limits will only be made by TC at the instruction of EIC while work limits remain in effect.
- TC will not release exclusive authority to move until the work limits have been released by EIC.

Table 6 provides a list of use cases in this series.

Table 6. Train Coordination Use Cases

Use Case ID	Use Case Title
UC-RWP-401	Train Coordination – Single Track
UC-RWP-402	Train Coordination – Single Track with Uncontrolled Spur Track
UC-RWP-403	Train Coordination – Single Track with Diverging Mainline
UC-RWP-404	Train Coordination – Double Track
UC-RWP-405	Train Coordination – Double Track with Crossovers
UC-RWP-406	Train Coordination – Double Track with Universal Crossovers
UC-RWP-407	Train Coordination – Triple Track
UC-RWP-408	Train Coordination – Quad Track

5.4.1. Train Coordination – Single Track

ID	UC-RWP-401
Title	Train Coordination – Single Track
Description	Train coordination used to provide protection to MOW worker(s) accessing Main track.
Method of Operation	Train Coordination
RR Personnel	Dispatcher, TC, EIC, MOW Worker(s)
RR Systems	Dispatch, Work Train, Road Train
Reference Track Configuration	Single track per Section 4.1.1.
Initial Condition	1) TC of Work Train obtains exclusive occupancy TW on Main track between WL_A and WL_B per UC-RWP-301. 2) TC of Work Train reads TW to EIC. 3) EIC copies TW. 4) EIC reads back TW to TC of Work Train. 5) TC of Work Train verifies TW. 6) TC of Work Train cedes control to EIC. 7) MOW worker(s) access Main track, as defined in TW
Trigger Event	Road Train approaches end of MA at WL_A on Main track.
Scenario Steps	1) PTC Onboard displays end of MA at WL_A to TC of Road Train. 2) TC of Road Train contacts dispatcher and requests TW (MA) to proceed beyond WL_A on Main track. 3) Dispatcher denies TW to TC of Road Train; exclusive occupancy TW for Main track segment AB is in effect. 4) TC stops Road Train short of WL_A on Main track. 5) Upon completion of work, MOW workers clear themselves and equipment from Main track. 6) EIC verifies MOW worker(s) and equipment are clear of Main track. 7) EIC contacts TC of Work Train. 8) EIC cedes control of TW back to Work Train TC. 9) TC of Work Train contacts dispatch to request TW to proceed beyond WL_B on Main track per UC-RWP-301. 10) Work Train clears WL_B on Main track. 11) TC of Work Train contacts dispatcher and releases TW for segment AB of Main track. 12) Dispatcher clears Work Train's TW for Main track segment AB via DBO. 13) Dispatcher creates TW for Road Train that includes all or part of track segment AB via DBO.

	14) Dispatcher contacts TC of Road Train and provides TW information. 15) Dispatcher verifies receipt of TW by TC of Road Train. 16) DBO provides TW information for Road Train to PTC system. 17) PTC Onboard releases enforcement of WL_A.
End State (Happy Path)	1) Work train and MOW worker(s) are clear of Main track segment AB. 2) Road Train proceeds into Main track segment AB.
References	49 CFR 214.325, GCOR 6.3.1, NORAC 142

5.4.2. Train Coordination – Single Track with Uncontrolled Spur Track

ID	UC-RWP-402
Title	Train Coordination – Single Track with Uncontrolled Spur Track
Description	Train coordination used to provide protection to MOW worker(s) accessing Main track. Uncontrolled spur track intersects Main track within limits of exclusive occupancy authority held by Work Train. Road Train approaches on spur track.
Method of Operation	Train Coordination
RR Personnel	Dispatcher, TC, EIC, MOW Worker(s)
RR Systems	Dispatch, Work Train, Road Train
Reference Track Configuration	Single track with uncontrolled spur per Section 4.1.2.
Initial Condition	1) TC of Work Train obtains exclusive occupancy TW on Main track between WL_A and WL_B per UC-RWP-301. 2) TC of Work Train reads TW to EIC. 3) EIC copies TW 4) EIC reads back TW to TC of Work Train. 5) TC of Work Train verifies TW. 6) TC of Work Train cedes control to EIC. 7) MOW worker(s) access Main track as defined in TW.
Trigger Event	Road Train on spur track approaches junction of mainline.
Scenario Steps	1) PTC Onboard displays end of MA at junction to TC or Road Train. 2) TC of Road Train contacts dispatcher and requests TW (MA) to proceed past junction to mainline. 3) Dispatcher denies TW to TC of Road Train; exclusive occupancy TW for Main track segment AB in effect. 4) TC stops Road Train short of junction to mainline. 5) Upon completion of work, MOW worker(s) clear themselves and equipment from Main track. 6) EIC verifies workers and equipment are in the clear of Main track. 7) EIC contacts TC of Work Train to cedes control of TW back to Work Train TC. 8) TC of Work Train contacts dispatch to request TW to proceed beyond WL_B per UC-RWP-301. 9) Work Train clears of WL_B on Main track 10) Dispatcher clears Work Train's TW for Main track segment AB via DBO. 11) Dispatcher contacts TC of Road Train and provides TW information.

	12) Dispatcher verifies receipt of TW by TC of Road Train. 13) DBO provides TW information for Road Train to PTC system. 14) PTC Onboard releases enforcement of junction at mainline.
End State (Happy Path)	1) Work train and MOW worker(s) are clear of Main track segment AB. 2) Road Train proceeds into Main track segment AB.
References	49 CFR 214.325, GCOR 6.3.1, NORAC 142

5.4.3. Train Coordination – Single Track with Diverging Mainline

ID	UC-RWP-403
Title	Train Coordination – Single Track with Diverging Mainline
Description	Train coordination used to provide protection to MOW worker(s) accessing East-West Main track. Diverging North-South Main track intersects East-West Main track within limits of exclusive occupancy authority held by Work Train. Road Train approaches on diverging North-South Main track.
Method of Operation	Train Coordination
RR Personnel	Dispatcher, TC, EIC, MOW Worker(s)
RR Systems	Dispatch, Work Train, Road Train
Reference Track Configuration	Single track with diverging mainline per Section 4.1.3.
Initial Condition	1) TC of Work Train obtains exclusive occupancy TW on East-West Main track between WL_A and WL_B per UC-RWP-301. 2) TC of Work Train reads TW to EIC. 3) EIC copies TW. 4) EIC reads back TW to TC of Work Train. 5) TC of Work Train verifies TW. 6) TC of Work Train cedes control to EIC. 7) MOW worker(s) access East-West Main track, as defined in TW.
Trigger Event	Road Train on North-South Main approaches junction of mainline occupied by MOW worker(s).
Scenario Steps	1) PTC Onboard displays end of MA at junction to TC or Road Train. 2) TC of Road Train contacts dispatcher and requests TW (MA) to proceed past junction to East-West mainline. 3) Dispatcher denies TW to TC or Road Train; exclusive occupancy TW for East-West Main track segment AB in effect. 4) TC stops Road Train short of junction mainline. 5) Upon completion of work, MOW worker(s) clear themselves and equipment from East-West Main track. 6) EIC verifies workers and equipment are in the clear of East-West Main track. 7) EIC contacts TC of Work Train to cedes control of TW back to Work train TC. 8) TC of Work Train contacts dispatch to request TW to proceed beyond WL_B per UC-RWP-301.

	9) When Work Train is clear of WL_B on East-West Main track, TC of Work Train contacts dispatcher and releases TW for segment AB of East-West Main track. 10) Dispatcher clears Work Train's TW for East-West Main track segment AB via DBO. 11) Dispatcher contacts TC of Road Train and provides TW information. 12) Dispatcher verifies receipt of TW by TC of Road Train. 13) DBO provides TW information for Road Train to PTC system. 1) PTC Onboard releases enforcement at junction of mainline.
End State (Happy Path)	1) Work train and MOW worker(s) are clear of East-West Main track segment AB. 2) Road Train proceeds into East-West Main track segment AB.
References	49 CFR 214.325, GCOR 14

5.4.4. Train Coordination – Single Track with Siding

ID: UC-RWP-404

Reference Track Configuration: Single Track with Siding per Section 4.1.4.

- If switches accessing siding are included in work limits, handle in accordance with use case 5.4.1.
- If switches accessing siding are not included in work limits, handle in accordance with use case 5.4.6.

References: 49 CFR 214.325, GCOR 14

5.4.5. Train Coordination – Double Track (Exclusive Occupancy on Track Main 1 and Track Main 2)

ID	UC-RWP-405a
Title	Train Coordination – Double Track
Description	Train coordination used to provide protection to MOW worker(s) accessing track Main 1. Road Train on track Main 2 approaches work area.
Method of Operation	Train Coordination
RR Personnel	Dispatcher, TC, EIC, MOW Worker(s)
RR Systems	Dispatch, Work Train, Road Train
Reference Track Configuration	Double track per Section 4.1.5.
Initial Condition	1) TC of Work Train obtains exclusive occupancy TW on track Main 1 and track Main 2 between WL_A and WL_B per UC-RWP-301. 2) TC of Work Train reads TW to EIC. 3) EIC copies TW. 4) EIC reads back TW to TC of Work Train. 5) TC of Work Train verifies TW. 6) TC of Work Train cedes control to EIC. MOW worker(s) access tracks between WL_A and WL_B, as defined in TW.
Trigger Event	Road Train on track Main 2 approaches track segment occupied by MOW worker(s).
Scenario Steps	Handle in accordance with uses case 5.4.1. Train Coordination – Single Track.
End State (Happy Path)	1) Work Train and MOW worker(s) are clear of authority. 2) Road Train can proceed.
References	49 CFR 214.325, GCOR 14

5.4.6. Train Coordination – Double Track (Exclusive Occupancy on Track Main 1, Watchman Lookout on Track Main 2)

ID	UC-RWP-405b
Title	Train Coordination – Double Track
Description	Train coordination used to provide protection to MOW worker(s) accessing track Main 1. Train on track Main 2 approaches work area.
Method of Operation	Train Coordination
RR Personnel	Dispatcher, TC, EIC, WM, MOW Worker(s)
RR Systems	Dispatch, Work Train, Road Train
Reference Track Configuration	Double track per section 4.1.5.
Initial Condition	1) TC of Work Train obtains exclusive occupancy TW on track Main 1 between WL_A and WL_B per UC-RWP-301. 2) TC of Work Train reads TW to EIC. 3) EIC copies TW. 4) EIC reads back TW to TC of Work Train. 5) TC of Work Train verifies TW. 6) TC of Work Train cedes control to EIC. 7) EIC designates WM on track Main 2 per use case 5.2.5, Watchman Lookout Protection – Double Track. 8) MOW worker(s) access track Main 1, as defined in TW.
Trigger Event	Road Train on track Main 2 approaches track segment adjacent to track Main 1 occupied by MOW worker(s). Road Train on track Main 2 has TW to proceed past work area.
Scenario Steps	1) WM observes Road Train approaching on track Main 2. 2) TC observes MOW worker(s) on track Main 1 and blows whistle. 3) WM alerts MOW worker(s) of approaching Road Train on track Main 2. 4) MOW worker(s) clear from foul of track Main 2 and area between tracks Main 1 and Main 2, to include any tools and equipment, that may be in use. *Note: MOW worker(s) may remain within the gauge of track Main 1.* 5) Road Train on track Main 2 proceeds past track Main 1 track segment WL_A WL_B.
End State (Happy Path)	1) Road Train proceeds past work area on track Main 2. MOW worker(s) continue work on track Main 1.
References	49 CFR 214.325, 49 CFR 214.339, GCOR 14

5.4.7. Train Coordination – Double Track with Crossovers

ID: UC-RWP-406

Reference Track Configuration: Double Track with Crossovers per Section 4.1.6.

- If exclusive occupancy TW is obtained for both tracks between the same working limits, handle in accordance with use case 5.4.5.
- If exclusive occupancy TW is only obtained for track to be occupied, handle in accordance with use case 5.4.6.

References: 49 CFR 214.325, 49 CFR 214.339, GCOR 14

5.4.8. Train Coordination – Double Track with Universal Crossovers

ID: UC-RWP-407

Reference Track Configuration: Double Track with Universal Crossovers per Section 4.1.7.

- If exclusive occupancy TW is obtained for both tracks between the same working limits, handle in accordance with use case 5.4.5.
- If exclusive occupancy TW is only obtained for track to be occupied, handle in accordance with use case 5.4.6.

References: 49 CFR 214.325, 49 CFR 214.339, GCOR 14

5.4.9. Train Coordination – Triple Track

ID	UC-RWP-408
Title	Train Coordination – Triple Track
Description	Train coordination used to provide protection to MOW worker(s) accessing track Main 3. Road Train on track Main 2 approaches work area.
Method of Operation	Train Coordination
RR Personnel	Dispatcher, TC, EIC, WL, MOW Worker(s)
RR Systems	Dispatch, Work Train, Road Train
Reference Track Configuration	Triple track per Section 4.1.8.
Initial Condition	Protection established per UC-RWP-405a or UC-RWP-405b at discretion of TC/EIC.
Trigger Event	Road Train on track Main 2 approaches track parallel to segment of track Main 3 occupied by MOW Workers. Road Train on track Main 2 has TW to proceed past work area.
Scenario Steps	1) Worker(s) do not clear track Main 3. 2) Road Train proceeds past work area track segment.
End State (Happy Path)	1) Work train and workers can continue work. 2) Road Train proceeds.
References	49 CFR 214.325, GCOR 14

5.4.10. Train Coordination – Quad Track

ID: UC-RWP-409

Reference Track Configuration: Quad Track per Section 4.1.9.

- If ETO is to be acquired for occupied and adjacent tracks, handle in accordance with use case 5.4.5.
- If ETO is to be acquired for occupied track, and watchman lookout protection used for adjacent tracks, handle in accordance with use case 5.4.6.

References: 49 CFR 214.325, GCOR 14

5.5. Exclusive Track Occupancy – Track Warrant Control Use Cases

The exclusive track occupancy use case set (UC-RWP-500) describes the processes by which a MOW worker, or a MOW work gang, establishes and maintains on-track safety and interacts with trains operating near, or within, work limits defined by an exclusive track occupancy authority track warrant control. If PTC is available, then PTC system components enforce train MA limits and provide train crew information as denoted in scenario steps.

Table 7 provides a list of use cases in this series.

Table 7. Exclusive Track Occupancy – Track Warrant Control Use Cases

Use Case ID	Use Case Title
UC-RWP-501	Exclusive Track Occupancy – TWC – Single Track
UC-RWP-502	Exclusive Track Occupancy – TWC – Single Track with Uncontrolled Spur Track
UC-RWP-503	Exclusive Track Occupancy – TWC – Single Track with Diverging Mainline
UC-RWP-504	Exclusive Track Occupancy – TWC – Single Track with Siding
UC-RWP-505	Exclusive Track Occupancy – TWC – Double Track
UC-RWP-506	Exclusive Track Occupancy – TWC – Double Track with Crossovers
UC-RWP-507	Exclusive Track Occupancy – TWC – Double Track with Universal Crossovers
UC-RWP-508	Exclusive Track Occupancy – TWC – Triple Track
UC-RWP-509	Exclusive Track Occupancy – TWC – Quad Track

5.5.1. Exclusive Track Occupancy - TWC - Single Track

ID	UC-RWP-501
Title	Exclusive Track Occupancy – TWC – Single Track
Description	Exclusive occupancy authority used to provide protection to MOW worker(s) accessing Main track. Road Train on Main track approaches work area.
Method of Operation	TWC
RR Personnel	EIC, MOW Worker(s), Dispatcher, Train Crew
RR Systems	DBO, Road Train, PTC Onboard
Reference Track Configuration	Single Track per Section 4.1.1.
Initial Condition	1) EIC of MOW worker(s) obtains exclusive authority TW on Main track between WL_A and WL_B per UC-RWP-301. 2) EIC or designee displays flags at work limits as defined by applicable operating rules. 3) MOW worker(s) access Main track, as defined in TW.
Trigger Event	Road Train approaches end of MA at WL_A on Main track.
Scenario Steps	1) PTC Onboard displays end of MA at WL_A to TC. 2) TC of Road Train contacts dispatcher and requests TW to proceed beyond WL_A. 3) Dispatcher verifies, via DBO, TW is in effect for track segment AB. 4) Dispatcher denies TW to TC – exclusive occupancy TW in effect. 5) TC stops Road Train short of WL_A. 6) MOW worker(s) access Main track within track segment AB until work is complete. 7) Upon completion of work, MOW worker(s) clear themselves and equipment from track. 8) EIC verifies all worker(s) clear of track segment AB. 9) EIC contacts dispatcher and releases TW for track segment AB. 10) Dispatcher clears EIC's TW for track segment AB via DBO. 11) Dispatcher creates TW for Road Train that includes all or part of track segment AB via DBO. 12) Dispatcher contacts TC of Road Train and provides TW information. 13) Dispatcher verifies receipt of TW by TC of Road Train. 14) DBO provides TW information for Road Train to PTC system. 15) PTC Onboard releases enforcement of WL_A

End State (Happy Path)	1) MOW worker(s) are clear of Main track segment AB. 2) Road Train proceeds into Main track segment AB.
References	49 CFR 214.321, GCOR Section 14

5.5.2. Exclusive Track Occupancy – TWC – Single Track with Uncontrolled Spur Track

ID	UC-RWP-502
Title	Exclusive Track Occupancy – TWC – Single Track with Uncontrolled Spur Track
Description	Exclusive occupancy authority used to provide protection to MOW worker(s) accessing Main track. Uncontrolled spur track intersects Main track within limits of exclusive occupancy authority held by EIC of MOW worker(s). Train approaches on spur track.
Method of Operation	TWC
RR Personnel	EIC, MOW Worker(s) Dispatcher, Train Crew
RR Systems	DBO, Train, PTC Onboard
Reference Track Configuration	Single track with uncontrolled spur per Section 4.1.2.
Initial Condition	1) EIC of MOW worker(s) obtains exclusive authority TW on Main track between WL_A and WL_B per UC-RWP-301. 2) EIC or designee displays flags at work limits as defined by applicable operating rules. 3) MOW worker(s) access Main track, as defined in TW.
Trigger Event	Road Train on spur track approaches junction of mainline.
Scenario Steps	1) PTC Onboard displays end of MA at junction to mainline to TC. 2) TC of Road Train contacts dispatcher and requests TW (MA) to proceed past junction to mainline. 3) Dispatcher denies TW to TC of Road Train; exclusive occupancy TW for Main track segment AB in effect. 4) TC stops Road Train short of junction at mainline. 5) Upon completion of work, MOW workers clear themselves and equipment from track. 6) EIC verifies workers and equipment are in the clear of track. 7) EIC contacts dispatcher and releases TW for segment AB of Main track. 8) Dispatcher clears EIC's TW for Main track segment AB via DBO. 9) Dispatcher contacts TC and provides TW information. 10) Dispatcher verifies receipt of TW by TC. 11) BDO provides TW information for Road Train to PTC system. 12) PTC onboard releases enforcement of junction at mainline.
End State (Happy Path)	1) MOW worker(s) are clear of Main track segment AB. 2) Road Train proceeds onto Main track segment AB.
References	49 CFR 214.321, GCOR 6.3.1

5.5.3. Exclusive Track Occupancy – TWC – Single Track with Diverging Mainline

ID	UC-RWP-503
Title	Exclusive Occupancy – TWC – Single Track with Diverging Mainline
Description	Exclusive occupancy authority used to provide protection to MOW worker(s) accessing East-West Main track. Diverging North-South Main track intersects East-West Main track within limits of exclusive occupancy authority held by EIC of MOW worker(s). Road Train approaches on diverging North-South Main track.
Method of Operation	TWC
RR Personnel	EIC, MOW Worker(s), Dispatcher, Train Crew
RR Systems	DBO, Road Train, PTC Onboard
Reference Track Configuration	Single track with diverging mainline per Section 4.1.3.
Initial Condition	1) EIC of MOW worker(s) obtains exclusive authority TW on East-West Main track between WL_A and WL_B per UC-RWP-301. 2) EIC or designee displays flags at work limits as defined by applicable operating rules. 1) MOW worker(s) access East-West Main track, as defined in TW.
Trigger Event	Road Train on North-South Main track approaches junction of mainline occupied by MOW worker(s).
Scenario Steps	1) PTC Onboard displays end of MA at junction to mainline to TC. 2) TC of Road Train contacts dispatcher and requests TW (MA) to proceed past junction to mainline. 3) Dispatcher denies TW to TC; exclusive occupancy TW for East-West Main track segment AB in effect. 4) TC stops Road Train short of junction at mainline. 5) Upon completion of work, MOW worker(s) clear themselves and equipment from East-West Main track. 6) EIC verifies MOW worker(s) and equipment are in the clear of East-West Main track. 7) EIC contacts dispatcher and releases TW for segment AB of East-West Main track. 8) Dispatcher clears EIC's TW for East-West Main track segment AB via DBO. 9) Dispatcher contacts TC of Road Train and provides TW information. 10) Dispatcher verifies receipt of TW by TC. 11) BDO provides TW information for Road Train to PTC system. 1) PTC onboard releases enforcement of junction at mainline.

End State (Happy Path)	1) MOW worker(s) are clear of East-West Main track segment AB. 2) Road Train proceeds onto East-West Main track segment AB.
References	49 CFR 214.321, GCOR 6.3.1

5.5.4. Exclusive Track Occupancy – TWC – Single Track with Siding

ID: UC-RWP-504

Reference Track Configuration: Single Track with Siding per Section 4.1.4.

- If switches accessing siding are included in work limits, handle in accordance with use case 5.5.1.
- If switches accessing siding are not included in work limits, handle in accordance with use case 5.5.6.

