Savannah River Site Experience With Groundwater Protection Standards

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SRMC SAVANNAH RIVER MISSION COMPLETION

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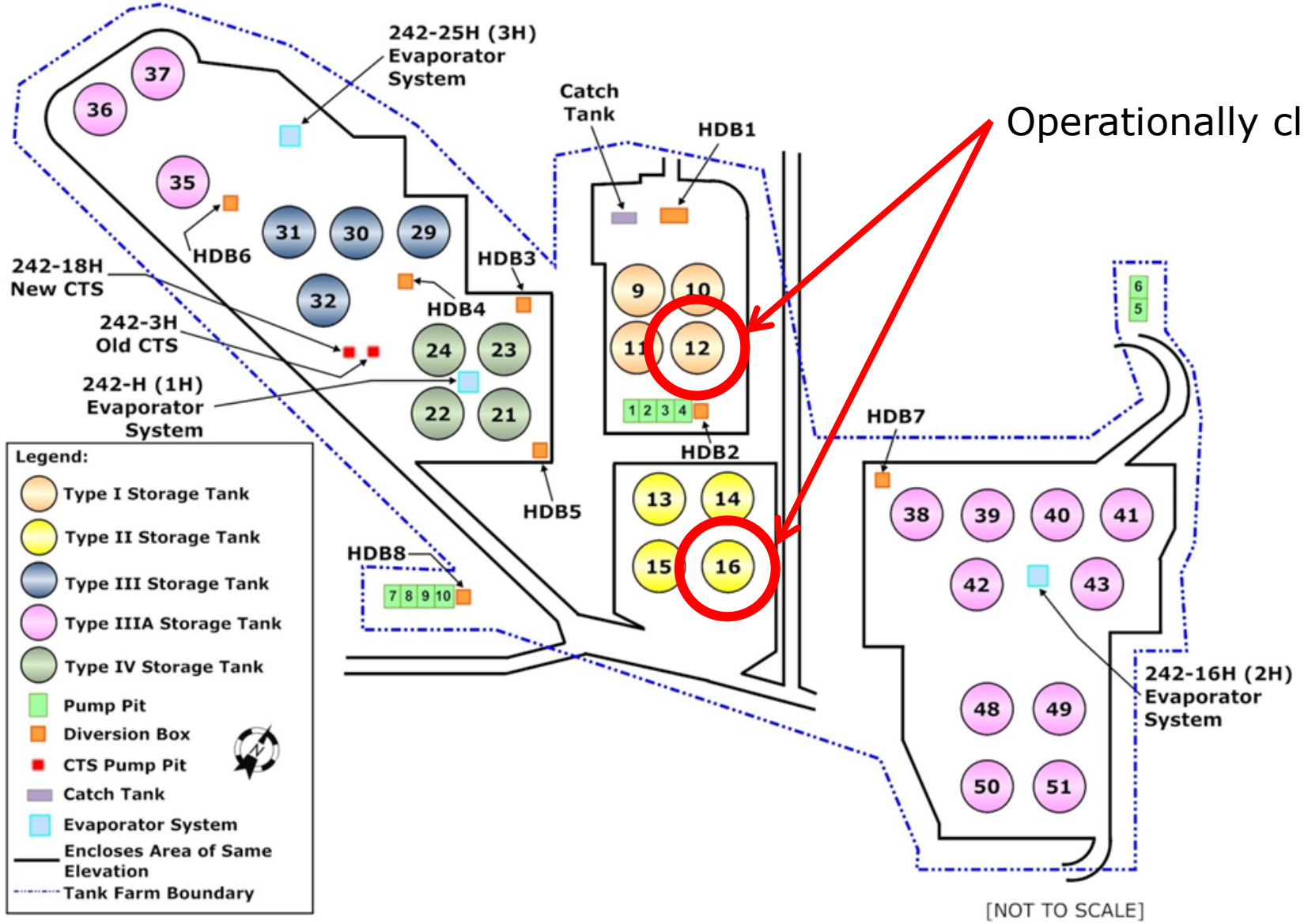
Background

