



National Transportation Safety Board

Union Pacific Railroad, Derailment with Hazardous Materials Release March 10, 2017

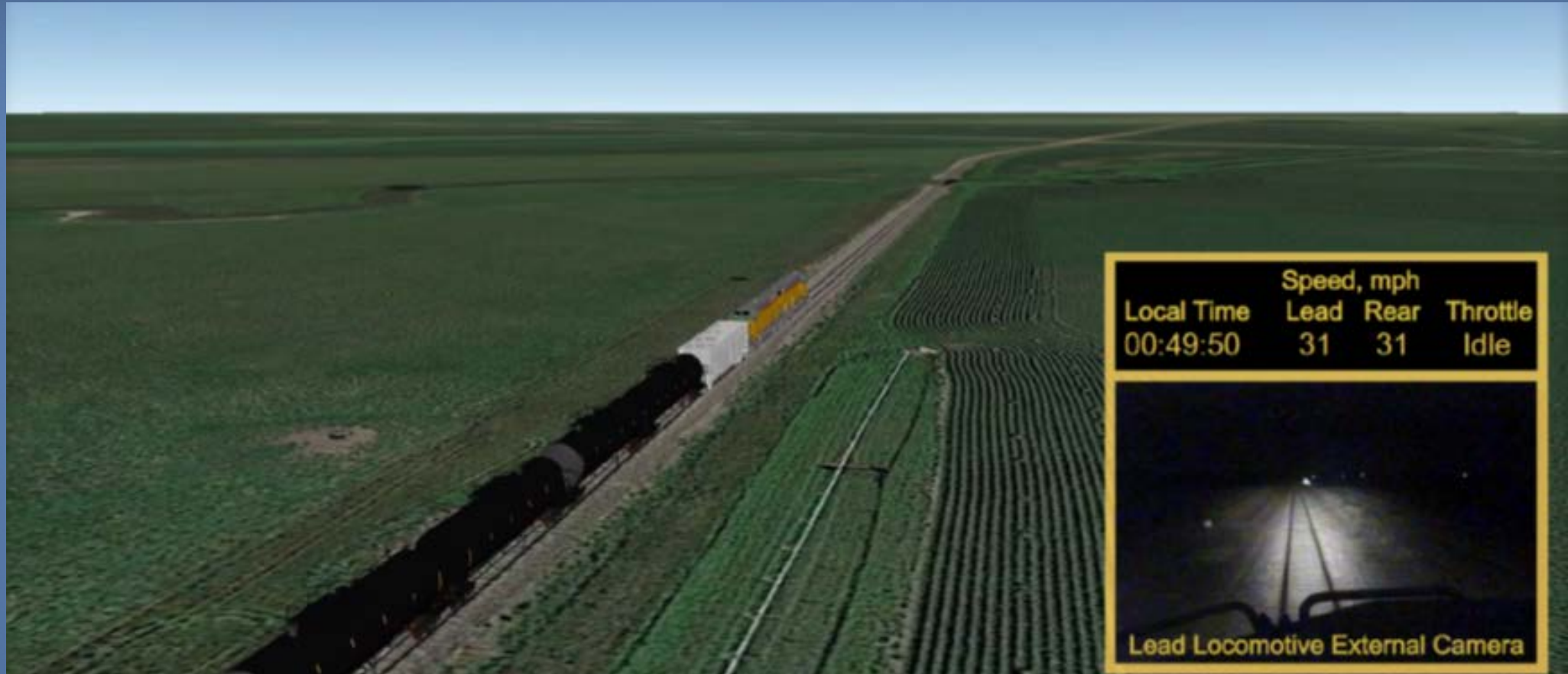
Michael Hiller, IIC



Event Recorder

- Train was traveling at 28 mph
- Two locomotives and 20 cars crossed the bridge
- Uncommanded emergency brake application at 12:50 a.m.

