Rail Transports Crude Safely

- Since 1980, railroads reduced rates for employee injuries, train accidents and grade crossing collisions by 80%.

- In 2016 BNSF moved hazardous materials 99.99% of the time without an accidental release.
BNSF’s Safety Overview

• Rail is the safest mode of land transportation.

• BNSF’s safety vision is to prevent accidents in the first place.

• BNSF has a broad-based risk reduction program.
Safety Leader for Continuous Risk Reduction

BNSF vs. Industry Reportable Rail Equipment Incident Rate *(Incidents per Million Train Miles)*

Source: FRA – Data for Calendar Year through Dec. 31, 2016
Prevention: Causes for Derailments

BNSF REPORTABLE TRAIN ACCIDENT CAUSES - 2016

- Human Factor: 50%
- Track/Signal: 24%
- Equipment: 10%
- Misc.: 16%
Prevention: Risk-Reduction Efforts – Layers of Safety

Risk Identification
- Risk ID: Proactively determine and prioritize sources of risk
- Design-In Safety: Engineer out risk during equipment, facility and process design
- Rules & Procedures: Set rules and procedures, culture of compliance and accountability
- Safety Information: Align efforts and communicate key messages to all levels

Incident & Injury Prevention
- Approaching Others About Safety: Develop people to ID, address and respond to exposure

Incident & Injury Response
- Emergency Planning & Response: Reduce severity and impact
- Re-enactment: Reduce severity and impact

Sources of Risk: Incident
Prevention: Reducing Risk

Human Factor
- Training
- Remote monitoring
- Positive Train Control
- Self reporting protocol

Equipment/Mechanical
- Ultrasonic inspection
- Detector network - dragging equipment
- Technology
  - Thermal/infrared scanning for warm bearing detection

Track/Signal
- Enhanced track inspection training
- Continued elimination of jointed rail
- Strong capital program for tie renewal
- Technology - ground penetrating radar and enhanced geometry testing

Our ongoing focus is on instilling a culture of commitment and compliance – a culture that is sensitive to exposure and risk.
BNSF plans to spend $3.3 billion on capital projects in 2017 to support maintenance and expansion – $2.4 billion for network maintenance.
Bridge and Track Inspections

- BNSF inspects tracks and bridges more often than required by the Federal Railroad Administration
- Most BNSF key routes inspected four times weekly and busiest daily
- Geometry car inspections performed at least two times on crude oil routes annually
- Track inspections with state-of-the-art technology to detect internal and external flaws in the rail and track structure
- Weather and earthquake inspections

Increased Rail Detection Testing Frequencies Along Critical Waterways

Increased rail detection testing along critical waterways from the FRA frequency of twice annually to 2.5 times in April 2015
**Prevention: Equipment Detection Technology**

- More than 2,000 trackside detectors
- Hot Box Detector (HBD)
- Wheel Load Impact Detector (WILD)
- Trackside Acoustical Detector (TADS)
- Sonic Cracked Wheel/Axle Detector (CWAD)
- Machine Vision Systems
- Magnetic Particle Inspection
- Warm Bearing Detection System (WBDS)
- Hot Wheel Detectors (HWD)
- Truck Performance Detectors (TPD)
Prevention: Rail Equipment Detector Examples

• **Acoustic Bearing Detector (ABD)** – acoustic systems used to evaluate sounds generated by specific bearing component defects

• **Hot Box Detector (HBD)** – evaluates bearing temperature history for statistical outliers; brake issues, burned off journals

• **Cracked Wheel/Axle Detector (CWAD)** – Rail mounted sensors capable of detecting the difference between tones generated by normal vs. flawed wheels and axles
A Key Train has one or more loads of Toxic Inhalation Hazard/Poisonous Inhalation (TIH/PIH) materials or a train with 20 or more tank loads of any hazardous materials.

Special Handling for Key Trains

- Speed restrictions for crude and ethanol
  - BNSF requires a speed of 35 mph for all shale crude trains through municipalities of 100,000 or larger as of March 2015
  - 50 mph for all Key Trains as of July 2014

- Special identification and tracking
  - Risk-based Routing
  - Key Train Routes
  - Parked and Secured Trains
  - Locomotive Cab Securement
**Prevention: Risk Reduction for Crude Trains**

