Improving Accuracy and Updating Methodology in Determining Effluent Dose

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Improving Accuracy and Updating Methodology in Determining Effluent Dose Project Overview

RESEARCH OBJECTIVE:

Identify opportunities for enhancing the accuracy of off-site dose calculations methods.

Phase I: Review of Regulation, Regulatory Approach, Regulatory Guides

Phase II: Review of Site-Specific Off-Site Dose Calculations Methods

- Explore international methods and experiences.
  - Up to date techniques and technologies
    - Best Practices.
  - Opportunities for enhancements.
    - Technical gaps.

IMPLEMENTATION OF RESEARCH RESULTS:

- *Utility members can use the results to enhance the accuracy of their dose calculations.*
- *Regulatory agencies can use the results as reference for regulatory updates.*

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Research Drivers

- Current off-site dose calculation regulations and methods continue to protect the health and safety of the public.

- However:
  - Regulators and stakeholders continue to become more interested in accurate accounting of effluents and doses.
  - Research (i.e. Cancer Studies) rely on plant effluents and dose information.
  - New radiation dose science is available.
  - Accurate understanding of effluents and dose to public may help inform plant operations.

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International Working Group

Provides international utility experiences and insights.

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Phase I: Review of Regulation, Regulatory Approach, Regulatory Guides

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Observations from the Review of International Regulatory Approaches

- Internationally, most countries have adopted or plan to adopt the ICRP-103 recommendations. The current US NRC effluent regulations are based on ICRP-2.

- The US NRC regulations apply the concept of maximally exposed individual (MEI). Internationally, the use of representative individuals or groups is more prevalent, consistent with recent ICRP recommendations.

- The US NRC provides conservative and generic guidance for calculating doses to the members of the public, while offering licensees the option to pursue more site-specific models and parameters.

- Some countries use effluent concentration limits as the main mechanism of compliance (instead of site-specific dose assessments).

- At least one country uses results from the radiological environmental monitoring program as the basis for calculating doses to the members of the public, while using effluent concentration levels for compliance with regulatory limits.

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Areas for Potential Enhancement in Off-Site Dose Calculations

- General/Regulatory Approach:
  - Conservative assessment for compliance versus (more accurate) dose assessment
  - Probabilistic versus deterministic modeling

- Environmental Transport and Dispersion
  - Short term or seasonal meteorology
  - Dry and wet deposition
  - Location specific dispersion calculations
  - Finite plume modeling

- Hydrological Transport and Dispersion
  - Near field dilution
  - Seasonal receiving water body flows/volumes

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Areas for Potential Enhancement in Off-Site Dose Calculations

- Pathway Modeling
  - Updated environmental transfer parameters
  - Use of site-specific characteristics and transport parameters
  - Finite plumes
  - Weathering effects of material through soil
  - Contaminated runoff to low lying areas
  - Animal contaminated material intake
  - Water contamination
  - Updates to bioaccumulation factors

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Areas for Potential Enhancement in Off-Site Dose Calculations

- Exposure Modeling:
  - Representative individuals versus maximum exposed
  - Direct exposure from all radionuclides in plume (not just noble gas)
  - Age based external exposure
  - Shielding factor
  - Updated Dose Conversion Factors (DCFs)

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Phase I Wrap-Up: Summary, Conclusions, Next Steps

- EPRI Report on Phase I will be published in September 2016.
  - Identifies potential areas of enhancements.
- The effort needed to implement each potential area of enhancement as been identified:
  - Can be accomplished under current regulatory structure or with currently available, updated data or models.
  - Requires regulatory approval
  - Requires additional research
  - Requires a rule change
- Additional research and analysis will be needed to quantify the impact and benefit of implementing the enhancements.
- The current methods continue to protect the health and safety of the public and ensure plant effluents stay below regulatory limits.

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Phase II: Review of Site-Specific Off-Site Dose Calculations Methods

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Evaluation of Site Specific Off-Site Dose Calculation Practices

OBJECTIVE:

Identify best practices and opportunities for enhancements for accurate site-specific off-site dose calculation methods.

- Phase I was the review of regulations and regulatory guides (i.e. regulatory framework.)
- Phase II will explore how nuclear power plants implement the regulatory framework with site-specific details.
- Identify best practices and opportunities for enhancements associated with:
  - Application of site-specific data and information
  - Use of default, conservative and/or hypothetical data and information
- Identify any gaps that require additional research.

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Evaluation of Site Specific Off-Site Dose Calculation Practices

Application of Results:

Results of this research are anticipated to be implemented by utility members, research organizations, and regulatory bodies.

- Utility members can evaluate identified best practices and opportunities for enhancements for application at their sites (i.e. where possible within current regulatory framework.)
- Research to close gaps may be conducted by EPRI or other organizations in the future.
- Learnings may inform revision of regulatory guides in the future (i.e. where sites have not implemented site-specific data due to lack of regulatory guidance.)

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Evaluation of Site Specific Off-Site Dose Calculation Practices

Approach:

- Review Off-Site Dose Calculation Manuals (ODCMs) or equivalents of U.S. and International nuclear power plants:
  - Ideally 4 PWRs and 3 BWRs in the U.S.
  - International member from Canada, Europe, and Asia

- Range of ODCMs to be reviewed:
  - ODCMs that represent basic, simple dose assessments
  - ODCM that identify some unique applications to site-specifics
  - ODCMs that include a detailed incorporation of site-specific characteristics or unique modeling
  - Various liquid effluent pathways: river, lake, ocean.

- ODCM Reviews organized along the same topics used for Phase I report
  - General considerations for dose assessment
  - Transport models – meteorology and hydrology
  - Various Exposure Pathway Models
  - Other considerations

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Evaluation of Site Specific Off-Site Dose Calculation Practices

Some initial observations and thoughts for discussion:

- Without exception, dose modeling in the U.S. based on RG 1.109.
- Hydrological modeling generally uses licensing studies/modeling
  - How are these studies/models incorporated into routine dose calculations? Simplified? Conservative?
- Meteorology – varies by site: ground level, mixed-mode, elevated, short-term met.
  - Site-specific consideration of carbon-14 doses
- Many sites use hypothetical versus real pathways/locations.
  - Some consideration of special pathways.
- Some sites may have developed site-specific bio-accumulation factors.
- Land Use Census: methods used and how integrated into dose modeling.

What aspects of site-specific dose calculations should we make sure to explore in this research?

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Phase II Future Steps

- EPRI will develop initial draft of research results for Working Group (WG) to review (early-August.)
- WG Discussion to take place via Webcast (mid-August.)
- Results of Phase II are anticipated to be published in early 2017.

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