Visualization of Estimated Derailed Car Motion

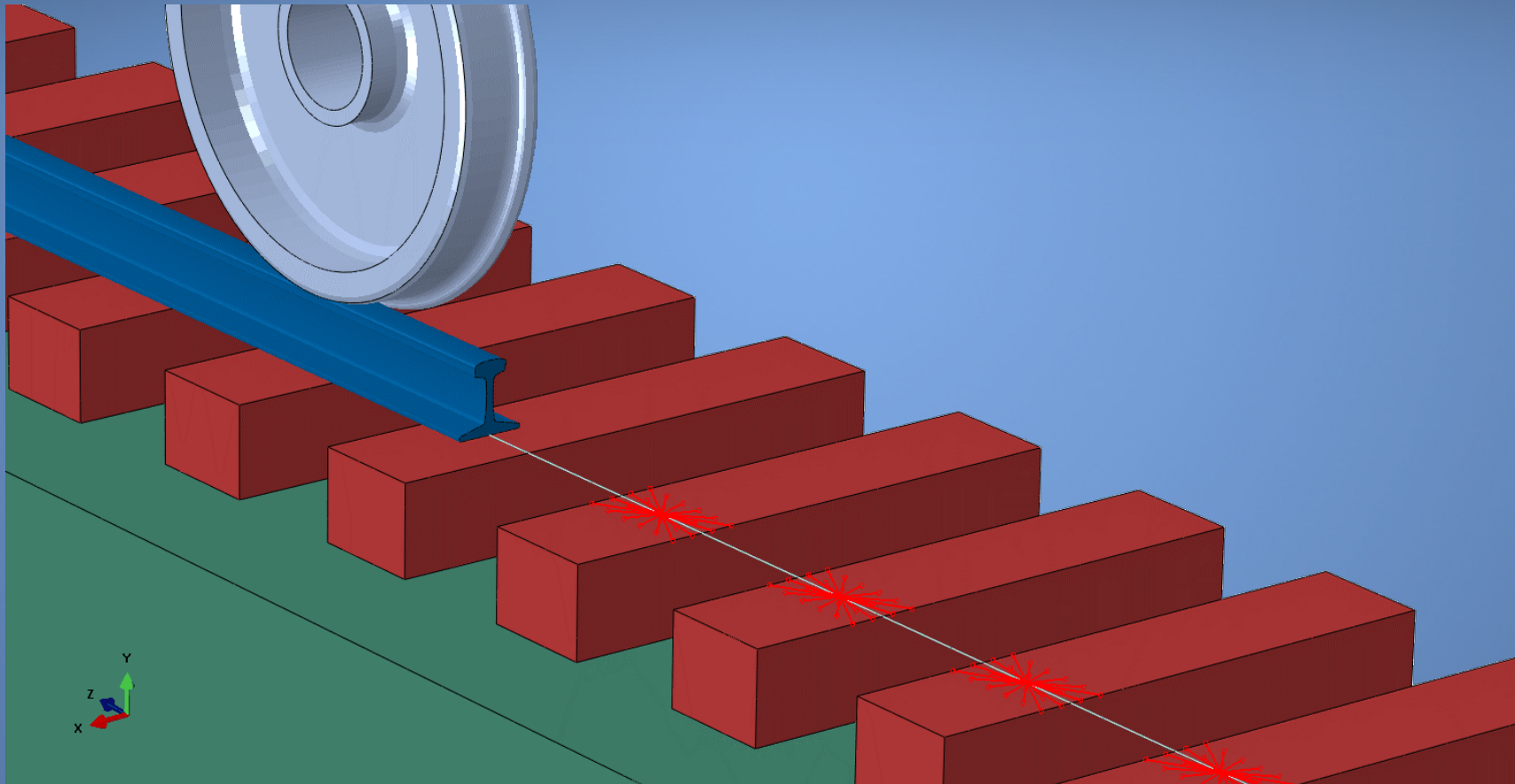


Tank Cars

- Legacy DOT-111
- 10 tank cars mechanically breached
- PHMSA developed new standard, DOT-117
- DOT-111 retrofitted or removed from ethanol service by May 1, 2023



Safety Study 90-lb. Rail



Investigation Team

- Robert Sumwalt – Board Member On-Scene
- Mike Hiller – IIC
- Dave Bucher – Operations
- Jim Southworth – Mechanical
- Joe Gordon – Track
- Paul Stancil – Hazardous Materials
- Dana Sanzo – Emergency Response
- Erik Mueller – Metallurgy
- Matt Fox – Metallurgy
- Kevin Renze – Vehicle Performance

Staff

- Rachel Gunaratnam
- Mary Pat McKay
- Gena Evans
- Mike Hamilton
- Robert Dodd
- Mike Budinski
- Carl Schultheisz
- Rick Downs
- Cassy Johnson
- Bill Tuccio
- Xiaohu Liu
- Bill English
- Paul Suffern
- James Anderson
- Steve Blackistone
- Carl Perkins
- Peter Knudson
- Ricky Page
- Troy Lloyd

Parties to the Investigation

- Federal Railroad Administration (FRA)
- Union Pacific Railroad (UP)
- Brotherhood of Railroad Signalmen (BRS)
- Brotherhood of Locomotive Engineers and Trainmen (BLET)
- Brotherhood of Maintenance of Way Employees Division (BMWED)
- International Association of Sheet Metal, Air, Rail and Transportation Workers (SMART)
- Iowa Emergency Management of Palo Alto County (IEM)

Safety Issues

- UP's track maintenance and inspection
- FRA's track inspection oversight
- Transportation of denatured vs. nondenatured ethanol