**DERAILMENT PREVENTION – INCREASED TRACKSIDE SAFETY TECHNOLOGY**

<table>
<thead>
<tr>
<th><strong>BNSF-SPECIFIC ACTION</strong></th>
<th><strong>INDUSTRY ACTION</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hot Bearing Detectors</strong> spacing of 10 miles on crude routes that parallel critical waterways, which is a higher standard than the industry maximum of 40 mile spacing. Key Trains stopped by Hot Bearing Detectors must set-out the indication car.</td>
<td>Additional Hot Bearing Detectors on crude oil routes (maximum 40 mile spacing).</td>
</tr>
<tr>
<td><em>Effective March 2015</em></td>
<td><em>Effective July 2014</em></td>
</tr>
<tr>
<td>Increase rail detection frequencies along critical waterways as BNSF went from the FRA frequency of twice a year to <strong>2.5 times</strong>.</td>
<td></td>
</tr>
<tr>
<td><em>Effective April 1, 2015</em></td>
<td></td>
</tr>
<tr>
<td>Key Trains with Level II Wheel Impact Load Detector (WILD) defect (120-140 Kilopound) will be handled as LEVEL I defect (immediate set-out).</td>
<td></td>
</tr>
<tr>
<td><em>Effective March 2015</em></td>
<td></td>
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</tbody>
</table>
Prevention: Positive Train Control (PTC) Deployment Will Enhance Safety

PTC is a digital wireless communication technology

BNSF’s PTC System

The Future

Network Operating Center

BNSF RAILWAY
Mitigation: U.S. DOT Final Rule

FINAL RULE ISSUED MAY 2015 AND EFFECTIVE JULY 7, 2015
(various aspects of the new rule are currently being challenged in court and with the U.S. DOT)

New Braking Standards

- Requires End-of-Train (EOT) device or Distributive Power (DP) braking
- Electronically Controlled Pneumatic (ECP) braking system for High Hazard Flammable Unit Trains (HHFUT) (70+ cars) by Jan. 1, 2021 or 30mph speed limit – Crude Oil
- ECP braking for High Hazard Flammable Trains by May 2023 or 30 mph speed limit – All Other HHFUT

Note: The FAST Act requires an independent evaluation of the electronic brakes standard, which may result in the repeal of the electronic brakes mandate.

New Operational Standards

- Reduced operating speeds - BNSF-specific standards exceed
- Routing requirements
- Notification information for government agencies

New Classification Requirements

- Document sampling and testing program
- Ruling applies to HHFT (High-hazard flammable trains) = ≥20 loaded tank cars in a continuous block or ≥35 or more loaded tank cars dispersed through a train
Tank Cars for High-Hazard Flammable Trains (HHFT)

New tank cars built after Oct. 1, 2015, must meet enhanced DOT 117 design or performance criteria for HHFT:

- Increased thickness from 7/16 inch to 9/16 inch steel
- Thermal protection required
- Jacketing with minimum 11-gauge steel and weather-tight
- Full-height Head Shield - 1/2-inch thick
Mitigation: New Tank Car Standards
### Mitigation: New Tank Car Standards

<table>
<thead>
<tr>
<th>Material</th>
<th>Jacketed or Non-jacketed Tank Cars</th>
<th>DOT-111 not authorized on or after:</th>
<th>DOT-111 CPC-1232 not authorized on or after:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unrefined petroleum products – Class 3, PG I (e.g., Crude Oil)</td>
<td>Non-jacketed</td>
<td>January 1, 2018</td>
<td>April 1, 2020</td>
</tr>
<tr>
<td></td>
<td>Jacketed</td>
<td>March 1, 2018</td>
<td>May 1, 2025</td>
</tr>
<tr>
<td>Class 3, PG I (flammable liquid), other than refined petroleum products</td>
<td>Non-jacketed</td>
<td>May 1, 2025</td>
<td>May 1, 2025</td>
</tr>
<tr>
<td></td>
<td>Jacketed</td>
<td>May 1, 2025</td>
<td>May 1, 2025</td>
</tr>
<tr>
<td>Unrefined petroleum product – Class 3, PG II OR PG III (flammable liquid)</td>
<td>Non-jacketed</td>
<td>January 1, 2018</td>
<td>April 1, 2020</td>
</tr>
<tr>
<td></td>
<td>Jacketed</td>
<td>March 1, 2018</td>
<td>May 1, 2025</td>
</tr>
<tr>
<td>Ethanol</td>
<td>Non-jacketed</td>
<td>May 1, 2023</td>
<td>July 1, 2023</td>
</tr>
<tr>
<td></td>
<td>Jacketed</td>
<td>May 1, 2023</td>
<td>May 1, 2025</td>
</tr>
<tr>
<td>Class 3, PG II or PG III (flammable liquid) other than unrefined petroleum products or ethanol (see above)</td>
<td>Non-jacketed</td>
<td>May 1, 2029</td>
<td>May 1, 2029</td>
</tr>
<tr>
<td></td>
<td>Jacketed</td>
<td>May 1, 2029</td>
<td>May 1, 2029</td>
</tr>
</tbody>
</table>
## Mitigation: New Tank Car Standards

