NRC-RADTRAN – Future Work

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Outline

- **Recap NRC-RADTRAN – Day 1**
- **NRC-RADTRAN Observations**
- **NRC-RADTRAN Current Updates**
- **NRC-RADTRAN Planned Updates**
- **Conclusions and Closing Remarks**

Recap NRC-RADTRAN – Day 1

- NRC-RADTRAN history and concepts were explored
- Installation and use cases were demonstrated
- Implementation in incident free and accident scenarios were demonstrated
- **Questions, Comments and Thoughts from Day 1?**

NRC-RADTRAN Observations

- NRC tasked PNNL with 3 primary tasks:
    - Source code and output comparison between version <u>6.02.1</u> and 6.1
    - Compare NRC-RADTRAN outputs with external calculations
    - Determine documentation and information needed to update NRC-RADTRAN
- Transportation and HP experts contributed to this effort
- 'NRC-Radioactive Material Transport (RADTRAN) Tasks 1-3' report was delivered to the NRC in March 2023

NRC-RADTRAN Observations (cont.)

- Preliminary Observations Task – 1:
  - Several changes in the LOS model:
    - ✓ B_COEF0 value was changed
    - ✓ Differences in pre-defined LOS distances between versions 6.02.1 (RAMP deployment) and 6.1
    - ✓ Difference in slump fractions were observed
    - ✓ Changes in output can be attributed to the annular dose LOS model implemented in version 6.1
  - Several organizational differences in the output were observed.
  - Incident free gamma dose:
    - ✓ Does not account for attenuation and buildup (point kernel solutions).
    - ✓ <1% difference between NRC-RADTRAN and spreadsheet calculations were observed.

NRC-RADTRAN Observations (cont.)

- Preliminary Observations Task – 1 (cont.):
  - Incident free neutron dose:
    - ✓ Accounts for attenuation and buildup.
    - ✓ Analytical and numerical solutions yielded close results (<1% difference)
    - ✓ Large differences observed in on-link and off-link (double integral) results (40% - 80%) – excluding barge results
    - ✓ Difference >500% was observed for barges (off-link)
  - Regulator checks:
    - ✓ NRC-RADTRAN successfully performed the regulator checks (10 mrem/hr at 2m) in accordance with DOT's 49 CFR 173.441(a)
  - Accidents – dispersal of radioactive material:
    - ✓ Kr-85 and Cs-137 were evaluated

NRC-RADTRAN Observations (cont.)

- Preliminary Observations Task – 1 (cont.):
  - Accidents – dispersal of radioactive material (cont.):
    - ✓ A difference under 0.1% was observed for the inhalation, resuspension, immersion, and groundshine pathways
    - ✓ Difference between the technical manual description and source code implemented equations were observed

- Preliminary Observations Task – 2:
  - NRC-RADTRAN default parameter display
  - Implementing changes in RADTRAN methodology
  - Implementing coding changes – streamline maintenance
  - Changes to LOS model

NRC-RADTRAN Observations (cont.)

- Preliminary Observations Task – 3:
    - NRC-RADTRAN GUI updates for enhanced clarity and user experience
    - Project documentation not saved in folders that can be backed up by products like Microsoft OneDrive

NRC-RADTRAN Current Updates

- Activities to update NRC-RADTRAN were initiated in late Q3 of CY2023.

- The activities were split into two tasks.

- Task – 1 activities are anticipated to be completed by Q2 of CY2024.

- Task – 2 activities and end-to-end testing to be completed by mid-Q2 of CY2025.