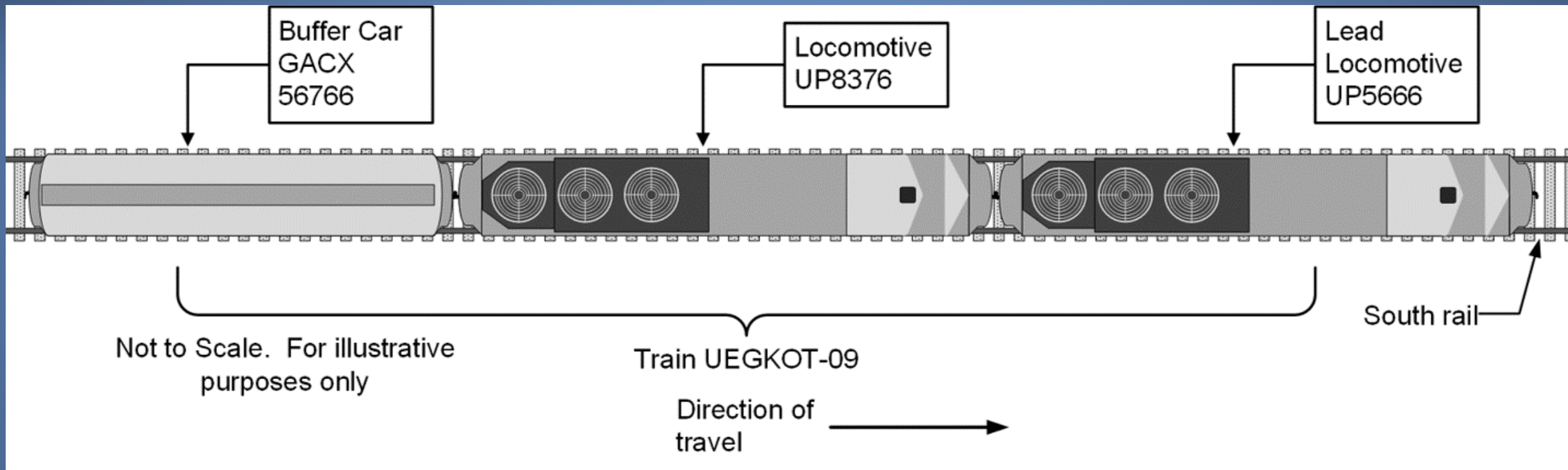
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Mechanical

Jim Southworth

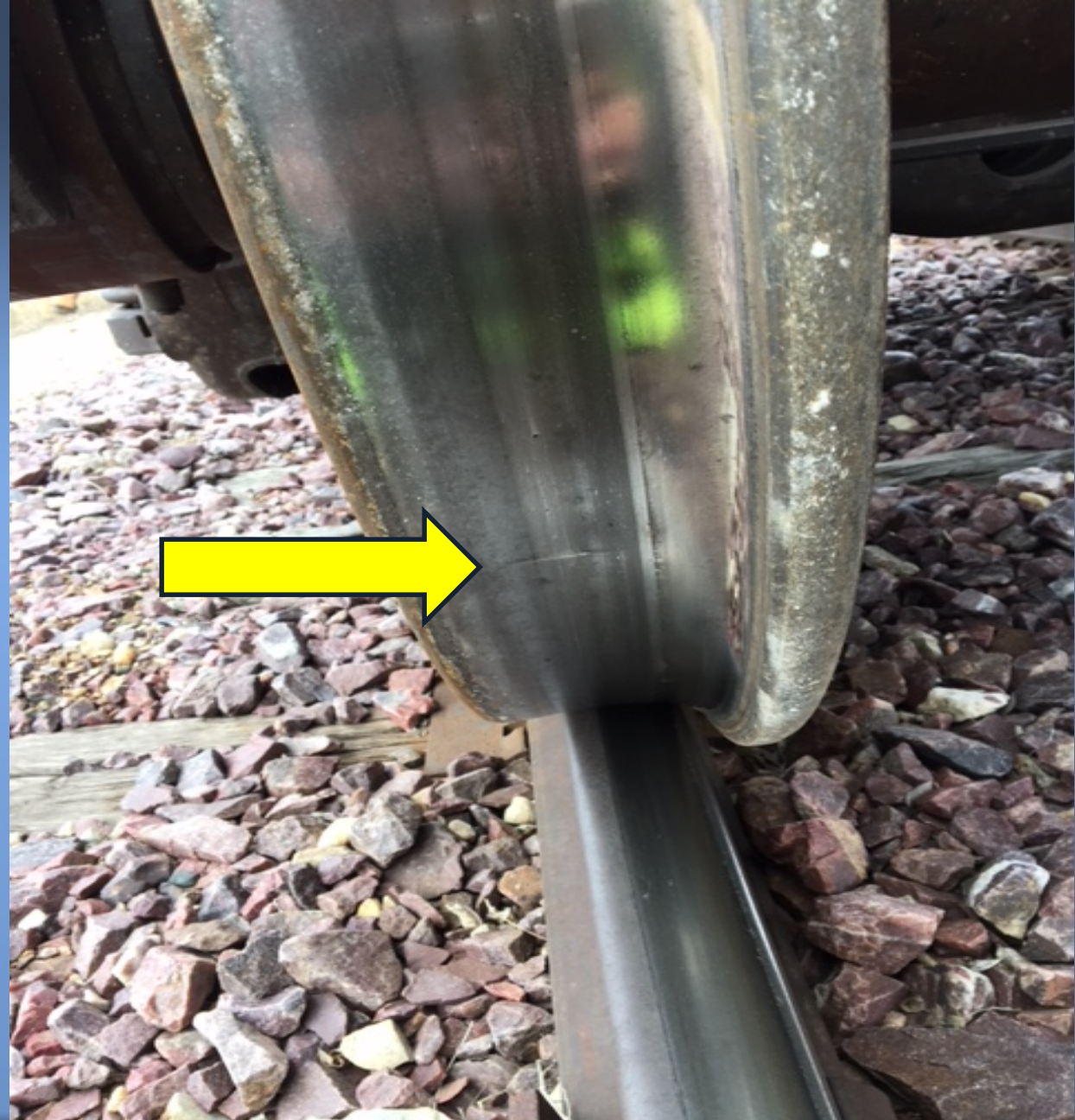


Preaccident Inspections and Records Review

- Initial terminal inspection March 9, 2017 –
Green Plains, LLC Superior, Iowa
 - 2.5 hours prior to the accident
 - Less than 20 miles from accident location
- Required inspection of equipment and brake testing
- Verified equipment and brake systems operate as intended
- No problems found