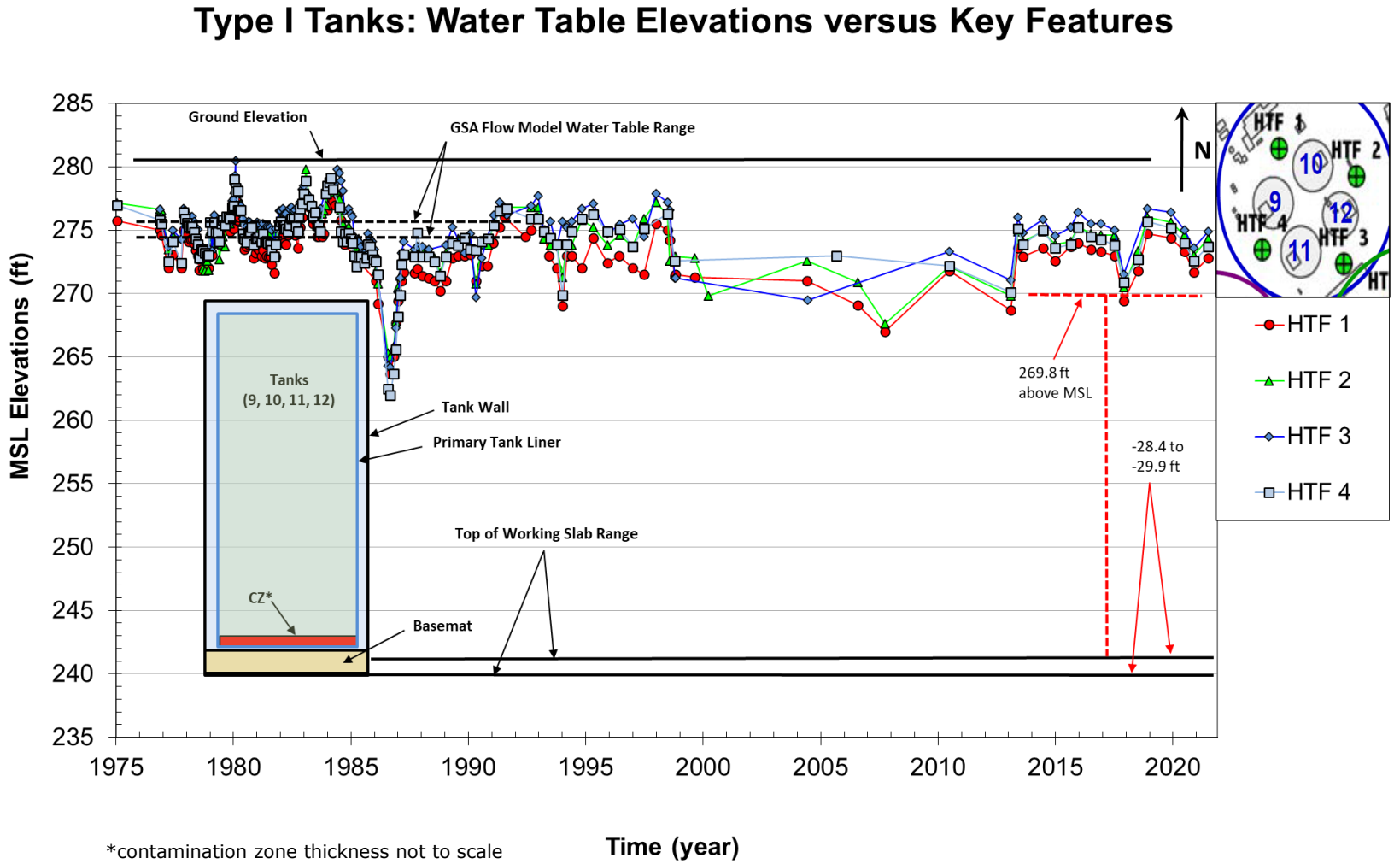
- Savannah River Site has 51 total tanks
- Eight tanks have been operationally closed to date
- Evaluations completed in preparation for closure of two tanks in H-Area Tank Farm indicated that Safe Drinking Water Act Maximum Contaminant Levels (MCLs) were met within 1,000 years following area closure but were exceeded for certain radionuclides within 10,000 years
- Data was examined relative to modeling approaches and the bases for the MCL doses and alternate information presented
- Department of Energy, South Carolina Department of Health and Environmental Control and Environmental Protection Agency Region IV approved closure action

H-Area Tank Farm

H-Area Tank Farm



H-Area Tank Farm



Closure Evaluation Results

- **Results documented in the Special Analysis in preparation for closure of Tank 16 in H-Area Tank Farm indicated concentrations of I-129 and Tc-99 over the MCLs within 10,000 years following closure**

- **Special Analysis discussed modeling approaches and bases of the MCLs in evaluating overall risk to human health**
  - Pessimistic assumptions made related to iodine retention in the residual material
  - MCL criteria of 4 mrem/yr from beta-gamma emitters is derived from consuming 2 liters of water per day from potentially contaminated source and using dose conversion factors from late 1950s

