




PRECISION TRAIN BUILDER

—
Union Pacific Railroad

July 11, 2023



Precision Train Builder – Operated by Union Pacific



FORENSIC **PLANNING** **OPTIMIZE**

PrecisionTrain™
B U I L D E R

ERANALYZER™
DIAGNOSTIC RECONSTRUCTION
Event Recorder Based
Incident Analysis

PTB VALIDATOR™
What-If Analysis -
In-Train Force Analytics

PTB MONITOR™
All Active Trains - Real Time
Force Analytics

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PTB Monitor

Symbol	Date	From/To	Status	Actions
CSACD9	04/13/23	AZ015 / WY367	Good	[Icons]
MASPR	04/14/23	CR000 / ZB145	Good	[Icons]
MEWCW	04/14/23	SY131 / SP636	Good	[Icons]
ZBRG2B	04/14/23	OZ626 / NX284V	Good	[Icons]

Items per page: 4 1 – 4 of 960

Event Recorder Results

Symbol	Date	Time Window	Status	Actions
MPDNP	04/07/23	04-08-2023 17:00 - 0...	Completed	[Icons]
MPDNP	04/07/23	04-08-2023 17:15 - 0...	Completed	[Icons]
CNAOL9	04/08/23	04-11-2023 08:41 - 0...	Bad Input	[Icons]
CNAOL9	04/08/23	04-11-2023 08:30 - 0...	Bad Input	[Icons]

Items per page: 4 1 – 4 of 958

My Results

Name	Creation Date	Last Updated	Actions
MASNP-08	08/11/21	08/11/21 13:17 osuz476	[Icons]
MSSNP 7/10 Derail 1st attempt	07/11/21	07/11/21 08:22 osuz733	[Icons]
Mason City 457 TPA Approved	07/07/21	07/07/21 08:33 osuz733	[Icons]
Waste Mgmt 10K H/R	07/07/21	07/07/21 08:21 osuz733	[Icons]

Items per page: 4 1 – 4 of 17

My Projects

Name	Scenarios	Created By	Actions
Train Size	73	OSUZ733	[Icons]
STOTTS	7	OSUZ265	[Icons]
Coast Sub Length ...	3	IGEN474	[Icons]
COAST SUB INTER...	3	OSUZ733	[Icons]

Items per page: 4 1 – 4 of 273

ER ANALYZER™ DIAGNOSTIC RECONSTRUCTION

- **Features**

- Converts data into simple graphics

- **Benefits:**

- Easily interpret and understand technical specifics

PTB VALIDATOR™

- **Features**

- Rapidly build multiple 'real' trains with UMLER data and run the train on a 'real' routes using GIS info

- **Benefits:**

- Vet existing train-build rules

- Safely build longer trains

PTB MONITOR™

- **Features**

- Real-time train analysis and monitoring

- **Benefits:**

- Dynamically recommend changes due to new train cuts or evolving weather conditions

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ERANALYZER™ DIAGNOSTIC RECONSTRUCTION

Event Recorder Results

- Forensic Tool – Causal Analysis
 - Derailment
 - Train Separation

Note: Utilized by 24/7 Operating Practices Desk

The screenshot shows the Precision Train Builder interface. The 'Event Recorder Results' section is highlighted with a red box. It contains a table with the following data:

Symbol	Date	Time Window	Status	Actions
MPDNP	04/07/23	04-08-2023 17:00 - 0...	Completed	[Icons]
MPDNP	04/07/23	04-08-2023 17:15 - 0...	Completed	[Icons]
CNAOL9	04/08/23	04-11-2023 08:41 - 0...	Bad Input	[Icons]
CNAOL9	04/08/23	04-11-2023 08:30 - 0...	Bad Input	[Icons]

Other sections include 'PTB Monitor' with a table of train symbols and dates, 'My Results' with a table of incident names and dates, and 'My Projects' with a table of project names and scenario counts.

The 'Create Scenario' form includes input fields for Train Symbol, Train Date, Station, Start Date, Start Time, End Date, and End Time. A 'FIND TRAIN' button is located at the bottom of the form.