References: 49 CFR 214.321, GCOR 6.3.1

5.5.5. Exclusive Track Occupancy – TWC – Double Track (Exclusive Occupancy on Track Main 1 and Track Main 2)

ID	UC-RWP-505a
Title	Exclusive Track Occupancy – TWC – Double Track
Description	Exclusive Occupancy – TWC used to provide protection to MOW worker(s) accessing track Main 1. Road Train on track Main 2 approaches work area.
Method of Operation	TWC
RR Personnel	EIC, MOW Worker(s), Dispatcher, Train Crew
RR Systems	DBO, Road Train, PTC Onboard
Reference Track Configuration	Double track per Section 4.1.5.
Initial Condition	1) EIC of MOW worker(s) obtains exclusive occupancy TW on track Main 1 and track Main 2 between WL_A and WL_B per UC-RWP-301. 2) EIC or designee displays flags at work limits as defined by applicable operating rules. 3) MOW worker(s) access tracks between WL_A and WL_B, as defined in TW.
Trigger Event	Road Train on track Main 2 approaches track segment occupied by MOW worker(s).
Scenario Steps	Handle in accordance with use case 5.5.1, Exclusive Track Occupancy – TWC – Single Track.
End State (Happy Path)	3) MOW worker(s) are clear of authority. 4) Road Train can proceed.
References	49 CFR 214.321, GCOR 14

5.5.6. Exclusive Track Occupancy – TWC – Double Track (Exclusive Occupancy on Track Main 1, Watchman Lookout on Track Main 2)

ID	UC-RWP-505b
Title	Exclusive Track Occupancy – TWC – Double Track
Description	Exclusive Occupancy – TWC used to provide protection to MOW worker(s) accessing track Main 1. Road Train on track Main 2 approaches work area.
Method of Operation	TWC
RR Personnel	EIC, WM, MOW Worker(s), Dispatcher, Train Crew
RR Systems	DBO, Road Train, PTC Onboard
Reference Track Configuration	Double track per Section 4.1.5.
Initial Condition	1) EIC of MOW worker(s) obtains exclusive occupancy TW on track Main 1 between WL_A and WL_B per UC-RWP-301. 2) EIC or designee displays flags at work limits as defined by applicable operating rules. 3) EIC designates WL on track Main 2 per use case 5.2.5. Watchman Lookout Protection – Double Track. 4) MOW worker(s) access track Main 1, as defined in TW.
Trigger Event	Road Train on track Main 2 approaches track segment adjacent to track Main 1 occupied by MOW worker(s). Road Train on track Main 2 has TW to proceed past work area.
Scenario Steps	1) WM observes Road train approaching on track Main 2. 2) TC observes MOW worker(s) on track Main 1 and blows whistle. 3) WM alerts MOW worker(s) of approaching Road train on track Main 2. 4) MOW worker(s) clear from foul of track Main 2 and area between tracks Main 1 and Main 2, to include any tools and equipment, which may be in use. *Note: MOW worker(s) may remain within the gauge of track Main 1.* 5) Road Train on track Main 2 proceeds past Main 1 track segment WL_A WL_B.
End State (Happy Path)	1) Road Train proceeds past work area on track Main 2. 2) MOW worker(s) continue work on track Main 1.
References	49 CFR 214.321, 49 CFR 214.329, 49 CFR 214.339, GCOR 14

5.5.7. Exclusive Track Occupancy – TWC – Double Track with Crossovers

ID: UC-RWP-506
Reference Track Configuration: Double Track with Crossovers per Section 4.1.6.

- If exclusive occupancy TW is obtained for both tracks between the same working limits, handle in accordance with use case 5.5.5.
- If exclusive occupancy TW is only obtained for track to be occupied, handle in accordance with use case 5.5.6.

References: 49 CFR 214.321, 49 CFR 214.329, 49 CFR 214.339, GCOR 14

5.5.8. Exclusive Track Occupancy – TWC – Double Track with Universal Crossovers

ID: UC-RWP-507
Reference Track Configuration: Double Track with Universal Crossovers per Section 4.1.7.

- If exclusive occupancy TW is obtained for both tracks between the same working limits, handle in accordance with use case 5.5.5.
- If exclusive occupancy TW is only obtained for track to be occupied, handle in accordance with use case 5.5.6.

References: 49 CFR 214.321, 49 CFR 214.329, 49 CFR 214.339, GCOR 14

5.5.9. Exclusive Track Occupancy – TWC – Triple Track

ID	UC-RWP-406
Title	Exclusive Occupancy – TWC Triple Track
Description	Exclusive Occupancy – TWC used to provide protection to MOW worker(s) accessing track Main 3. Road Train on track Main 2 approaches work area.
Method of Operation	TWC
RR Personnel	EIC, MOW Worker(s), Dispatcher, Train Crew
RR Systems	Dispatch, Work Train, Road Train
Reference Track Configuration	Triple track per Section 4.1.8.
Initial Condition	Protection established per UC-RWP-505a or UC-RWP-505b at discretion of EIC.
Trigger Event	Road Train on track Main 2 approaches track parallel to segment of track Main 3 occupied by MOW worker(s). Road Train on track Main 2 has TW to proceed past work area.
Scenario Steps	1) MOW worker(s) do not clear track. 2) Road Train proceeds past work area track segment.
End State (Happy Path)	1) Work train and MOW worker(s) can continue work. 2) Road Train proceeds.
References	49 CFR 214.321, GCOR 14

5.5.10. Exclusive Track Occupancy – TWC – Quad Track

ID: UC-RWP-509
Reference Track Configuration: Quad Track per Section 4.1.9.

- If ETO is acquired for occupied and adjacent tracks, handle in accordance with use case 5.5.5.
- If ETO is acquired for occupied track, and watchman lookout protection used for adjacent tracks, handle in accordance with use case 5.5.6.

References: 49 CFR 214.321, GCOR 14

5.6. Exclusive Track Occupancy – Centralized Traffic Control Use Cases

The exclusive track occupancy use case set (UC-RWP-600) describes the processes by which a MOW worker, or a MOW work gang, establishes and maintains on-track safety and interacts with trains operating near, or within, work limits defined by an exclusive track occupancy authority track warrant control. If PTC is available, then PTC system components enforce train MA limits and provide train crew information as denoted in scenario steps.

Table 8 provides a list of use cases in this series.

Table 8. Exclusive Track Occupancy – Centralized Traffic Control Use Cases

Use Case ID	Use Case Title
UC-RWP-601	Exclusive Track Occupancy – CTC – Single Track
UC-RWP-602	Exclusive Occupancy – CTC – Single Track with Uncontrolled Spur Track
UC-RWP-603	Exclusive Track Occupancy – CTC – Single Track with Diverging Mainline
UC-RWP-604	Exclusive Track Occupancy – CTC – Single Track with Siding
UC-RWP-605	Exclusive Track Occupancy – CTC – Double Track
UC-RWP-606	Exclusive Track Occupancy – CTC – Double Track with Crossovers
UC-RWP-607	Exclusive Track Occupancy – CTC – Double Track with Universal Crossovers
UC-RWP-608	Exclusive Track Occupancy – CTC – Triple Track
UC-RWP-609	Exclusive Track Occupancy – CTC – Quad Track

5.6.1. Exclusive Track Occupancy - CTC - Single Track

ID	UC-RWP-601
Title	Exclusive Track Occupancy – CTC – Single Track
Description	Exclusive occupancy authority used to provide protection to MOW worker(s) accessing Main track. Road Train on Main track approaches work area.
Method of Operation	CTC
RR Personnel	EIC, MOW Worker(s), Dispatcher, Train Crew
RR Systems	DBO, Road Train, PTC Onboard
Reference Track Configuration	Single Track per Section 4.1.1.
Initial Condition	1) EIC of MOW worker(s) obtains exclusive authority TW on Main track between WL_A and WL_B per UC-RWP-301. 2) MOW worker(s) access Main track, as defined in TW.
Trigger Event	Road Train approaches end of MA at WL_A on Main track.

Scenario Steps	1) PTC Onboard displays end of MA at WL_A to TC. 2) TC of Road Train contacts dispatcher and requests TW to proceed beyond WL_A. 3) Dispatcher verifies, via DBO, TW is in effect for track segment AB. 4) Dispatcher denies TW to TC – exclusive occupancy TW in effect. 5) TC stops Road Train short of WL_A. 6) MOW worker(s) access Main track within track segment AB until work is complete. 7) Upon completion of work, MOW worker(s) clear themselves and equipment from Main track. 8) EIC verifies all MOW worker(s) clear of track segment AB. 9) EIC contacts dispatcher and releases TW for track segment AB. 10) Dispatcher clears EIC's TW for track segment AB via DBO. 11) Dispatcher creates TW for Road Train that includes all or part of track segment AB via DBO. 12) Dispatcher contacts TC of Road Train and provides TW information. 13) Dispatcher verifies receipt of TW by TC. 14) DBO provides TW information for Road Train to PTC system. 15) PTC Onboard releases enforcement of WL_A.
End State (Happy Path)	1) MOW worker(s) are clear of Main track segment AB. 2) Road Train proceeds into Main track segment AB.
References	49 CFR 214.321, GCOR 14

5.6.2. Exclusive Track Occupancy – CTC – Single Track with Uncontrolled Spur Single Track

ID	UC-RWP-602
Title	Exclusive Track Occupancy – CTC – Single Track with Uncontrolled Spur Track
Description	Exclusive occupancy authority used to provide protection to MOW worker(s) accessing Main track. Uncontrolled spur track intersects Main track within limits of exclusive occupancy authority held by EIC of MOW worker(s). Road Train approaches on spur track.
Method of Operation	CTC
RR Personnel	EIC, MOW Worker(s), Dispatcher, Train Crew
RR Systems	DBO, Road Train, PTC Onboard
Reference Track Configuration	Single track with uncontrolled spur per Section 4.1.2.
Initial Condition	1) EIC of MOW worker(s) obtains exclusive authority TW on Main track between WL_A and WL_B per UC-RWP-301.

	2) MOW worker(s) access Main track, as defined in TW.
Trigger Event	Road Train on spur track approaches junction of mainline.
Scenario Steps	1) PTC Onboard displays end of MA at junction to mainline to TC. 2) TC of Road Train contacts dispatcher and requests TW (MA) to proceed past junction to mainline. 3) Dispatcher denies TW to TC of Road Train; exclusive occupancy TW for Main track segment AB in effect. 4) TC stops Road Train short of junction at mainline. 5) Upon completion of work, MOW worker(s) clear themselves and equipment from track. 6) EIC verifies MOW worker(s) and equipment are in the clear of track. 7) EIC contacts dispatcher and releases TW for segment AB of Main track. 8) Dispatcher clears EIC's TW for Main track segment AB via DBO. 9) Dispatcher contacts TC of Road Train and provides TW information. 10) Dispatcher verifies receipt of TW by TC. 11) BDO provides TW information for Road Train to PTC system. 12) PTC onboard releases enforcement of junction at mainline.
End State (Happy Path)	1) MOW worker(s) are clear of Main track segment AB. 2) Road Train proceeds onto Main track segment AB.
References	49 CFR 214.321, GCOR 6.3.1

5.6.3. Exclusive Track Occupancy – CTC – Single Track with Diverging Mainline

ID	UC-RWP-603
Title	Exclusive Occupancy – CTC – Single Track with Diverging Mainline
Description	Exclusive occupancy authority used to provide protection to MOW worker(s) accessing East-West Main track. Diverging North-South Main track intersects East-West Main track within limits of exclusive occupancy authority held by EIC of MOW worker(s). Road Train approaches on diverging North-South Main track.
Method of Operation	CTC
RR Personnel	EIC, MOW Worker(s), Dispatcher, Train Crew
RR Systems	DBO, Road Train, PTC Onboard
Reference Track Configuration	Single track with diverging mainline per Section 4.1.3.
Initial Condition	1) EIC of MOW worker(s) obtains exclusive authority TW on East-West Main track between WL_A and WL_B per UC-RWP-301. 2) MOW worker(s) access East-West Main track, as defined in TW.

Trigger Event	Road Train on North-South Main track approaches junction of mainline occupied by MOW worker(s).
Scenario Steps	1) PTC Onboard displays end of MA at junction to mainline to TC. 2) TC of Road Train contacts dispatcher and requests TW (MA) to proceed past junction to mainline. 3) Dispatcher denies TW to TC of Road Train; exclusive occupancy TW for East-West Main track segment AB in effect. 4) TC stops Road Train short of junction at mainline. 5) Upon completion of work, MOW worker(s) clear themselves and equipment from East-West Main track. 6) EIC verifies MOW worker(s) and equipment are in the clear of East-West Main track. 7) EIC contacts dispatcher and releases TW for segment AB of East-West Main track. 8) Dispatcher clears EIC's TW for East-West Main track segment AB via DBO. 9) Dispatcher contacts TC of Road Train and provides TW information. 10) Dispatcher verifies receipt of TW by TC. 11) BDO provides TW information for Road Train to PTC system. 12) PTC onboard releases enforcement of junction at mainline.
End State (Happy Path)	1) MOW worker(s) are clear of East-West Main track segment AB. 2) Road Train proceeds onto East-West Main track segment AB.
References	49 CFR 214.321, GCOR 6.3.1

5.6.4. Exclusive Track Occupancy – CTC – Single Track with Siding

ID: UC-RWP-604

Reference Track Configuration: Single Track with Siding per Section 4.1.4.

- If switches accessing siding are included in work limits, handle in accordance with use case 5.6.1.
- If switches accessing siding are not included in work limits, handle in accordance with use case 5.6.6.

References: 49 CFR 214.325, GCOR 6.3.1

5.6.5. Exclusive Track Occupancy – CTC – Double Track (Exclusive Occupancy on Track Main 1 and Track Main 2)

ID	UC-RWP-605a
Title	Exclusive Track Occupancy – CTC – Double Track

Description	Exclusive Occupancy – TWC used to provide protection to MOW worker(s) accessing track Main 1. Road Train on track Main 2 approaches work area.
Method of Operation	TWC
RR Personnel	EIC, MOW Worker(s), Dispatcher, Train Crew
RR Systems	DBO, Road Train, PTC Onboard
Reference Track Configuration	Double track per Section 4.1.5.
Initial Condition	1) EIC of MOW worker(s) obtains exclusive occupancy TW on track Main 1 and track Main 2 between WL_A and WL_B per UC-RWP-301. 2) MOW worker(s) access tracks between WL_A and WL_B, as defined in TW.
Trigger Event	Road Train on track Main 2 approaches track segment occupied by MOW worker(s).
Scenario Steps	Handle in accordance with uses case 5.5.1. Exclusive Track Occupancy – CTC – Single Track
End State (Happy Path)	1) MOW worker(s) are clear of authority. 2) Road Train can proceed.
References	49 CFR 214.321, GCOR 14

5.6.6. Exclusive Track Occupancy – CTC – Double Track (Exclusive Occupancy on Track Main 1, Watchman Lookout on Track Main 2)

ID	UC-RWP-605b
Title	Exclusive Track Occupancy – CTC – Double Track
Description	Exclusive Occupancy – CTC used to provide protection to MOW worker(s) accessing track Main 1. Road Train on track Main 2 approaches work area.
Method of Operation	TWC
RR Personnel	EIC, WM, MOW Worker(s), Dispatcher, Train Crew
RR Systems	DBO, Road Train, PTC Onboard
Reference Track Configuration	Double track per Section 4.1.5.
Initial Condition	1) EIC of MOW worker(s) obtains exclusive occupancy TW on track Main 1 between WL_A and WL_B per UC-RWP-301. 2) EIC designates WL on track Main 2 per use case 5.2.5. Watchman Lookout Protection – Double Track. 3) MOW worker(s) access track Main 1, as defined in TW.
Trigger Event	Road Train on track Main 2 approaches track segment adjacent to track Main 1 occupied by MOW worker(s). Road Train on track Main 2 has TW to proceed past work area.
Scenario Steps	1) WM observes Road Train approaching on track Main 2. 2) TC observes MOW worker(s) on track Main 1 and blows whistle. 3) WM alerts MOW worker(s) of approaching Road train on track Main 2. 4) MOW worker(s) clear from foul of track Main 2 and area between tracks Main 1 and Main 2, to include any tools and equipment, that may be in use. *Note: MOW worker(s) may remain within the gauge of track Main 1.* 5) Road Train on track Main 2 proceeds past Main 1 track segment WL_A WL_B.
End State (Happy Path)	1) MOW worker(s) continue work on track Main 1. 2) Road Train proceeds past work area on track Main 2.
References	49 CFR 214.321, 49 CFR 214.329, 49 CFR 214.339, GCOR 14

5.6.7. Exclusive Track Occupancy – CTC – Double Track with Crossovers

ID: UC-RWP-606
Reference Track Configuration: Double Track with Crossovers per Section 4.1.6.

- If exclusive occupancy TW is obtained for both tracks between the same working limits, handle per scenario 5.6.5.
- If exclusive occupancy TW is only obtained for track to be occupied, handle per scenario 5.6.6.

References: 49 CFR 214.321, 49 CFR 214.329, 49 CFR 214.339, GCOR 14

5.6.8. Exclusive Track Occupancy – CTC - Double Track with Universal Crossovers

ID: UC-RWP-607
Reference Track Configuration: Double Track with Universal Crossovers per section 4.1.7.

- If exclusive occupancy TW is obtained for both tracks between the same working limits, handle in accordance with use case 5.6.5.
- If exclusive occupancy TW is only obtained for track to be occupied, handle in accordance with use case 5.6.6.

References: 49 CFR 214.321, 49 CFR 214.329, 49 CFR 214.339, GCOR 14

5.6.9. Exclusive Track Occupancy – CTC – Triple Track

ID	UC-RWP-608
Title	Exclusive Occupancy – CTC – Triple Track
Description	Exclusive Occupancy – CTC used to provide protection to MOW worker(s) accessing track Main 3. Road Train on track Main 2 approaches work area.
Method of Operation	TWC
RR Personnel	EIC, MOW Worker(s), Dispatcher, Train Crew
RR Systems	Dispatch, Work Train, Road Train
Reference Track Configuration	Triple track per Section 4.1.8.
Initial Condition	Protection established per UC-RWP-505a or UC-RWP-505b at discretion of EIC.
Trigger Event	Road Train on track Main 2 approaches track parallel to segment of track Main 3 occupied by MOW worker(s). Road Train on track Main 2 has TW to proceed past work area.
Scenario Steps	1) MOW worker(s) do not clear track. 2) Road Train proceeds past work area track segment.
End State (Happy Path)	1) MOW worker(s) can continue work. 2) Road Train proceeds.
References	49 CFR 214.321, GCOR 14

5.6.10. Exclusive Track Occupancy – CTC – Quad Track

ID: UC-RWP-609

Reference Track Configuration: Quad Track per Section 4.1.9.

- If ETO is acquired for occupied and adjacent tracks, handle in accordance with use case 5.5.5.
- If ETO is acquired for occupied track, and watchman lookout protection used for adjacent tracks, handle in accordance with use case 5.5.6.

References: 49 CFR 214.321, GCOR 14

5.7. Track Bulletin Use Cases

The track bulletin use case set (UC-RWP-700) describes the processes by which a MOW worker, or a MOW work gang, establishes and maintains on-track safety and interacts with trains operating near, or within, work limits defined by a track bulletin. If PTC is available, then PTC system components enforce train MA limits and provide train crew information as denoted in scenario steps.

Table 9 provides a list of use cases in this series.

Table 8. Track Bulletin Use Cases

Use Case ID	Use Case Title
UC-RWP-701	Track Bulletin – Single Track
UC-RWP-702	Track Bulletin – Single Track with Uncontrolled Spur Track
UC-RWP-703	Track Bulletin – Single Track with Diverging Mainline
UC-RWP-704	Track Bulletin – Single Track with Siding
UC-RWP-705	Track Bulletin – Double Track
UC-RWP-706	Track Bulletin – Double Track with Crossovers
UC-RWP-707	Track Bulletin – Double Track with Universal Crossovers
UC-RWP-708	Track Bulletin – Triple Track
UC-RWP-709	Track Bulletin – Quad Track

5.7.1. Track Bulletin – Single Track

ID	UC-RWP-701
Title	Track Bulletin – Single Track
Description	Track bulletin used to provide protection to MOW worker(s) accessing Main track.
Method of Operation	TB
RR Personnel	EIC, MOW Worker(s), Train Crew
RR Systems	DBO, Road Train, PTC Onboard
Reference Track Configuration	Single Track per Section 4.1.1.
Initial Condition	1) EIC of MOW worker(s) obtains TB on Main track between WL_A and WL_B per UC-RWP-308. 2) MOW worker(s) access Main track, as defined in TB.
Trigger Event	Road Train approaches end of MA at WL_A on Main track.
Scenario Steps	1) TB provided to TC of Road Train at initial station unless otherwise instructed by dispatcher. 2) PTC Onboard displays end of MA at WL_A to TC. 3) TC of Road Train contacts EIC and requests permission to proceed beyond WL_A. 4) TC stops Road Train short of WL_A. 5) EIC denies TC permission past WL_A. 6) MOW worker(s) access Main track within track segment AB until work is complete. 7) Upon completion of work, MOW worker(s) clear themselves and equipment from Main track. 8) EIC verifies all MOW worker(s) are clear of track segment AB. 9) EIC contacts TC of Road Train and grants permission to proceed beyond WL_A through work zone at a given speed. 10) PTC Onboard releases enforcement of WL_A.
End State (Happy Path)	1) MOW worker(s) are clear of Main track segment AB. 2) Road Train proceeds into Main track segment AB.
References	49 CFR 214.325, GCOR 14

5.7.2. Track Bulletin – Single Track with Uncontrolled Spur Track

ID	UC-RWP-702
Title	Track Bulletin – Single Track with Uncontrolled Spur Track
Description	Track bulletin used to provide protection to MOW worker(s) accessing Main track. Uncontrolled spur track intersects Main track within limits of track bulletin. Road Train approaches on spur track.
Method of Operation	TB
RR Personnel	EIC, MOW worker(s), Train Crew
RR Systems	DBO, Road Train, PTC Onboard
Reference Track Configuration	Single Track with Uncontrolled Spur Track per Section 4.1.2.
Initial Condition	1) EIC of MOW worker(s) obtains TB on Main track between WL_A and WL_B per UC-RWP-305. 2) MOW worker(s) access Main track, as defined in TB.
Trigger Event	Road Train approaches junction to mainline on uncontrolled spur track.
Scenario Steps	1) TB provided to TC of Road Train at initial station unless otherwise instructed by dispatcher. 2) PTC Onboard displays end of MA at junction to mainline. 3) TC of Road Train contacts EIC and requests permission to proceed past junction to mainline. 4) TC stops Road Train short of junction to mainline. 5) EIC denies TC of Road Train permission past junction to mainline. 6) MOW worker(s) access Main track within track segment AB until work is complete. 7) Upon completion of work, MOW worker(s) clear themselves and equipment from Main track. 8) EIC verifies all MOW worker(s) are clear of track segment AB. 9) EIC contacts TC of Road Train and grants permission to proceed beyond junction to mainline, through work zone, at a given speed. 10) PTC Onboard releases enforcement of junction to mainline.
End State (Happy Path)	1) MOW worker(s) are clear of Main track segment AB. 2) Road Train proceeds onto Main track segment AB.
References	49 CFR 214.325, GCOR 14

5.7.3. Track Bulletin – Single Track with Diverging Mainline

ID	UC-RWP-703
Title	Track Bulletin – Single Track with Diverging Mainline
Description	Track bulletin used to provide protection to MOW worker(s) accessing East-West Main track. Diverging North-South Main track intersects East-West Main track within limits of track bulletin. Road Train approaches on diverging North-South Main track.
Method of Operation	TB
RR Personnel	EIC, MOW Worker(s), Train Crew
RR Systems	DBO, Road Train, PTC Onboard
Reference Track Configuration	Single Track with Uncontrolled Spur Track per Section 4.1.2.
Initial Condition	1) EIC of MOW worker(s) obtains TB on East-West Main track between WL_A and WL_B per UC-RWP-305. 2) MOW worker(s) access East-West Main track, as defined in TB.
Trigger Event	Road Train on North-South Main track approaches junction of mainline occupied by MOW worker(s).
Scenario Steps	1) TB provided to TC of Road Train at initial station unless otherwise instructed by dispatcher. 2) PTC Onboard displays end of MA at junction to mainline. 3) TC of Road Train contacts EIC and requests permission to proceed past junction to mainline. 4) TC stops Road Train short of junction to mainline. 5) EIC denies TC of Road Train permission past junction to mainline. 6) MOW worker(s) access East-West Main track within track segment AB until work is complete. 7) Upon completion of work, MOW worker(s) clear themselves and equipment from East-West Main track. 8) EIC verifies all MOW worker(s) are clear of East-West Main track segment AB. 9) EIC contacts TC of Road Train and grants permission to proceed beyond junction to mainline, through work zone, at a given speed. 10) PTC Onboard releases enforcement of junction to mainline.
End State (Happy Path)	3) MOW worker(s) are clear of East-West Main track segment AB.

