Overview of the 2017 IDF Performance Assessment for LAW

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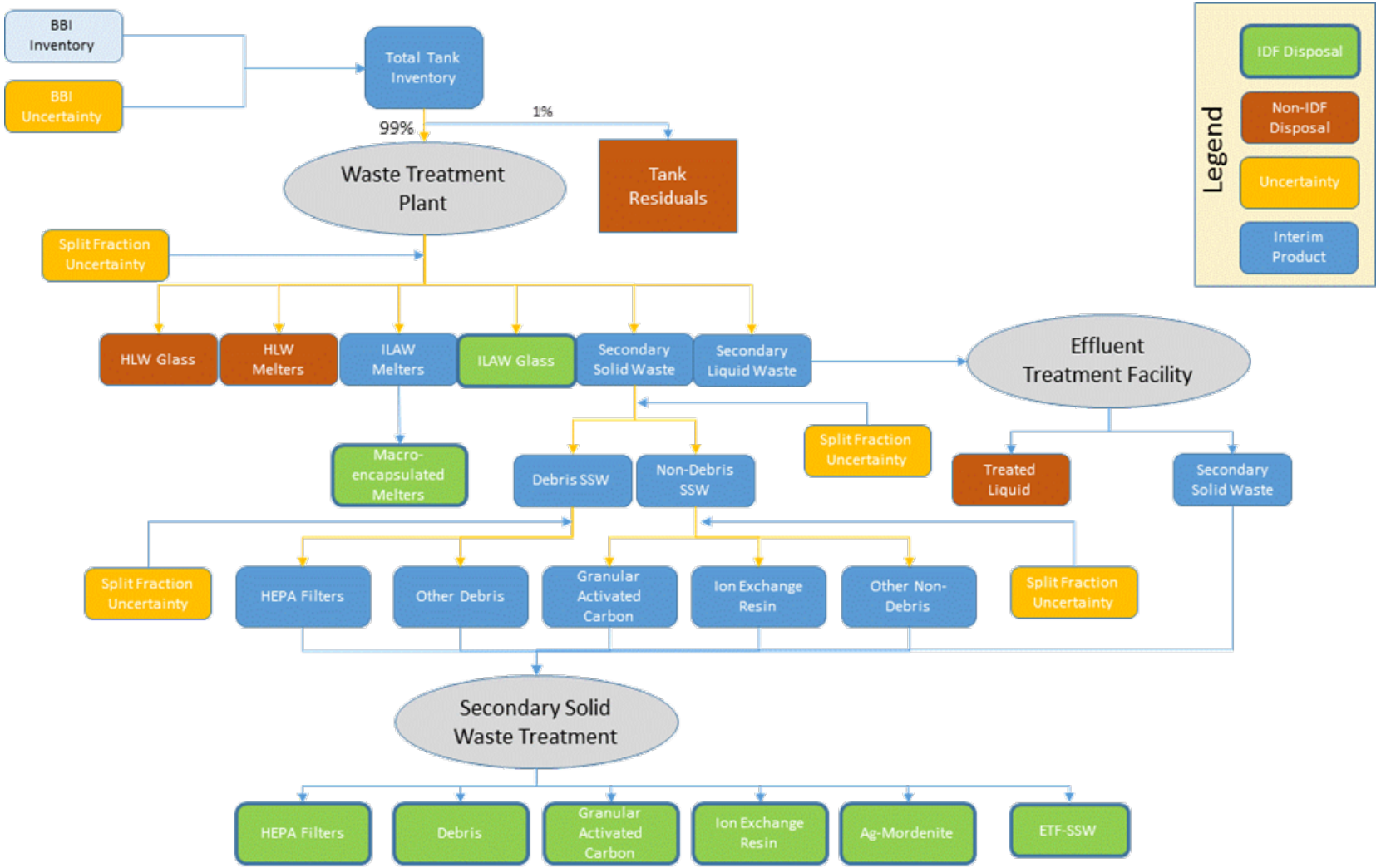
Performance Assessment

The 2017 Integrated Disposal Facility (IDF) Performance Assessment (PA) is a modeling activity to provide reasonable assurance that the near-surface disposal facility for low-level and mixed-low-level waste will be protective of human health and the environment once the facility is closed.

Performance is measured against DOE Order 435.1 performance objectives

- 1,000-year time frame, 100-m buffer zone
- Air Pathway (10 mrem/yr)
- Groundwater & Air Pathway (25 mrem/yr)
- Radon Flux 20 pCi/m^2/s
- Inadvertent Intruder Scenario
  - Acute 500 mrem/yr
  - Chronic 100 mrem/yr
- EPA, State, or local groundwater protection standards

IDF PA Source Terms from WTP



WTP = Hanford Waste Treatment and Immobilization Plant
HLW = High-Level Waste
SSW = Solid Secondary Waste

BBI = Best Basis Inventory
ILAW = immobilized low activity waste
ETF = Hanford Effluent Treatment Facility

Inventory and Concentration

Waste Stream	Waste Volume[1] (m^3)	As-disposed waste volume[2]	^{99}Tc Inventory (Ci)	^{99}Tc Concentration (Ci/m^3)	^{129}I Inventory (Ci)	^{129}I Concentration (Ci/m^3)
ILAW glass	278,797	278,797	26,400	9.47E-02	16.5	5.92E-05
LSW	18,900	18,900	0.229	1.21E-05	0.0642	3.40E-06
SSW	41,447	11,436	21.2	1.85E-03	12.1	1.06E-03
SSW-HEPA (debris)	*1,832*	*183.2*	*17.45*	*9.53E-02*	*0.13*	*7.10E-04*
SSW-other debris	*26,546*	*5,309*	*0.11*	*2.07E-05*	*0*	*0.00E+00*
SSW - IX resin	*686*	*1,029*	*2.36*	*2.29E-03*	*0.02*	*1.94E-05*
SSW – carbon adsorber (GAC)	*1,137*	*1,706*	*0*	*0.00E+00*	*4.42*	*2.59E-03*
SSW- Ag mordenite	*104*	*156*	*0*	*0.00E+00*	*7.56*	*4.85E-02*
Secondary waste management	*9,489*	*1,898*	*9.92E-2*	*5.23E-05*	*1.43E-5*	*7.53E-09*
FFTF	*1,030*	*1,030*	*0.015*	*1.46E-05*	*0*	*0.00E+00*
On site non CERCLA non tank	*623*	*125*	*1.21*	*9.68E-03*	*1.32E-3*	*1.06E-05*

