Redundancy and Resilience: Moving Hazmat by Rail

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Addressing Hazmat by Rail

- Improve tank car design currently being done
  - Upgrading DOT 111 cars
  - New DOT 117 and 114 standards
- Disclosure of routes, commodities and volumes
  - Problem of SSI classification
  - Hazmat routing reg
  - Need to know
  - FOIA
- Reroute hazmat trains
Hazmat and Rerouting
Historically, resilience was found in route redundancy
Competitors’ lines has been a way to circumvent natural disasters and derailments
Today, fewer route miles
(approx. 254K => 138K)
U.S. Railroad Network - 1914
U.S. Railroad Network - 2014
New Meaning of Resilience

- Alternative routing for hazmat trains
- Operational considerations when no alternate route
- Need to avoid or minimize operations
  - Population centers
  - Points of interest and gathering
  - Historical and cultural venues
  - Iconic targets
  - Passenger lines
Designation of a “Key train”

- ≥20 cars of crude oil or ethanol*, or intermodal cars** with T/PIH, flammable gas, or environmentally sensitive materials
- ≥5 cars of P/TH materials (e.g. ammonia or chlorine)
- ≥1 cars of spent nuclear fuel
- Max speed of 50 mph
- Requires route planning procedures (RCRMS)

*Assumes newer spec cars; just one DOT 111 carload will designate a train “key”
**Also known as ISO tanks
Legal Mandate

- Regulations
  - Federal Railroad Administration
  - Pipeline and Hazardous Materials Safety Administration
  - Transportation Security Administration

- 27 factor algorithm assessing relative risk (RCRMS)

- Railroads required to perform annually

- Objective function:
  - Hazmat freight to be moved in the safest manner possible
  - Avoid densely populated areas
The FRA’s 27 Factors

1. Hazmat volume transported
2. Rail traffic density
3. Route length
4. Railroad facilities
5. Track type, class and maintenance
6. Track geometry
7. Signals and speed control
8. Wayside detectors
9. Grade crossings
10. Single vs. double track
11. Turnouts
12. Proximity to iconic targets
13. Environmentally significant areas
14. Population density
15. Venues along routes
16. Emergency response capabilities
17. High consequence areas
18. Shared track with passenger trains
19. Operating speeds
20. Maintenance and repair facilities
21. Know threats
22. Safety/security risk mitigation
23. Alternate route availability
24. Past incidents
25. Overall transit time
26. Training and skills of crews
27. Rail network traffic and congestion
Potential Problem with the 27 Factors

- Routing analysis is expensive and time-consuming
- Relationship among many factors
- How no feasible alternate routes are addressed
- How routes that are ineffective operationally and not cost effective are not addressed
- Class I railroads have the resources, but many regional and short line railroads do not
- Interline options add to complexity of best solution
The Utility of Factor Consolidation

FRA 27 Factors

- Rail shipments
- Train operations
- Route configuration
- Technology safety measures
- Rail system network
- Safety and incident response
- Threats, risks, and vulnerabilities
Illustrative Example

Rail System Network

- Rail traffic density
- Route length
- Shared track with passenger trains
- Alternate route availability
- Rail network traffic and congestion
## Factors Defined

<table>
<thead>
<tr>
<th>Factor</th>
<th>Key Determinants</th>
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</thead>
<tbody>
<tr>
<td>Rail traffic density</td>
<td>High density increases probability that a hazmat train will idle</td>
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<tr>
<td>Route length</td>
<td>Shorter routes are preferable, but to what extent does short route selection have on rerouting non-hazmat</td>
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<tr>
<td>Shared track with passenger</td>
<td>Freight railroads often share tracks or rights-of-way with passenger railroads, which is not a preferred option</td>
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<tr>
<td>Alternate route availability</td>
<td>One or more of these factors may render a route as “unavailable”</td>
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<tr>
<td>Rail network traffic and congestion</td>
<td>Congested networks increase the probability of idled trains, or reduced speeds which increase vulnerability in a safety-security factor tradeoff</td>
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Summary

- More user-friendly and inexpensive analysis method for short lines and regional railroads
- Takes less resources to collect and input data
- Less resources enables more frequent assessment
- Recognizes "deal killers" that preclude routes that are operationally ineffective and cost prohibitive
- How no alternate routes are considered
- Remaining issue: can the model be used for routes over multiple railroads?