The 'Event Recorder Dashboard' displays a table of recorded events with the following data:

User	Symbol	Date	Event Window	Station	Creation Date	Status	Notes	Action
Arjun Satish	MKSNPB	06/27/23	06-27-2023 22:49 ...	KX005	07-05-2023 14:57	Waiting For Sim		[Icons]
Steven Terrell	CBTIM	06/26/23	06-30-2023 00:30 ...	MX013	06-30-2023 03:21	Completed		[Icons]
Daniel McLean	OGTT4	06/23/23	06-25-2023 18:30 ...	WX843	06-29-2023 15:47	Completed		[Icons]
Daniel McLean	OGTT4	06/23/23	06-25-2023 18:30 ...	WX843	06-29-2023 14:33	Completed		[Icons]
Arjun Satish	MKSNPB	06/27/23	06-27-2023 22:49 ...	KX005	06-29-2023 09:40	Completed With Warnings		[Icons]

At the bottom, it states: 'These results will be refreshed in 97 seconds.' and 'Items per page: 5 1 - 5 of 989'.



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My Projects

- Perform simulations for new business opportunities that may enter the network.
- Analyze transportation plans with blocking changes to ensure a safe train.
- Determine best locomotive configurations for train handling, improved in-train forces and velocity.
- Test for safest and most efficient route on trains where configurations are new to the network.
- Used to implement new train makeup restrictions to improve train build and producing a safer train.
 - Drive increased train size.

The screenshot shows the PrecisionTrain Builder interface. The 'My Projects' section is highlighted with a red box. It contains a table with the following data:

Name	Scenarios	Created By	Actions
Train Size	73	OSUZ733	[Icons]
STOTTS	7	OSUZ265	[Icons]
Coast Sub Length ...	3	IGEN474	[Icons]
COAST SUB INTER...	3	OSUZ733	[Icons]

This screenshot shows a detailed view of the 'My Projects' section. It features a search bar and a table with the following data:

Project	Description	Scenarios	Creation Date	Shared	Created By	Actions
TPA Test		1	06/30/2023	OSUZ733	OSUZ733	[Icons]
12K ft conventional	Hope to NLR	19	06/02/2021	OSUZ733,IGEN474	OSUZ733	[Icons]
Z Train Performance		4	10/06/2022	OSUZ733,OSUV8...	OSUZ733	[Icons]
Train Size		97	03/18/2022	OSUZ733,IGEN47...	OSUZ733	[Icons]
Derailment Train		1	06/08/2023	OSUZ733	OSUZ733	[Icons]

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PTB MONITOR

The screenshot displays the PTB Monitor interface. The 'PTB Monitor' section is highlighted with a red box and contains the following data:

Symbol	Date	From/To	Status	Actions
CSACD9	04/13/23	AZ015 / WY367	Good	[Icons]
MASPR	04/14/23	CR000 / ZB145	Good	[Icons]
MECWC	04/14/23	SY131 / SP636	Good	[Icons]
ZBRG2B	04/14/23	OZ626 / NX284V	Good	[Icons]

Below this table is a 'My Results' section with a search bar and a table of results:

Name	Creation Date	Last Updated	Actions
MASNP-08	08/11/21	08/11/21 13:17 osuz476	[Icons]
MSSNP 7/10 Derail 1st attempt	07/11/21	07/11/21 08:22 osuz733	[Icons]
Mason City 457 TPA Approved	07/07/21	07/07/21 08:33 osuz733	[Icons]
Waste Mgmt 10K H/R	07/07/21	07/07/21 08:21 osuz733	[Icons]

The 'Event Recorder Results' section shows the following data:

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Coast Sub Length ...	3	IGEN474	[Icons]
COAST SUB INTER...	3	OSUZ733	[Icons]

