Tritium Management in FHRs

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**Introduction**

**Objective:** To investigate tritium control strategies in FHRs

**Accomplishments:**
- Modeling of tritium dispersion in the atmosphere
- Design of a tritium control and mitigation system
- Design of a cross-flow tritium removal facility
- Logarithmic Mean Square root of Partial pressure Difference (LMSPD) mass transport calculation method and model validation with hydrogen permeation experiments
- Validation experiments of the cross-flow tritium removal facility design using reactor off gas as the hydrogen carrier

**Tritium Dispersion**

**Calculation output**
- Maximum annual dose that an individual resident who lives around the site would receive

**Comparison to regulatory limits**
- < 2 mrem in any one hour
- < 5 mrem annually
- During startup, the dose would exceed regulatory limits

**Interpretation of the results**
- For a specific site, the meteorological parameters are unlikely to change dramatically
- May provide information for other candidate locations in the future

**Radiation source**
- 30-m stack point source
- HTO 5,000 Ci/day (FHR startup)
- 1-year chronic release

**Tritium Control Strategy**

**Tritium control system with a cross-flow tritium removal facility**

**LMSPD Mass Transport Calculation Method**

Logarithmic Mean Square root of Partial pressure Difference Calculation Method

\[
\left(\frac{P_{K}}{P_{H}}\right)^{LMSPD} = \left(\frac{P_{K}}{P_{H}}\right)^{LMSPD_1} \left(\frac{P_{K}}{P_{H}}\right)^{LMSPD_2} \cdots \left(\frac{P_{K}}{P_{H}}\right)^{LMSPD_n}
\]

**Validation with H\textsubscript{2} Permeation Experiments**

**Validation Experiments at University of Idaho**

**Working fluids**
- 50% Kr-50% H\textsubscript{2}
- N\textsubscript{2} as the sweep gas

**Measurements**
- Temperatures around the facility
- Pressure in the Kr+H\textsubscript{2} loop

**Tests**
- N\textsubscript{2} control test: showed no leakage in the system
- Two H\textsubscript{2} tests: 6-h and 10-h duration

**Conclusions and Ongoing Research**

- Tritium dispersion in the atmosphere and its health impact on the public have been modeled
- A tritium control and mitigation strategy has been proposed and analyzed
- A mass transport calculation method has been developed and validated with H\textsubscript{2} permeation experiments
- Investigation of effect of precipitation on atmospheric tritium dispersion
- Computer simulation and code calculation of the validation experiments performed at University of Idaho

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