Special analysis can be viewed at: https://www.nrc.gov/docs/ML1505/ML15058A394.pdf

Pessimistic Assumptions

- **Predictive modeling necessitates making decisions on modeling parameters especially when evaluating time periods many thousands of years in the future**
- **Pessimistic values are often chosen due to ease of their defense to stakeholders or due to lack of detailed understanding of system performance in the future**
- **Variable modeling parameters can include:**
  - Water infiltration rates through engineered closure caps
  - Material degradation rates and modeling values especially related to cementitious material fluid movement and chemical conditions
  - Human receptor behaviors
  - Climate change

Water Consumption

- **Basis for approximately 2 liters/day often attributed to military field operations planning not necessarily typical member of the public consumption of well water**
- **Typical water consumption is a value that has and will vary over time influenced by factors such as bottled water and other liquid consumption**
- **The Environmental Protection Agency's *Exposure Factors Handbook* is excellent source of data on water consumption and is updated as new data is available and evaluated**
- **Latest water consumption data from Chapter 3 was issued in 2019: https://cfpub.epa.gov/ncea/efp/recordisplay.cfm?deid=343661**

Water Consumption

- **Water consumption for your particular site applications should consider:**
  - Sources of water such as community water supply or bottled water
  - Adjustments for various activity levels and occupational differences
  - Adjustments for United States regional consumption data

- **Savannah River Mission Completion (SRMC) established a compliance case water consumption rate of 1.595 liters/day based on current information and our specific adjustments**

Details of the MCLs

- Radionuclide Maximum Contaminant Level for beta/photon emitters is 4 mrem/yr
- Discussion is related to how that 4 mrem/yr concentration limit is calculated
- Current derived concentrations for 179 radionuclides to yield 4 mrem/yr are presented in EPA 815-R-02-001 as calculated from National Bureau of Standards Handbook 69 from 1959
- Concentration for I-129 is 1 pCi/liter and for Tc-99 is 900 pCi/liter
- Already discussed water consumption rate differences so let us discuss dose conversion factors

Dose Conversion Factors

- Understanding of potential organ and body impacts of various radionuclides has increased greatly since 1959 and more information continues to be learned
- In 1991 Environmental Protection Agency proposed new concentrations for radionuclides to meet the 4 mrem/yr limit based on knowledge at that time: https://www.govinfo.gov/content/pkg/FR-1991-07-18/pdf/FR-1991-07-18.pdf
- I-129 proposed concentration changed from 1 pCi/liter to 21 pCi/liter
- Tc-99 proposed concentration changed from 900 pCi/liter to 3790 pCi/liter
- 1991 concentrations were not adopted following public comments but illustrate dose conversion factor changes

Dose Conversion Factors

- As previously stated, the dose conversion factors change as our knowledge changes
- Current Department of Energy factors (also called dose coefficients) are presented in DOE-STD-1196-2021: https://www.standards.doe.gov/standards-documents/1100/1196-astd-2021
- PNNL-30466, *Evaluation of Dose- and Risk-Based Groundwater Cleanup Levels for Low Energy Beta Radioisotopes*, issued in September 2020 provides an excellent history of changes in data and examples specific to possible uses for Hanford cleanup situations: https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-30466.pdf
- Recommend reading this report to gain perspective on risk assessments

Examples

- **Dose consequences for I-129 of 1 pCi/liter using SRMC compliance case water consumption and DOE standard dose coefficients:**

$$1\ \frac{pCi}{liter}\left(\frac{1.595\ liters}{day}\right)\left(\frac{365.25\ days}{year}\right)\left(\frac{3.57E-4\ mrem}{pCi}\right)=0.21\frac{mrem}{year}$$

- **Dose consequences for Tc-99 of 900 pCi/liter using SRMC compliance case water consumption and DOE standard dose coefficients:**

$$900\ \frac{pCi}{liter}\left(\frac{1.595\ liters}{day}\right)\left(\frac{365.25\ days}{year}\right)\left(\frac{5.25E-7\ mrem}{pCi}\right)=0.28\frac{mrem}{year}$$

Conclusions

- **When performing environmental evaluations it is vital to understand:**
  - Modeling parameters and the impact of decisions on results
  - Context of time period of peak results following site closure
  - Basis of radionuclide standards or limits you are comparing to in order to fully understand potential risk
  - Current human habits and science to fully appreciate risk significance of modeling results

- **Discuss your results and the potential risk with your regulators and stakeholders so everyone has a full appreciation for what the modeling results are telling us in order to make well informed decisions**