Postaccident Inspection and Testing

- Nonderailed cars moved from derailment area
 - Inspections and FRA brake testing performed
 - Revealed good integrity of the train brake system
- Derailed tank cars also examined







Summary

- Rail broke under the train
- Indications show rail break began at the 4th car behind the locomotives
- Progressively worsened



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Track and Engineering

Joe Gordon

Estherville Subdivision

- Single main track
- About 79 miles of track
- Averages one train every other day
- Operates on 90-lb. rail
- Maximum speed 30 mph

Compliance Agreement

- Prompted by a UP High-Hazard Flammable Train Derailment in Mosier, Oregon
- Began in December 2016
- Focused on improving UP's compliance with minimum track safety standards

UP Track Inspection and Maintenance

- Records review: July 2016 – March 2017
 - Required inspections
 - Defective crosstie conditions
 - Marginal crosstie conditions

FRA Inspection Findings

- March 2015: marginal tie conditions
- July 2015: marginal tie conditions with emphasis of risk due to the movement of ethanol
- August 2016: defective and marginal tie conditions with emphasis of risk due to the movement of ethanol
- December 2016: marginal tie conditions
- No civil penalties

Postaccident Inspections

- 7 track defects found
- May 2017, FRA found 78 defective conditions
 - 51 defective crossties
- No civil penalties recommended



Summary

- UP was not maintaining the Estherville Subdivision
- UP supervision was not ensuring defective crossties conditions were being identified and remediated
- All defective crosstie conditions were not identified by the FRA
- All available FRA enforcement options not used



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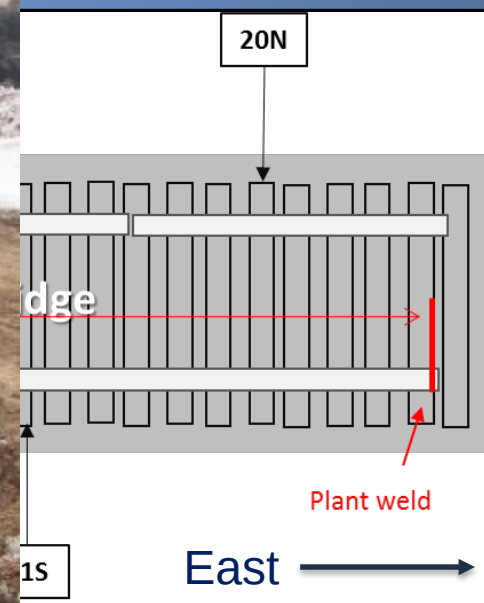
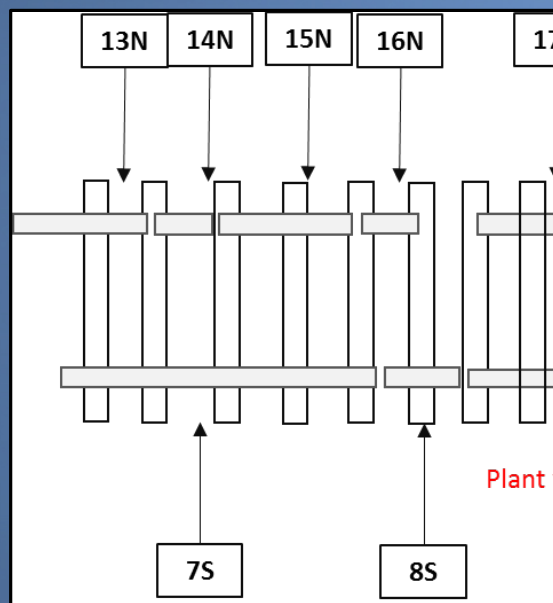
Metallurgy and Finite Element Modeling

Erik Mueller, Ph.D., P.E.