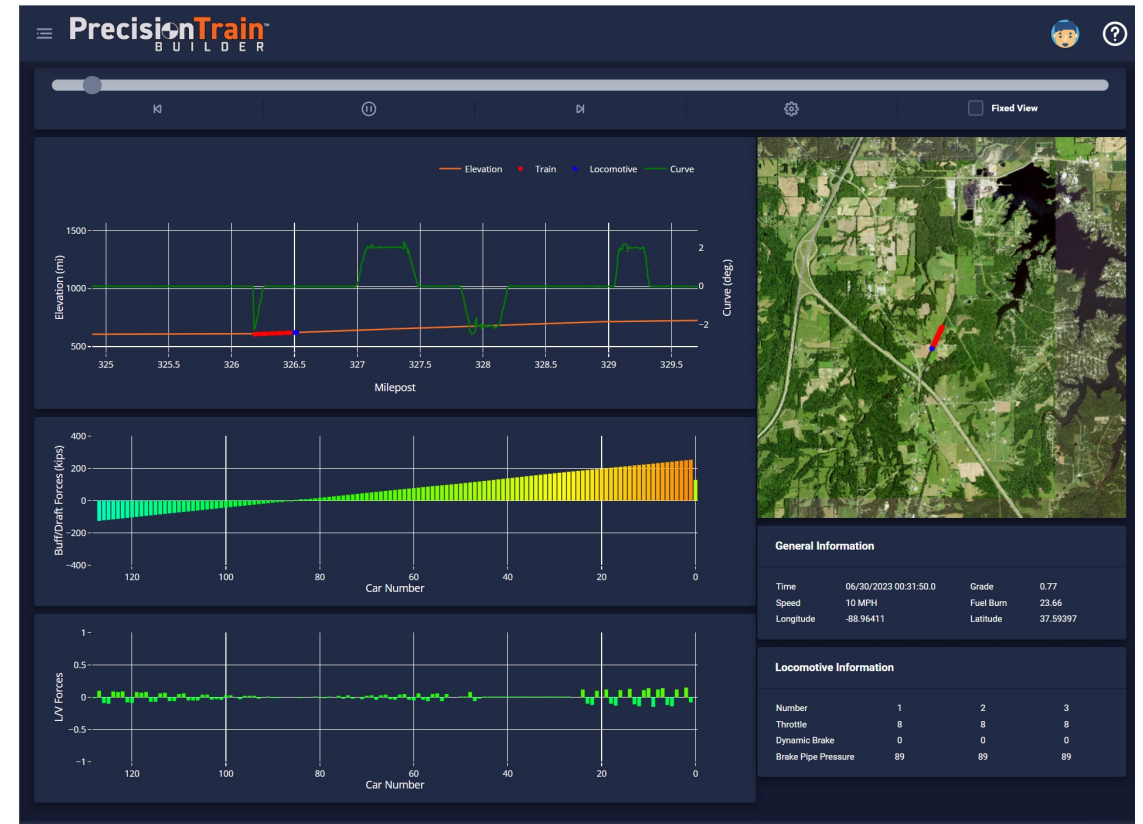
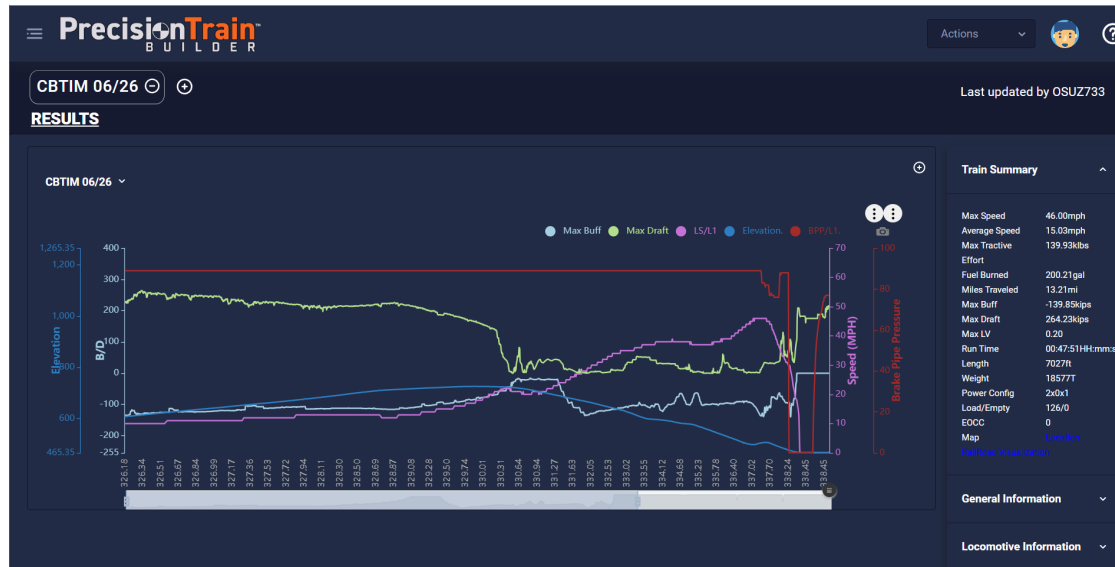
PTB Monitor

Monitoring Live Trains

- A 24/7 Operating Practices team dedicated to monitor live trains for variability risk.
- Monitor live trains for excessive buff or draft forces.
- Performs simulations on trains out of origin to work event location(s) or destination when no work events are scheduled.
- **PTB Workqueue** identifies trains with a high buff/draft risk and provides the speed recommendation from the workqueue on segments of track and provides speed reductions to the train crew (typically 5 miles or less).

