Current Functions and Capabilities of DOE’s Stakeholder Tool for Assessing Radioactive Transportation (START)

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Disclaimer

This is a technical presentation that does not take into account contractual limitations or obligations under the Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste (Standard Contract) (10 CFR Part 961). For example, under the provisions of the Standard Contract, spent nuclear fuel in multi-assembly canisters is not an acceptable waste form, absent a mutually agreed to contract amendment.

To the extent discussions or recommendations in this presentation conflict with the provisions of the Standard Contract, the Standard Contract governs the obligations of the parties, and this presentation in no manner supersedes, overrides, or amends the Standard Contract. This presentation reflects technical work which could support future decision making by DOE. No inferences should be drawn from this presentation regarding future actions by DOE, which are limited both by the terms of the Standard Contract and Congressional appropriations for completing a spent nuclear fuel repository.
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What is START?

The Office of Integrated Waste Management’s web-GIS transportation decision-support tool developed to enable visualization and analyses of geospatial data relevant to planning and operating large-scale spent nuclear fuel and high-level radioactive waste transport to storage and/or disposal facilities.
Development History

- **Fall 2014**: First START version published, hosted by Idaho National Laboratory (INL)
- **Summer 2018**: Began exploring options to move hosting onto a cloud server
- **Spring/Summer 2019**: DOE procured GIS software licenses for cloud server
- **Spring 2020**: DOE Office of the Chief Information Officer (OCIO) indicated they were ready to host START, but shortly after other tasks took priority
- **Fall 2020**: Security changes to INL server systems
- **Spring 2021**: Discussions with OCIO resumed with a path forward
- **Fall 2021**: Cloud accounts procured for DOE-NE, security reviews began
- **Winter 2022**: Migration of START to DOE-HQ cloud server in process
- **Spring 2022**: Expect to have a production version of START up and running at DOE-HQ
Program Utilization

• **Routing Options & Risk Attributes**
  • Rail, highway, waterway, intermodal

• **Training Preparations Along Routes**
  • Fire & police stations, hospitals
  • DOE TEPP* trained personnel

• **Communications**
  • Visualize transportation networks relative to nuclear plants and DOE sites

• **Environmental Analyses**
  • Transportation dose estimates

• **Integration With Systems Analysis**
  • Provides inputs to NGSAM

*Transportation Emergency Preparedness Program (TEPP)
Example routes are for illustrative purposes only and do not reflect a selected destination site.
### Route Evaluation Results

<table>
<thead>
<tr>
<th>Routing Criteria</th>
<th>Min. Travel Time</th>
<th>Min. Population</th>
<th>Min. Travel Time (through Tulsa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buffer Distance</td>
<td>800 Meters</td>
<td>800 Meters</td>
<td>800 Meters</td>
</tr>
<tr>
<td>Result:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Distance</td>
<td>1608.04 miles</td>
<td>1775.10 miles</td>
<td>1609.38 miles</td>
</tr>
<tr>
<td>Total Travel Time</td>
<td>2132.6 minutes</td>
<td>2935.7 minutes</td>
<td>2217.7 minutes</td>
</tr>
<tr>
<td>Accident Likelihood (per mile)</td>
<td>0.000000451</td>
<td>0.000001065</td>
<td>0.0000005</td>
</tr>
<tr>
<td>Water Crossings</td>
<td>142</td>
<td>147</td>
<td>121</td>
</tr>
<tr>
<td>Average Track Class</td>
<td>3.9</td>
<td>3.5</td>
<td>3.9</td>
</tr>
<tr>
<td>Avg Rail Traffic Density</td>
<td>5</td>
<td>3.8</td>
<td>4.9</td>
</tr>
<tr>
<td>Average Population Density</td>
<td>389.1</td>
<td>202.6</td>
<td>308.2</td>
</tr>
<tr>
<td>Total Population (within buffer)</td>
<td>590047 persons</td>
<td>323740 persons</td>
<td>462304 persons</td>
</tr>
<tr>
<td>Mass Gathering Places</td>
<td>1019</td>
<td>730</td>
<td>904</td>
</tr>
<tr>
<td>Tribal Lands</td>
<td>0 square miles</td>
<td>3.58 square miles</td>
<td>203.43 square miles</td>
</tr>
<tr>
<td>Sensitive Environmental Areas</td>
<td>183.8 square miles</td>
<td>147.48 square miles</td>
<td>166.14 square miles</td>
</tr>
<tr>
<td>Tunnels</td>
<td>2</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Emergency Response Capability (per mile)</td>
<td>0.21</td>
<td>0.16</td>
<td>0.21</td>
</tr>
<tr>
<td>Educational Institutions</td>
<td>336</td>
<td>238</td>
<td>285</td>
</tr>
<tr>
<td>Special Age Groups</td>
<td>473</td>
<td>282</td>
<td>449</td>
</tr>
<tr>
<td>Railroad Crossings (at grade)</td>
<td>1620</td>
<td>1460</td>
<td>1645</td>
</tr>
</tbody>
</table>