<table>
<thead>
<tr>
<th>Cut-Off Date</th>
<th>Flammable Liquid/Packing Group</th>
<th>TC/DOT-111 removed from service</th>
</tr>
</thead>
<tbody>
<tr>
<td>November 1, 2016</td>
<td>Crude Oil, PG I, II, AND III</td>
<td>Non-CPC-1232, non-jacketed “Legacy tank cars”</td>
</tr>
<tr>
<td>November 1, 2016</td>
<td>Crude Oil, PG I, II, AND III</td>
<td>Non-CPC-1232, jacketed “Legacy tank cars”</td>
</tr>
<tr>
<td>April 1, 2020</td>
<td>Crude Oil, PG I, II, and III</td>
<td>CPC-1232, non-jacketed</td>
</tr>
<tr>
<td>May 1, 2023</td>
<td>Ethanol, PG II</td>
<td>Non-CPC-1232, non-jacketed; non-CPC-1232, jacketed</td>
</tr>
<tr>
<td>July 1, 2023</td>
<td>Ethanol, PG II</td>
<td>CPC-1232, non-jacketed</td>
</tr>
<tr>
<td>May 1, 2025</td>
<td>Crude Oil and Ethanol, PG I, II, and III</td>
<td>CPC-1232, jacketed</td>
</tr>
<tr>
<td>May 1, 2025</td>
<td>All other flammable Liquids, PG I, II, and III</td>
<td>Non-CPC, non-jacketed; non-CPC, jacketed; CPC-1232, non-jacketed; CPC-1232, jacketed</td>
</tr>
</tbody>
</table>
Response: First Responder Coordination

- **Shipment information access** by first responders
- **Training** first responders, employees and customer employees
- **Mobilizing** in the event of an incident
Response: First Responder Access to Information

• Since July 2014, BNSF provides State Emergency Response Commissions with Bakken crude traffic train counts on transport of 1 million+ gallons.

• BNSF offers SECURETRAK website, a real-time Geographic Information System tracking program, to state and/or regional fusion centers.

• Industry launched AskRail app to provide first responders with car-specific data for hazmat contents and railroad contacts during incident.

• BNSF developed national inventory of resources for first responders, staging of emergency response equipment and community notification contacts.

• BNSF launched www.BNSFHAZMAT.com website to provide information such as training and emergency response plans to first responders.
Response: First Responder Training

BNSF and the railroad industry train first responders in their communities under a longstanding program called “TRANSCAER” (Transportation Community Awareness and Emergency Response)

- Hands-on equipment in field – Instructor lead
- Train list/shipping papers
- Placards
- Equipment
- Incident assessment

BNSF trained more than 11,000 local emergency responders in 2016.

More than 90,000 emergency responders trained by BNSF since 1996.
Response: Training First Responders at National Facilities

- Security and Emergency Response Training Center (SERTC) at national railroad research/training facility
- First responders learn crude incident techniques in three-day class with 24 hours of training
- Since 2014, BNSF has sponsored over 1,500 first responders from 25 states and one Canadian province at the Security and Emergency Response Training Center (SERTC) in Colorado and at Texas A&M University
- BNSF believes first responders must be properly trained to respond safely
Response: Incident Mobilization

BNSF pre-positions equipment across its network

- Industrial fire-fighting foam trailers
- Emergency breathing air trailers
- Chlorine kits
- Midland kits
- Air monitoring assets
Response: Mobilization of Prepositioned Hazmat Responders

More than 260 responders at 67 locations
Restoration of sites

• BNSF is responsible for mitigation of the spill and any restoration tasks

• BNSF contracts with pre-approved consultants and contractors to perform the remediation and restoration

• State agencies oversee the work and BNSF must obtain their concurrence before a site is acceptably closed

Cameron, Texas, post derailment
Future Technology Plays a Key Role in Driving Safety Improvements
Unmanned Aerial Vehicles

BNSF is one of only a few companies in the United States – and the first railroad – to take the lead in the use of Unmanned Aerial Vehicles (UAVs)

Supplemental track and structure inspection

- Small multi-rotor aircraft
- Operations governed by FAA Section 333 Exemption

Track integrity flights for key train operation

- Larger fixed wing aircraft
- Initially governed by FAA Research Agreement (CRDA)