	4) Road Train proceeds onto East-West Main track segment AB.
References	49 CFR 214.325, GCOR 14

5.7.4. Track Bulletin – Single Track with Siding

ID: UC-RWP-704

Reference Track Configuration: Single Track with Siding per Section 4.1.4.

- If switches accessing siding are included in work limits, handle in accordance with use case 5.7.1.
- If switches accessing siding are not included in work limits, handle in accordance with use case 5.7.6.

References: 49 CFR 214.325, GCOR 14

5.7.5. Track Bulletin – Double Track (Track Bulletin establishing Work Limits on Track Main 1 and Track Main 2)

ID	UC-RWP-705a
Title	Track Bulletin – Double Track
Description	Track bulletin used to provide protection to MOW worker(s) accessing Main track. Road Train on track Main 2 approaches work area.
Method of Operation	TB
RR Personnel	EIC, MOW Worker(s), Dispatcher, Train Crew
RR Systems	DBO, Road Train, PTC Onboard
Reference Track Configuration	Double track per Section 4.1.5.
Initial Condition	1) EIC of MOW worker(s) obtains TB on tracks Main 1 and Main 2 between WL_A and WL_B per UC-RWP-305. 2) MOW worker(s) access tracks between WL_A and WL_B, as defined in TW.
Trigger Event	Road Train on track Main 2 approaches track segment occupied by MOW worker(s).
Scenario Steps	Handle in accordance with uses case 5.7.1. Track Bulletin – Single Track
End State (Happy Path)	1) MOW worker(s) are clear of authority. 2) Road Train can proceed.
References	49 CFR 214.325, GCOR 14

5.7.6. Track Bulletin – Double Track (Track Bulletin establishing Work Limits on Track Main 1, Watchman Lookout on Track Main 2)

ID	UC-RWP-705b
Title	Exclusive Track Occupancy – CTC – Double Track
Description	Track bulletin used to provide protection to MOW worker(s) accessing Main track. Road Train on track Main 2 approaches work area.
Method of Operation	TB
RR Personnel	EIC, WM, MOW Worker(s), Dispatcher, Train Crew
RR Systems	DBO, Road Train, PTC Onboard
Reference Track Configuration	Double track per Section 4.1.5.
Initial Condition	1) EIC of MOW worker(s) obtains TB on track Main 1 between WL_A and WL_B per UC-RWP-305. 2) EIC designates WL on track Main 2 per use case 5.2.5. Watchman Lookout Protection – Double Track. 3) MOW worker(s) access track Main 1, as defined in TB.
Trigger Event	Road Train on track Main 2 approaches track segment adjacent to track Main 1 occupied by MOW worker(s). Road Train on track Main 2 has TW to proceed past work area.
Scenario Steps	1) WM observes Road Train approaching on track Main 2. 2) TC observes MOW worker(s) on track Main 1 and blows whistle. 3) WM alerts MOW worker(s) of approaching Road Train on track Main 2. 4) MOW worker(s) clear from foul of track Main 2 and area between tracks Main 1 and Main 2, to include any tools and equipment, which may be in use. *Note: MOW worker(s) may remain within the gauge of track Main 1.* 5) Road Train on track Main 2 proceeds past Main 1 track segment WL_A WL_B.
End State (Happy Path)	1) MOW worker(s) continue work on track Main 1. 2) Road Train proceeds past work area on track Main 2.
References	49 CFR 214.325, 49 CFR 214.339, GCOR 14

5.7.7. Track Bulletin – Double Track with Crossovers

ID: UC-RWP-706
Reference Track Configuration: Double Track with Crossovers per Section 4.1.6.

- If track bulletin is obtained for both tracks between the same working limits, handle in accordance with use case 5.7.5.
- If track bulletin is only obtained for track to be occupied, handle in accordance with use case 5.7.6.

References: 49 CFR 214.325, 49 CFR 214.339, GCOR 14

5.7.8. Track Bulletin – Double Track with Universal Crossovers

ID: UC-RWP-707
Reference Track Configuration: Double Track with Universal Crossovers per Section 4.1.7.

- If track bulletin is obtained for both tracks between the same working limits, handle in accordance with use case 5.7.5.
- If track bulletin is only obtained for track to be occupied, handle in accordance with use case 5.7.6.

References: 49 CFR 214.325, 49 CFR 214.339, GCOR 14

5.7.9. Track Bulletin – Triple Track

ID	UC-RWP-708
Title	Track Bulletin – Triple Track
Description	Track Bulletin used to provide protection to MOW worker(s) accessing track Main 3. Road Train on track Main 2 approaches work area.
Method of Operation	TWC
RR Personnel	EIC, MOW Worker(s), Dispatcher, Train Crew
RR Systems	Dispatch, Work Train, Road Train
Reference Track Configuration	Triple track per Section 4.1.8.
Initial Condition	Protection established per UC-RWP-705a or UC-RWP-705b at discretion of EIC.
Trigger Event	Road Train on track Main 2 approaches track parallel to segment of track Main 3 occupied by MOW worker(s). Road Train on track Main 2 has TW to proceed past work area.
Scenario Steps	1) MOW worker(s) do not clear track. 2) Road Train proceeds past work area track segment.
End State (Happy Path)	1) MOW worker(s) can continue work. 2) Road Train proceeds.
References	49 CFR 214.325, GCOR 14

5.7.10. Track Bulletin – Quad Track

ID: UC-RWP-709
Reference Track Configuration: Quad Track per Section 4.1.9.

- If track bulletin is acquired for occupied and adjacent tracks, handle in accordance with use case 5.7.5.
- If track bulletin is acquired for occupied track, and watchman lookout protection used for adjacent tracks, handle in accordance with use case 5.7.6.

References: 49 CFR 214.325, GCOR 14

5.8. Joint Occupancy Use Cases

The joint occupancy use case set (UC-JOP-800) describes the processes by which a separate roadway work group is afforded on-track safety by the EIC of a pre-established exclusive track occupancy, and that is located away from the EIC of the pre-established exclusive track occupancy. If PTC is available, then PTC system components enforce train MA limits and provide train crew information as denoted in scenario steps.

Maintenance-of-Way Enhanced Safety System (MOWESS) Use Cases

Table 9. Joint Occupancy Use Cases

Use Case ID	Use Case Title
UC-JOP-801	Joint Occupancy – Single Track
UC-JOP-802	Joint Occupancy – Single Track with Uncontrolled Spur Track
UC-JOP-803	Joint Occupancy – Single Track with Diverging Mainline
UC-JOP-804	Joint Occupancy – Single Track with Siding
UC-JOP-805	Joint Occupancy – Double Track
UC-JOP-806	Joint Occupancy – Double Track with Crossovers
UC-JOP-807	Joint Occupancy – Double Track with Universal Crossovers
UC-JOP-808	Joint Occupancy – Triple Track
UC-JOP-809	Joint Occupancy – Quad Track

5.8.1. Joint Occupancy – Single Track

ID	UC-JOP-801
Title	Joint Occupancy – Single Track
Description	Joint Occupancy of exclusive occupancy authority used to provide protection to a second group of MOW worker(s) accessing Main track.
Method of Operation	CTC, TWC
RR Personnel	EIC-1, EIC-2, MOW Worker(s), Train Crew
RR Systems	DBO, Road Train, PTC Onboard
Reference Track Configuration	Single Track per Section 4.1.1.
Initial Condition	1) EIC-1 of MOW worker(s) obtains exclusive authority TW on Main track between WL_A and WL_B per UC-RWP-301. 2) MOW worker(s) access Main track, as defined in TW. 3) EIC-2 of second MOW worker(s) contacts EIC-1 to obtain joint occupancy TW per UC-RWP-307. 4) MOW worker(s) in second work group access track WL_A and WL_B, as defined in TW.
Trigger Event	Road Train approaches end of MA at WL_A on Main track.
Scenario Steps	1) PTC Onboard displays end of MA at WL_A to TC. 2) TC of Road Train contacts dispatcher and requests TW to proceed beyond WL_A. 3) Dispatcher verifies, via DBO, TW is in effect for track segment AB. 4) Dispatcher denies TW to TC of Road Train – exclusive occupancy TW in effect. 5) TC stops Road Train short of WL_A. 6) MOW worker(s) access Main track within track segment AB until work is complete. 7) Upon completion of work, MOW worker(s) clear themselves and equipment from Main track. 8) EIC-1 verifies all MOW worker(s) clear of track segment AB. 9) EIC-1 contacts EIC-2 to verify all MOW worker(s) are clear of track segment AB. 10) EIC-2 confirms MOW worker(s) are clear of track segment AB. 11) EIC-2 releases JO. 12) EIC-1 contacts dispatcher and releases TW for track segment AB. 13) Dispatcher clears EIC-1's TW for track segment AB via DBO.

	14) Dispatcher creates TW for Road Train that includes all or part of track segment AB via DBO. 15) Dispatcher contacts TC of Road Train and provides TW information. 16) Dispatcher verifies receipt of TW by TC. 17) DBO provides TW information for Road Train to PTC system. 18) PTC Onboard releases enforcement of $WL_{A.}$
End State (Happy Path)	1) All MOW worker(s) are clear of Main track segment AB. 2) Road Train proceeds into Main track segment AB.
References	49 CFR 214.325, GCOR 14

5.8.2. Joint Occupancy – Single Track with Uncontrolled Spur Track

ID	UC-JOP-802
Title	Joint Occupancy – Single Track with Uncontrolled Spur Track
Description	Joint Occupancy of exclusive occupancy authority used to provide protection to a second group of MOW worker(s) accessing Main track. Uncontrolled spur track intersects Main track within limits of track bulletin. Road Train approaches on spur track.
Method of Operation	CTC, TWC
RR Personnel	EIC-1, EIC-2, MOW Worker(s), Train Crew
RR Systems	DBO, Road Train, PTC Onboard
Reference Track Configuration	Single Track with Uncontrolled Spur Track per Section 4.1.2.
Initial Condition	1) EIC-1 of MOW worker(s) obtains exclusive authority TW on Main track between WL_A and WL_B per UC-RWP-301. 2) MOW worker(s) access Main track, as defined in TW. 3) EIC-2 of second MOW worker(s) contacts EIC-1 to obtain joint occupancy TW per UC-RWP-307. 4) MOW worker(s) in second work group access track WL_A and WL_B, as defined in TW.
Trigger Event	Road Train approaches junction to mainline on uncontrolled spur track.
Scenario Steps	1) PTC Onboard displays end of MA at WL_A to TC. 2) TC of Road Train contacts dispatcher and requests TW to proceed beyond WL_A. 3) Dispatcher verifies, via DBO, TW is in effect for track segment AB. 4) Dispatcher denies TW to TC – exclusive occupancy TW in effect. 5) TC stops Road Train short of WL_A. 6) MOW worker(s) access Main track within track segment AB until work is complete. 7) Upon completion of work, MOW worker(s) clear themselves and equipment from Main track. 8) EIC-1 verifies all MOW worker(s) clear of track segment AB. 9) EIC-1 contacts EIC-2 to verify all MOW worker(s) are clear of track segment AB. 10) EIC-2 confirms MOW worker(s) are clear of track segment AB. 11) EIC-2 releases JO. 12) EIC-1 contacts dispatcher and releases TW for track segment AB.

	13) Dispatcher clears EIC-1's TW for track segment AB via DBO. 14) Dispatcher creates TW for Road Train that includes all or part of track segment AB via DBO. 15) Dispatcher contacts TC of Road Train and provides TW information. 16) Dispatcher verifies receipt of TW by TC. 17) DBO provides TW information for Road Train to PTC system. 18) PTC Onboard releases enforcement of $WL_{A.}$
End State (Happy Path)	3) All MOW worker(s) are clear of Main track segment AB. 4) Road Train proceeds into Main track segment AB.
References	49 CFR 214.325, GCOR 14

5.8.3. Joint Occupancy – Single Track with Diverging Mainline

ID	UC-JOP-803
Title	Joint Occupancy – Single Track with Diverging Mainline
Description	Joint Occupancy of exclusive occupancy authority used to provide protection to a second group of MOW worker(s) accessing East-West Main track. Diverging North-South Main track intersects East-West Main track within limits of track bulletin. Road Train approaches on diverging North-South Main track.
Method of Operation	CTC, TWC
RR Personnel	EIC-1, EIC-2, MOW Worker(s), Train Crew
RR Systems	DBO, Road Train, PTC Onboard
Reference Track Configuration	Single Track with Diverging Mainline per Section 4.1.3.
Initial Condition	1) EIC-1 of MOW worker(s) obtains exclusive authority TW on East-West Main track between WL_A and WL_B per UC-RWP-301. 2) MOW worker(s) access East-West Main track, as defined in TW. 3) EIC-2 of second MOW worker(s) contacts EIC-1 to obtain joint occupancy TW per UC-RWP-307. 4) MOW worker(s) in second work group access East-West Main track WL_A and WL_B, as defined in TW.
Trigger Event	Road Train approaches junction to mainline on diverging mainline.
Scenario Steps	1) PTC Onboard displays end of MA at WL_A to TC. 2) TC of Road Train contacts dispatcher and requests TW to proceed beyond WL_A. 3) Dispatcher verifies, via DBO, TW is in effect for track segment AB. 4) Dispatcher denies TW to TC – exclusive occupancy TW in effect. 5) TC stops Road Train short of WL_A. 6) MOW worker(s) access East-West Main track within track segment AB until work is complete. 7) Upon completion of work, MOW worker(s) clear themselves and equipment from East-West Main track. 8) EIC-1 verifies all MOW worker(s) clear of track segment AB. 9) EIC-1 contacts EIC-2 to verify all MOW worker(s) are clear of track segment AB. 10) EIC-2 confirms MOW worker(s) are clear of track segment AB. 11) EIC-2 releases JO.

	12) EIC-1 contacts dispatcher and releases TW for track segment AB. 13) Dispatcher clears EIC-1's TW for track segment AB via DBO. 14) Dispatcher creates TW for Road Train that includes all or part of track segment AB via DBO. 15) Dispatcher contacts TC of Road Train and provides TW information. 16) Dispatcher verifies receipt of TW by TC. 17) DBO provides TW information for Road Train to PTC system. 18) PTC Onboard releases enforcement of $WL_{A.}$
End State (Happy Path)	5) All MOW worker(s) are clear of East-West Main track segment AB. 6) Road Train proceeds into East-West Main track segment AB.
References	49 CFR 214.325, GCOR 14

5.8.4. Joint Occupancy – Single Track with Siding

ID: UC-RWP-804

Reference Track Configuration: Single Track with Siding per Section 4.1.4.

- If switches accessing siding are included in work limits, handle in accordance with use case 5.8.1.
- If switches accessing siding are not included in work limits, handle in accordance with use case 5.8.6.

References: 49 CFR 214.325, GCOR 14

5.8.5. Joint Occupancy – Double Track (Exclusive Occupancy on Track Main 1 and Track Main 2)

ID	UC-JOP-805a
Title	Joint Occupancy – Double Track
Description	Joint Occupancy of exclusive occupancy authority used to provide protection to a second group of MOW worker(s) accessing Main track. Road Train on track Main 2 approaches work area.
Method of Operation	CTC, TWC
RR Personnel	EIC-1, EIC-2, MOW Worker(s), Train Crew
RR Systems	DBO, Road Train, PTC Onboard
Reference Track Configuration	Double track per Section 4.1.5.
Initial Condition	1) EIC-1 of MOW worker(s) obtains exclusive occupancy TW on track Main 1 and track Main 2 between WL_A and WL_B per UC-RWP-301. 2) MOW worker(s) access tracks between WL_A and WL_B, as defined in TW. 3) EIC-2 of second MOW worker(s) contacts EIC-1 to obtain joint occupancy TW per UC-RWP-307. 4) MOW worker(s) in second work group access tracks WL_A and WL_B, as defined in TW.
Trigger Event	Road Train on track Main 2 approaches track segment occupied by MOW worker(s).
Scenario Steps	Handle in accordance with uses case 5.8.1. Joint Occupancy – Single Track.
End State (Happy Path)	1) MOW worker(s) are clear of authority. 2) Road Train can proceed.
References	49 CFR 214.325, GCOR 14

5.8.6. Joint Occupancy – Double Track (Exclusive Occupancy on Track Main 1, Watchman Lookout on Track Main 2)

ID	UC-JOP-805b
Title	Joint Occupancy – Double Track
Description	Joint Occupancy of exclusive occupancy authority used to provide protection to a second group of MOW worker(s) accessing Main track. Road Train on track Main 2 approaches work area.
Method of Operation	CTC, TWC
RR Personnel	EIC-1, EIC-2, MOW Worker(s), Train Crew
RR Systems	DBO, Road Train, PTC Onboard
Reference Track Configuration	Double track per Section 4.1.5.

Initial Condition	1) EIC of MOW worker(s) obtains exclusive occupancy TW on track Main 1 between WL_A and WL_B per UC-RWP-301. 2) EIC designates WL on track Main 2 per use case 5.2.5. Watchman Lookout Protection – Double Track. 3) MOW worker(s) access track Main 1, as defined in TW. 4) EIC-2 of second MOW worker(s) contacts EIC-1 to obtain joint occupancy TW per UC-RWP-307. 5) EIC-2 designates WL on track Main 2 per use case 5.2.5. Watchman Lookout Protection – Double Track. 6) MOW worker(s) in second work group access tracks WL_A and WL_B, as defined in TW.
Trigger Event	Road Train on track Main 2 approaches track segment adjacent to track Main 1 occupied by MOW worker(s). Road Train on track Main 2 has TW to proceed past work area.
Scenario Steps	1) WM, from both work groups, observes Road Train approaching on track Main 2. 2) TC of Road Train observes MOW worker(s) on track Main 1 and blows whistle. 3) WM, from both work groups, alerts MOW worker(s) of approaching Road Train on track Main 2. 4) MOW worker(s), from both work groups, clear from foul of track Main 2 and area between tracks Main 1 and Main 2, to include any tools and equipment, that may be in use. *Note: MOW worker(s) may remain within the gauge of track Main 1.* 5) Road Train on track Main 2 proceeds past Main 1 track segment WL_A WL_B.
End State (Happy Path)	1) MOW worker(s) continue work on track Main 1. 2) Road Train proceeds past work area on track Main 2.
References	49 CFR 214.325, 49 CFR 214.339, GCOR 14

5.8.7. Joint Occupancy – Double Track with Crossovers

ID: UC-RWP-806

Reference Track Configuration: Double Track with Crossovers per Section 4.1.6.

- If exclusive occupancy TW is obtained by EIC-1 for both tracks between the same working limits, handle in accordance with use case 5.8.5.
- If exclusive occupancy TW is obtained by EIC-1 for track to be occupied only, handle in accordance with use case 5.8.6.

References: 49 CFR 214.325, 49 CFR 214.339, GCOR 14

5.8.8. Joint Occupancy – Double Track with Universal Crossovers

ID: UC-RWP-807

Reference Track Configuration: Double Track with Universal Crossovers per Section 4.1.7.

- If exclusive occupancy TW is obtained by EIC-1 for both tracks between the same working limits, handle in accordance with use case 5.8.5.
- If exclusive occupancy TW is obtained by EIC-1 for track to be occupied only, handle in accordance with use case 5.8.6.

References: 49 CFR 214.325, 49 CFR 214.339, GCOR 14

5.8.9. Joint Occupancy – Triple Track

ID	UC-RWP-808
Title	Joint Occupancy – Triple Track
Description	Joint Occupancy of exclusive occupancy authority used to provide protection to a second group of MOW worker(s) accessing track Main 3. Road Train on track Main 2 approaches work area.
Method of Operation	TWC
RR Personnel	EIC, MOW Worker(s), Dispatcher, Train Crew
RR Systems	Dispatch, Work Train, Road Train
Reference Track Configuration	Triple track per Section 4.1.8.
Initial Condition	Protection established per UC-RWP-805a or UC-RWP-805b.
Trigger Event	Road Train on track Main 2 approaches track parallel to segment of track Main 3 occupied by MOW worker(s). Road Train on track Main 2 has TW to proceed past work area.
Scenario Steps	3) MOW worker(s) do not clear track. 4) Road Train proceeds past work area track segment.
End State (Happy Path)	3) MOW worker(s) can continue work. 4) Road Train proceeds.
References	49 CFR 214.325, GCOR 14

5.8.10. Joint Occupancy – Quad Track

ID: UC-RWP-809

Reference Track Configuration: Quad Track per Section 4.1.9.

