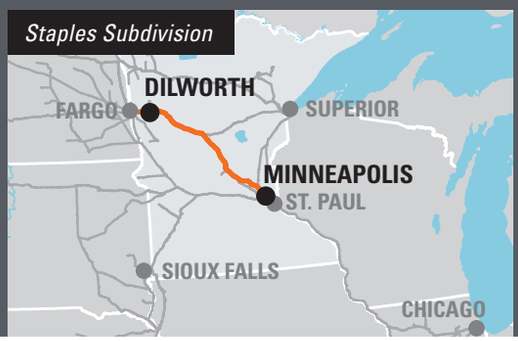
MAKING MINNESOTA SAFER

BNSF Safety Technology in Action in Minnesota

BNSF Railway invests in our infrastructure in Minnesota to keep it sound and safe – and plans another $90 million of investments here in 2018. BNSF also leverages multiple layers of technology to enhance safety. For a snapshot of safety technology and big data at work, consider the 240-mile Staples Subdivision, our main route in the state.



SAFETY TECHNOLOGY ON THE STAPLES SUBDIVISION

PTC Technology *Positive Train Control (PTC) Infrastructure 100% Installed*

Equipment Detector Technology

Dragging Equipment Detector Systems
Hot Box/Bearing Detector Systems
Hot Wheel Detector Systems
Wheel Impact Load Detectors

Track Inspection Technology

Rail Detector Vehicles
Unmanned and Manned Track Geometry Cars
Machine Vision Systems and x-rays
Ground Penetrating Radar
Testing of cameras mounted on Unmanned Aerial Vehicles and other equipment

Big Data: Applying Data and Analytics

Issues identified by equipment detector and track inspection technologies are turning our employees from finders into fixers, working to prevent a problem. Through big data analytics, algorithms sort data, identify potential issues, and make maintenance more accurate and efficient.

Safety Results in Minnesota

Equipment detector readings have enabled our maintenance team to address anomalies before they become issues on thousands of wheels.

8,000+ trains have been protected with PTC, including Northstar commuter trains, in the first 6 months of operation.

More than 60% of freight moves in MN are protected with PTC.

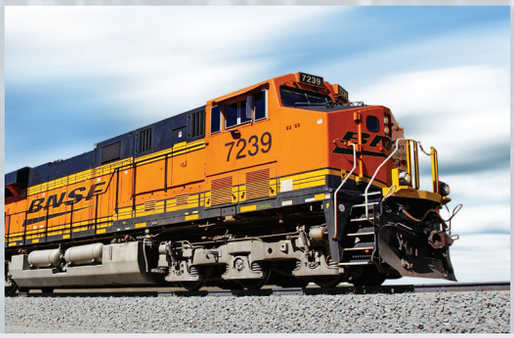
MN derailment rate has been reduced by 18% since 2011.

MN's BNSF employee injury rate has been reduced by 9% since 2011.

BNSF RAILWAY

LEVERAGING TECHNOLOGY TO ENHANCE SAFETY

BNSF Railway is significantly reducing incidents by deploying layers of technology that help our equipment, track and people perform at their best.



Enabling Our Equipment to Operate Efficiently

Equipment Detector Technology

Equipment Detectors

Across our network, BNSF deploys more than 4,000 trackside equipment detectors that monitor every locomotive and railcar on our network 24/7. Some of these detectors sense heat or feel the force of the equipment on the tracks, while others can hear defects on wheel bearings or cracks in wheels before they are visible. Through cameras and machine learning, certain detectors can see when parts are missing or are not in the right position.

Data Analysis

Algorithms sort through more than 35 million readings every day and identify potential problems. BNSF uses this data to determine the urgency of equipment repairs and to spot trends that indicate when maintenance should happen to avoid potential incidents.

Keeping Our Track in Top Condition

Track Inspection Technology

Rail Detector Vehicles

These vehicles use ultra-sonic waves to detect internal flaws in rail.

Unmanned and Manned Track Geometry Cars

Utilizing high-speed laser technology to test track surface and alignment, the addition of unmanned geometry cars is enabling BNSF to nearly double the miles of track inspected every year.

Machine Vision Systems (MVS)

MVS, with high-quality photography, combined with x-ray technology allows BNSF to monitor the condition of rail ties on hundreds of miles of track each week. The data gathered helps BNSF be more precise and effective in replacing ties to bolster the safety of the network.

Ground Penetrating Radar

Using radar pulses, BNSF can scan up to 2 feet below the rail to the substructure of track, informing us when we need to replace ballast to improve the support of the track structure.

Unmanned Aerial Vehicles (UAVs)

BNSF is determining the viability of leveraging UAV technology for inspecting tall bridges or hard-to-reach towers. BNSF is the only railroad working with the FAA to test flying UAVs beyond visual line-of-sight.

Adding Another Layer of Safety

PTC Technology

Positive Train Control (PTC)

BNSF has completed the infrastructure installation of PTC on mandated routes. Using GPS, Wi-Fi and high-band radio transmissions, PTC allows equipment onboard locomotives, wayside systems and a back office server to work together to determine a train's location, direction and speed. The system warns the crew of problems and stops the train if needed.

Learn more about BNSF's safety measures at www.bnsf.com/mn

BNSF RAILWAY