LSW = Liquid Secondary Waste
FFTF = Hanford Fast Flux Test Facility
GAC = Granular Activated Carbon
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980

Models: ILAW Source Term

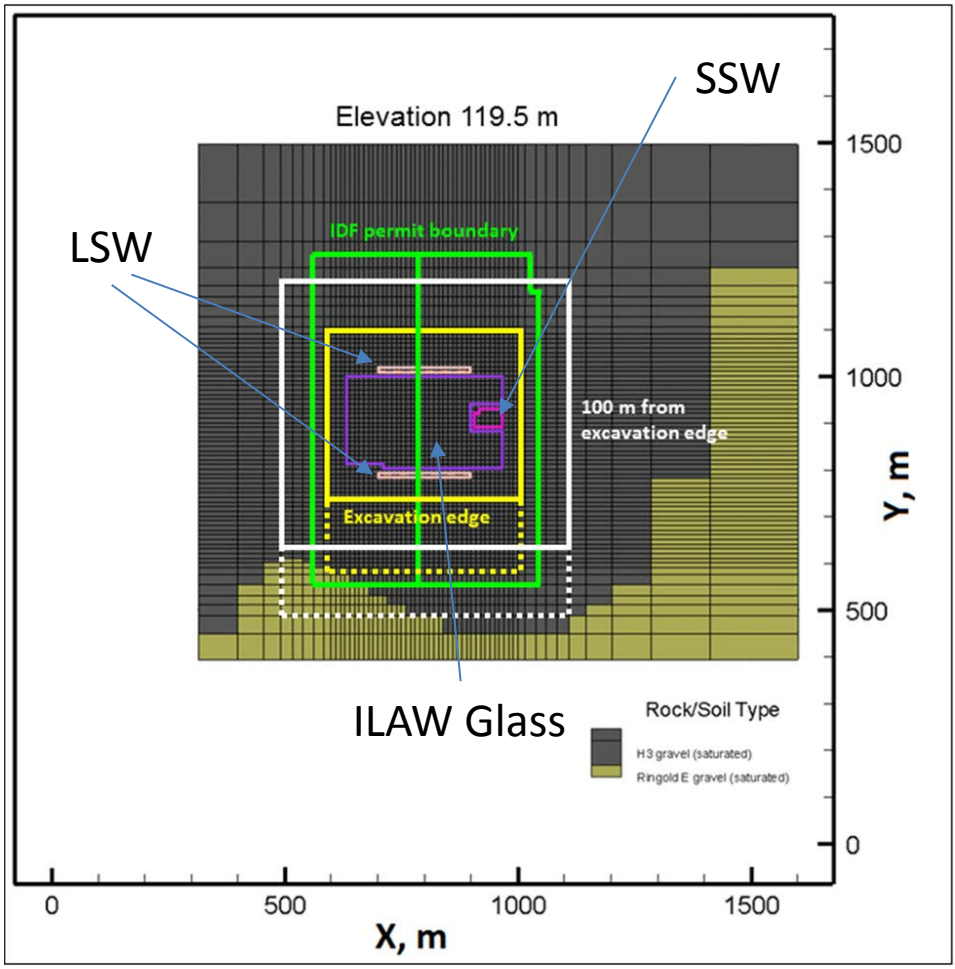
- Evaluate releases from ILAW glass waste forms
  - Assumed supplemental LAW is vitrified
- Transition-State Theory model coupled with ion exchange and a secondary mineral reaction network
- Glass Types (WTP base line, not advanced glasses)
  - LAWA22
  - LAWB45
  - LAWC22
- Sensitivity Studies
  - CO_2 gas phase pressure
  - Kinetic rate parameters
  - Secondary phase products
  - Near-field flow rate

Models: Other Source Terms

- Evaluate releases from cement-based waste forms for secondary solid wastes
  - Solidified media
    - Activated carbon
    - Silver mordenite
    - Ion exchange resins
  - Encapsulated debris
    - Compacted HEPA filters
    - Other debris
  - Sensitivity
    - Effective diffusion coefficients
    - Hydraulic conductivity
    - Initial waste form saturation
    - Encapsulation thickness
    - Backfill saturation
    - Sorption coefficients
    - Near-Field Flow Rate