- If ETO is acquired by EIC-1 for occupied and adjacent tracks, handle in accordance with use case 5.8.5.
- If ETO is acquired by EIC-1 for occupied track, and watchman lookout protection used for adjacent tracks, handle in accordance with use case 5.8.6.

References: 49 CFR 214.325, GCOR 14

Appendix B.
MOWESS PHA

B1. Lone Worker

Unique ID	Hazard	Hazard Cause
UC-RWP-101	LW does not notice train approaching.	LW inattention
UC-RWP-101		
UC-RWP-101		
UC-RWP-101		LW visibility reduced environmental conditions. Rain, fog, snow, sun glare, etc.
UC-RWP-101		
UC-RWP-101		
UC-RWP-101		LW visibility reduced by low light conditions
UC-RWP-101		
UC-RWP-101	Insufficient time for LW to clear track as train approaches	LW error in determining ITD - track speed higher than LW thought.

UC-RWP-101		
UC-RWP-101	LW incapacitated and lying within the foul	Varied (medical and/or external factors)
UC-RWP-102	Include all from UC-RWP-101 (LW-Single Track)	
	Insufficient time for LW to clear track as train approaches on spur	LW error in determining ITD for spur
UC-RWP-103	Include all from UC-RWP-102 (Single Track with Uncontrolled Spur)	

UC-RWP-104	Include all from UC-RWP-102 (LW-Single Track with uncontrolled Spur)	
	Opposing track field of view obscured	Train or track equipment tied down on opposing track and LW fails to reassess ITD
UC-RWP-105	Include all from UC-RWP-104 (LW-Single Track with siding)	
UC-RWP-106	Include all from UC-RWP-104 (LW-Single Track with siding)	
UC-RWP-107	Include all from UC-RWP-104 (LW-Single Track with siding)	
UC-RWP-108	Include all from UC-RWP-104 (LW-Single Track with siding)	
UC-RWP-109	Include all from UC-RWP-104 (LW-Single Track with siding)	
	Obstruction on field side of Main Track 4 causing LW to clear over occupied Main Track 1	Train or track equipment tied down/physical barrier on opposing track and LW fails to incorporate additional time in ITD

Hazard Cause Type	Hazard Effect(s) Explanation of C & D	Potential Mishap
LW Inattention	LW does not have sufficient time to clear self and equipment from track or is still in the foul of the track	LW fails to clear track. Hit by train
	LW is able to clear self from track but not equipment	Damaged equipment
	LW is able clear the foul of track but is not able to reach safe zone without risk of injury	LW rushes to clear track. Slip, trip, fall, etc
LW failure to correctly assess ITD/Inattention	LW does not have sufficient time to clear self and equipment from track or is still in the foul of the track	LW fails to clear track. Hit by train
	LW is able to clear self from track but not equipment	Damaged equipment
	LW is able clear the foul of track but is not able to reach safe zone without risk of injury	LW rushes to clear track. Slip, trip, fall, etc
LW failure to correctly assess ITD/Inattention	LW does not have sufficient time to clear self and equipment from track or is still in the foul of the track	LW fails to clear track. Hit by train
	LW is able to clear self from track but not equipment	Damaged equipment
	LW is able clear the foul of track but is not able to reach safe zone without risk of injury	LW rushes to clear track. Slip, trip, fall, etc
LW failure to correctly assess ITD	LW does not have sufficient time to clear self and equipment from track or is still in the foul of the track	LW fails to clear track. Hit by train

	LW is able to clear self from track but not equipment	Damaged equipment
	LW is able clear the foul of track but is not able to reach safe zone without risk of injury	LW rushes to clear track. Slip, trip, fall, etc
LW incapicitated	LW is struck by oncoming train (train does not have adequate time to stop)	LW incapable of clearing track. LW hit by train
	Equipment left on track	Damaged equipment
		LW fails to clear track. Hit by train
LW failure to correctly assess ITD	LW does not have sufficient time to clear self and equipment from track or is still in the foul of the track	LW fails to clear track. Hit by train
	LW is able to clear self from track but not equipment	Damaged equipment
	LW is able clear the foul of track but is not able to reach safe zone without risk of injury	LW rushes to clear track. Slip, trip, fall, etc

LW failure to correctly assess ITD/Inattention	LW does not have sufficient time to clear self and equipment from track or is still in the foul of the track	LW fails to clear track. Hit by train
	LW Is able to clear self from track but not equipment	Damaged equipment
	LW is able clear the foul of track but is not able to reach safe zone without risk of injury	LW Rushes to clear track. Slip, trip, fall, etc
LW failure to correctly assess ITD/Inattention	LW does not have sufficient time to clear self and equipment from track or is still in the foul of the track	LW fails to clear track. Hit by train
	LW is able to clear self from track but not equipment	Damaged equipment

	LW is able clear the foul of track but is not able to reach safe zone without risk of injury	LW rushes to clear track. Slip, trip, fall, etc

B2. WLP

Unique ID	Hazard	Hazard Cause
UC-RWP-201	WM does not notice train approaching.	WM inattention
		WM visibility reduced environmental conditions. Rain, fog, snow, sun glare, etc.
		WM visibility reduced by low light conditions
	Insufficient time for MOW Worker(s) to clear track as train approaches	WM error in determining ITD - track speed higher than WM thought.
		WM not close enough to MOW Worker(s)

	MOW Worker(s) incapacitated and lying within the foul	Varied (medical and/or external factors)
UC-RWP-202	Include all from UC-RWP-201 (WLP-Single Track)	
	Insufficient time for MOW Worker(s) to clear track as train approaches on spur	WM error in determining ITD for spur
UC-RWP-203	Include all from UC-RWP-202 (WLP-Single Track with Uncontrolled Spur)	
UC-RWP-204	Include all from UC-RWP-202 (WLP-Single Track with Uncontrolled Spur)	
	Opposing track field of view obscured	train or track equipment tied down on opposing track and WM fails to reassess ITD
UC-RWP-205	Include all from UC-RWP-204 (WLP-Single Track with Uncontrolled Spur)	
UC-RWP-206	Include all from UC-RWP-204 (WLP-Single Track with Uncontrolled Spur)	

UC-RWP-207	Include all from UC-RWP-204 (WLP-Single Track with Uncontrolled Spur)	
UC-RWP-208	Include all from UC-RWP-204 (WLP-Single Track with Uncontrolled Spur)	
UC-RWP-209	Include all from UC-RWP-204 (WLP-Single Track with Uncontrolled Spur)	
	Obstruction on field side of Main Track 4 causing LW to clear over occupied Main Track 1	train or track equipment tied down/ physical barrier on opposing track and LW fails to incorporate additional time in ITD

Hazard Cause Type	Hazard Effect(s) Explanation of C & D	Potential Mishap
WM Inattention	MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track.	MOW Worker(s) fails to clear track. Hit by train.
	MOW Worker(s) Is able to clear self from track but not equipment	Damaged equipment.
	MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) Rushes to clear track. Slip, trip, fall, etc
WM failre to correctly assess ITD / WM inattention	MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track.	MOW Worker(s) fails to clear track. Hit by train.
	MOW Worker(s) Is able to clear self from track but not equipment	Damaged equipment.
	MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) Rushes to clear track. Slip, trip, fall, etc
WM failre to correctly assess ITD / WM inattention	MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track.	MOW Worker(s) fails to clear track. Hit by train.
	MOW Worker(s) Is able to clear self from track but not equipment	Damaged equipment.
	MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) Rushes to clear track. Slip, trip, fall, etc
WM failre to correctly assess ITD	MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track.	MOW Worker(s) fails to clear track. Hit by train.
	LW Is able to clear self from track but not equipment	Damaged equipment.
	LW is able clear the foul of track but is not able to reach safe zone without risk of injury	LW Rushes to clear track. Slip, trip, fall, etc
WM Inattention	MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track.	MOW Worker(s) fails to clear track. Hit by train.

	LW Is able to clear self from track but not equipment	Damaged equipment.
	LW is able clear the foul of track but is not able to reach safe zone without risk of injury	LW Rushes to clear track. Slip, trip, fall, etc
WM inattention / Workman incapicitated	MOW Worker(s) is struck by oncoming train (train does not have adequate time to stop)	MOW Worker(s) incapable of clearing track. MOW Worker(s) hit by train.
	Equipment left on track	Damaged equipment.
WM failure to correctly assess ITD	MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track.	MOW Worker(s) fails to clear track. Hit by train.
	MOW Worker(s) Is able to clear self from track but not equipment	Damaged equipment.
	MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) Rushes to clear track. Slip, trip, fall, etc
WM failre to correctly assess ITD / WM inattention	MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track.	LW fails to clear track. Hit by train.
	MOW Worker(s) Is able to clear self from track but not equipment	Damaged equipment.
	MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	LW Rushes to clear track. Slip, trip, fall, etc

WM failure to reassess ITD / WM inattention	LW does not have sufficient time to clear self and equipment from track or is still in the foul of the track.	LW fails to clear track. Hit by train.
	LW Is able to clear self from track but not equipment	Damaged equipment.
	LW is able clear the foul of track but is not able to reach safe zone without risk of injury	LW Rushes to clear track. Slip, trip, fall, etc

B3. Acquisition Exclusive Occ.

Unique ID	Hazard	Hazard Cause
UC-RWP-301	TWC issued with incorrect work limits	EIC requests TW for between points A and B instead of to include points A and B. IE. Switch points etc
		EIC fails to request TWC for correct location. (incorrect milepost or track)
	EIC mistakes the train	TWC is issued with understanding that it is not effective until train 1234 with lead locomotive ID ABC has past. EIC mistakes the train
UC-RWP-302	Include all from UC-RWP-301 (Acquisition of Exclusive Occupancy Authority Track Warrant Territory)	
	Dispatcher fails to set "stop" signal at both ends of working limits	Dispatcher improperly configures signals. Signals do not display proper "stop" message
UC-RWP-303	Include all from UC-RWP-302 (Acquisition of Exclusive Occupancy in CTC (Track and Time))	
UC-RWP-304	Not mentioned in scenarios	
UC-RWP-305	Not mentioned in scenarios	

UC-RWP-306	Not mentioned in scenarios	
UC-RWP-307	Include all from UC-RWP-301 and UC-RWP-302	
	Miscommunication between EIC-1 and EIC-2	MOW worker(s) from either group is on the incorrect section of track
UC-RWP-308	Bulletin issued with incorrect limits	EIC or Manager of MOW enters bulletin request between points A and B instead of to include points A and B. IE. Switch points etc
		EIC or Manager of MOW fails to request bulletin for correct location. (incorrect milepost or track)
	Workmen working outside of CTC (Track and Time) limits	Working out of CTC (Track and Time) boundaries
	EIC fails to alert and clear all of workmen	EIC mistake (fails to alert all workmen)

	CTC (Track and Time) issued with incorrect work limits	Dispatch issues CTC (Track and Time) for between points A and B instead of to include points A and B. IE. Switch points etc
		EIC requests CTC(Track and Time) for between points A and B instead of to include points A and B. IE. Switch points etc
		Dispatch fails to establish CTC (Track and Time) for correct location. (incorrect milepost or track)

		EIC fails to request CTC (Track and Time) for correct location. (incorrect milepost or track)
	Workmen do not clear upon warning from EIC	Workmen do not "recognize" warning from EIC
		Working outside of CTC (Track and Time) time limits (TW has expired or not began)

UC-RWP-303	Workmen working outside of Track Permit limits.	Working out of Track Permit boundaries
	EIC fails to alert and clear all of workmen	EIC mistake (fails to alert all workmen)
	Track Permit issued with incorrect work limits	Dispatch issues TW for between points A and B instead of to include points A and B. IE. Switch points etc

		EIC requests TW for between points A and B instead of to include points A and B. IE. Switch points etc
		Dispatch fails to establish Track Permit for correct location. (incorrect milepost or track)
		EIC fails to request Track Permit for correct location. (incorrect milepost or track)

	Workmen do not clear upon warning from EIC	Workmen do not "recognize" warning from EIC
UC-RWP-304	Workmen working outside of Track Permit limits	Working out of Track Permit boundaries
	EIC fails to alert and clear all of workmen	EIC mistake (fails to alert all workmen)

	Track Permit issued with incorrect work limits	Dispatch issues TW for between points A and B instead of to include points A and B. IE. Switch points etc
		EIC requests TW for between points A and B instead of to include points A and B. IE. Switch points etc
		Dispatch fails to establish Track Permit for correct location. (incorrect milepost or track)
		EIC fails to request Track Permit for correct location. (incorrect milepost or track)

		Dispatch fails to inform all other occupants in Overlapping Occupancy Track Warrant
	Workmen do not clear upon warning from EIC	Workmen do not "recognize" warning from EIC
UC-RWP-305	Workmen working outside of CTC (Track and Time) limits.	Working out of CTC (Track and Time) boundaries
	EIC fails to alert and clear all of workmen	EIC mistake (fails to alert all workmen)

	CTC (Track and Time) issued with incorrect work limits	Dispatch issues CTC (Track and Time) for between points A and B instead of to include points A and B. IE. Switch points etc
		EIC requests CTC(Track and Time) for between points A and B instead of to include points A and B. IE. Switch points etc.
		Dispatch fails to establish CTC (Track and Time) for correct location. (incorrect milepost or track)
		EIC fails to request CTC (Track and Time) for correct location. (incorrect milepost or track)
	Workmen do not clear upon warning from EIC	Workmen do not "recognize" warning from EIC
		Working outside of CTC (Track and Time) time limits (TW has expired or not began)

Hazard Cause Type	Hazard Effect(s) Explanation of C & D	Potential Mishap
EIC inattention / EIC disorientation	Workmen unknowingly work outside of TWC work limits unprotected	Potential Mishap if MOW Worker(s) present
EIC disorientation	Workmen unknowingly work outside of TWC work limits unprotected	Potential Mishap if MOW Worker(s) present
EIC inattention / EIC disorientation	MOW Worker(s) fouling track at the wrong time	Potential Mishap if MOW Worker(s) present
Dispatcher inattention	Train enters working limit from unprotected end. Workmen not able to clear the track before train enters work zone	Potential Mishap if MOW Worker(s) present

EIC-1 and / or EIC-2 miscommunication	Workmen unknowingly work outside of work limits unprotected	Potential Mishap if MOW Worker(s) present
EIC inattention / EIC disorientation	Workmen unknowingly work outside of TWC work limits unprotected	Potential Mishap if MOW Worker(s) present
EIC inattention / EIC disorientation	Workmen unknowingly work outside of TWC work limits unprotected	Potential Mishap if MOW Worker(s) present
Workmen inattention / disorientation	Workmen are un aware of train presence and do not have sufficient time to clear themselves and equipment from track or are still in the foul of the track.	Workmen fail to clear track. Hit by train.
	Workmen Is able to clear self from track but not equipment	Damaged equipment.
	Workmen is able clear the foul of track but is not able to reach safe zone without risk of injury	Workmen rushes to clear track. Slip, trip, fall, etc
EIC inattention	Workmen are un aware of train presence and do not have sufficient time to clear themselves and equipment from track or are still in the foul of the track.	Workmen fail to clear track. Hit by train.

	Workmen is able to clear self from track but not equipment	Damaged equipment
	Workmen is able clear the foul of track but is not able to reach safe zone without risk of injury	Workmen rushes to clear track. Slip, trip, fall, etc
Dispatch inattention / disorientation	Workmen unknowingly work outside of CTC (Track and Time) work limits unprotected	Workmen fail to clear track. Hit by train
	Workmen is able to clear self from track but not equipment	Damaged equipment
	Workmen is able clear the foul of track but is not able to reach safe zone without risk of injury	Workmen rushes to clear track. Slip, trip, fall, etc
EIC inattention / disorientation	Workmen unknowingly work outside of CTC (Track and Time) work limits unprotected	Workmen fail to clear track. Hit by train
	Workmen is able to clear self from track but not equipment	Damaged equipment
	Workmen is able clear the foul of track but is not able to reach safe zone without risk of injury	Workmen rushes to clear track. Slip, trip, fall, etc
DIspatch inattention / disorientation	Workmen unknowingly work outside of CTC (Track and Time) work limits unprotected	Workmen fail to clear track. Hit by train
	Workmen is able to clear self from track but not equipment	Damaged equipment

	Workmen is able clear the foul of track but is not able to reach safe zone without risk of injury	Workmen rushes to clear track. Slip, trip, fall, etc
EIC inattention / disorientation	Workmen unknowingly work outside of CTC (Track and Time) work limits unprotected	Workmen fail to clear track. Hit by train
	Workmen is able to clear self from track but not equipment	Damaged equipment
	Workmen is able clear the foul of track but is not able to reach safe zone without risk of injury	Workmen rushes to clear track. Slip, trip, fall, etc
EIC / Workmen miscommunication	Workmen does not have sufficient time to clear and equipment from track or remains in the foul of the track	Workmen fail to clear track. Hit by train
	Workmen is able to clear self from track but not equipment	Damaged equipment
	Workmen is able clear the foul of track but is not able to reach safe zone without risk of injury	Workmen rushes to clear track. Slip, trip, fall, etc
Workmen Inattention / disorientation	Workmen are unaware of train presence and do not have sufficient time to clear themselves and equipment from track or are still in the foul of the track.	Workmen fail to clear track. Hit by train
	Workmen is able to clear self from track but not equipment	Damaged equipment

	Workmen is able clear the foul of track but is not able to reach safe zone without risk of injury	Workmen rushes to clear track. Slip, trip, fall, etc
Workmen inattention / disorientation	Workmen are unaware of train presence and do not have sufficient time to clear themselves and equipment from track or are still in the foul of the track	Workmen fail to clear track. Hit by train
	Workmen is able to clear self from track but not equipment	Damaged equipment
	Workmen is able clear the foul of track but is not able to reach safe zone without risk of injury	Workmen rushes to clear track. Slip, trip, fall, etc
Workmen inattention	Workmen are unaware of train presence and do not have sufficient time to clear themselves and equipment from track or are still in the foul of the track	Workmen fail to clear track. Hit by train
	Workmen is able to clear self from track but not equipment	Damaged equipment
	Workmen is able clear the foul of track but is not able to reach safe zone without risk of injury	Workmen rushes to clear track. Slip, trip, fall, etc
DIspatch inattention / disorientation	Workmen unknowingly work outside of Track Permit work limits unprotected	Workmen fail to clear track. Hit by train
	Workmen is able to clear self from track but not equipment	Damaged equipment

	Workmen is able clear the foul of track but is not able to reach safe zone without risk of injury	Workmen rushes to clear track. Slip, trip, fall, etc
EIC inattention / disorientation	Workmen unknowingly work outside of Track Permit work limits unprotected	Workmen fail to clear track. Hit by train
	Workmen is able to clear self from track but not equipment	Damaged equipment
	Workmen is able clear the foul of track but is not able to reach safe zone without risk of injury	Workmen rushes to clear track. Slip, trip, fall, etc
DIspatch inattention / disorientation	Workmen unknowingly work outside of Track Permit work limits unprotected	Workmen fail to clear track. Hit by train
	Workmen is able to clear self from track but not equipment	Damaged equipment
	Workmen is able clear the foul of track but is not able to reach safe zone without risk of injury	Workmen rushes to clear track. Slip, trip, fall, etc
EIC inattention / disorientation	Workmen unknowingly work outside of Track Permit work limits unprotected	Workmen fail to clear track. Hit by train
	Workmen is able to clear self from track but not equipment	Damaged equipment
	Workmen is able clear the foul of track but is not able to reach safe zone without risk of injury	Workmen rushes to clear track. Slip, trip, fall, etc

EIC / Workmen miscommunitcation	Workmen does not have sufficient time to clear and equipment from track or remains in the foul of the track	Workmen fail to clear track. Hit by train
	Workmen is able to clear self from track but not equipment	Damaged equipment
	Workmen is able clear the foul of track but is not able to reach safe zone without risk of injury	Workmen rushes to clear track. Slip, trip, fall, etc
Workmen inattention / disorientation	Workmen are unaware of train presence and do not have sufficient time to clear themselves and equipment from track or are still in the foul of the track	Workmen fail to clear track. Hit by train
	Workmen is able to clear self from track but not equipment	Damaged equipment
	Workmen is able clear the foul of track but is not able to reach safe zone without risk of injury	Workmen rushes to clear track. Slip, trip, fall, etc
EIC inattention	Workmen are unaware of train presence and do not have sufficient time to clear themselves and equipment from track or are still in the foul of the track	Workmen fail to clear track. Hit by train
	Workmen is able to clear self from track but not equipment	Damaged equipment
	Workmen is able clear the foul of track but is not able to reach safe zone without risk of injury	Workmen rushes to clear track. Slip, trip, fall, etc

	Workmen unknowingly work outside of Track Permit work limits unprotected	Workmen fail to clear track. Hit by train
	Workmen is able to clear self from track but not equipment	Damaged equipment
	Workmen is able clear the foul of track but is not able to reach safe zone without risk of injury	Workmen rushes to clear track. Slip, trip, fall, etc
	Workmen unknowingly work outside of Track Permit work limits unprotected	Workmen fail to clear track. Hit by train
	Workmen is able to clear self from track but not equipment	Damaged equipment
	Workmen is able clear the foul of track but is not able to reach safe zone without risk of injury	Workmen rushes to clear track. Slip, trip, fall, etc
	Workmen unknowingly work outside of Track Permit work limits unprotected	Workmen fail to clear track. Hit by train.
	Workmen is able to clear self from track but not equipment	Damaged equipment
	Workmen is able clear the foul of track but is not able to reach safe zone without risk of injury	Workmen rushes to clear track. Slip, trip, fall, etc
	Workmen unknowingly work outside of Track Permit work limits unprotected	Workmen fail to clear track. Hit by train

