Why this topic?

- Several large (greater than 7.0) earthquakes in recent history
- 2010 Revision to MW&S Standard Procedure 380
Step #1: What’s the risk?
What’s the risk?
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1886 Charleston, SC: 7.3M

• $5 to $6 million in damage
• 60 deaths

– Facts from USGS website report
What’s the risk?

1886 Charleston, SC: 7.3M

• Effects in the epicentral region included:
  • ~50 miles of severely damaged railroad track
  • More than 500 square miles of extensive cratering and fissuring.
  • Damage to railroad tracks, about 4 miles northwest of Charleston, included lateral and vertical displacement of tracks, formation of S-shaped curves and longitudinal movement.
  • This earthquake was reported from distant places such as Boston, Massachusetts; Milwaukee, Wisconsin, Chicago, Illinois; Cuba and Bermuda.

  – Facts from USGS website report
What’s the risk?

1811-1812 Memphis, TN: two 7.7M quakes

- Seven quakes 6.0 to 7.7 in three months
- Dec 16: 7.7M Northeast Arkansas
  - People were awakened by the shaking in New York City, Washington, D.C., and Charleston, South Carolina. Perceptible ground shaking was in the range of one to three minutes depending upon the observers location. The ground motions were described as most alarming and frightening in places like Nashville, Tennessee, and Louisville, Kentucky. Reports also describe houses and other structures being severely shaken with many chimneys knocked down. In the epicentral area the ground surface was described as in great convulsion with sand and water ejected tens of feet into the air (liquefaction).

- Feb 7: 7.7M New Madrid, Missouri
  - The town of New Madrid was destroyed. At St. Louis, many houses were damaged severely and their chimneys were thrown down. The meizoseismal area was characterized by general ground warping, ejections, fissuring, severe landslides, and caving of stream banks.

- Facts from USGS website report
“A process by which water-saturated sediment temporarily loses strength and acts as a fluid, like when you wiggle your toes in the wet sand near the water at the beach. This effect can be caused by earthquake shaking.”

- USGS
Step #2: Plan Response

• Make a plan
  – Set goals & limits
  – Build in Flexibility
  – Define Roles
Step #2: Plan Response

• 15.07: Emergency Inspections: Earthquakes
• Written by NS B&S ADE Howard Swanson from AREMA and BNSF recommendations
NS Procedure 380

- 100 Miles until intensity known

Earthquakes
a. Upon report of an earthquake, the Chief Dispatching center will immediately notify Engineering Department personnel to make an inspection of the affected line segments and notify all affected trains within a 100-mile radius of the reported area to operate at Restricted Speed. After the epicenter and magnitude of the earthquake has been obtained, the following response chart will

- What to Inspect?

c. Following are items to make particular note of in post earthquake inspections:
   (1) Track
      i. Line, surface, and cross-level irregularities caused by embankment slides or liquefaction, track buckling, or pull-a-parts.
      ii. Cracks or slope failures in fills. Slides and/or potential slides in cuts, or loose rocks that could fall in an aftershock.
      iii. Potential for scour or ponding on embankments due to changes in watercourses.
   (2) Steel Bridges
      i. Displaced or damaged bearings
      ii. Stretched or broken anchor bolts
      iii. Misalignment in viaduct towers, bracing, or main members
      iv. Displaced substructure elements
   (3) Concrete and Masonry Bridges
      i. Displacement and/or cracks
   (4) Timber Trestle Bridges
      i. Line, surface, and cross-level of track.
      ii. Displaced timbers, particularly in frame bents.
      iii. Broken bracing
      iv. Bent bolts or drift pins
   (5) Moveable Span Bridges
      i. Any misalignment that affects opening or closing

d. Safety
   (1) Depending on the severity and location of the quake some roads may be impassable, utility disruptions may also knock out communications.
   (2) Ruptured pipelines or downed power lines crossing under or over the tracks pose additional hazards.
NS Procedure 380

- Affected Distance Varies by intensity

Earthquake - 18 APR 2008
Area of Greatest Intensity

April 18, 2008
5.2 magnitude
18 APR 2008: 5.2M IL

- 100 Mile Radius
- Inspect CP Velpen to CP Buford on SE District (Princeton to Louisville)
18 APR 2008: 5.2M IL

- 100 Mile Radius
- Inspect CP Velpen to CP Buford on Southern East District
Inspection Areas of Concern

- C&S gets it worst!
- Old Stone Box Culverts
- Segmented Pipes
- Weak fills
- Rock cuts
Define Roles & Delegate

- Track Alignment Re-establishment
- Cut and Fill Inspection
- Damage Assessment
- Right-of-Way Confirmation/Staking
- Facility Repair
Step #3: Train & Implement

- Don’t let the plan gather dust!
- Make sure everyone knows the risks and their roles
- Assign back-up roles
Example:
New Zealand 7.0M SEP2010
New Zealand 7.0M 9/10
New Zealand 7.0M 9/10
New Zealand 7.0M 9/10
New Zealand 7.0M 9/10
New Zealand 7.0M 9/10
New Zealand 7.0M 9/10
New Zealand 7.0M 9/10
New Zealand 7.0M 9/10
Example:
Japan 9.0M MAR2011
Japan 9.0M March 2011
Japan 9.0M March 2011
Japan 9.0M March 2011
Japan 9.0M March 2011
Japan 9.0M March 2011
Japan 9.0M March 2011
Japan 9.0M March 2011
Japan 9.0M March 2011
Japan 9.0M March 2011
Japan 9.0M March 2011
Japan 9.0M March 2011
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