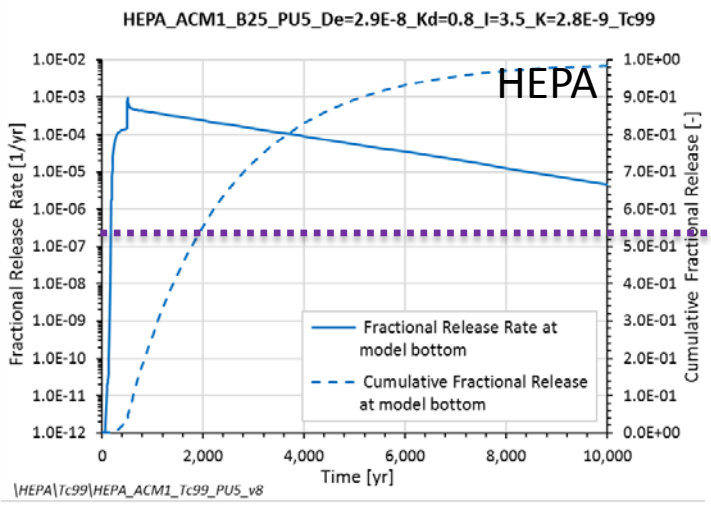
Process Models: VZ / SZ F &T

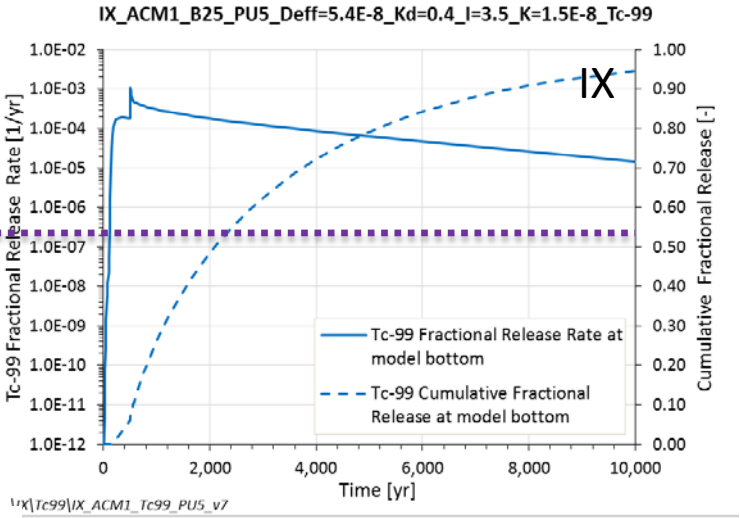
- Evaluate ^{99}Tc and ^{129}I transport though the vadose zone to the water table
- Evaluate ^{99}Tc and ^{129}I transport though the saturated zone 100-m down gradient
- Key Parameters
  - Vadose zone saturation
  - Sorption
  - Dispersivity
  - Saturated Zone hydraulic conductivity and gradient
- Sensitivity Studies
  - Key Parameters



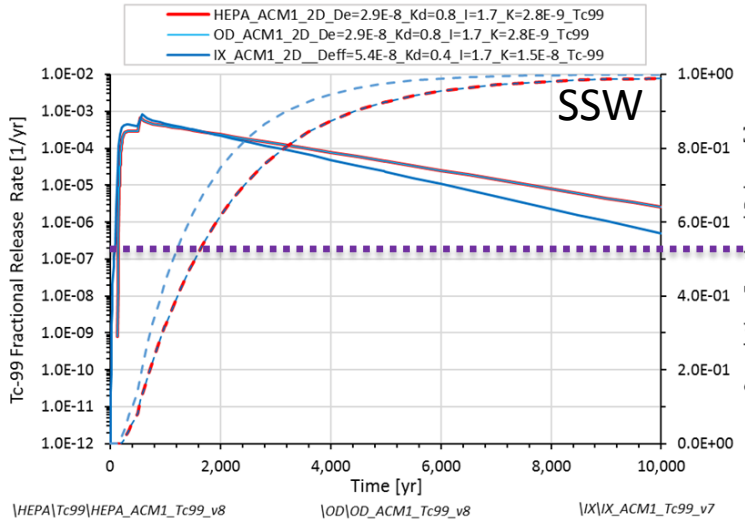
VZ / SZ F &T: Vadose Zone / Saturated Zone Flow and Transport