	Workmen Is able to clear self from track but not equipment	Damaged equipment
	Workmen is able clear the foul of track but is not able to reach safe zone without risk of injury	Workmen rushes to clear track. Slip, trip, fall, etc
	workmen unknowingly work outside of Track Permit work limits unprotected	Workmen fail to clear track. Hit by train
	Workmen Is able to clear self from track but not equipment	Damaged equipment
	Workmen is able clear the foul of track but is not able to reach safe zone without risk of injury	Workmen rushes to clear track. Slip, trip, fall, etc
	Workmen does not have sufficient time to clear and equipment from track or remains in the foul of the track	Workmen fail to clear track. Hit by train
	Workmen is able to clear self from track but not equipment	Damaged equipment
	Workmen is able clear the foul of track but is not able to reach safe zone without risk of injury	Workmen rushes to clear track. Slip, trip, fall, etc
	Workmen are unaware of train presence and do not have sufficient time to clear themselves and equipment from track or are still in the foul of the track	Workmen fail to clear track. Hit by train
	Workmen is able to clear self from track but not equipment	Damaged equipment
	Workmen is able clear the foul of track but is not able to reach safe zone without risk of injury	Workmen rushes to clear track. Slip, trip, fall, etc
	Workmen are unaware of train presence and do not have sufficient time to clear themselves and equipment from track or are still in the foul of the track	Workmen fail to clear track. Hit by train
	Workmen is able to clear self from track but not equipment	Damaged equipment
	Workmen is able clear the foul of track but is not able to reach safe zone without risk of injury	Workmen rushes to clear track. Slip, trip, fall, etc

	workmen unknowingly work outside of CTC (Track and Time) work limits unprotected	Workmen fail to clear track. Hit by train
	Workmen Is able to clear self from track but not equipment	Damaged equipment
	Workmen is able clear the foul of track but is not able to reach safe zone without risk of injury	Workmen rushes to clear track. Slip, trip, fall, etc
	workmen unknowingly work outside of CTC (Track and Time) work limits unprotected	Workmen fail to clear track. Hit by train
	Workmen is able to clear self from track but not equipment	Damaged equipment
	Workmen is able clear the foul of track but is not able to reach safe zone without risk of injury	Workmen rushes to clear track. Slip, trip, fall, etc
	workmen unknowingly work outside of CTC (Track and Time) work limits unprotected	Workmen fail to clear track. Hit by train
	Workmen is able to clear self from track but not equipment	Damaged equipment
	Workmen is able clear the foul of track but is not able to reach safe zone without risk of injury	Workmen rushes to clear track. Slip, trip, fall, etc
	workmen unknowingly work outside of CTC (Track and Time) work limits unprotected	Workmen fail to clear track. Hit by train
	Workmen Is able to clear self from track but not equipment	Damaged equipment.
	Workmen is able clear the foul of track but is not able to reach safe zone without risk of injury	Workmen rushes to clear track. Slip, trip, fall, etc
	Workmen does not have sufficient time to clear and equipment from track or remains in the foul of the track	Workmen fail to clear track. Hit by train
	Workmen is able to clear self from track but not equipment	Damaged equipment
	Workmen is able clear the foul of track but is not able to reach safe zone without risk of injury	Workmen rushes to clear track. Slip, trip, fall, etc
	Workmen are unaware of train presence and do not have sufficient time to clear themselves and equipment from track or are still in the foul of the track	Workmen fail to clear track. Hit by train

	Workmen is able to clear self from track but not equipment	Damaged equipment
	Workmen is able clear the foul of track but is not able to reach safe zone without risk of injury	Workmen rushes to clear track. Slip, trip, fall, etc

Mishap Severity	Process/practice affecting Probability	Revised Hazard Frequency (initial frequency modified by Processes and practices affecting frequency)

I	Train crew expected to blow whistle to alert workmen of train approach.	E
I	Train crew expected to blow whistle to alert workmen of train approach.	E

I	Train crew expected to blow whistle to alert workmen of train approach.	E
I	Train crew expected to blow whistle to alert workmen of train approach.	E

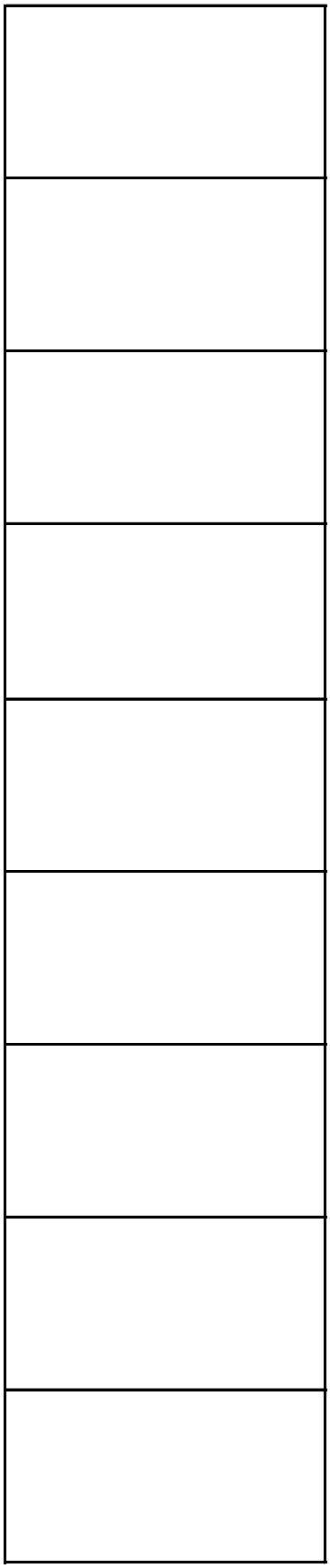
I	Train crew expected to blow whistle to alert workmen of train approach.	E

Initial HRI	Risk Class	System Input

Proposed Mitigation	Residual Severity	Residual Frequency

Residual HRI	Residual Risk Class	Assumptions

Notes



B4. Train Coordination

Unique ID	Hazard	Hazard Cause	Hazard Cause Type	Hazard Effect(s) Explanation of C & D
UC-RWP-401				
	TWC issued with incorrect work limits	EIC requests TW for between points A and B instead of to include points A and B. IE. Switch points etc	EIC disorientation	workmen unknowingly work outside of TWC work limits unprotected
		EIC fails to request TWC for correct location (incorrect milepost or track)	EIC disorientation	workmen unknowingly work outside of TWC work limits unprotected
	EIC mistakes the train	TWC is issued with understanding that it is not effective until train 1234 with lead locomotive ID ABC has past. EIC mistakes the train	EIC disorientation/EIC inattention	MOW Worker(s) fouling track at the wrong time
	EIC - Workmen communicaiton problem			
		EIC misunderstand that workmen has cleared track	EIC/workman miscommunication	MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track.
				MOW Worker(s) is able to clear self from track but not equipment
				MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury

		EIC did not verify MOW Worker(s) were clear of track	EIC inattention	MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track.
				MOW Worker(s) is able to clear self from track but not equipment
				MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury
	EIC Communication Problem to Work Train	EIC edes WL back to the crew of the work train while workmen still on track	EIC inattention	MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track.
				MOW Worker(s) is able to clear self from track but not equipment
				MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury
UC-RWP-402	Include all from UC-RWP-401			
	EIC/Workmen fails to properly identify the track they are occupying	MOW worker(s) is on the incorrect section of track	EIC/Workmen disorientation	MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track.
				MOW Worker(s) is able to clear self from track but not equipment
				MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury
UC-RWP-403	Include all from UC-RWP-402			
UC-RWP-404	Include all from UC-RWP-402			
	EIC/MOW Worker(s) Inattention	MOW worker(s) attempt to clear working track in direction of opposing occupied track (disorientation)	Workmen disorientation/WM inattention	MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track.
				MOW Worker(s) is able to clear self from track but not equipment
				MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury

	Train approach on adjacent track	MOW Worker(s) unable to see train approach on track 2 because line of site impaired by work train on siding	Work train/workman inattention/workmen failure to correctly reassess ITD	MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track.
		MOW Worker(s) attempts to clear in direction of track 1	Workmen inattention	MOW Worker(s) is able to clear self from track but not equipment
				MOW worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury
	Obstruction on field side of Main Track causing MOW worker(s) to clear over occupied Main Track	Train or track equipment tied down/ physical barrier on opposing track and workman fails to incorporate additional time in ITD	Work train/workman inattention / workmen failure to correctly reassess ITD	LW does not have sufficient time to clear self and equipment from track or is still in the foul of the track
				LW is able to clear self from track but not equipment
				LW is able clear the foul of track but is not able to reach safe zone without risk of injury
UC-RWP-405A	Include all from UC-RWP-401			
UC-RWP-405B	Include all from UC-RWP-401			
	Include all from UC-RWP-404			
	Opposing track field of view obscured	Train or track equipment tied down on opposing track and WM fails to reassess ITD	Work train/workman inattention/workmen failure to correctly reassess ITD	MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track.
				MOW Worker(s) is able to clear self from track but not equipment
				MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury

	Insufficient time for MOW Worker(s) to clear track as train approaches on spur	WM error in determining ITD for spur	Work train and Workman inattention/ disorientation. Workmen failure to correctly reassess ITD	MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track
				MOW Worker(s) is able to clear self from track but not equipment
				MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury
	WM does not notice train approaching	WM inattention	Work train and Workman inattention/ disorientation. Workmen failure to correctly reassess ITD	MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track
				MOW Worker(s) is able to clear self from track but not equipment
				MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury
		WM visibility reduced environmental conditions. Rain, fog, snow, sun glare, etc.	WM failure to correctly asses ITD/ workmen inattention	MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track
				MOW Worker(s) is able to clear self from track but not equipment
				MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury
		WM visibility reduced by low light conditions	WM failure to correctly asses ITD/ Workmen Inattention	MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track
				MOW Worker(s) is able to clear self from track but not equipment
				MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury

	Insufficient time for MOW Worker(s) to clear track as train approaches	WM error in determining ITD - track speed higher than WM thought.	WM failure to correctly asses ITD	MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track.
				LW Is able to clear self from track but not equipment
				LW is able clear the foul of track but is not able to reach safe zone without risk of injury
		WM not close enough to MOW Worker(s)	WM Inattention	MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track.
				LW Is able to clear self from track but not equipment
				LW is able clear the foul of track but is not able to reach safe zone without risk of injury
	MOW Worker(s) incapacitated and lying within the foul	Varied (medical and/or external factors)	Workman incapacitated/WM inattenion	MOW Worker(s) is struck by oncoming train (train does not have adequate time to stop)
				Equipment left on track
UC-RWP-406	Include all from UC-RWP-402			
	Include all from UC-RWP-405B			
UC-RWP-407	Include all from UC-RWP-402			
	Include all from UC-RWP-405B			
UC-RWP-408	Include all from UC-RWP-402			
	Include all from UC-RWP-405B			
UC-RWP-409	Include all from UC-RWP-402			
	Include all from UC-RWP-405B			

Potential Mishap	Mishap Severity	Process/practice affecting Probability	Revised Hazard Frequency (initial frequency modified by Processes and practices affecting frequency)
MOW worker(s) fails to clear track. Hit by train			
Damaged equipment			
MOW Worker(s) Rushes to clear track. Slip, trip, fall, etc			
MOW Worker(s) fails to clear track. Hit by train			
Damaged equipment			
MOW Worker(s) Rushes to clear track. Slip, trip, fall, etc			
MOW worker(s) fails to clear track. Hit by train			
Damaged equipment			
MOW Worker(s) Rushes to clear track. Slip, trip, fall, etc			
MOW Worker(s) fails to clear track. Hit by train			
Damaged equipment			
MOW Worker(s) Rushes to clear track. Slip, trip, fall, etc			

MOW Worker(s) fails to clear track. Hit by train			
Damaged equipment			
MOW Worker(s) Rushes to clear track. Slip, trip, fall, etc			
MOW Worker(s) fails to clear track. Hit by train			
Damaged equipment			
MOW Worker(s) Rushes to clear track. Slip, trip, fall, etc			
MOW Worker(s) fails to clear track. Hit by train			
Damaged equipment			
MOW Worker(s) rushes to clear track. Slip, trip, fall, etc			
MOW Worker(s) fails to clear track. Hit by train			
Damaged equipment			
MOW Worker(s) rushes to clear track. Slip, trip, fall, etc			

MOW Worker(s) fails to clear track. Hit by train			
Damaged equipment			
MOW Worker(s) rushes to clear track. Slip, trip, fall, etc			
LW fails to clear track. Hit by train			
Damaged equipment			
LW rushes to clear track. Slip, trip, fall, etc			
LW fails to clear track. Hit by train			
Damaged equipment			
LW rushes to clear track. Slip, trip, fall, etc			

MOW Worker(s) fails to clear track. Hit by train			
Damaged equipment			
MOW Worker(s) rushes to clear track. Slip, trip, fall, etc			
MOW Worker(s) fails to clear track. Hit by train.			
Damaged equipment			
MOW Worker(s) rushes to clear track. Slip, trip, fall, etc			
MOW Worker(s) fails to clear track. Hit by train			
Damaged equipment			
MOW Worker(s) rushes to clear track. Slip, trip, fall, etc			
MOW Worker(s) fails to clear track. Hit by train			
Damaged equipment			
MOW Worker(s) rushes to clear track. Slip, trip, fall, etc			

MOW Worker(s) fails to clear track. Hit by train			
Damaged equipment			
LW rushes to clear track. Slip, trip, fall, etc			
MOW Worker(s) fails to clear track. Hit by train			
Damaged equipment			
LW rushes to clear track. Slip, trip, fall, etc			
MOW Worker(s) incapable of clearing track. MOW Worker(s) hit by train			
Damaged equipment			

Initial HRI	Risk Class	System Input	Proposed Mitigation	Residual Severity	Residual Frequency	Residual HRI	Residual Risk Class

Assumptions	Notes			

B5. Exclusive Track Occ. - TWC

Unique ID	Hazard	Hazard Cause	Hazard Cause Type
UC-RWP-501	EOA issued with incorrect work limits	EIC requests EO for points A and B instead of to include points A and B. IE. Switch points etc	EIC disorientation
	EIC improperly displays flags at WL	EIC does not display flag at either/ both ends of WL and MOW worker(s) are unknowingly outside protected WL	EIC inattention/ disorientation
	EIC fails to request EOA for correct location. (incorrect milepost or track)	Workmen unknowingly work outside of EOA work limits unprotected	EIC disorientation
	EIC mistakes the train	EOA is issued with understanding that it is not effective until train 1234 with lead locomotive ID ABC has past. EIC mistakes the train	EIC inattention

	EIC - MOW worker(s) communicaiton problem		
		EIC misunderstand that workmen has cleared track	EIC miscommunication
		EIC did not verify MOW Worker(s) were clear of track	EIC inattention
UC-RWP-502	Include all hazards from UC-RWP-501		
	EIC/Workmen fails to properly identify the track they are occupying	MOW Worker(s) is on the incorrect section of track	EIC disorientation/ workman disorientation
UC-RWP-503	Include everything from UC-RWP-502		
UC-RWP-504	Include everything from UC-RWP-502		
	EIC/MOW Worker(s) Inattention	MOW Worker(s) attempt to clear working track in direction of opposing occupied track (disorientation)	worker inattention

	Train approach on adjacent track	MOW Worker(s) unable to see train approach on track 2 because line of site impaired by work train on siding	worker inattention
		MOW Worker(s) attempts to clear in direction of track 1	
	Obstruction on field side of Main Track causing MOW Worker(s) to clear over occupied Main Track	Train or track equipment tied down/ physical barrier on opposing track and LW fails to incorporate additional time in ITD	
UC-RWP-505A	Include everything from UC-RWP-502		
UC-RWP-505B	Include everything from UC-RWP-501		
	Include everything from UC-RWP-504		
	Opposing track field of view obscured	Train or track equipment tied down on opposing track and WM fails to reassess ITD	
	Insufficient time for MOW Worker(s) to clear track as train approaches on spur	WM error in determining ITD for spur	

	WM does not notice train approaching	WM inattention	
		WM visibility reduced environmental conditions. Rain, fog, snow, sun glare, etc.	
		WM visibility reduced by low light conditions	
	Insufficient time for MOW Worker(s) to clear track as train approaches	WM error in determining ITD - track speed higher than WM thought	
		WM not close enough to MOW Worker(s)	

	MOW Worker(s) incapacitated and lying within the foul	Varied (medical and/or external factors)	
UC-RWP-506	Include everything from UC-RWP-502		
	Include everything from UC-RWP-505b		
UC-RWP-507	Include everything from UC-RWP-502		
	Include everything from UC-RWP-505b		
UC-RWP-508	Include everything from UC-RWP-502		
	Include everything from UC-RWP-505b		
UC-RWP-509	Include everything from UC-RWP-502		
	Include everything from UC-RWP-505b		

Hazard Effect(s) Explanation of C & D	Potential Mishap
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW Worker(s) fails to clear track. Hit by train
MOW Worker(s) is able to clear self from track but not equipment	Damaged equipment
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW Worker(s) fails to clear track. Hit by train
MOW Worker(s) is able to clear self from track but not equipment	Damaged equipment
MOW worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW worker(s) fails to clear track. Hit by train
MOW Worker(s) is able to clear self from track but not equipment	Damaged equipment.
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW Worker(s) fails to clear track. Hit by train
MOW Worker(s) is able to clear self from track but not equipment	Damaged equipment
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) rushes to clear track. Slip, trip, fall, etc

MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track.	MOW Worker(s) fails to clear track. Hit by train.
MOW Worker(s) is able to clear self from track but not equipment	Damaged equipment
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW Worker(s) fails to clear track. Hit by train
MOW Worker(s) is able to clear self from track but not equipment	Damaged equipment
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW Worker(s) fails to clear track. Hit by train
MOW Worker(s) is able to clear self from track but not equipment	Damaged equipment
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW Worker(s) fails to clear track. Hit by train
MOW Worker(s) is able to clear self from track but not equipment	Damaged equipment
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) rushes to clear track. Slip, trip, fall, etc

MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW Worker(s) fails to clear track. Hit by train
MOW Worker(s) is able to clear self from track but not equipment	Damaged equipment
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) rushes to clear track. Slip, trip, fall, etc
LW does not have sufficient time to clear self and equipment from track or is still in the foul of the track	LW fails to clear track. Hit by train
LW is able to clear self from track but not equipment	Damaged equipment
LW is able clear the foul of track but is not able to reach safe zone without risk of injury	LW rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	LW fails to clear track. Hit by train
MOW Worker(s) Is able to clear self from track but not equipment	Damaged equipment
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	LW Rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW Worker(s) fails to clear track. Hit by train
MOW Worker(s) is able to clear self from track but not equipment	Damaged equipment
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) rushes to clear track. Slip, trip, fall, etc

MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW Worker(s) fails to clear track. Hit by train
MOW Worker(s) is able to clear self from track but not equipment	Damaged equipment
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW Worker(s) fails to clear track. Hit by train
MOW Worker(s) is able to clear self from track but not equipment	Damaged equipment
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW Worker(s) fails to clear track. Hit by train
MOW Worker(s) is able to clear self from track but not equipment	Damaged equipment
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) Rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW Worker(s) fails to clear track. Hit by train
LW is able to clear self from track but not equipment	Damaged equipment
LW is able clear the foul of track but is not able to reach safe zone without risk of injury	LW rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW Worker(s) fails to clear track. Hit by train
LW is able to clear self from track but not equipment	Damaged equipment

LW is able clear the foul of track but is not able to reach safe zone without risk of injury	LW rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) is struck by oncoming train (train does not have adequate time to stop)	MOW Worker(s) incapable of clearing track. MOW Worker(s) hit by train
Equipment left on track	Damaged equipment

B6. Exclusive Track Occ. - CTC

Unique ID	Hazard	Hazard Cause
UC-RWP-601	EOA issued with incorrect work limits	EIC requests EO for between points A and B instead of to inlcude points A and B. IE. Switch points etc
	Dispatch improperly applies blocking at WL	Dispatcher does not apply blocking at either/both ends of WL and MOW worker(s) are unknowingly outside protected WL
	EIC fails to request EOA for correct location (incorrect milepost or track)	workmen unknowingly work outside of EOA work limits unprotected

	EIC mistakes the train	EOA is issued with understanding that it is not effective until train 1234 with lead locomotive ID ABC has past. EIC mistakes the train
	EIC - MOW Worker(s) communicaiton problem	
		EIC misunderstand that workmen has cleared track

		EIC did not verify MOW Worker(s) were clear of track
UC-RWP-602	Include all hazards from UC-RWP-601	
	EIC/Workmen fails to properly identify the track they are occupying	MOW Worker(s) is on the incorrect section of track
UC-RWP-603	Include everything from UC-RWP-602	
UC-RWP-604	Include everything from UC-RWP-602	
	EIC/MOW Worker(s) Inattention	MOW Worker(s) attempt to clear working track in direction of opposing occupied track (disorientation)

	Train approach on adjacent track	MOW worker(s) unable to see train approach on track 2 because line of site impaired by work train on siding
		MOW worker(s) attempts to clear in direction of track 1
	Obstruction on field side of Main Track causing MOW worker(s) to clear over occupied Main Track	Train or track equipment tied down/ physical barrier on opposing track and LW fails to incorporate additional time in ITD
UC-RWP-605A	Include everything from UC-RWP-602	
UC-RWP-605B	Include everything from UC-RWP-601	
	Include everything from UC-RWP-604	
	Opposing track field of view obscured	Train or track equipment tied down on opposing track and WM fails to reassess ITD
	Insufficient time for MOW Worker(s) to clear track as train approaches on spur	WM error in determining ITD for spur
	WM does not notice train approaching.	WM inattention

		WM visibility reduced environmental conditions. Rain, fog, snow, sun glare, etc
		WM visibility reduced by low light conditions
	Insufficient time for MOW Worker(s) to clear track as train approaches	WM error in determining ITD - track speed higher than WM thought.
		WM not close enough to MOW Worker(s)
	MOW Worker(s) incapacitated and lying within the foul	Varied (medical and/or external factors)

UC-RWP-606	Include everything from UC-RWP-602	
	Include everything from UC-RWP-605b	
UC-RWP-607	Include everything from UC-RWP-602	
	Include everything from UC-RWP-605b	
UC-RWP-608	Include everything from UC-RWP-602	
	Include everything from UC-RWP-605b	
UC-RWP-609	Include everything from UC-RWP-602	
	Include everything from UC-RWP-605b	

Hazard Effect(s) Explanation of C & D	Potential Mishap
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track.	MOW Worker(s) fails to clear track. Hit by train
MOW Worker(s) is able to clear self from track but not equipment	Damaged equipment
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW Worker(s) fails to clear track. Hit by train
MOW Worker(s) is able to clear self from track but not equipment	Damaged equipment
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW Worker(s) fails to clear track. Hit by train

MOW Worker(s) is able to clear self from track but not equipment	Damaged equipment
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW Worker(s) fails to clear track. Hit by train
MOW Worker(s) is able to clear self from track but not equipment	Damaged equipment
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW Worker(s) fails to clear track. Hit by train
MOW Worker(s) is able to clear self from track but not equipment	Damaged equipment
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) rushes to clear track. Slip, trip, fall, etc

MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW Worker(s) fails to clear track. Hit by train
MOW Worker(s) is able to clear self from track but not equipment	Damaged equipment
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW Worker(s) fails to clear track. Hit by train
MOW Worker(s) is able to clear self from track but not equipment	Damaged equipment
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW Worker(s) fails to clear track. Hit by train
MOW Worker(s) is able to clear self from track but not equipment	Damaged equipment
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) rushes to clear track. Slip, trip, fall, etc

MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW Worker(s) fails to clear track. Hit by train
MOW Worker(s) is able to clear self from track but not equipment	Damaged equipment
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) rushes to clear track. Slip, trip, fall, etc
LW does not have sufficient time to clear self and equipment from track or is still in the foul of the track	LW fails to clear track. Hit by train
LW Is able to clear self from track but not equipment	Damaged equipment
LW is able clear the foul of track but is not able to reach safe zone without risk of injury	LW Rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	LW fails to clear track. Hit by train
MOW Worker(s) is able to clear self from track but not equipment	Damaged equipment
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	LW rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW Worker(s) fails to clear track. Hit by train
MOW Worker(s) is able to clear self from track but not equipment	Damaged equipment
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) Rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW Worker(s) fails to clear track. Hit by train

MOW Worker(s) is able to clear self from track but not equipment	Damaged equipment
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW Worker(s) fails to clear track. Hit by train
MOW Worker(s) is able to clear self from track but not equipment	Damaged equipment
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW Worker(s) fails to clear track. Hit by train
MOW Worker(s) is able to clear self from track but not equipment	Damaged equipment
MOW Worker(s) is able clear the foul of track	MOW Worker(s) Rushes to clear track. Slip, trip,
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW Worker(s) fails to clear track. Hit by train
LW is able to clear self from track but not equipment	Damaged equipment
LW is able clear the foul of track but is not able to reach safe zone without risk of injury	LW rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW Worker(s) fails to clear track. Hit by train
LW is able to clear self from track but not equipment	Damaged equipment
LW is able clear the foul of track but is not able to reach safe zone without risk of injury	LW Rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) is struck by oncoming train (train does not have adequate time to stop)	MOW Worker(s) incapable of clearing track. MOW Worker(s) hit by train
Equipment left on track	Damaged equipment

B7. Track Bulletin

Unique ID	Hazard	Hazard Cause
UC-RWP-701	Bulletin issued with incorrect work limits	EIC or manager of MOW requests bulletin for between points A and B instead of to include points A and B. IE. Switch points etc
	EIC or manager of MOW fails to request bulletin for correct location (incorrect milepost or track)	workmen unknowingly work outside of bulletin work limits unprotected
	EIC - MOW Worker(s) communication problem	
		EIC misunderstand that workmen has cleared track
		EIC did not verify MOW Worker(s) were clear of track
UC-RWP-702	Include all hazards from UC-RWP-701	
	EIC/MOW Worker(s) fails to properly identify the track they are occupying	MOW Worker(s) is on the incorrect section of track

UC-RWP-703	Include everything from UC-RWP-702	
UC-RWP-704	Include everything from UC-RWP-702	
	EIC/MOW worker(s) Inattention	MOW Worker(s) attempt to clear working track in direction of opposing occupied track (disorientation)
	Train approach on adjacent track	MOW Worker(s) unable to see train approach on track 2 because line of site impaired by work train on siding
		MOW Worker(s) attempts to clear in direction of track 1
	Obstruction on field side of Main Track causing MOW Worker(s) to clear over occupied Main Track	Train or track equipment tied down/ physical barrier on opposing track and LW fails to incorporate additional time in ITD
UC-RWP-705A	Include everything from UC-RWP-702	
UC-RWP-705B	Include everything from UC-RWP-701	
	Include everything from UC-RWP-704	
	Opposing track field of view obscured	train or track equipment tied down on opposing track and WM fails to reassess ITD
	Insufficient time for MOW Worker(s) to clear track as train approaches on spur	WM error in determining ITD for spur

	WM does not notice train approaching.	WM inattention
		WM visibility reduced environmental conditions. Rain, fog, snow, sun glare, etc
		WM visibility reduced by low light conditions
	Insufficient time for MOW Worker(s) to clear track as train approaches	WM error in determining ITD - track speed higher than WM thought
		WM not close enough to MOW Worker(s)
	MOW Worker(s) incapacitated and lying within the foul	Varied (medical and/or external factors)
UC-RWP-706	Include everything from UC-RWP-702	

	Include everything from UC-RWP-705b	
UC-RWP-707	Include everything from UC-RWP-702	
	Include everything from UC-RWP-705b	
UC-RWP-708	Include everything from UC-RWP-702	
	Include everything from UC-RWP-705b	
UC-RWP-709	Include everything from UC-RWP-702	
	Include everything from UC-RWP-705b	

Hazard Effect(s) Explanation of C & D	Potential Mishap
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track.	MOW Worker(s) fails to clear track. Hit by train
MOW Worker(s) is able to clear self from track but not equipment	Damaged equipment
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW Worker(s) fails to clear track. Hit by train
MOW Worker(s) is able to clear self from track but not equipment	Damaged equipment
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW Worker(s) fails to clear track. Hit by train
MOW Worker(s) is able to clear self from track but not equipment	Damaged equipment
MOW worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW Worker(s) fails to clear track. Hit by train
MOW Worker(s) is able to clear self from track but not equipment	Damaged equipment
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW Worker(s) fails to clear track. Hit by train
MOW Worker(s) is able to clear self from track but not equipment	Damaged equipment

MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW Worker(s) fails to clear track. Hit by train.
MOW Worker(s) is able to clear self from track but not equipment	Damaged equipment
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW worker(s) fails to clear track. Hit by train.
MOW Worker(s) is able to clear self from track but not equipment	Damaged equipment
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) rushes to clear track. Slip, trip, fall, etc
LW does not have sufficient time to clear self and equipment from track or is still in the foul of the track	LW fails to clear track. Hit by train
LW is able to clear self from track but not equipment	Damaged equipment.
LW is able clear the foul of track but is not able to reach safe zone without risk of injury	LW rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track.	LW fails to clear track. Hit by train
MOW Worker(s) is able to clear self from track but not equipment	Damaged equipment
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	LW rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW Worker(s) fails to clear track. Hit by train
MOW Worker(s) is able to clear self from track but not equipment	Damaged equipment

MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW Worker(s) fails to clear track. Hit by train
MOW Worker(s) Is able to clear self from track but not equipment	Damaged equipment
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW Worker(s) fails to clear track. Hit by train
MOW Worker(s) is able to clear self from track but not equipment	Damaged equipment
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW Worker(s) fails to clear track. Hit by train
MOW Worker(s) is able to clear self from track but not equipment	Damaged equipment
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury	MOW Worker(s) rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track	MOW Worker(s) fails to clear track. Hit by train
LW is able to clear self from track but not equipment	Damaged equipment
LW is able clear the foul of track but is not able to reach safe zone without risk of injury	LW Rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track.	MOW Worker(s) fails to clear track. Hit by train.
LW Is able to clear self from track but not equipment	Damaged equipment
LW is able clear the foul of track but is not able to reach safe zone without risk of injury	LW Rushes to clear track. Slip, trip, fall, etc
MOW Worker(s) is struck by oncoming train (train does not have adequate time to stop)	MOW Worker(s) incapable of clearing track. MOW Worker(s) hit by train.
Equipment left on track	Damaged equipment

B8. Joint Occupancy

Unique ID	Reference Use	Hazard	Hazard Cause	Specific Hazard	Notes
		include all hazards from UC-RWP-301 and 307			
UC-RWP-801	UC-RWP-201 (WLP - Single Track)	EOA issued with incorrect work limits	EIC requests EO for points A and B instead of to include points A and B. IE. Switch points etc		
		EIC improperly displays flags at WL	EIC does not display flag at either / both ends of WL and MOW worker(s) are unknowingly outside protected WL		
		EIC fails to request EOA for correct location (incorrect milepost or track)	Workmen unknowingly work outside of EOA work limits unprotected		
		EIC mistakes the train	EOA is issued with understanding that it is not effective until train 1234 with lead locomotive ID ABC has past. EIC mistakes the train		
		EIC - MOW Worker(s) communication problem			
			EIC misunderstand that workmen has cleared track		

			EIC did not verify MOW Worker(s) were clear of track		
		Miscommunication between EIC-1 and EIC-2	EIC and workgroup with JO miscommunication about clearing track		
			EIC and workgroup with JO miscommunication about time when they are able to occupy track		
UC-JOP-802		Include all hazards from UC-JOP-801			
		EIC/Workmen fails to properly identify the track they are occupying	MOW Worker(s) is on the incorrect section of track		
UC-JOP-803		Include all from UC-JOP-802			
UC-JOP-804		Include all from UC-JOP-802			
		EIC/MOW worker(s) Inattention	MOW Worker(s) attempt to clear working track in direction of opposing occupied track (disorientation)		

		Train approach on adjacent track	MOW Worker(s) unable to see train approach on track 2 because line of site impaired by work train on siding		
			MOW worker(s) attempts to clear in direction of track 1		
		Obstruction on field side of Main Track causing MOW worker(s) to clear over occupied Main Track	Train or track equipment tied down/ physical barrier on opposing track and LW fails to incorporate additional time in ITD		
UC-JOP-805a		Include all from UC-JOP-802			
UC-JOP-805b		Include all from UC-JOP-801			
		Include everything from UC-RWP-804			
		Opposing track field of view obscured	train or track equipment tied down on opposing track and WM fails to reassess ITD		
		Insufficient time for MOW Worker(s) to clear track as train approaches on spur	WM error in determining ITD for spur		

		WM does not notice train approaching.	WM inattention		
			WM visibility reduced environmental conditions. Rain, fog, snow, sun glare, etc.		
			WM visibility reduced by low light conditions		
		Insufficient time for MOW Worker(s) to clear track as train approaches	WM error in determining ITD - track speed higher than WM thought.		
			WM not close enough to MOW Worker(s)		
		MOW Worker(s) incapacitated and lying within the foul	Varied (medical and/or external factors)		
UC-JOP-806		Include all from UC-JOP-802 or 805B			

UC-JOP-807		Include all from UC-JOP-802 or 805B			
UC-JOP-808		Include all from UC-JOP-804			
UC-JOP-809		Include all from UC-JOP-804			

Hazard Effect(s) Explanation of C & D	Initial Probabilit	Potential Mishap	Mishap Severity	Process/practice
MOW worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track.	C	MOW worker(s) fails to clear track. Hit by train.		
MOW worker(s) Is able to clear self from track but not equipment		Damaged equipment.		
MOW worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury		MOW worker(s) Rushes to clear track. Slip, trip, fall, etc		
MOW worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track.	C	MOW worker(s) fails to clear track. Hit by train.		
MOW worker(s) Is able to clear self from track but not equipment		Damaged equipment.		
MOW worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury		MOW worker(s) Rushes to clear track. Slip, trip, fall, etc		
MOW worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track.	C	MOW worker(s) fails to clear track. Hit by train.		
MOW worker(s) Is able to clear self from track but not equipment		Damaged equipment.		
MOW worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury		MOW worker(s) Rushes to clear track. Slip, trip, fall, etc		
MOW worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track.	C	MOW worker(s) fails to clear track. Hit by train.		
MOW worker(s) Is able to clear self from track but not equipment		Damaged equipment.		
MOW worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury		MOW worker(s) Rushes to clear track. Slip, trip, fall, etc		
MOW worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track.	C	MOW worker(s) fails to clear track. Hit by train.		

MOW worker(s) Is able to clear self from track but not equipment		Damaged equipment.		
MOW worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury		MOW worker(s) Rushes to clear track. Slip, trip, fall, etc		
MOW worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track.	C	MOW worker(s) fails to clear track. Hit by train.		
MOW worker(s) Is able to clear self from track but not equipment		Damaged equipment.		
MOW worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury		MOW worker(s) Rushes to clear track. Slip, trip, fall, etc		
Workmen not able to clear the track before train enters work zone		workmen hit by train		
Workmen Is able to clear self from track but not equipment		Damaged equipment.		
Workmen is able clear the foul of track but is not able to reach safe zone without risk of injury		Workmen rushes to clear track. Slip, trip, fall, etc		
Workmen not able to clear the track before train enters work zone		workmen hit by train		
Workmen Is able to clear self from track but not equipment		Damaged equipment.		
Workmen is able clear the foul of track but is not able to reach safe zone without risk of injury		Workmen rushes to clear track. Slip, trip, fall, etc		
MOW worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track.	C	MOW worker(s) fails to clear track. Hit by train.		
MOW worker(s) is able to clear self from track but not equipment		Damaged equipment.		
MOW worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury		MOW worker(s) rushes to clear track. Slip, trip, fall, etc		
MOW worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track.	C	MOW worker(s) fails to clear track. Hit by train.		
MOW worker(s) is able to clear self from track but not equipment		Damaged equipment.		

MOW worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury		MOW worker(s) Rushes to clear track. Slip, trip, fall, etc		
MOW worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track.	C	MOW worker(s) fails to clear track. Hit by train.		
MOW worker(s) is able to clear self from track but not equipment		Damaged equipment.		
MOW worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury		MOW worker(s) Rushes to clear track. Slip, trip, fall, etc		
LW does not have sufficient time to clear self and equipment from track or is still in the foul of the track.	C	LW fails to clear track. Hit by train.		
LW Is able to clear self from track but not equipment		Damaged equipment.		
LW is able clear the foul of track but is not able to reach safe zone without risk of injury		LW Rushes to clear track. Slip, trip, fall, etc		
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track.	C	LW fails to clear track. Hit by train.		
MOW Worker(s) Is able to clear self from track but not equipment		Damaged equipment.		
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury		LW Rushes to clear track. Slip, trip, fall, etc		
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track.	C	MOW Worker(s) fails to clear track. Hit by train.		
MOW Worker(s) Is able to clear self from track but not equipment		Damaged equipment.		
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury		MOW Worker(s) Rushes to clear track. Slip, trip, fall, etc		

MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track.	C	MOW Worker(s) fails to clear track. Hit by train.		
MOW Worker(s) Is able to clear self from track but not equipment		Damaged equipment.		
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury		MOW Worker(s) Rushes to clear track. Slip, trip, fall, etc		
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track.	C	MOW Worker(s) fails to clear track. Hit by train.		
MOW Worker(s) Is able to clear self from track but not equipment		Damaged equipment.		
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury		MOW Worker(s) Rushes to clear track. Slip, trip, fall, etc		
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track.	C	MOW Worker(s) fails to clear track. Hit by train.		
MOW Worker(s) Is able to clear self from track but not equipment		Damaged equipment.		
MOW Worker(s) is able clear the foul of track but is not able to reach safe zone without risk of injury		MOW Worker(s) Rushes to clear track. Slip, trip, fall, etc		
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track.	C	MOW Worker(s) fails to clear track. Hit by train.		
LW Is able to clear self from track but not equipment		Damaged equipment.		
LW is able clear the foul of track but is not able to reach safe zone without risk of injury		LW Rushes to clear track. Slip, trip, fall, etc		
MOW Worker(s) does not have sufficient time to clear self and equipment from track or is still in the foul of the track.	C	MOW Worker(s) fails to clear track. Hit by train.		
LW Is able to clear self from track but not equipment		Damaged equipment.		
LW is able clear the foul of track but is not able to reach safe zone without risk of injury		LW Rushes to clear track. Slip, trip, fall, etc		
MOW Worker(s) is struck by oncoming train (train does not have adequate time to stop)	D	MOW Worker(s) incapable of clearing track. MOW Worker(s) hit by train.		
Equipment left on track		Damaged equipment.		

Revised Hazard	Initial HRI	Risk Class	System Input	Proposed Mitigation	Residual Severity	Residual Frequency	Residual HRI	Residual Risk Class	Assumptions	Notes

B9. Hazard Prob (PTCDP2 10.2.4)

A	**Frequent**	P(incident) > 1E-3 per operating hour	Event likely to occur often in life of the system or item. May be "continuously experienced in fleet/inventory.
B	**Probable**	1E-3 per operating hour >= P(incident) > 1E-5 per operating hour	Event likely to occur several times in life of the system or item. Expected to occur frequently in fleet/inventory.
C	**Occasional**	1E-5 per operating hour >= P(incident) > 1E-7 per operating hour	Event likely to occur in life of the system or item. Expected to occur several times in fleet/inventory.
D	**Remote**	1E-7 per operating hour >= P(incident) > 1E-9 per operating hour	Event unlikely, but possible to occur in life of the system or item. Unlikely, but can be expected to occur in fleet/inventory.
E	**Improbable**	P(incident) <= 1E-9 per operating hour	Event so unlikely to occur that it can be assumed not to be experienced in the life of a individual system or item. Unlikely to occur, but is possible in fleet. Not interpreted as zero probability.

B10. Hazard Severity (PTCDP2 10.2.4)

I	**Catastrophic**	Deaths, system loss, or severe environmental damage
II	**Critical**	Severe injury, severe occupational illness, major system or environmental damage
III	**Marginal**	Minor injury, minor occupational illness, or minor system or environmental damage
IV	**Negligible**	Less than minor injury, less than minor occupational illness, or less than minor system or environmental damage

B11. Specific Hazard

LOS	**Line of Sight**	Adverse weather conditions. Low light conditions. Working on a curve. Looking in wrong direction. Working near a tunnel.
Neg	**Negligence**	Event likely to occur several times in life of the system or item. Expected to occur frequently in fleet/inventory.

B12. Out of Scope

Unique ID	Reference Use Case	Hazard	Hazard Cause
Train crew innattention.	Train wistle not blown. LW not alerted to train presence	C	LW fails to clear track. Hit by train.
LW not wearing high visibility PPE.	""	C	""
TC visibility reduced environmental conditions. Rain, fog, snow, sun glare, etc.	""	A	""
TC visibility reduced by low light conditions	""	A	""

Hazard Effect(s)	Initial Probability	Potential Mishap	Mishap Severity
	LW expected to be watching for train. Potential mishap is reslt of multiple erros. This hazard and LW not seeing train.		
	""		
	"" + LW expected to reevaluate ITD as conditions change. If ITD insuffucient for track access, then LW expected to not be on track.		
	"" + LW expected to reevaluate ITD as conditions change. If ITD insuffucient for track access, then LW expected to not be on track.		

Process/practice affecting Probability	Revised Hazard Frequency (initial freqency modified by Processes and practices affecting frequency)	Initial HRI	Risk Class

Proposed Mitigation	Residual Severity	Residual Frequency	Residual HRI

Residual Risk Class	Assumptions	Notes

Appendix C.
MOWESS Concept of Operations

Concept of Operation

For the

Maintenance-of-Way Enhanced Safety System (MOWESS)

Prepared by

Transportation Technology Center, Inc.

Document: MOWESS CONOPS

Version 1.0

August, 2018

The information in this document is based upon work supported by the Federal Railroad Administration under contract DTFR5311D00008L. Any opinions, findings, and conclusions or recommendations expressed in this report are those of the author(s) and do not necessarily reflect the views of the Federal Railroad Administration or U.S. Department of Transportation.

1. Scope

The Maintenance-of-Way Employee Safety System (MOWESS) is intended to reduce the risk of maintenance-of-way (MOW) worker injuries while engaged in activities within the foul of track. The document will summarize current methods MOW worker protection and explain how MOWESS might be utilized in conjunction with current practices to improve overall safety for the MOW worker. The scope of this document is limited to MOW worker protection methods from the perspective of the MOW worker.

1.1 System Overview

The proposed MOWESS is not necessarily a single system, rather it is a suite of risk reducing software applications, used together or individually, that are intended to improve MOW worker safety by reducing specific risks by enhancing situational awareness of MOW workers. The user platform for the risk reduction application is a small portable device that will be able to be worn by the MOW worker, Watchman, and employee-in-charge (EIC). A cell phone or tablet may have the capability to perform the functions of the MOWESS applications. However, to reduce the risk of distraction by other applications, the device will need to be dedicated to the MOWESS application functions. This small portable device will have the capability to be used in different modes specific to the risk reduction application being utilized. The device will need to be able to alert the MOW worker, Watchman, and EIC via a visual, audible, and physical alert. Figures is Section 5 of this document detail conceptual architecture diagrams for the MOWESS applications.

2. Referenced Documents

1. GCOR, Seventh Edition, April 1, 2015
2. NORAC Operating Rules, Tenth Edition, November 6, 2011
3. 49 CFR Part 214

3. Current System or Situation

MOW workers currently utilize operating rules that must be followed to ensure safety when working within the foul limits of any track, bridge or wayside structure. These rules should be strictly adhered to while performing any work function within the track foul limits. Track foul limits under most circumstances is considered any space along the right-of-way within four feet of the nearest rail.

MOW workers working on or near rail lines are currently governed by safety rules and guidelines in the following:

- Federal regulations (CFR 214 define requirements for protecting MOW workers).
- Railroad operating rules (General Code of Operating Rules [GCOR], Northeast Operating Rules Advisory Committee [NORAC] rules, and individual railroad rule books) expand on the regulatory requirements).

These rule books have been developed to ensure the safety of MOW workers. Workers are trained on the various forms of on-track protection and the proper establishment of those forms of protection before performing MOW job functions within the foul of track. The methods of on-track protection used by MOW include:

- Lone Worker
- Watchman Lookout
- Train Coordination
- Exclusive Authority
- Track Bulletin
- Joint Occupancy

These processes are described in detailed in Appendix A.

MOW workers are trained in operating rules and procedures before being allowed to establish on-track protection; however, hazardous events can still occur, due to human errors. The MOWESS is intended as an additional measure of safety to work in conjunction with current

operating rules to aid in mitigating accidents caused by human error on the part of the MOW worker.

3.1 Railroad Personnel Involved in MOW Worker Protection

There is a set group of railroad personnel involved in setting up and maintaining MOW worker protection while performing job functions on rail lines. These personnel and their roles are detailed in the bullets below.