* Example routes are for illustrative purposes only and do not reflect a selected destination site.
Validation

- **Rail Routing Workshop**
  - DOE’s National Transportation Stakeholders Forum Rail/Routing Ad Hoc Working Group
  - Rail carriers from UP, BNSF, CSXT, and KCS

- **Outcome**
  - Routes generated using START compared well with rail carrier routes using industry’s Rail Corridor Risk Management System (RCRMS)
  - Population buffer - 800m for START vs 322m for RCRMS
  - Operational differences – North/South track
  - Weighting security and safety risks - RCRMS gives equal weight, though historically rail incidents have been caused by safety issues
Validation cont.

- **Verification & Validation**
  - Pacific Northwest National Laboratory
  - Check START outputs against independent assessments in ArcMap and QGIS
    - route buffer zone population and population density
    - route distance

- **Outcome**
  - In all test cases, the route buffer zone population and route distance showed good agreement between START and the test cases.
    - The percent difference was within 5% in all cases, with most cases under ±1%.
Recent Improvements

- Added new ESRI ArcServer features as available
- Batch routing capability
- Incident-free dose rates
  - Crew, off-link public, on-link highway public available
  - Displayed in route summaries as percent of background
- Continuous routing logic improvements (~quarterly)
- Route assessment results by jurisdictional boundary (e.g., State, Tribal, county)
- Continuous data updates (6-12 month intervals)
  - Created hybrid highway network layer
- Ongoing verification & validation
  - Now using LandScan population data for dose
  - Resolving aberrations in exported route shapefiles
Challenges

• Data Quality & Coverage
  • Fire Stations
  • Rail Network Currency

• Rail routing
  • More complex than highway or waterway

• Manual addition of data
  • Transload points
  • Geocoded site photos
  • High Threat Urban Areas
Future Work

• Maintain data currency
  • Update geocoded photo layers

• Virtual Trainings for Tribal & State partners

• Continue Verification & Validation Work

• Utilize cloud platform code diagnostics

• Continue developing NEPA-related support functions
  • More conditions for dose estimates

• Improve integration with systems tools

• Create suite of use cases to support DOE activities

• Consider other applications for analysis
<table>
<thead>
<tr>
<th>Potential Transload Sites</th>
<th>Schools</th>
<th>Highway Hazmat Route Registry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuclear Reactors</td>
<td>Colleges/Universities</td>
<td>DOE WIPP Highway Routes</td>
</tr>
<tr>
<td>Shutdown Sites</td>
<td>Day Care Centers</td>
<td>U.S. Navy Spent Fuel Rail Routes</td>
</tr>
<tr>
<td>DOE and Other Facilities</td>
<td>Nursing Homes</td>
<td>Parks</td>
</tr>
<tr>
<td>Fire Departments</td>
<td>Rail Network</td>
<td>National Forests</td>
</tr>
<tr>
<td>TEPP Trained Personnel</td>
<td>Rail Freight Stations</td>
<td>Federal Lands</td>
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<td>Police</td>
<td>Rail Junctions</td>
<td>Military Bases</td>
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<tr>
<td>Hospitals</td>
<td>Rail Crossings</td>
<td>Hazard Threat Urban Areas</td>
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<tr>
<td>State EOCs</td>
<td>Rail Yards</td>
<td>Surface Water Areas</td>
</tr>
<tr>
<td>Advance Notification Designees</td>
<td>Rail Bridges</td>
<td>Tribal Lands</td>
</tr>
<tr>
<td>Theme Parks and Zoos</td>
<td>Rail Tunnels</td>
<td>Congressional Districts</td>
</tr>
<tr>
<td>Casinos</td>
<td>Highway Network</td>
<td>States</td>
</tr>
<tr>
<td>Performing Arts Centers</td>
<td>Highway Bridges</td>
<td>State Legislative Districts</td>
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<tr>
<td>Stadiums and Arenas</td>
<td>Navigable Waterway Network</td>
<td>Counties</td>
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<tr>
<td>Malls</td>
<td>Locks/Dams</td>
<td>City Limits</td>
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<tr>
<td>National Monuments/Icons</td>
<td>Water Terminals</td>
<td>Urban Areas</td>
</tr>
<tr>
<td>Places of Worship</td>
<td>Coast Guard Districts</td>
<td></td>
</tr>
<tr>
<td>Airports</td>
<td>Captain of the Port Zones</td>
<td>Transportation Infrastructure Photos</td>
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</tbody>
</table>