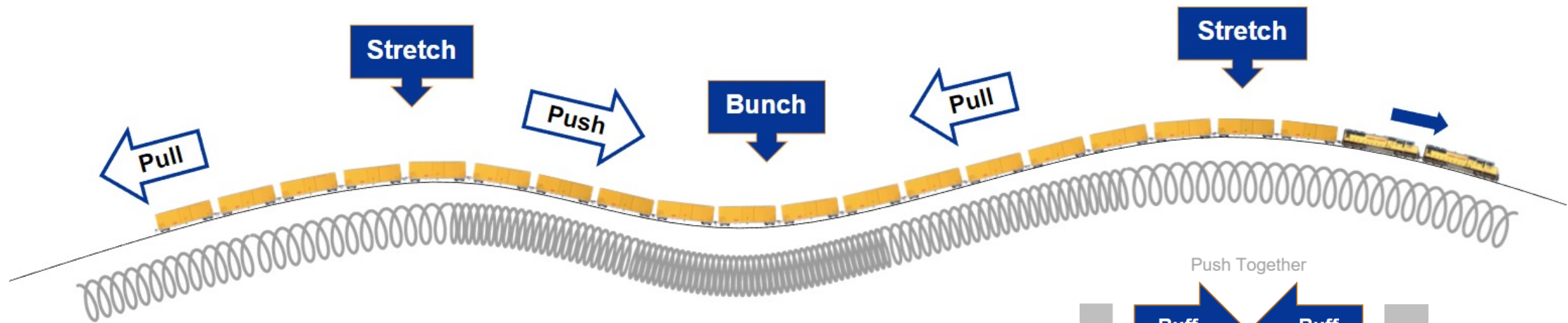
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ERANALYZER™ DIAGNOSTIC RECONSTRUCTION

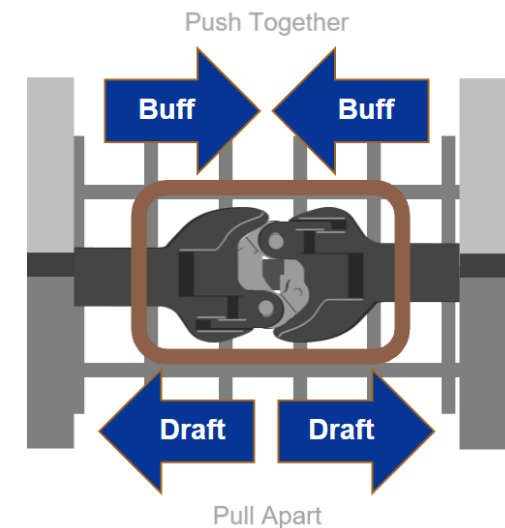


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Understanding Buff and Draft Forces