- MOW worker (Lone Worker or as part of team) - A MOW worker is the personnel that is responsible for performing the work on the track or other railroad structure that is located on or within the foul limits of track. Fouling track, under most circumstances, is considered to be any space along the right-of-way within 4 feet of the nearest rail. The job functions of a MOW worker can vary from simple visual track inspections to entire removal and replacement of track structure, subgrade or bridges. The MOW worker can perform specific functions alone as a Lone Worker or as part of a team of MOW workers, often referred to as a workgroup.
- MOW Watchman/Lookout (specialized roll of MOW worker) - A MOW watchman/lookout is responsible for being the lookout for personnel performing a job function requiring them to foul track. The watchman has a single responsibly; to watch for oncoming rail traffic or hazards. The watchman must stay within such proximity to the MOW worker such that they are able to signal the worker of hazards and/or oncoming rail traffic. The signal to clear track may be visual, audible, physical, or any combination of the three. The proper method of presenting a signal to clear the track is dependent upon the job function being performed. For example, when a MOW worker is using loud power tools such as a rail grinder, the Watchman must be close enough to use a physical signal (i.e., touching the worker on the shoulder) to alert the workmen.
- Employee in Charge (EIC) - The EIC is the member of the MOW team that is responsible for coordinating track time, working limits, and communications with dispatch and other railroad entities as required. The EIC is also the leader of the MOW team performing work that requires them to foul track. An EIC is not required when performing work as a lone worker or with watchman lookout protection. An EIC is utilized in all other MOW situations.

- Dispatcher - The dispatcher is the railroad personnel that supervises train movement and any employees connected with that movement. They are also responsible for train dispatch and coordination of track bulletins. The EIC and the dispatcher communicate to setup MOW work zones when utilizing Exclusive Track Occupancy and Track Warrant as a method of MOW safe work zones.
- Train Crew (Engineer and Conductor) - The train crew is the railroad personnel responsible for operations of a road train or work train. The MOW worker may be required to communicate directly with the train crew if Train Coordination or a Form B is used as the MOW safety method. Under all other MOW safety methods, the communication with the train crew is normally directly with the dispatcher.

3.2 Current MOW Worker Protection Methods

3.2.1 Lone Worker Protection

A Lone Worker is an individual roadway worker who is not being afforded on-track protection by another roadway worker, who is not a member of a roadway work group, and who is not engaged in a common task with another roadway worker. A lone worker is responsible for their own safety while on track or within the foul of track. The lone worker must be able to see approaching trains with enough advance warning to be clear of the track 15 seconds before a train's arrival. Additional details about Lone Worker Protection are provided in the Operational Use Case document found in Appendix A.

3.2.2 Watchman Lookout

Watchman lookout is a method of establishing on track protection by utilizing an employee who has been annually trained & qualified to provide warning to MOW roadway workers of approaching trains or on-track equipment. Watchman/Lookout should be properly equipped to provide visual and auditory warning such as whistle, air horn, white disk, red flag, lantern, and fusee. A Watchman/Lookout's sole duty is to look out for approaching trains/on-track equipment and provide adequate time for workmen to be positioned in the clear of the track in no less than 15 seconds before the arrival of trains/on-track equipment. Additional details about Watchman Lookout Protection are provided in the Operational Use Case document found in Appendix A.

3.2.3 Train Coordination

Train coordination is a method of establishing working limits on a track over which a train holds exclusive authority to move whereby the crew of that train yields that authority to a MOW worker.

Train Coordination provides for men or equipment to use a train's authority to establish working limits. The employee must contact the train's engineer to request use of Train Coordination. To establish working limits:

- The train must be in view and stopped.
- The employee in charge of working limits will communicate with the engineer who will notify other crew members that working limits are to be established.
- The engineer will make movements only as permitted by the employee in charge until the working limits have been released to the engineer.
- The train will not release its authority within the limits until those working limits have been released by the employee in charge.

Additional details about Train Coordination are provided in the Operational Use Case document found in Appendix A.

3.2.4 Exclusive Occupancy

Exclusive track occupancy is used to establish working limits on controlled tracks. Exclusive track occupancy is requested by the EIC and issued by the train dispatcher or control operator. When MOW exclusive occupancy has been established, train movement on the segment of MOW occupied track are held clear by the authority of the dispatch or control operator. The procedure depends upon communication of precise information between the train dispatcher or control operator, the roadway worker in charge of the working limits, and the crews of affected trains. Additional details about Exclusive Track Occupancy are provided in the Operational Use Case document found in Appendix A.

3.2.5 Track Bulletin

Track Bulletin protection is a method of establishing MOW worker protection by filing a track bulletin (Form B in GCOR) with the train dispatcher. Under most circumstances, the track

bulletin is required to be submitted to the train dispatcher no less than 24 hours in advance. A track bulletin establishes working limits for the MOW work crew by identifying:

- Subdivision
- Specific work limits
- Start and finish time
- Track(s) affected
- MOW EIC, Foreman, and MOW work crew names

Additional details about Track Bulletin protection are provided in the Operational Use Case document found in Appendix A.

3.2.6 Joint Occupancy

Joint Occupancy is the processes by which a separate roadway work group is afforded on-track safety by the EIC of a pre-established exclusive track occupancy, and that is located away from the EIC of the pre-established exclusive track occupancy. If Positive Train Control (PTC) is available, then PTC system components enforce train Movement Authority (MA) limits and provide train crew information. Additional details about Joint Occupancy are provided in the Operational Use Case document found in Appendix A.

4. Justification for MOWESS

The MOW worker must complete FRA mandated On-Track Safety training, as well as railroad operating rules training before being allowed permission to perform MOW work. Even with appropriate training, there is potential for accidents. These accidents could cause injury, damage to equipment and potentially death. To identify the hazards associated with MOW workers, a Preliminary Hazard Analysis (PHA) was conducted based on the Operational Uses Cases in Appendix A of this document. The PHA identified hazards still present to the MOW worker even when following all of the rules and training for the MOW worker.

To reduce the risk of these potential hazards, this document will describe four potential Maintenance of Way Employee Safety System applications. The concept of the MOWESS has been designed to aid in preventing accidents from the following hazard categories identified by the PHA under current MOW operations. These hazards fall into the following categories:

- Miscommunication – A misunderstanding of, or error in, communications between the MOW worker, EIC, train crew and/or dispatcher. The miscommunication may be the error of any of the parties involved.
- Inattention – A lack of attention to the current working situation by the MOW worker, Watchman, EIC, train crew and/or dispatcher.
- Incorrect Individual Train Detections (ITD) assessment – ITD is a procedure by which a lone worker or watchman lookout acquires on-track safety by determining they have adequate sight distance to see approaching trains and clear the track no less than 15 seconds before a train arrives at their location on track. Before beginning work on track, the MOW worker or EIC has the responsibility of performing an ITD assessment. This assessment has the potential for human error. An example of this is not adequately assessing sight distance available from the intended work zone.
- Workmen Incapacitated – The workmen is physically unable to clear the track. This has the greatest potential risk in a lone worker situation.

4.1 Identified MOW Worker Risks

When a MOW worker is subject to any of the hazard groups identified by the PHA, there are additional risks to the MOW worker. This section provides some examples of potential risks while working under hazardous conditions.

Miscommunication – Miscommunication is any error in relaying a message that causes the meaning of the message to be misunderstood. MOW worker miscommunications can result in a failure to clear a hazardous situation. An example of this is a situation where MOW workers are working under the rules of Joint Occupancy. In this example, the EIC of the primary work group gives the order to that work group to clear the track for the movement of MOW equipment by the secondary work group. The EIC of the primary work group receives what he/she believes to be "clear of track" radio messages from all members of the work group. However, one of the radio transmissions was not clear and what the EIC heard as "clear of track" was actually "not clear of track for another 5 minutes." As a result, the EIC of the primary work group gives the EIC of the secondary work group permission to move on-track equipment through the area of track where members of the primary work group are still working. This miscommunication, potentially caused by a faulty radio transmission, introduces the potential risk of accidents, or even fatality, to the members of the primary work group still working on track. This hazard could be minimized by a MOWESS application that identified the exact location of each of the MOW crew members to the EIC. An example of an application designed to mitigate this risk of this is included in Section 5.2.5.

Inattention – Inattention is the failure of a MOW worker to give full attention to a situation resulting is a loss of situational awareness. MOW worker inattention can lead to a MOW worker not being able to clear a hazardous situation in time. An example of this is inattention while working under the rules of Watchman Lookout. While working as a watchman lookout, the watchman is responsible for alerting the on-track worker of approaching trains and other potential hazards such as on-track equipment. This alert should allow for the on-track worker to safely be in the clear of the track no less than 15 seconds prior to train arrival at the worker's location. In this example, while working as a Watchman Lookout, the watchman is distracted by another railroad employee that stopped to talk about last night's game. The conversation introduces a brief moment of inattention by the watchman. Because of this inattention, the

watchman does not notice a train approaching until too late. This situation introduces a potentially severe hazard to the on-track worker and his equipment.

This situation could be mitigated by the watchman utilizing the Train Approach Detection Application described in Section 5.2.3. The train alert sent from this application would allow the workmen enough time to get in the clear of the track at least 15 seconds before the arrival of the train.

Incorrect ITD Assessment – An incorrect ITD assessment is the failure of the MOW roadway worker to correctly determine time table train speed, available sight distance, or the amount of time required to clear the track. An ITD requires reassessment while performing work if any of these three factors change. If a lone worker would like to access track, it is their responsibility to perform an ITD prior to entering the foul of the track. Additionally, it is the responsibility of the watchman lookout to properly assess ITD prior to allowing workers to foul track. An example of an incorrect ITD Assessment may be due to a change in weather conditions. For example, a lone worker arrives at the place on the track where he/she needs to take a photo of a switch. While performing the ITD worksheet prior fouling track, it begins to lightly rain. The MOW worker does not take the rain into account because it is very light. By the time the ITD is finished, it has begun to rain heavily. The lone worker fouls the track to take a photo but does not notice the train approaching, due to the noise and poor visibility from the rain. This situation increased the hazard of severe injury or death due to the ITD being done incorrectly.

This situation could have been potentially mitigated by the MOWESS by providing the exact location of the train to the loan worker before he/she entered the foul limits of the track. An example of a MOWESS application designed to provide this information to the MOW worker is the High Accuracy Train Location found in Section 5.2.2.

Workmen incapacitated – An incapacitated workman is any workman that is not able to clear the foul limits of the track due to a physical impairment. While the MOWESS may not be able to alert the incapacitated worker of a train approach due to the workman's physical state, it may be able to provide information to the EIC indicating that a workman has not cleared the track by providing the workman GPS location. For example, if a MOW work crew are working under Exclusive Track Occupancy and the authority is nearing its end time granted by the dispatcher,

the EIC will radio each of the members of the work crew to notify them to clear track. Each of the workmen will then radio the EIC to confirm they have cleared the foul of the track. If one of the workmen working in a remote location is not able to answer the EIC's call to the clear the track, the MOWESS Worker Position Monitoring application would potentially be able to provide the GPS location of the incapacitated workmen to the EIC. This will allow the EIC to more efficiently keep track of his workers and take action more immediately if one fails to respond when a call to clear is made.

4.2 Description of Potential Changes

The addition of MOWESS working in conjunction with established MOW safety training and rules has the potential to greatly enhance situational awareness of the MOW worker. The information the MOWESS applications could provide the MOW worker is intended to reduce potential hazards caused by human error. With the use of several potential applications, the MOWESS provides the MOW worker with information about position of trains and other MOW workers. The MOWESS also provides an additional means of communication between MOW workers. MOWESS alerting would give the worker an audible, visual and physical alert to make them aware of potentially dangerous situations. Table 1 gives a high-level overview of potential benefits to the safety of the MOW worker. The risk reduction applications are explained in more detail in Section 5 of this document.

Risk	Risk Reduction Application	Benefit
Environmental conditions, such as weather or time of day results in a reduction in sight distance that is not recognized by a lone worker.	Train Approach Detection Alarm	Worker provided additional audible, visual, physical notification of a train approach. improving situational awareness and reducing the occurrence rate of incident
Workman moves outside of working limits.	MOW Worker Position Monitoring	MOW Workman provided accurate location of working

		limits and alerted when encroaching upon them
Watchman fails to notice train approaching due to inattention	Train Approach Detection / Watchman Warning System	Watchman / Worker provided additional audible, visual, physical notification of a train approach. Watchman / Workman communication enhanced.
Exclusive Track Occupancy (ETO) issued with incorrect work limits	Train Position Application	EIC provided access to information as input by dispatch. EIC able to verify ETO was entered as requested prior to occupying track
High speed train approach on track A while MOW workmen on Track B	High Accuracy Train Position	MOW workmen provided with information about train approach on adjacent track. Improved situational awareness.

Table 1: Examples of MOWESS Application Benefits

5. MOWESS System Concept

The proposed MOWESS is not a single system, rather it is a set of risk reducing applications that are intended to improve MOW worker safety by reducing specific risks. PTC is required by Federal mandate but only mitigates a subset of hazards. PTC is not designed to mitigate human error by the MOW roadway worker. The MOWESS is not able to force the MOW roadway working into a "safe condition," as PTC is able to do through automatic application of the train brake system. Rather, the intent of the MOWESS is to provide information to the roadway worker that will further enhance situational awareness. In the event of a MOWESS failure, the system is not able to pass critical information to the MOW roadway worker. Because of this, the MOWESS cannot be considered a fail-safe system. The MOWESS is considered to be a non-vital collection of operational data access to the MOW worker, rather than a replacement of current MOW operating and safety rules. Because of this, the current MOW operating rules must remain in place and continue to be followed. Not all capabilities described in the Section 5 are intended to work simultaneously in a single product. The intention of the MOWESS is to allow the MOW roadway worker to select an application that provides the most applicable data to the work situation.

5.1 System Constraints

The MOWESS constraints are centered on the communication platform and human factors. These constraints include but are not limited to:

- The MOWESS relies on wireless data communications such a Wi-Fi, cellular, and 220MHz for system updates.
- The MOWESS is not a fail-safe system architecture. If the MOWESS fails to provide information to the MOW roadway worker, it must be able to provide an audible, visual and physical alarm to the MOW worker to inform them of the loss of communications and to clear the track.
- The alert device battery life and/or system functions when battery life is nearly depleted could also be considered a constraint for the MOWESS.

- The MOWESS is it is not able to force a MOW worker out of a hazardous situation. Its intention is to provide useful data and alerts to the MOW worker allowing them to avoid or mitigate a hazardous situation.

5.2 MOWESS Applications

This section includes descriptions of how each risk reduction application functions as well as how it may be utilized in conjunction with current MOW operating rules to enhance the safety of the MOW roadway worker.

5.2.1 MOWESS Train Location Application

The Train Location Application will utilize a mobile device used by MOW workers to receive information about train location. The application will display a subdivision schematic with track block occupancy information. The display will be similar, if not the same, as that used by dispatchers. Block occupancy information will provide the MOW worker general information about train location. The track block information can be used by the MOW worker, or watchman, to determine, with some level of accuracy, when a train may begin to occupy the block in which they are working, or proceeding block, as appropriate to the work location. The information will supply the MOW worker with an early warning of a train approach, However, it will still be incumbent upon the MOW worker to maintain situational awareness, as this application will not inform of precise train location with respect to the worker's current position.

The main benefit of this application is that it provides MOW workers an improved awareness of train block occupancy with respect to their work location. The application requires a communication link to provide updates of track occupancy data to the MOW worker. This dependency on a communication link could allow the application to not function if there is a loss of communication with cellular or radio signal. The loss of communication in an application of this architecture will result in the MOW worker having stale data. This application is not fail safe in design. Figure 1 depicts a potential communication architecture for this application.

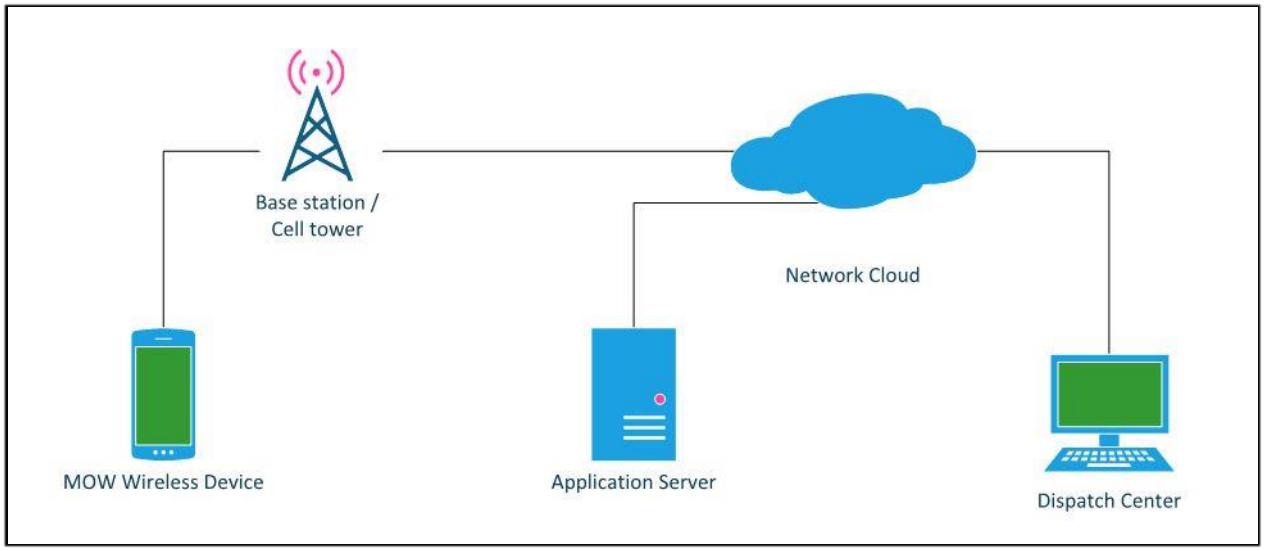


Figure 1: MOWESS Train Location Application

An example of how MOWESS Train Location Application might be utilized is provided in Table 2 below. The information in this table is an example of how MOWESS could be used in the situation of Use Case UC-RWP-105 from Appendix A.

ID	MOWESS UC-RWP-105
Title	Lone Worker with Train Location Application– Double Track
Description	Lone worker must foul track Main 1 to perform inspection or minor adjustment/repair. Lone worker is equipped with MOWESS Train Location Application. Road train on track Main 2 approaches work area.
Method of Operation	Any
RR Personnel	LW, TC
RR Systems	Road Train
Reference Track Configuration	Double track per Section 4.1.5.
Initial Condition	1) LW determines maximum train speed.

	2) LW determines clear time. 3) LW determines sight distance available. 4) LW determines sight distance required. 5) Track Main 1 to be accessed by LW is unoccupied. 6) Lone worker verifies MOWESS Application is active and determines train location *7)* LW accesses track Main 1 and begins work if ITD is acceptable.
Trigger Event	Road train on track Main 2 approaches track segment occupied by LW.
Scenario Steps	1) LW observes MOWESS Train Location Application display that shows train occupancy in nearby signal block. Focusing LW attention of train approach. 2) LW observes road train approaching. 3) TC blows whistle. 4) LW clears track Main 1. 5) TC proceeds through track Main 2 segment.
End State (Happy Path)	1) LW cleared track. 2) Road train proceeded.
References	49 CFR 214.337, 49 CFR 214.339, GCOR 5.8

Table 2: MOWESS Train Location – Lone Worker Double Track

5.2.2 High Accuracy Train Location Application

The MOWESS High Accuracy Train Location application provides data with improved accuracy of train position and track occupancy by integrating onboard position information from the locomotives. The information from this application will display track block occupancy as well

as precise position of the train within the track block. The application will include a position message from the lead locomotive in the train via the ITCM network and 220 MHz radio transmission. The End of Train (EOT) can also be estimated by the train length value input into the PTC onboard system of the locomotive, or by other means of high accuracy EOT location. Train speed and acceleration data could also be included in updates provided to the MOW worker. These inputs will give the MOW worker a much better estimate of train arrival time. This estimated time of arrival (ETA) report could also potentially be automated and be provided as an output from the MOW train tracking application.

The main benefit of this application is that it provides MOW workers a precise position and speed of a train and an ETA of the train at their work location. The application requires multiple communication links to provide updates of track occupancy data to the MOW worker. The dependency on a communication link could allow the application to become unavailable if there is a loss of communication with cellular or radio signal. The loss of communication in an application of this architecture will result in the MOW worker having stale data. This application is not fail safe in design. Figure 2 depicts a potential communication architecture for this application.

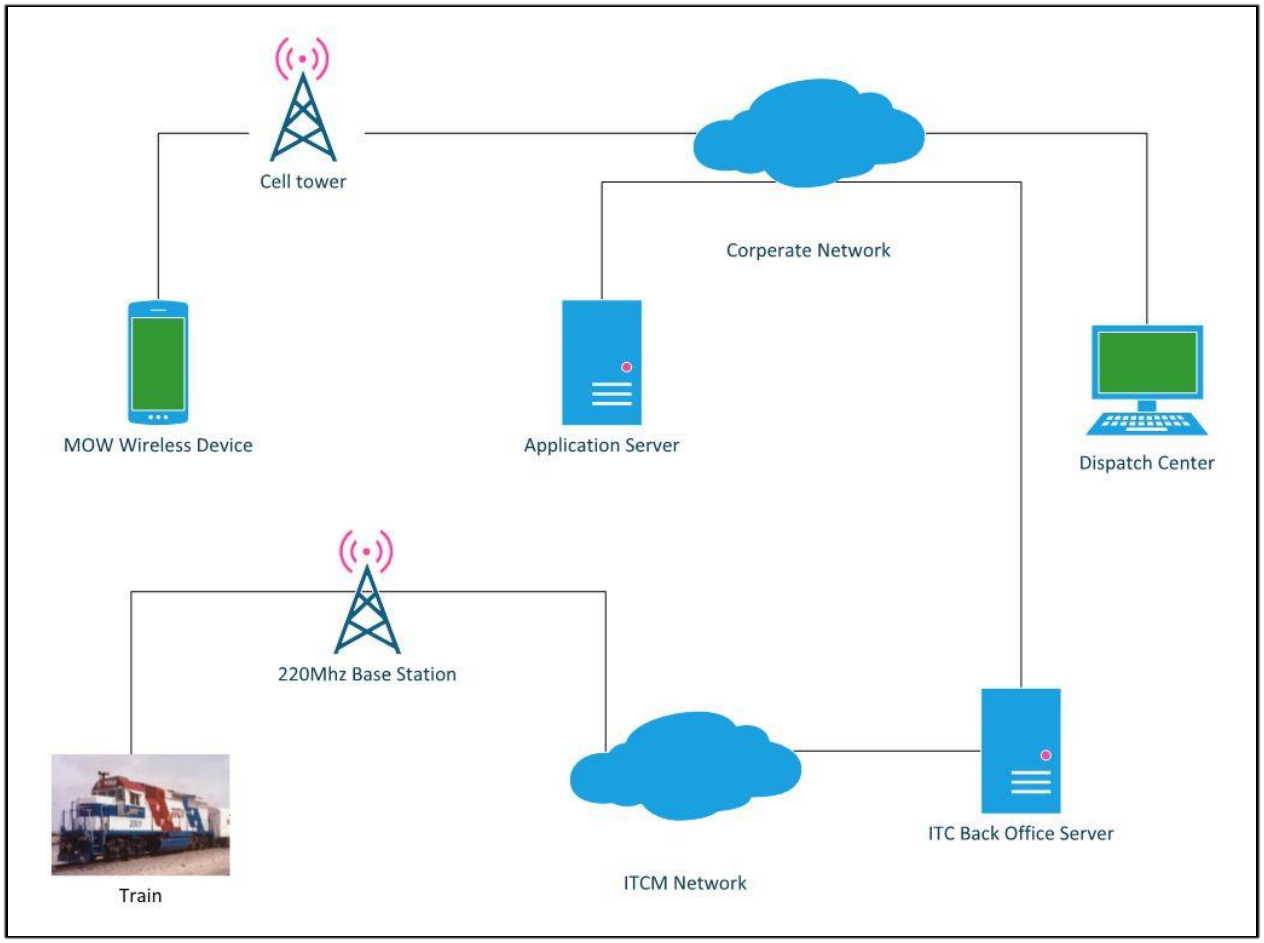


Figure 2: High Accuracy Train Location Application

An example of how MOWESS High Accuracy Train Location Application might be utilized is provided in Table 3 below. The information in this table is an example of how MOWESS could be used in the situation of Use Case UC-RWP-201 from Appendix A.