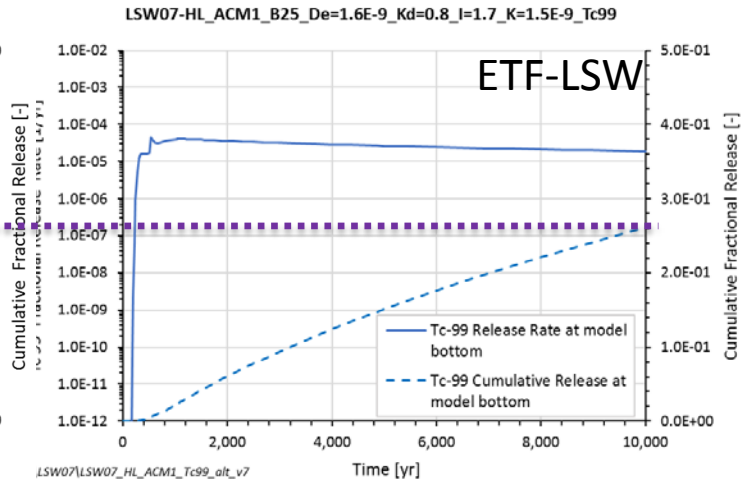
Fractional Release Comparison -^{99}Tc





ILAW

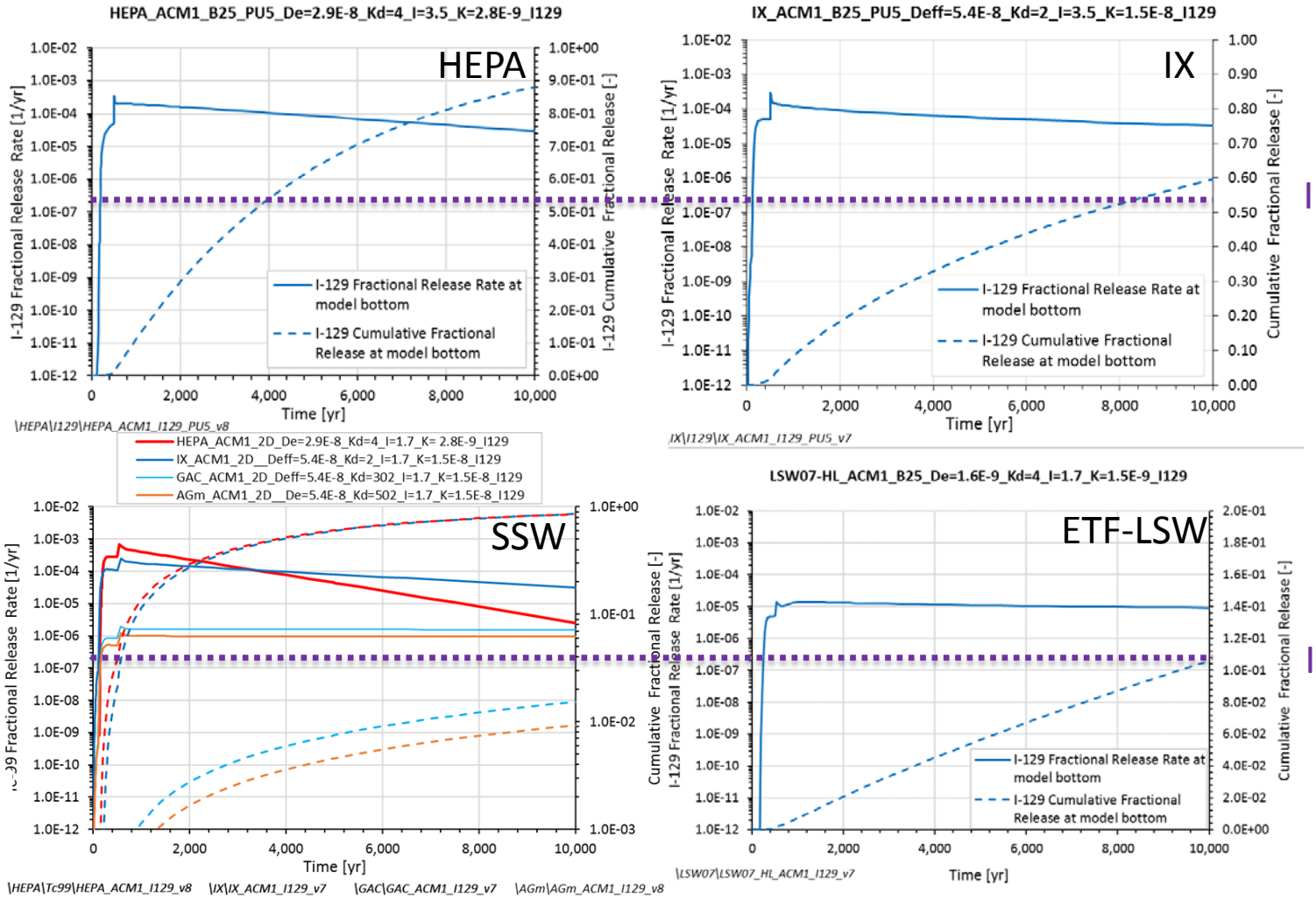




ILAW

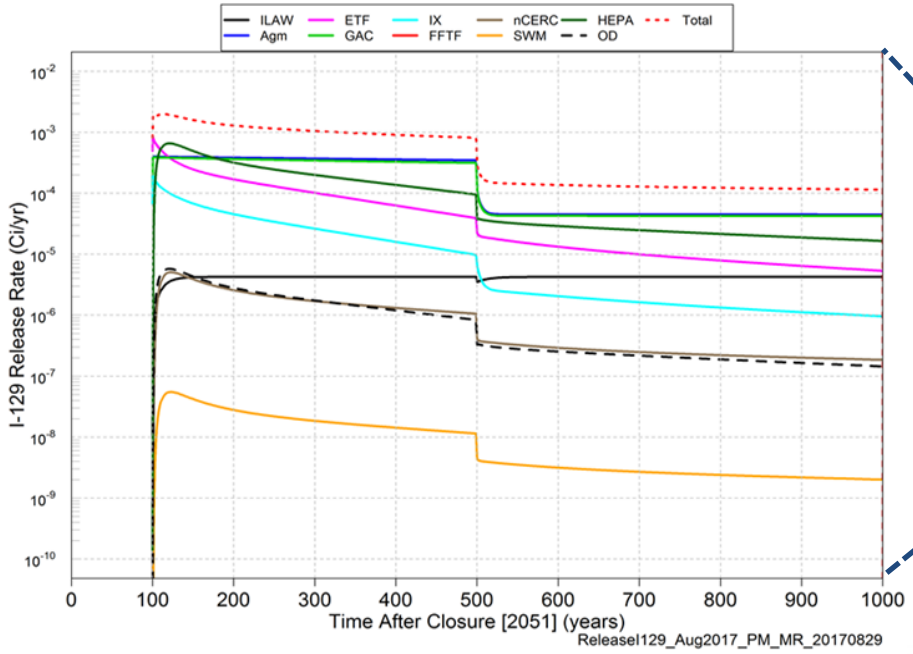
Modeled assuming oxidized conditions for a typical Hanford waste grout (no getters) in the waste forms (increased mobility of Tc-99).