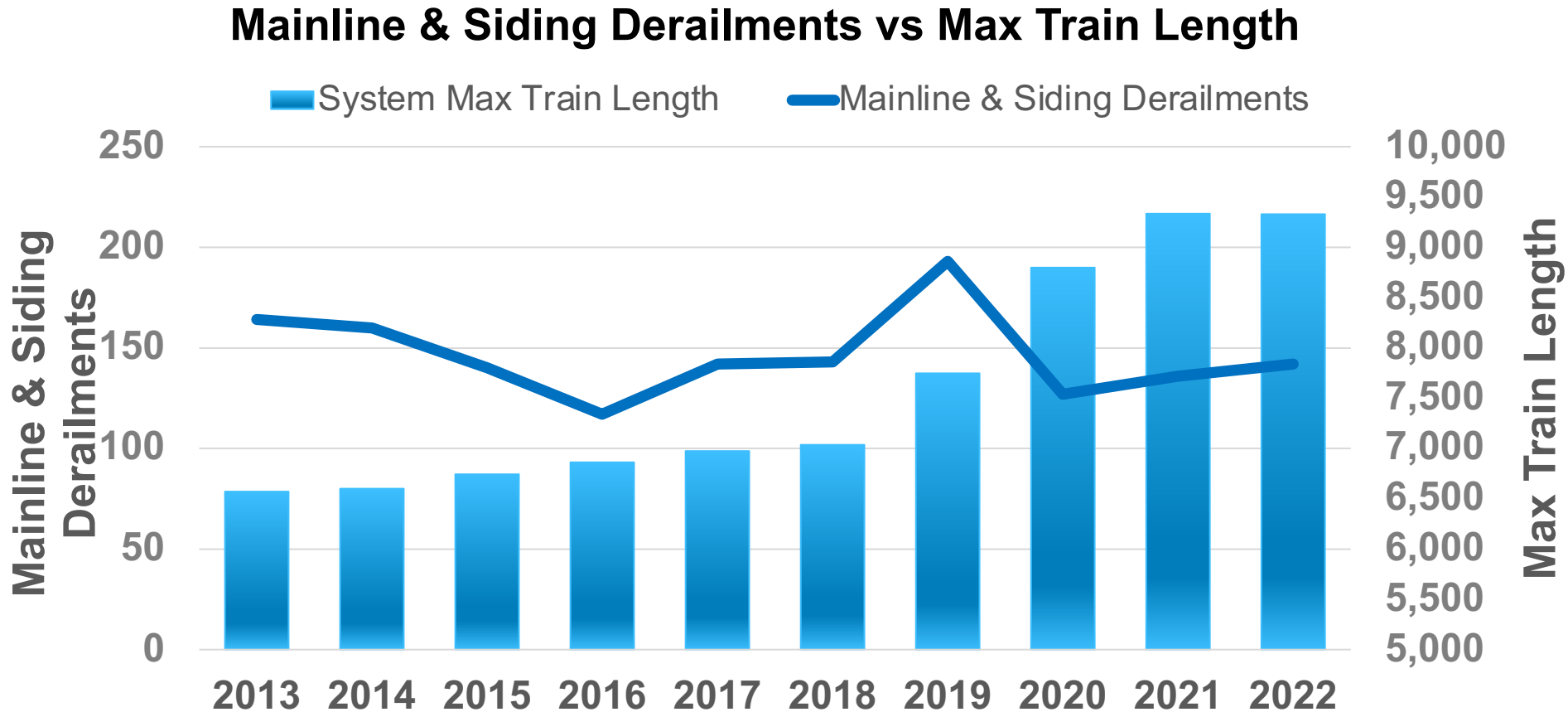


- Buff and Draft forces can occur simultaneously on any territory on Union Pacific Railroad.
- Hills combined with curves compounds derailment and break-in-two potential.
- Amount of slack in a train can vary on size and car types.
- Between cars slack can occur with 6½ to 30 inches of movement.
- On an 8,500 ft train with 30 inches of slack on each car can equate to about 100 yards of slack which is the length of a football field between end zones.



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Derailments vs Max Train Length





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BY UNION PACIFIC

—
BACK-UP SLIDES

Operating Practices Command Center (OPCC)

Introduction into PTB

Precision Train Builder (PTB)

- PS Technology started with a physics engine in a locomotive simulator for locomotive engineer training and recertification.
- This physics engine is used by both NYAB and Wabtec for validation of their own products.
- With this powerful physics engine, a business case came to PS Technology for a predictive tool, which introduced the creation of PTB.

Union Pacific's Introduction to PTB's Real-Time Use

- We can't disregard the fact the industry has experienced major derailments recently. The Norfolk Southern in East Palestine and our very own on the Cima Sub in Southern California.
- Neither one of these derailments would have been prevented utilizing PTB.
- The NS incident was mechanical caused due to an overheated wheel bearing.
- There are various derailment causes, which can generically be categorized as mechanical car or locomotive, track and human factor.
- PTB is designed to identify risk with human factor events such as train makeup and train handling.
- Last fall we experienced a derailment on the Mason City Sub. After the incident, we tested PTB to validate if we would have predicted this event and provided a speed recommendation to reduce the risk.
- After testing this event, PTB would have predicted this event within one-hundredth of a mile.
- Additionally, it would have provided a speed recommendation to lower the speed and reduce in-train forces, preventing the derailment saving \$20 million.