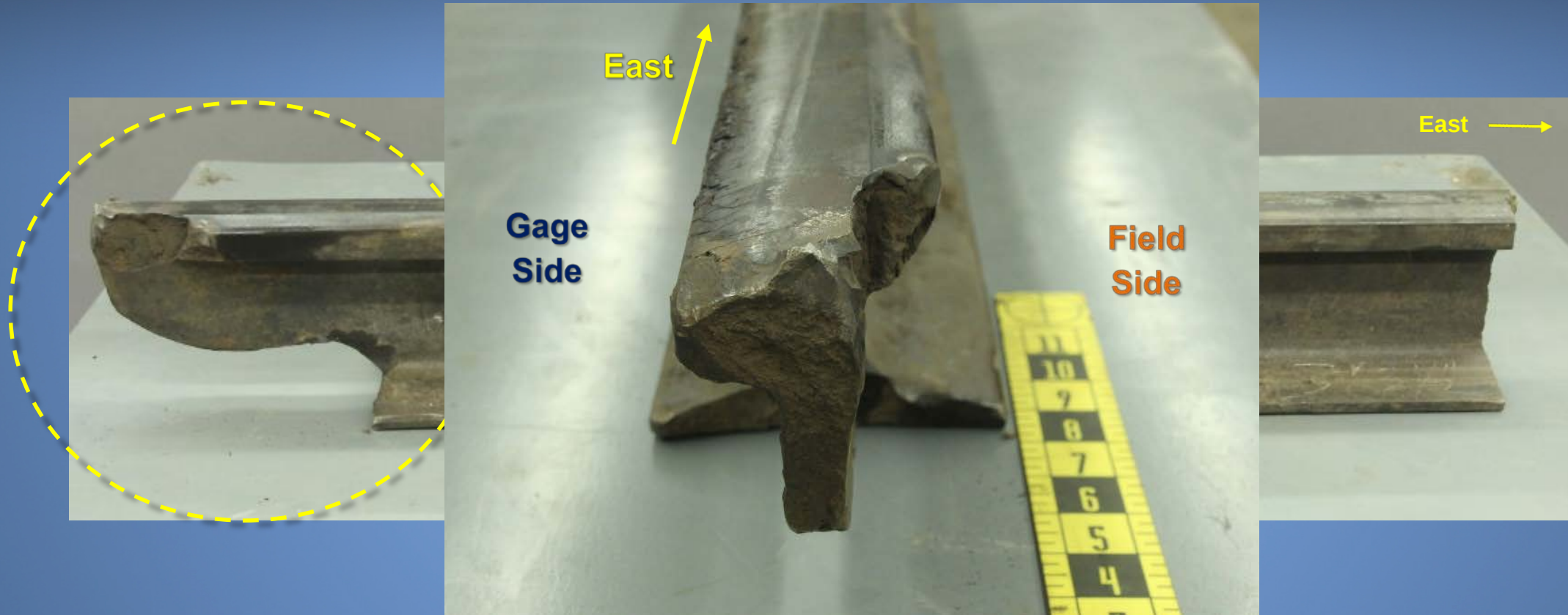
Overview

- Layout of Track Pieces
- Probable Point of Derailment
- Finite Element Modeling

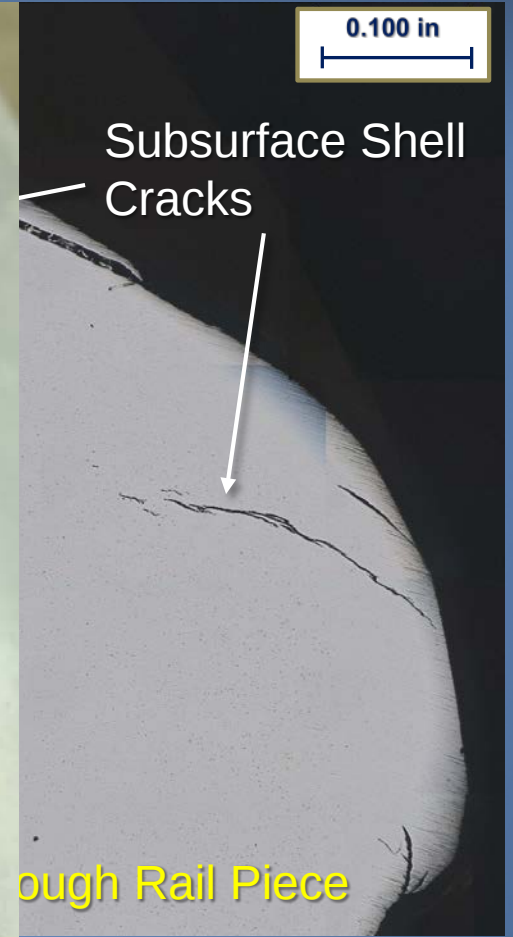
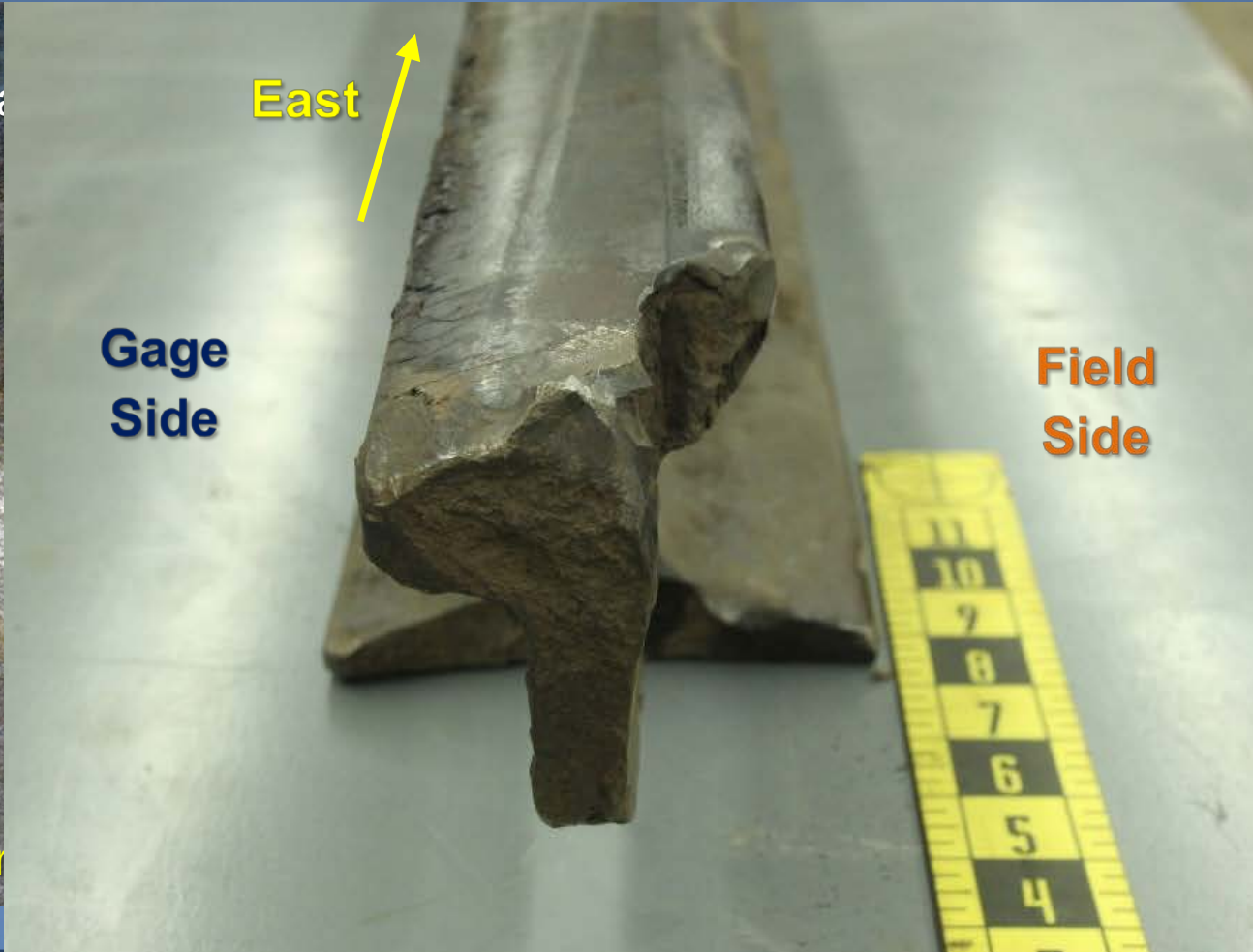
Layout of Rail Track Pieces