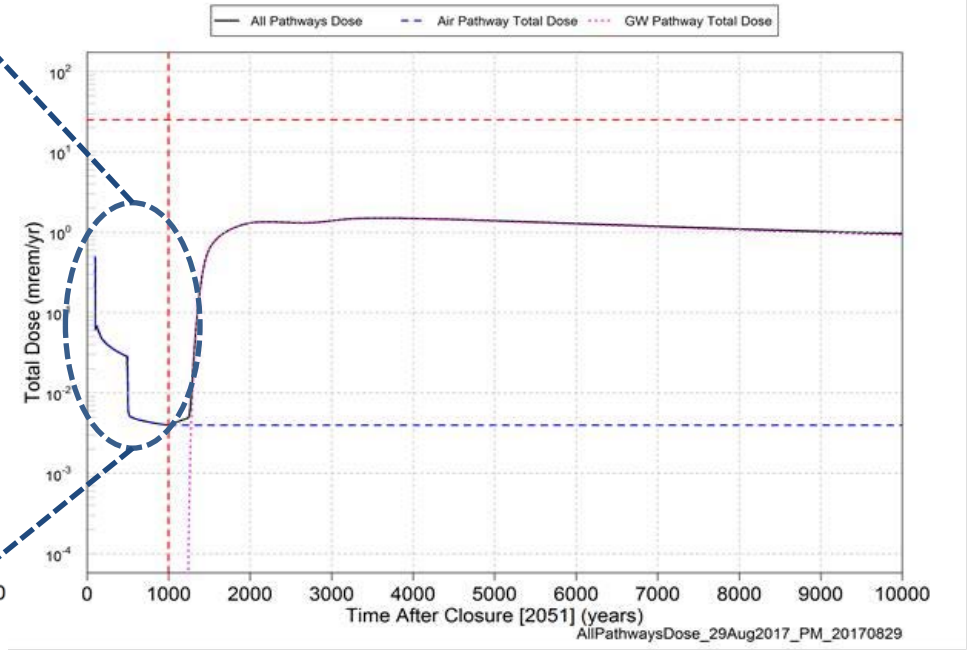
Fractional Release Comparison - ^{129}I



Modeled assuming oxidized conditions for a typical Hanford waste grout (no getters) in the waste forms.

Air Pathway Dose





Air pathway release rates by waste stream

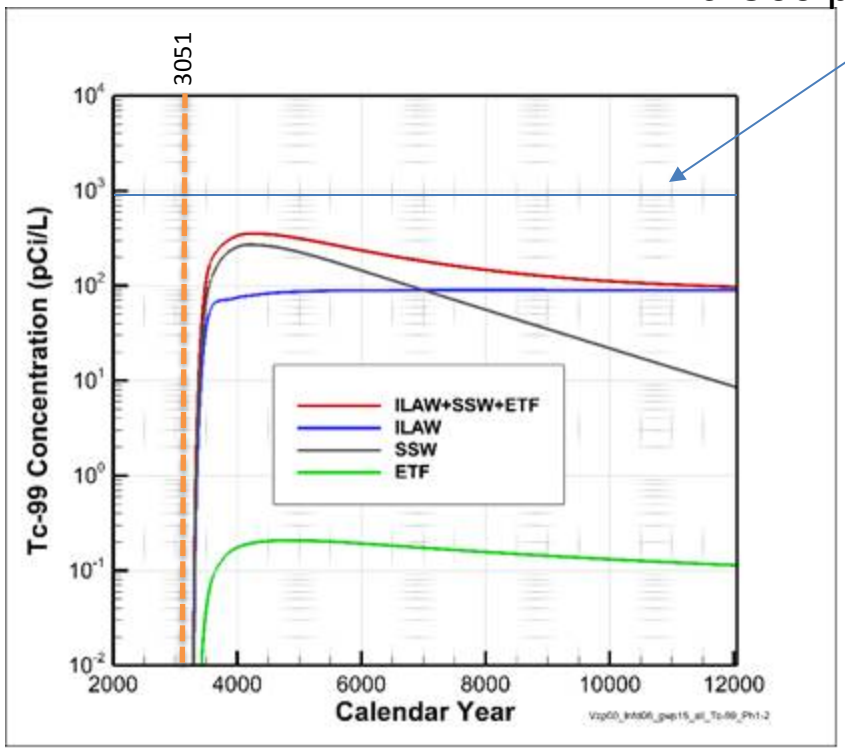
Combined air pathway and groundwater dose

