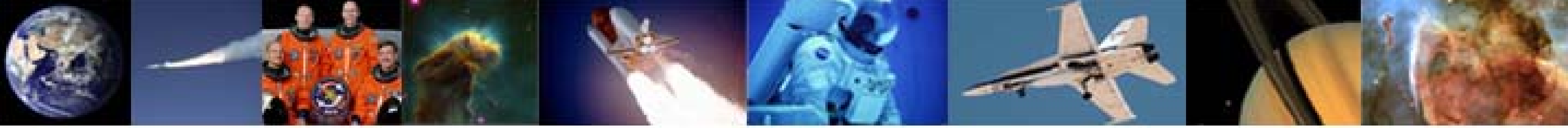


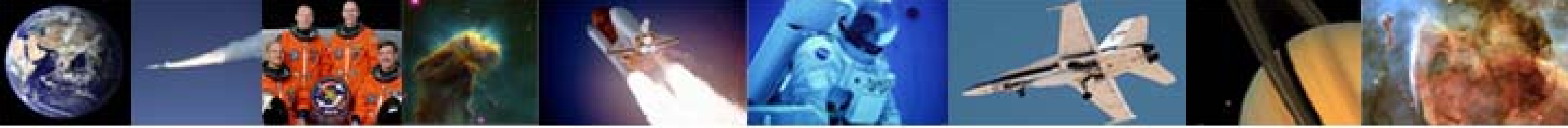
Eschede Train Disaster

Leadership ViTS Meeting
May 7, 2007

Bryan O'Connor
Chief, Safety and Mission Assurance

This and previous presentations are archived at:

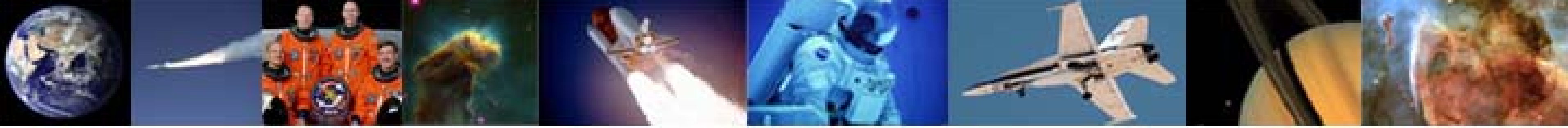
https://sma.nasa.gov/safety-messages



The Mishap

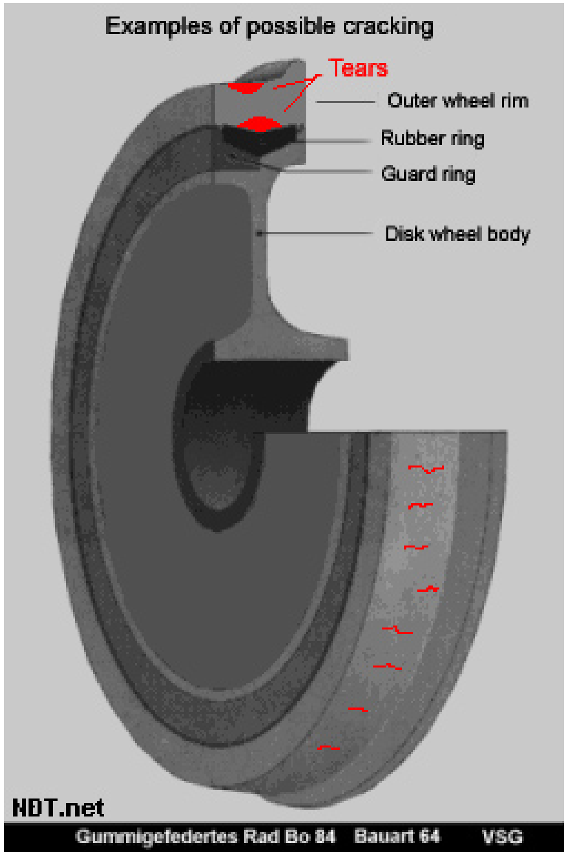
- In June of 1998, one of Germany's InterCity Express (ICE) trains, traveling at over 200kph, slammed into an overpass, killing 101 people.
- The accident happened to a high speed ICE train just outside the town of Eschede in northern Germany.

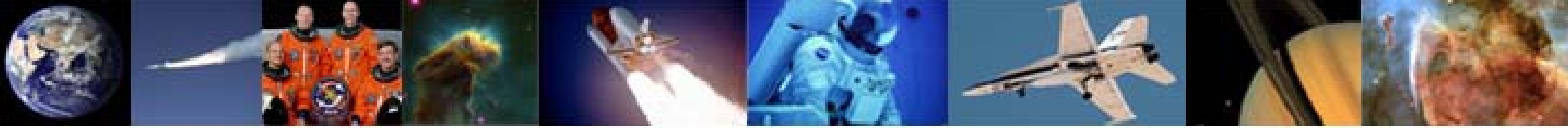
- As the train was traveling to the Eschede Station, a wheel rim on a passenger coach peeled away from the wheel body, puncturing the floor, and becoming embedded underneath the car.
- Passengers noticed the wheel rim when it came through the floor of the rail car.
  - Policy required the train manager investigate the damage before stopping the train.
  - No one activated the emergency brake.
- The train traveled over 3 km before derailing.
- Cars were crushed when an overpass, which was not designed to withstand impact of train derailment, collapsed.



Fatal Wheel “Improvement”

- First generation ICE trains were made with single-cast or **“mono-block”** wheels.
- That design could result in **metal fatigue** and out-of-round conditions which caused vibrations at cruising speeds.
- Based on heritage streetcar design, the mono-block wheel was **modified to include a rubber damping ring** 20mm thick between the metal wheel rim and the wheel body.





Proximate Causes in Event Chain

- Delamination of wheel rim
- Failure to stop immediately upon delamination of wheel rim

Causal Web – Underlying Issues

- Inadequate testing and design verification
  - The rubber cushioned wheels, which had been used successfully on streetcars, were not suitable for the heavier load of ICE trains operating at much higher speeds.
  - At the time, Germany did not have the facilities to adequately test such designs, so many of the wheel design decisions were based on analysis and theory rather than test data.
- Inadequate independent verification of analyses
- Failure to establish and follow necessary operational margins of safety and “acceptable” wear and tear limits
- Failure to consider external hazards in operating area
- Flawed emergency response policies and procedures

NASA Applicability

- Use of heritage hardware for a similar but fundamentally different operating environment
- Use of heritage software
  - Consider Ariane V , flight 501
- Design verification and the degree of testing necessary to adequately certify a design.
- Level of independent verification of analysis necessary to certify a design in cases where operational testing is impossible
  - Consider the extensive independent analyses and evaluation associated with certification of SSP Super Lightweight Tank
- Operating margins and the determination of acceptable wear and tear for operational systems (e.g., Space Shuttle).
- Adequacy of active safety monitoring/alert systems and emergency procedures
- Operational contingency planning or operational response to anomalous conditions.