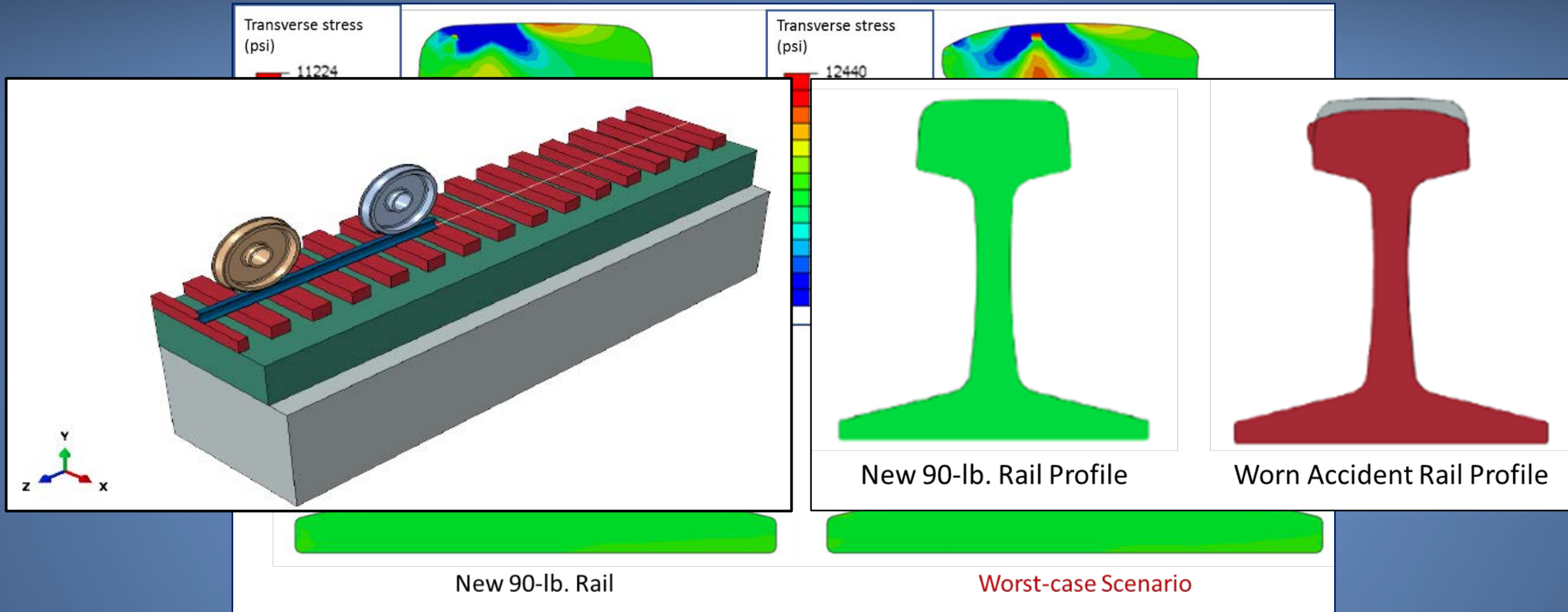
Probable Point of Derailment



Metallurgical Examination



Finite Element Modeling



Summary

- The train derailed at a broken south rail on the west approach prior to the timber bridge
 - Rail fragment recovered was most damaged
 - Located adjacent to largest missing rail section
- Finite element modeling performed on worn 90-lb. rail with varying track support
 - Worn rail with degraded supports leads to higher stress
 - Could increase risk of rail head failure