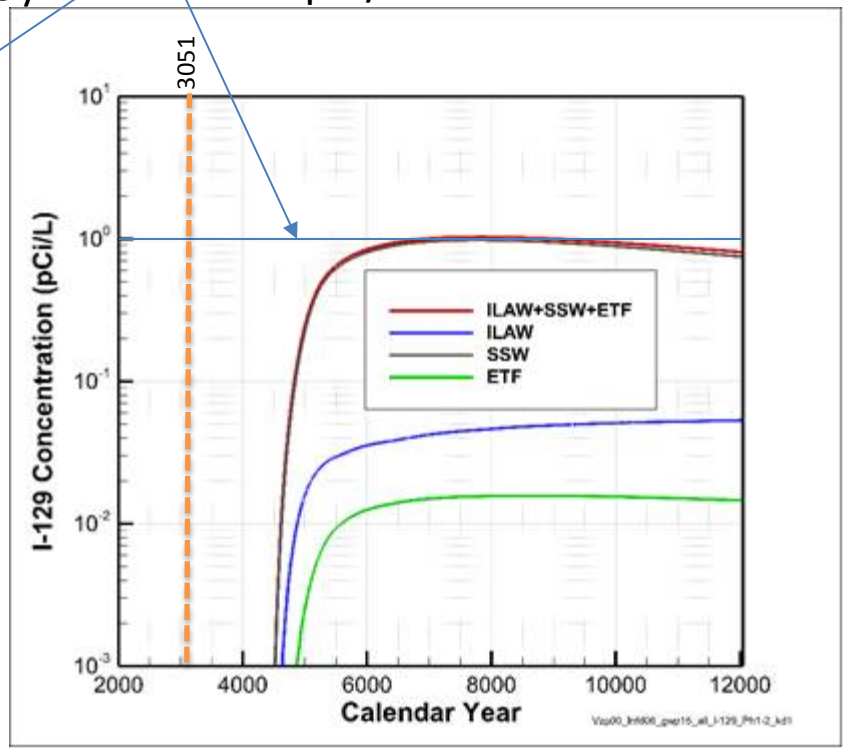
Tc & I Concentration >1,000 Years

Drinking Water Standard

^{99}Tc: 900 pCi/l

^{129}I: 1 pCi/l



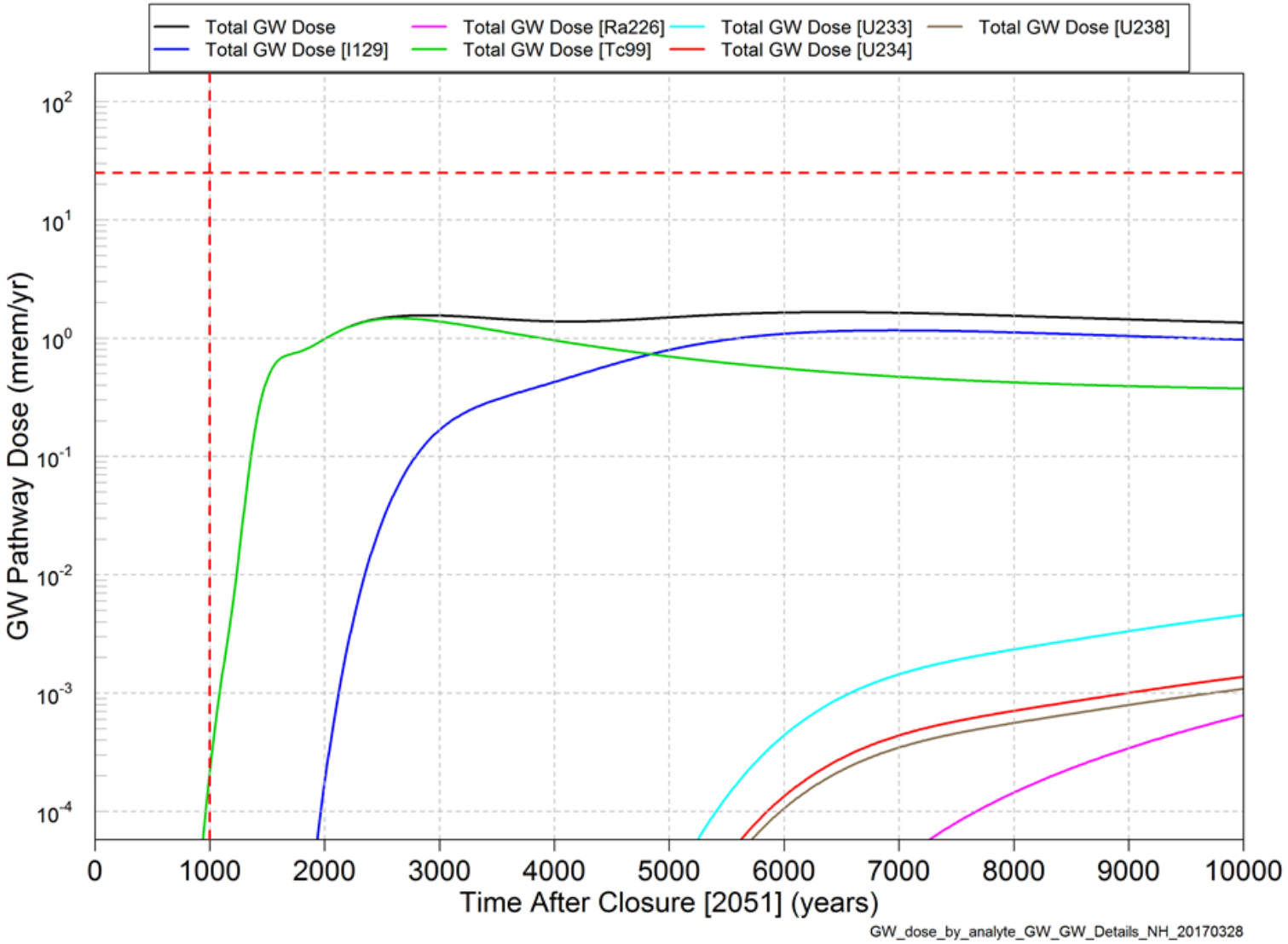


Groundwater concentrations

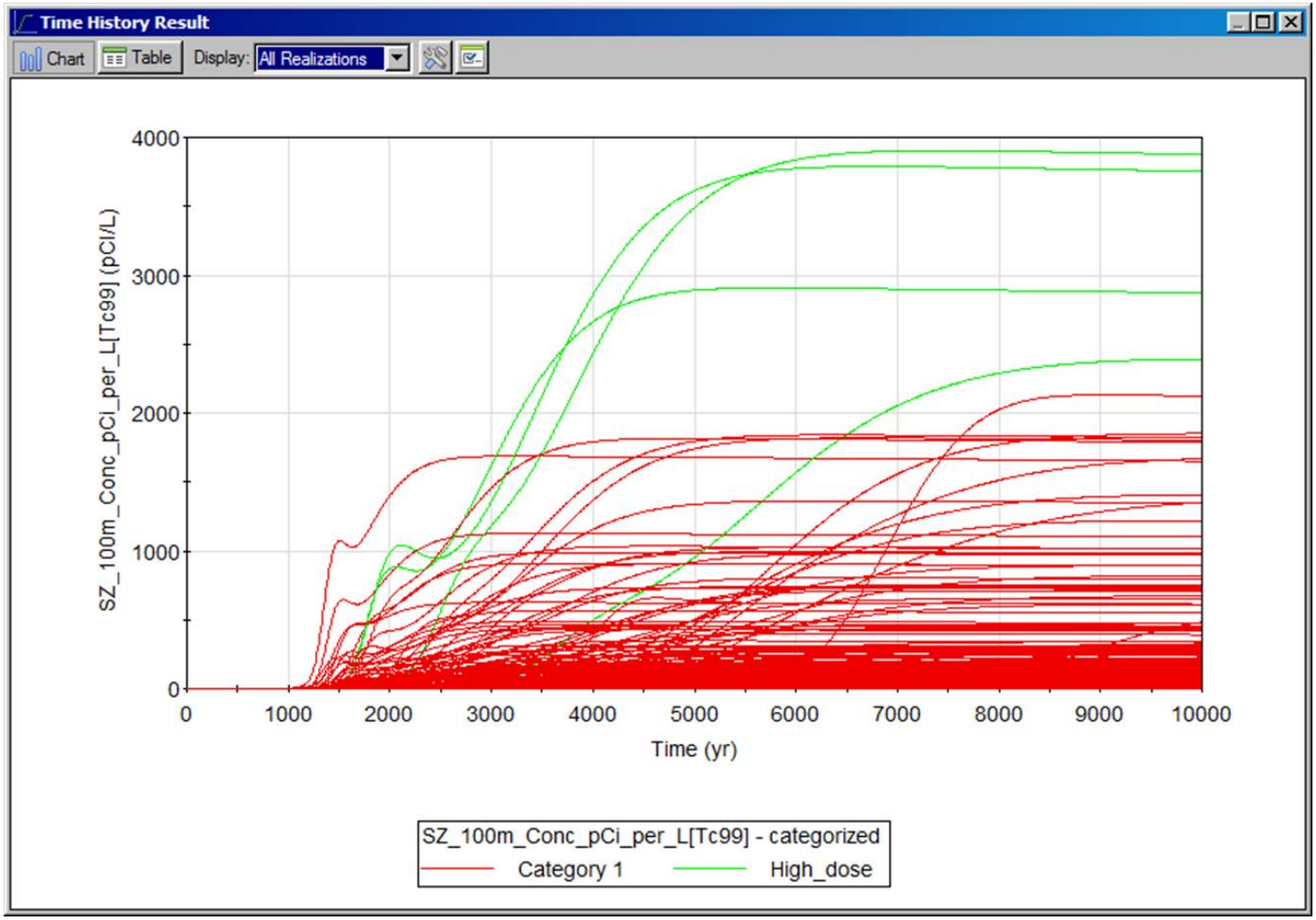
Tc-99 driven by SSW initially, then ILAW glass when SSW inventory in IDF is depleted. ILAW source is about 10×below drinking water standard

I-129 driven by SSW at all times. ILAW source is about 18× below drinking water standard

