



# TVA Clinch River SMR Project

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**Source Term and Accident Analyses**

# Agenda

Accident Source Term

Dose Estimates

Severe Accidents

Note: all vendor data discussed herein is preliminary

# Accident Source Term

# Accident Source Term

Accident source term data received from four vendors

Evaluated for radioisotope constituents and quantities

- “Vendor C” data used as evaluation benchmark per NEI 10-01
  - High power level
  - Familiar fuel vendor
  - Mature analytical tools

“Vendor C” source term data used for surrogate plant  
(bounding/reasonable)

Outlier data from other vendors reconciled to benchmark

# Dose Estimates



# Vendor Accident Dose Estimates

Accident dose estimates received from three of four vendors

Vendor	Vendor LOCA Dose Estimates
A	15 rem TEDE (EAB 734 ft) 1 rem TEDE (LPZ 1 mi)
B	3.2 rem TEDE (EAB 0.25 mi) 4.6 rem TEDE (LPZ 0.25 mi)
C	4.35 rem TEDE (EAB 0.5 mi) 4.75 rem TEDE (LPZ 1 mi)

Vendor values evaluated on common basis (normalized to EAB and LPZ)  
and “Vendor C” accident dose data determined to be bounding

# Bounding Dose Estimate Adjustment

Bounding vendor dose estimate adjusted using methodology from NEI 10-01, Revision 1

$$Dose_{Site} = Dose_{Vendor} \left[ \frac{(X/Q)_{Site}}{(X/Q)_{Vendor}} \right]$$

“Vendor C” dose estimate data adjusted to become surrogate plant site dose at Clinch River EAB and LPZ

# USE of LOCA as Bounding Accident

Review of prior ESPAs indicates loss-of-coolant accident is bounding with regard to meeting 10 CFR 52.17 dose limits

- Experience has shown significantly higher doses compared to other postulated accidents
- Each SMR design under consideration for Clinch River has advanced design features that are expected to further minimize accident consequences



# Clinch River Accident Dose Estimates (1/2)

## Clinch River Site LOCA Doses for Site Safety Analysis Report

Location	Time (hr)	X/Q (sec/m <sup>3</sup> )		$\chi$ /Q Ratio (Site/Vendor)	Dose (rem TEDE)	
		Vendor	Site		Vendor	Site
EAB	0 - 2	1.00E-03	4.96E-03	4.96	4.35	21.6
LPZ	0 - 8	5.00E-04	3.08E-04	0.616	4.44	2.74
	8 - 24	3.00E-04	2.25E-04	0.750	0.20	0.150
	24 - 96	1.50E-04	1.13E-04	0.753	0.05	0.0377
	96 - 720	8.00E-05	4.22E-05	0.528	0.06	0.0316
	Total				4.75	2.95

### Notes:

- (1) All values are preliminary
- (2) SSAR site results using 95<sup>th</sup> percentile X/Q values
- (3) Dose limit is 25 REM

# Clinch River Accident Dose Estimates (2/2)

## Clinch River Site LOCA Doses for Environmental Report

Location	Time (hr)	X/Q (sec/m <sup>3</sup> )		$\chi$ /Q Ratio (Site/Vendor)	Dose (rem TEDE)	
		Vendor	Site		Vendor	Site
EAB	0 - 2	1.00E-03	5.58E-04	0.558	4.35	2.43
LPZ	0 - 8	5.00E-04	4.26E-05	0.0852	4.44	0.378
	8 - 24	3.00E-04	3.78E-05	0.126	0.20	0.0252
	24 - 96	1.50E-04	2.91E-05	0.194	0.05	0.00970
	96 - 720	8.00E-05	2.00E-05	0.250	0.06	0.0150
	Total				4.75	0.428

### Notes:

- (1) All values are preliminary
- (2) ER site results using 50<sup>th</sup> percentile X/Q values

# Severe Accidents

# Severe Accidents (1/4)

Four small modular reactor (SMR) technologies included in PPE

TVA asked four vendors to provide available PRA information to allow assessment of potential severe accident consequences

- Most information regarding severe accident release categories, source terms, and release frequencies provided by “Vendors B & C”
- Lesser information provided by “Vendors A & D”

TVA concluded that it was not reasonable to develop a PPE for severe accidents “blended” from the four designs

TVA decided to make a reasonable, representative PPE estimate by evaluating “Vendor C” design at Clinch River Site

# Severe Accidents (2/4)

“Vendor C” provided MACCS2 files for SMR design

- Release categories and relative core damage frequencies comparable to an existing design

Release source terms were reduced by ratio of thermal power levels for SMR and existing designs

Total core damage frequency for “Vendor C” SMR  $< 5E-8/\text{rx-yr}$

TVA made no changes in MACCS2 modeling of the “Vendor C” SMR design

# Severe Accidents (3/4)

SECPOP, Version 4.2, (updated with 2010 census data) estimated 50-mi population of approximately 1.2 million

- Projected population of ~1.8 million for 2067 was used for consequence calculations

SECPOP also provided the economic data for consequence calculations

Wind speed and direction and stability were from Clinch River meteorological measurements

Radiological consequences calculated using MACCS2 code (with WinMACCS graphical user interface)

2-mile Emergency Planning Zone (EPZ) was modeled in calculations



# Severe Accidents (4/4)

Calculated population dose risk for air pathway to 50 mile population is  $3.8 \times 10^{-5}$  person-Sievert/reactor-year

- No-evacuation assumption increases population dose risk from air pathway by ~1%

Population dose risk number for Clinch River site appear reasonable

- Population dose risk for air pathway for previously evaluated site ESP was  $2.8 \times 10^{-4}$  person-Sievert/reactor-year (Clinch River risk ~7 times lower)
- SMR CDF is factor of five lower than previously evaluated site CDF
- SMR power level significantly lower than previously evaluated site
- Clinch River meteorology results in more conservative atmospheric dispersion than at previously evaluated site

# Summary

“Vendor C” source term data accepted as bounding

“Vendor C” accident dose data accepted as bounding

“Vendor C” dose estimate data adjusted to become site PPE values using methodology from NEI 01-01, Revision 1

Clinch River site dose estimates meet 10 CFR 52.17(a)(1)(ix) limits of 25 rem TEDE

Existing design severe accident data scaled for SMR

# Closing

## Questions?

## Follow-up Action Review