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Hazardous Materials Safety Issues

Paul L. Stancil

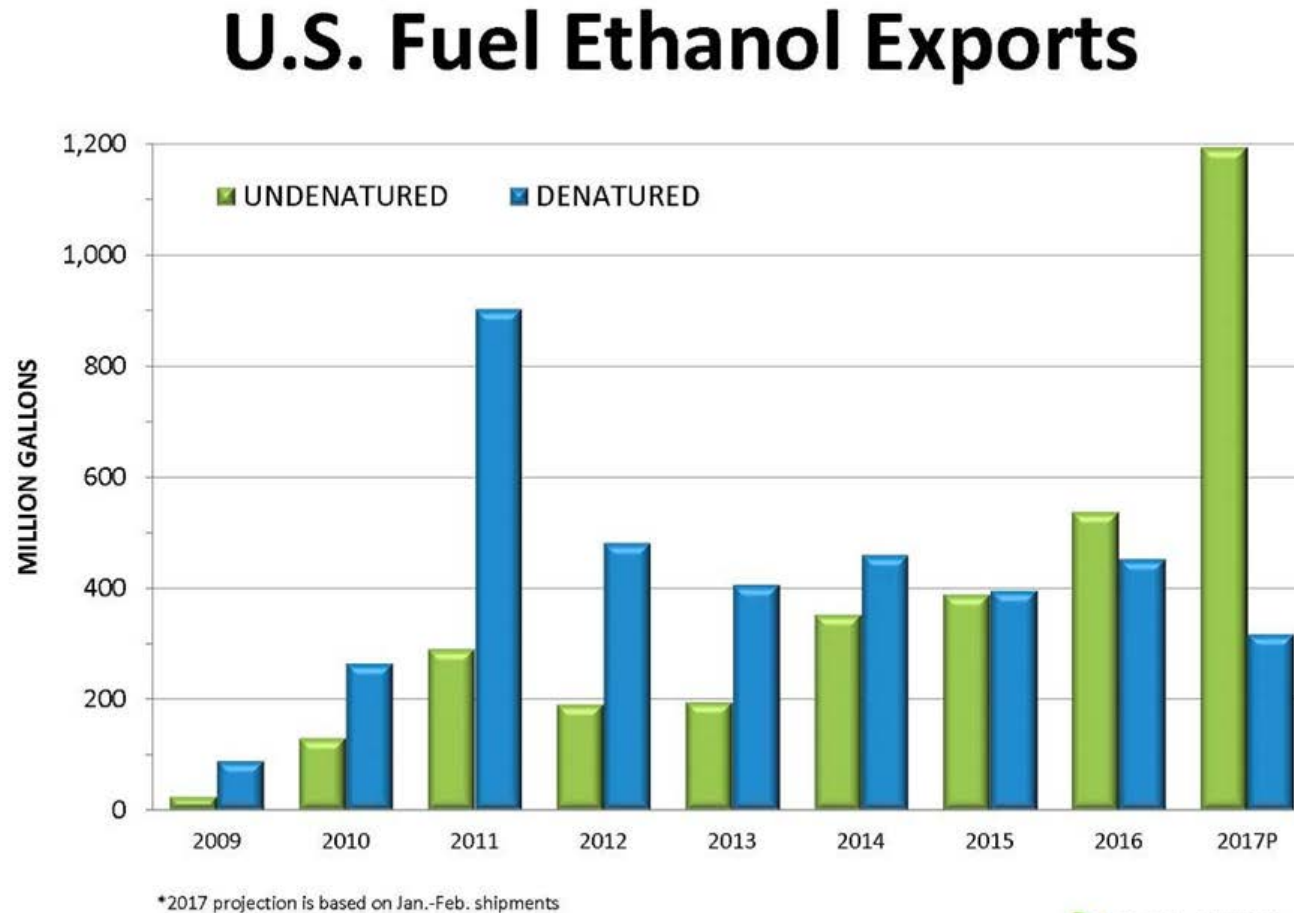
Hazardous Materials Safety Issues

- Possible safety benefits of shipping ethanol undenatured
- Progress of converting or replacing DOT-111 tank cars used to transport ethanol

Denatured Fuel Ethanol

- Fuel ethanol is currently the top hazardous material transported by rail
- TTB regulations require alcohol fuel plants render spirits unfit for beverage use with denaturants
- Ethanol does not become a renewable fuel under renewable fuel standard provisions until it is denatured

Increasing Shipments of Undenatured Ethanol



Sources: U.S. Department of Commerce, U.S. Census Bureau, Foreign Trade Statistics





