How Often to Calculate X/Q and D/Q and to Revise Programs? –A Peer Discussion

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Beginning of Thread

- Does anyone know if there is a regulatory requirement to perform XOQDOQ calculations annually?

Perspective from Industry Consultant s

- RG 1.109 and NUREG 0133 all make use of historical meteorology
- Guidance is silent on what "historical" means.
- It is wise to at least review the met data and satisfy yourself that the historical data is reasonably representative of recent meteorology – (e.g. compare wind roses).

Perspective from Industry Consultant

- Rev 2 of RG 1.21 provides some input on this issue.
- The Rev 2 idea of updating X/Q when a 10% difference is seen is not reasonable because the statistical uncertainty is much greater than that.
- In reality historical X/Q is accurate to only 1 significant figure (actually less).

Perspective from Industry Consultant

- NCRP publication 76 (1984) addresses the variance seen in historical and live time X/Qs. It turns out the historical values have significantly less variance that live time values.

Perspective from Industry Peer

- Any calculation of X/Q dispersion factors or D/Q deposition factors is probably only "accurate" within a factor of three or four times, or even an order of magnitude.
- How accurate is calculating X/Q or D/Q using a series of sigma-y and sigma-z plots that are crude approximations fitted to a hypothetical curve on a log-log graph?

Perspective from Industry Peer

- If one included the error bars on the sigma curves, they'd probably span over half the distance to the adjacent line for the next Pasquill stability class
- It is totally absurd to think that a X/Q value of 7.65E-9 sec/m^3 calculated using a 2012 meteorological dataset is any different than a value of 5.10E-9 sec/m^3 using a 2009 dataset?

Perspective from Industry Peer

- Yet, we'll accept the "new" X/Q as being 50% higher than the "old" X/Q, and use that as a decision-making process to place a new REMP air sampler station, possibly at the cost of abandoning a long-term historic air sampler that's been out in the field for 30+ years.

Perspective from Industry Peer

- Factor into this whole mess the "binning" of vertical temperature gradient (Delta-T) values to calculate stability class. For example, Class D ranges from -1.5 to -0.5 degrees-C per 100 meters.
- I'd venture to guess that a given Delta-T of -0.4 degrees will result in less mixing and look more like a Class E stability than would a Delta-T of -1.4 degrees, which probably looks more like Class C.

Perspective from Industry Peer

- Yet, we’ll bin both into the same Class D stability, when in reality the sigma-y or sigma-z between the two extremes might easily be more than a factor of 20 or 30.

Perspective from Industry Peer

- "Regulatory Guide 1.109 has an evaluation criterion to add a new garden to the REMP program if the calculated D/Q is only 20% higher than an existing garden."
- "Now Rev.2 of RG-1.21 ratchets things down to a 10% difference."

Perspective from Industry Peer

- Would a review of uncertainty associated dispersion modeling justify a comparison criteria based on 10% or 20% difference.
- "Mathematically, given the uncertainty I'd find it difficult to justify a decision-making process based on a factor of 2-times difference, let alone 10%."

A Closer Look

- Regulations
- Guidance
- Standards

Regulations – 10 CFR 50.36a(a)(2)

- **10 CFR 50.36a(a)(2)** requires nuclear power plant licensees to submit a report to the Commission <u>annually</u> that specifies the quantity of each of the principal radionuclides released to unrestricted areas in liquid and gaseous effluents during the previous 12 months, including any other information that the Commission may need to estimate maximum potential annual radiation doses to the public resulting from effluent releases

Guidance – RG 1.109

- RG 1.109 Page 5 "…annual average gaseous dispersion factor"
  - Doesn't provide guidance on how many years needed for annual average

Guidance – NUREG-0133

- Section 3.3 of NUREG-0133 discusses, "…historic annual average atmospheric dispersion condition rather than real time dispersion conditions in determining the LCO for radioactive materials in gaseous effluents."

Guidance – RG 1.21

- Section 3.2 of RG 1.21 Rev 2 reiterates RG 1.111 relative to "average annual" but also states,
  - "When calculating long-term, annual average frequency distributions, 5 (or more) years of data should be used.
  - If long-term, annual average χ/Q and D/Q values are used in determining dose to individual members of the public, the values should be revalidated or updated periodically (e.g., every 3 to 5 years).
  - If the evaluation indicates the long-term, annual average χ/Q and D/Q are non-conservative by 10 percent or more, either revise the affected values or document the reason why such changes are not deemed necessary.