System Model - Integrated

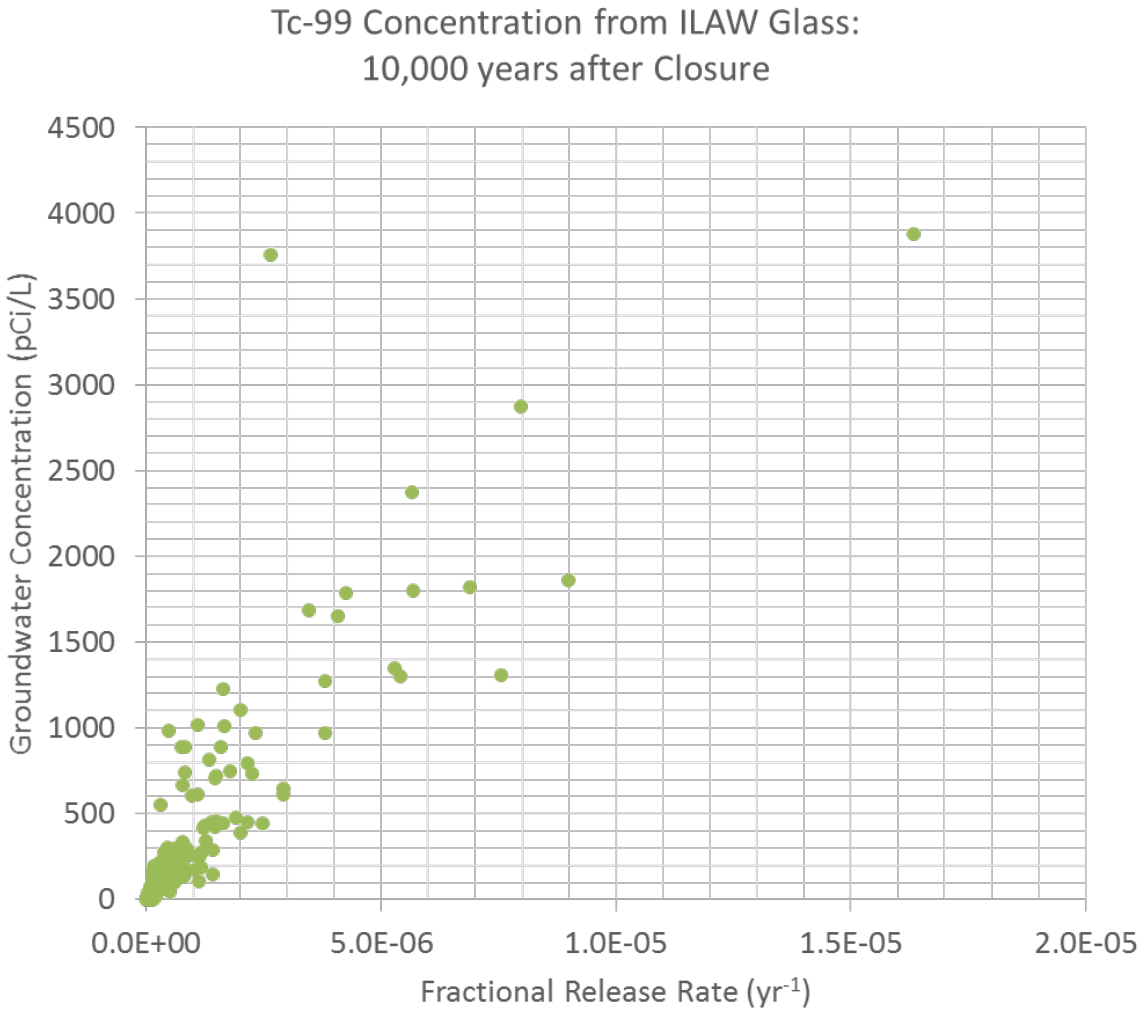


Tc-99 Concentration in Groundwater from ILAW Sources



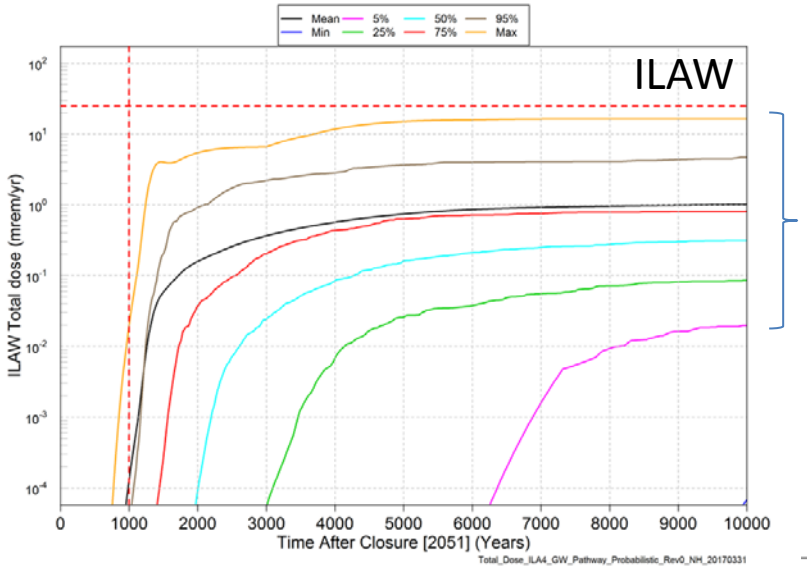
Mean = 0.035 pCi/L @ 1,000 years and 250 pCi/L at 10,000 years.
Median = 0.0 pCi/L @ 1,000 years and 77 pCi/L at 10,000 years.

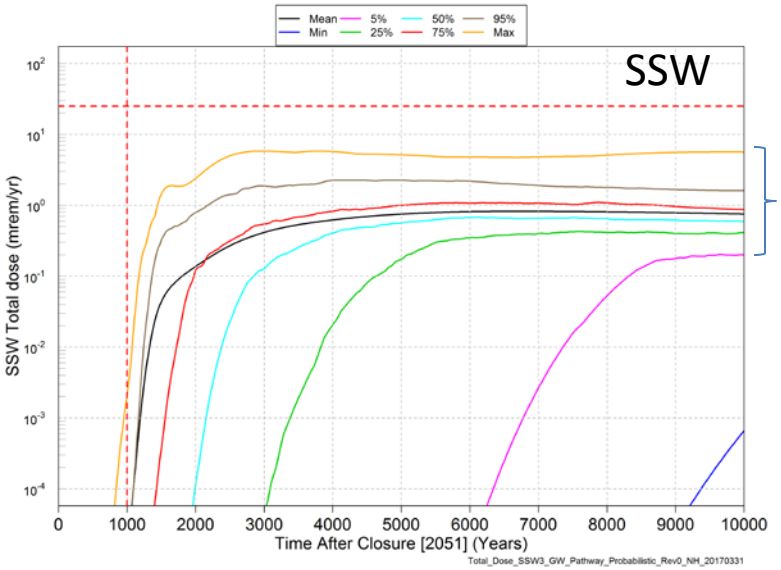
ILAW Rate Correlation to Tc-99 Concentration in Groundwater

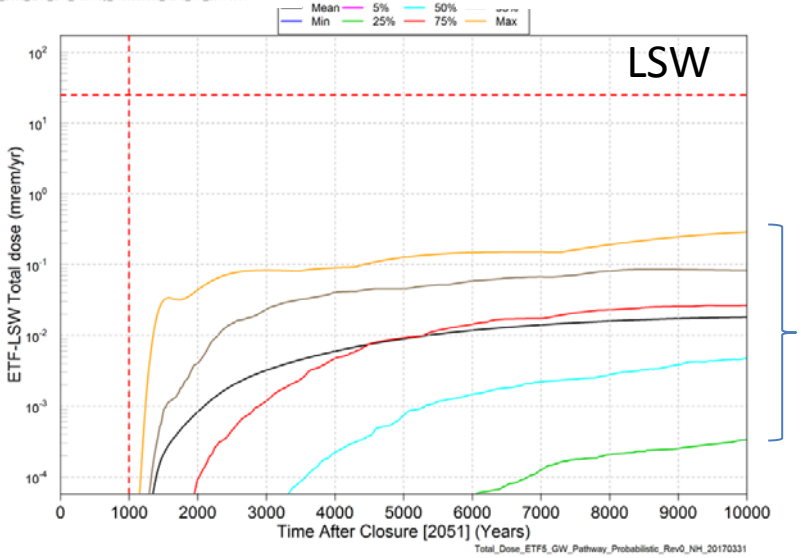


Mean ILAW Fractional Release Rate = 7.0E-07 yr^{-1}
Median ILAW Fractional Release Rate = 2.1E-07 yr^{-1}

Variability in Source Term Doses







Groundwater pathway

Compliance Case Conclusions

- During the period of compliance:
  - Encapsulated HEPA filters have the highest source term release rates (Ci/yr).
  - ILAW glass has the second highest source term release rates (Ci/yr).
  - The disposal system is capable of meeting DOE O 435.1 performance objectives during the time of compliance.
  - There is no impact to groundwater during the time of compliance.