Summary: Denatured vs. Undenatured Ethanol

- 23 billion gallons of ethanol denatured for domestic transportation annually
- Lack of postaccident damages suggests a potential safety benefit from shipping ethanol in its undenatured form
- More scientific data is needed to quantify and understand potential safety benefits

Tank Car Damages

- 14 of 20 derailed tank cars released ethanol
- Heads and/or shells of 10 tank cars were breached from mechanical impact
- 1 small thermal tear from fire exposure
- 3 cars released product only from top fitting and/or bottom outlet valve damage

DOT-111 Tank Cars in Ethanol Service



Punctured DOT-111 Tank Car, Graettinger, Iowa

- Typical poor DOT-111 lading-retention performance
- Must be replaced or retrofitted by May 1, 2023
- All tank cars in the accident train were specification DOT-111

Ethanol Tank Car Fleet

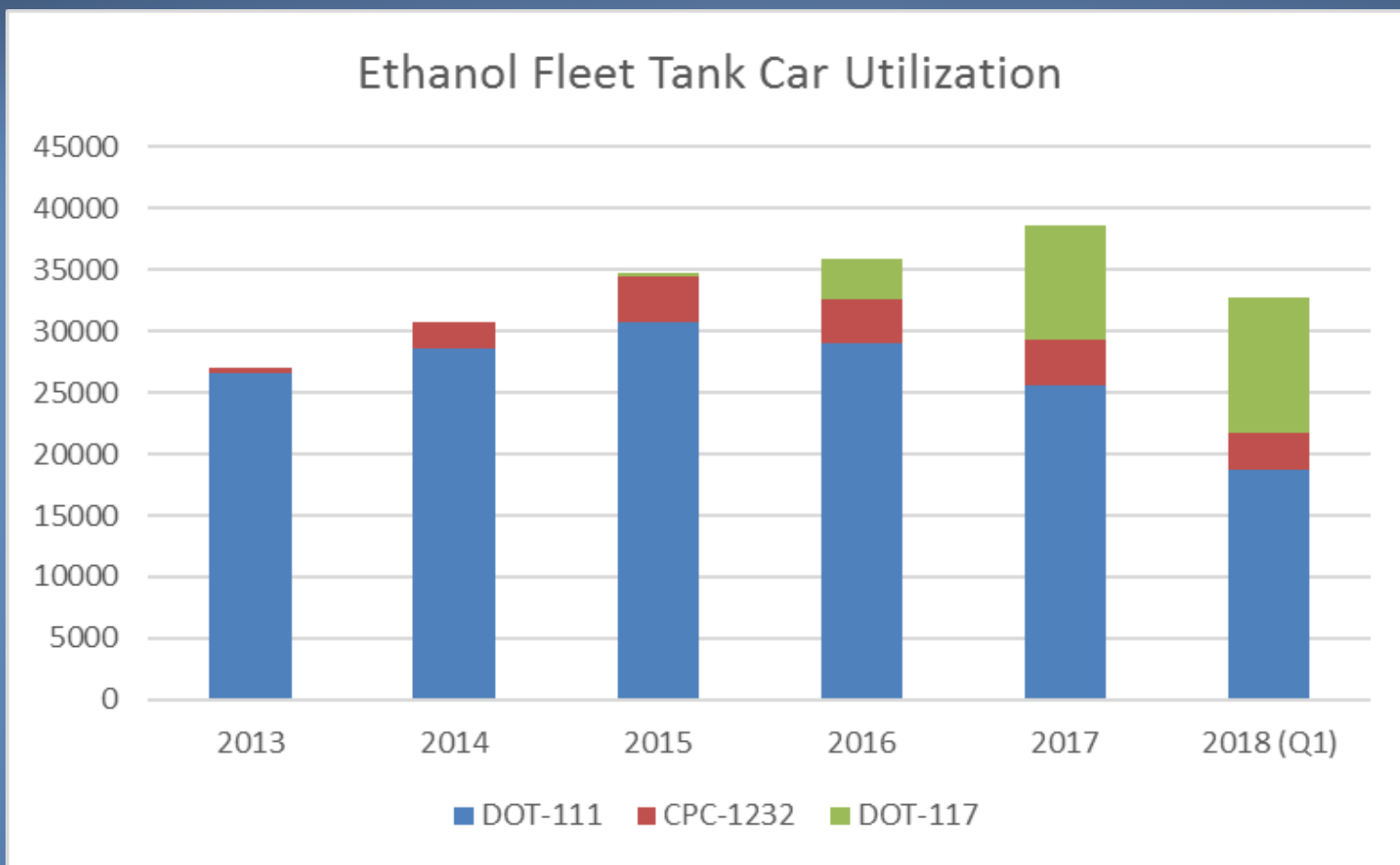


Chart courtesy Association of American Railroads

Previous Safety Recommendation

To PHMSA: Require an aggressive, intermediate progress milestone schedule, for DOT-111 and CPC-1232 tank car replacements or retrofiting. (R-15-16)

Open – Unacceptable Response

Summary: Ethanol Tank Car Fleet Replacements

- Initial ethanol fleet replacement progress appeared very slow
- Leasing companies that supplied tank cars in accident train had few DOT-117 compliant tank cars
- Achievement of established deadlines may be overly reliant on future market and economic conditions



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