Guidance – RG 1.111

- RG 1.111-1977 Page 13 under section "Meteorological Data for Models"
  - States, "Sufficient meteorological information should be obtained to characterize transport processes."
  - States, "If emissions are continuous, annual data summaries should be used."
  - States, "If emissions are infrequent…meteorological data applicable to the time of release should be considered."

Standards – NCRP-76

- NCRP-76 Section 6.4.1
  - Long term & flat terrain – "Gaussian plume models appear to be relatively accurate (within a factor of 2 to 4)"
  - Short term & complex terrain – uncertainties of one to two orders of magnitude
  - Short term, Wet & Dry deposition uncertainty one to three orders of magnitude
  - Resuspension uncertainty several orders of magnitude

Standards – ANSI N3.11-2005

- Section 6.1: When using meteorological data for licensing or other regulatory purposes, <u>3-5 years</u> of data should be sufficient to ensure that meteorological conditions have been adequately represented for use in transport and dispersion calculations (i.e., temporal representativeness).

Presenter Perspective

- Columbia Generating Station
  - Met data review frequency bases: History, Regs, & Industry
  - 5-yr rolling average & 20% threshold
    - Threshold reached twice - input parameter value revisions.
  - 5-yr average values only during tower failure and for ODCM effluent monitor alarm thresholds.
  - Calculates X/Q and D/Q monthly, quarterly, and annually.
  - Some peers driving toward this, but CGS moving to industry norm

Presenter Perspective

- 10% or 20% threshold affects
  - REMP – Monitors/Sampling
  - RETS – monitor alarms, dose calcs
  - EP – EAL thresholds
  - Licensing – FSAR/USAR/ODCM
  - Engineering – Calculations
  - Maintenance – Setpoints

Presenter Perspective

- Effluent monitor <u>alarm setpoints</u>
  - At highest X/Q at or beyond site boundary
  - ODCM Effluent monitor alarms use XOQDOQ results (ground/mixed/elevated)
  - UE and Alert based on ODCM monitor setpoints

    (See NUMARC/NESP-007 or NEI 99-01)
  - Note: accident analysis uses PAVAN (ground mode)

Presenter Perspective

- 10% – 20% change puts Configuration Control at risk
  - Emergency Action levels
  - Design Calculations – Appendix C to Loop Uncertainty
  - Software: EP, Effluent, Setpoints, etc
  - Instrument Master Data Sheets
  - Instrument Setpoint Change Requests
  - ODCM/FSAR/USAR
  - Procedures
  - etc

Presenter Perspective

- Effluent and Post Accident Monitor Alarm Setpoint Errors
  - Loop Uncertainty (20% not uncommon)
  - Instrument Drift (variable)
  - I&C electronic calibration of 6 decade chart recorders have a tolerance of 20% for each decade (LCRM to Recorder).
  - Radiological calibration has a 20% acceptance band for the secondary transfer source.
  - Uncertainty of Dispersion Modeling (?)

Contributions to Model Uncertainty

Internal:
- Numerical approximations
- Modeling errors
- Treatment of dynamic processes

External:
- Data errors in execution and evaluation
- Model parameterizations
- Initial & boundary conditions

Stochastic:
- Natural variability of the atmosphere (turbulence)

Presenter Perspective

- Dose Effects
  - Dose is proportional to dispersion and deposition
  - Non-depositing nuclides are largest contributing types (noble gases/<u>H-3</u>/<u>C-14</u>/Halogens/Particulates)
  - Gaseous effluent releases are very low. Is a reduction to 10% needed?

Summary

- Does anyone know if there is a regulatory requirement to perform XOQDOQ calculations annually?
  - CFR requirement: No
  - License Commitment: Varies
  - RG 1.111: Can be interpreted as annual

Summary

- Frequency of Dispersion and Deposition analysis?
  - No regulation or regulatory guidance noted.
  - ANSI N3.11-2005: Every 3-5 Years
  - Industry practice variable.
  - EP PAVAN vs ODCM XOQDOQ

Summary

- Is a 10% or 20% threshold for program change reasonable?
  - UE and Alert EALs based on ODCM instantaneous release rate limitations…no conservative value.
  - Dispersion and deposition errors not quantified
  - Significant resources needed to make program changes
  - Have improvements in models reduced errors?
  - What caused the difference?
    - Met tower instrument performance?
    - Release characteristics?

How would you respond to the issues?

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