ID	MOWESS UC-RWP-201
Title	Watchmen Lookout with High Accuracy Train Location – Single Track
Description	MOW worker(s) under same WLP must foul Main track to perform adjustments and/or minor repairs. Watchman is equipped with MOWESS High Accuracy Train Location Application. Road train on Main track approaches work area.

Method of Operation	Any
RR Personnel	WM, MOW Worker(s), TC
RR Systems	Road Train
Reference Track Configuration	Single track per Section 4.1.1.
Initial Condition	1) WM determine maximum train speed for approaches to work area. 2) WM obtain clear time estimate from MOW worker(s). 3) WM determine sight distance available. 4) WM determine sight distance required. 5) WM briefs MOW worker(s) on conditions (i.e. train speed, clear-to location(s), etc.) 6) WM to get in appropriate position to watch for trains and alert MOW worker(s) of approaching train. 7) Main track to be accessed by MOW worker(s) is unoccupied by train or other vehicles. 8) Watchman verifies High Accuracy Train Location Application is functional and assess train location. 9) MOW worker(s) access track and begin work.
Trigger Event	Road train approaches track segment occupied by MOW worker(s).
Scenario Steps	1) WM observes road train approaching. 2) TC observes MOW worker(s) and blows whistle. 3) WM alerts MOW worker(s) of approaching road train.

	4) MOW worker(s) clear track, to include any tools that may be in the foul. 5) Road train proceeds through track segment.
End State (Happy Path)	1) WM and MOW worker(s) cleared track. 2) Road train proceeds.
References	49 CFR 214.339, 49 CFR 214.349, GCOR 5.8

Table 3: High Accuracy Train Location / Watchman Lookout on Single Track

5.2.3 Train Approach Detection Application

The Train Approach Detection Application is designed to provide the MOW worker notification of an approaching train. This application integrates a set of train approach indicator devices that can be installed on or near the track to signal the MOW worker and/or the EIC of an approaching train. The train presence detectors would need to be temporally installed in the same way flags are installed at the ends of a MOW work zone. Once installed, the device will send a heartbeat signal to an application utilized by the MOW worker. The persistence of this heartbeat, or continual link, between the train presence detectors and the MOW worker application will indicate that no train is present. When a train enters the safe stop area of the MOW work zone the device would stop the heartbeat. The loss of the "no train present" heartbeat will signal the MOW application to alert the MOW worker of train presence or loss of heartbeat. The application communication is fail safe because it alerts MOW workers to clear the track in the event of loss of communication. The application is not failsafe overall, however, because it relies on the use of a battery-operated alert device to be worn by the MOW worker. Some of the drawbacks to an application of this type are would include:

- The device must be installed on the track prior to beginning work
- The application would require a secure signal between the train presence device and the MOW application
- Loss of signal would trigger false alarms

- The potential still exists for the train presence device to be placed in an incorrect position/location on track

The application is relatively simple in design and is a closed loop system. It would not depend on any communication with the Back Office to function. The application is not failsafe in design due to its dependency on a battery-operated alert device. Figure 3 details a potential communication architecture for this application.

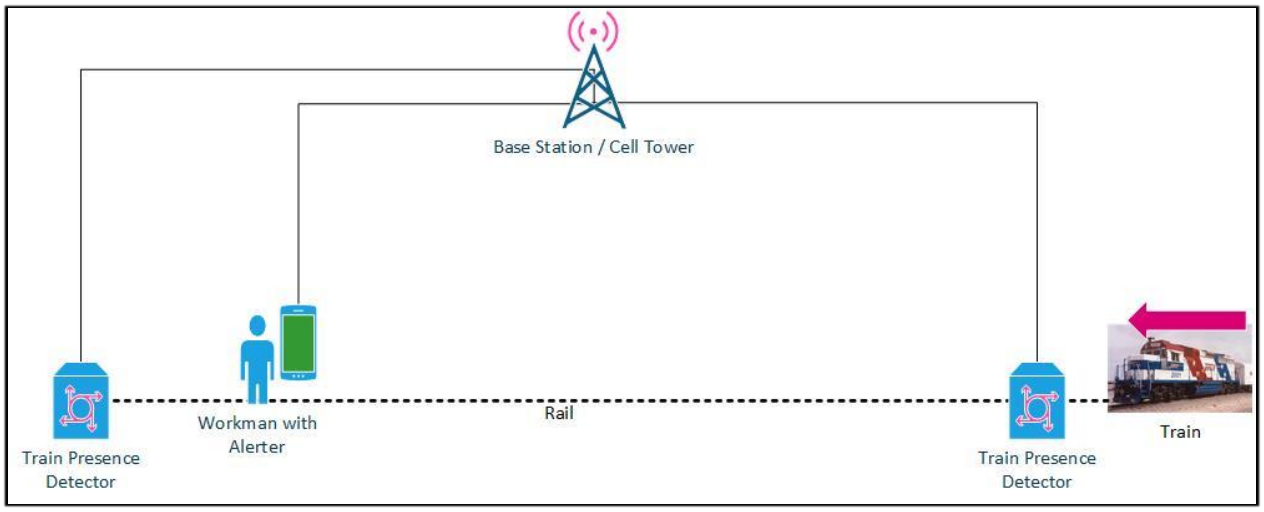


Figure 3: Train Approach Detection Application

An example of how MOWESS Train Approach Detection Application might be utilized is provided in Table 4 below. The information in this table is an example of how MOWESS would be used in the situation of Use Case UC-RWP-208 from Appendix A.

ID	MOWESS UC-RWP-208
Title	Watchmen Lookout with MOWESS Train Approach Detection – Triple Track
Description	MOW worker(s) under same WLP must foul track Main 3 to perform adjustments and/or minor repairs. Watchman is equipped with MOWESS High Accuracy Train Location Application. Road train on track Main 2 approaches work area.
Method of Operation	Any

RR Personnel	WM, MOW Worker(s), TC
RR Systems	Road Train
Reference Track Configuration	Triple track per Section 4.1.8.
Initial Condition	1) WM determine maximum train speed for approaches to work area. 2) WM obtain clear time estimate from MOW worker(s). 3) WM determine sight distance available. 4) WM determine sight distance required. 5) WM briefs MOW worker(s) on conditions (i.e. train speed, clear-to location(s), etc.) 6) WM to get in appropriate position to watch for trains and alert MOW worker(s) of approaching train. 7) Track Main 3 to be accessed by MOW worker(s) is unoccupied by train or other vehicles. 8) MOW worker(s) deploy Train Detection sensors on Track Main 3 and verify that the MOWESS application is functioning. 9) MOW worker(s) access track Main 3 and begin work.
Trigger Event	Road train on track Main 2 approaches track segment occupied by MOW worker(s). *Note: Scenario is the same as double track if train is approaching on same track or track adjacent to track occupied by LW.*
Scenario Steps	1) WM observes road train approaching.

	2) TC observes MOW worker(s) and blows whistle. 3) WM determines road train not on same track or adjacent track. 4) MOW worker(s) do not clear track. 5) Road train proceeds past work area track segment.
End State (Happy Path)	1) WM and MOW worker(s) continue work. 2) Road train proceeds.
References	49 CFR 214.339, 49 CFR 214.349, GCOR 5.8

Table 4: Train Approach Detection Application/Watchman Lookout Triple Track

5.2.4 Watchman Warning System

The Watchman Warning System application is designed to allow better communication between a watchman and the MOW workers on track. The application could be particularly useful in situations where the watchman and MOW worker visibility is impaired by weather or terrain. The application is designed as a closed loop secure commination system. To function, each of the members of the MOW work group, as well as the watchman, will be required to wear a communication/alerting device. When deployed, each of the MOW workers will need to pair communication with each of the watchman. A watchman would then be able to send an alert signal to all of the MOW workers to clear track as well as receive an all clear signal in return from each of the MOW workers. The device worn by the MOW worker will be equipped with audible, visual and physical alerts. The application functions by sending a heartbeat shared between each of the members of the MOW work crew. The device communication is fail safe because the alert is triggered by loss of "all clear" heartbeat sent from the watchman. In the event of loss of communication or termination of this heartbeat by the watchman or any member of the MOW workers, an alert to clear track will be sent to every member of the MOW work crew. The Watchman Warning Device will produce a visual, audible and physical alarm. This MOWESS application communication is fail-safe in design; however, due to the battery-operated alert device worn by the MOW worker, the overall application cannot be considered fail-safe. Figure 4 depicts the communication architecture of the Watchman Warning System Application.

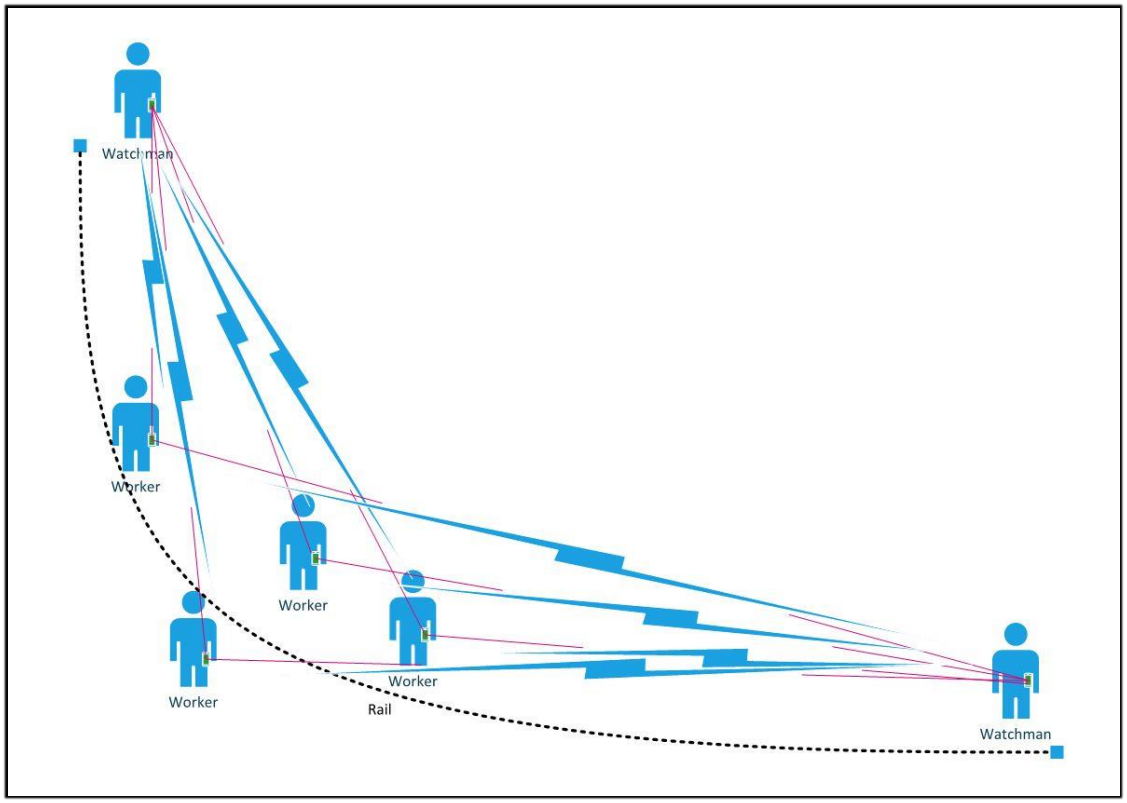


Figure 4: Watchman Warning Application

An example of how MOWESS Watchman Warning System Application might be utilized is provided in Table 5 below. The information in this table is an example of how MOWESS would be used in the situation of Use Case UC-RWP-201 from Appendix A.

ID	MOWESS UC-RWP-201
Title	Watchmen Lookout with MOWESS Watchman Warning Application– Single Track
Description	MOW worker(s) under same WLP must foul Main track to perform adjustments and/or minor repairs. Watchman is equipped with MOWESS Watchman Warning Application. Road train on Main track approaches work area.
Method of Operation	Any
RR Personnel	WM, MOW Worker(s), TC

RR Systems	Road Train
Reference Track Configuration	Single track per Section 4.1.1.
Initial Condition	10) WM determine maximum train speed for approaches to work area. 11) WM obtain clear time estimate from MOW worker(s). 12) WM determine sight distance available. 13) WM determine sight distance required. 14) WM briefs MOW worker(s) on conditions (i.e., train speed, clear-to location(s), etc.) 15) WM to get in appropriate position to watch for trains and alert MOW worker(s) of approaching train. 16) Main track to be accessed by MOW worker(s) is unoccupied by train or other vehicles. 17) Watchman/Workmen perform system function test to assure MOWESS Watchman Warning Application is working properly. 18) MOW worker(s) access track and begin work.
Trigger Event	Road train approaches track segment occupied by MOW worker(s).
Scenario Steps	6) WM observes road train approaching. 7) TC observes MOW worker(s) and blows whistle. 8) WM alerts MOW worker(s) of approaching road train but verbally and via the MOWESS Watchman Warning Application.

	9) MOW worker(s) clear track, to include any tools that may be in the foul. 10) Road train proceeds through track segment.
End State (Happy Path)	3) WM and MOW worker(s) cleared track. 4) Road train proceeds.
References	49 CFR 214.339, 49 CFR 214.349, GCOR 5.8

Table 5: Watchman Warning Application/Watchman Lookout Single Track

5.2.5 MOW Worker Position Monitoring

The MOW Worker Position Monitoring application is designed to help keep MOW workers working within the limits of the assigned track authority bulletin. The application works in conjunction with a device worn by the MOW worker designed to alert them when they are encroaching on the limits of the track authority. When the EIC requests authority to work on track, the working boundaries will be defined and entered as part of the granted authority. These boundaries will then be enforced by the MOW Worker Position Monitoring application. When the MOW worker approaches the end of the track authority limits, they will receive a boundary alarm. The alarm will be visual, audible and physical to ensure the highest potential for the MOW worker to receive the alarm. The main benefit of the MOW Worker Position Monitoring application is its ability to enhance the MOW worker's awareness of the track authority limits they are working under. Some of the potential drawbacks of the application include:

- Potential for MOW worker to not receive alerts
- Alert device battery life
- Potential for device to lose GPS signal
- Potential for MOW worker to begin work without donning the device
- Nuisance alarms generated when MOW worker leaves the perimeter of the track authority purposely for a legitimate reason

This MOWESS application is not fail-safe in design.

Figure 5 depicts a potential communication architecture of the Watchman Warning System Application.

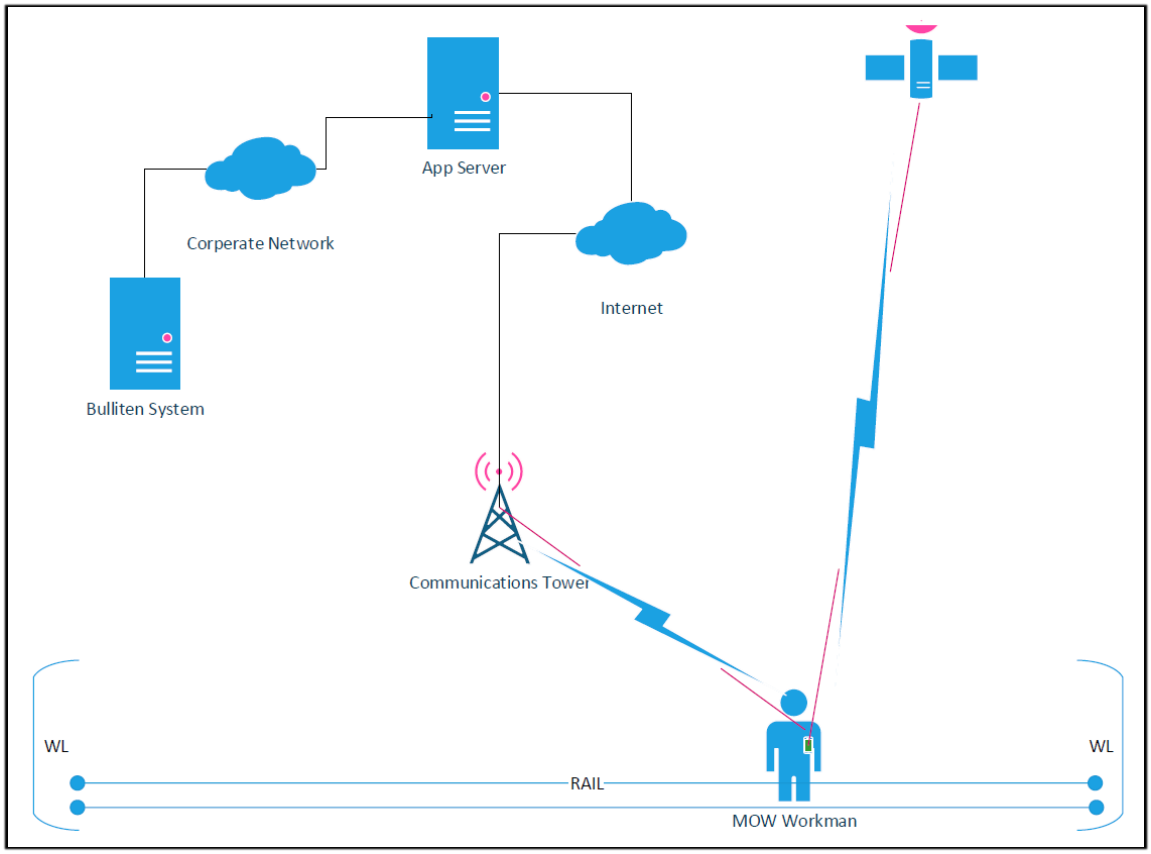


Figure 5: MOW Worker Position Monitoring Application

An example of how MOWESS Watchman Warning System Application might be utilized is provided in Table 6 below. The information in this table is an example of how MOWESS would be used in the situation of Use Case UC-RWP-701 from Appendix A.

ID	UC-RWP-701
Title	Track Bulletin – Single Track with MOW Worker Position Monitoring Application
Description	Track bulletin used to provide protection to MOW worker(s) accessing Main track. MOW worker equipped with Worker Position Monitoring device encroaches on bulletin limit

Method of Operation	TB
RR Personnel	EIC, MOW Worker(s), Train Crew
RR Systems	DBO, Road Train, PTC Onboard
Reference Track Configuration	Single Track per Section 4.1.1.
Initial Condition	1) EIC of MOW worker(s) obtains TB on Main track between WL_A and WL_B per UC-RWP-308. Authority limits added to the track bulletin system 2) MOW worker(s) access Main track, as defined in TB.
Trigger Event	Road Train approaches end of MA at WL_A on Main track.
Scenario Steps	1) TB provided to TC of Road Train at initial station unless otherwise instructed by dispatcher. 2) PTC Onboard displays end of MA at WL_A to TC. 3) TC of Road Train contacts EIC and requests permission to proceed beyond WL_A. 4) TC stops Road Train short of WL_A. 5) EIC denies TC permission past WL_A. 6) MOW worker(s) don MOW Position Monitoring device and access Main track within track segment AB until work is complete. 7) MOW worker encroaches on track bulletin authority limits due to disorientation. 8) MOW worker receives perimeter alarm from MOW Position Monitoring device 9) MOW worker moves back into safe area of track bulletin

	10) Upon completion of work, MOW worker(s) clear themselves and equipment from Main track. 11) EIC verifies all MOW worker(s) are clear of track segment AB. MOW workers power down MOW Position Monitoring device. 12) EIC contacts TC of Road Train and grants permission to proceed beyond WL_A through work zone at a given speed. 13) PTC Onboard releases enforcement of WL_A.
End State (Happy Path)	1) MOW worker(s) are clear of Main track segment AB. 2) Road Train proceeds into Main track segment AB.
References	49 CFR 214.325, GCOR 14

Table 6: MOW Position Monitoring/Track Bulletin Single Track

Abbreviations and Acronyms

BOS	Back Office Server
EIC	Employee-in-Charge
ETA	Estimated Time of Arrival
FRA	Federal Railroad Administration
GCOR	General Code of Operating Rules
GPS	Global Positioning System
ITCM	Interoperable Train Control Messaging
ITD	Individual Train Detection
MA	Movement Authority
MOW	Maintenance-of-Way

MOWESS	Maintenance-of-Way Employee Safety System
NORAC	Northeast Operating Rules Advisory Committee
PHA	Primary Hazard Assessment
PTC	Positive Train Control
TC	Train Crew
TTC	Transportation Technology Center
TTCI	Transportation Technology Center, Inc.
WM	Watchman