- Activity description documents are being developed for each activity that are completed.
  - Provides a synopsis of the bug/feature request, action implemented, and the revised outputs

NRC-RADTRAN Current Updates

- Task – 1 activities:
  - Speed and population density errors (segment and state level data)
    - ✓ Challenges reading KML files (change in file format)
    - ✓ Relatively high population density values
    - ✓ Fix: Updated the population density equation to match the user manual; modifying code to accept latest KML files.
  - Adding functionality to accept START files
    - ✓ **S**takeholder **T**ool for **A**ssessing **R**adioactive **T**ransportation (OUO status)
    - ✓ Redundant data sources, alternative to WebTRAGIS
    - ✓ Status: Data mapping between START and WebTRAGIS completed; coding efforts completed to accept START generated KML files

NRC-RADTRAN Current Updates
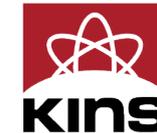
- Task – 1 activities (cont.):
  - Population risk summing across all links
    - ✓ Only link wise dose data (inhalation, cloud shine, ground shine, and re-suspension is presented.
    - ✓ Fix: The code was modified to output total doses from all 4 exposure pathways for all the links thereby improving user experience.
  - Display not used values values
    - ✓ Currently '-1' is displayed in the code where no values are used for the field.
    - ✓ Displaying '-1' is not intuitive from a user experience standpoint
    - ✓ Fix: changed '-1' to 'Not a Number (NaN)' to show that no numbers are being used in the field.

NRC-RADTRAN Current Updates
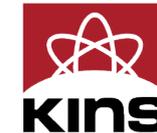
- Task – 1 activities (cont.):
  - Implementing GUI changes to include Air Transportation
    - ✓ Current air transportation modes not available on the GUI
    - ✓ Can be implemented by modifying the text file generated by the GUI
    - ✓ Fix: add an option on the GUI to include air transportation
  - Errors with >9 rail links
    - ✓ Scenarios with >9 rail links were assumed to be air transportation
    - ✓ The outputs were different based on number of links as opposed to mode of transportation
    - ✓ Fix: Coding changes are being implemented to print out the accurate description of the scenario being run by the user.

NRC-RADTRAN Current Updates
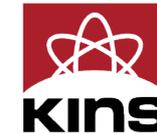
- Task – 1 activities (cont.):
  - Hard coded conversion factors
    - ✓ There are several hard coded conversion factors used in the NRC-RADTRAN source code
    - ✓ Makes it challenging to debug and streamline code maintenance/ development
    - ✓ Fix: Modifying the source code to replace conversion factors with variables
  - Quality Assurance activities
    - ✓ Develop test suites for cases, activity wise unit-testing
    - ✓ End-to-end as well as integration testing
    - ✓ Software grading and SQAP development
    - ✓ Implementation: these tasks are being implemented as part of the development process

NRC-RADTRAN Planned Updates
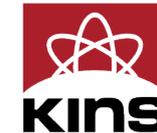
- Task – 2 activities (Q3 of CY2024 to Q2 of CY2025):
  - Investigate and implement incident free neutron dose corrections
  - Investigate and implement MEI neutron and gamma dose corrections
  - Investigate variable neutron and gamma shielding factors
  - Update user guide to implement updated rail crew dose methodology
  - Investigate, implement, and update user manual for LOS model
  - Investigate and implement atmospheric dispersion factors and model corrections

Conclusion and Closing Remarks
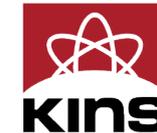
- Concepts from Day-1 were recapped

- NRC-RADTRAN errors/ bugs were explored

- Code development activities (bug fixes and feature requests) were discussed

- Current changes being implemented were covered

- Future and planned changes were discussed

- Planned completion of activities: Q2 CY2025

Conclusion and Closing Remarks
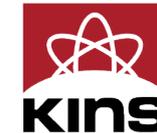
- NRC User Acceptance Testing (UAT):
    - Post delivery of the NRC-RADTRAN beta release (version 1.1), UAT is planned to be conducted.
    - If you are interested in participating as a beta tester, please reach out to Don Lowman at Donald.Lowman@nrc.gov
    - Beta Testers will have an opportunity to test out the new version and share feedback with the development team to incorporate potential changes in NRC-RADTRAN v1.1

Conclusion and Closing Remarks

Questions, Comments, or Suggestions

NRC-RADTRAN Open Discussion

Thank you