FUEL HANDLING ACCIDENT DOSE CONSEQUENCES USING AST METHODS

Licensee Document Number: SM-1080538201-001, Version 2

Method/Computer Program Used: RADTRAD Version 3.03

Regulatory Guidance: RG-1.183, including Appendix B

Model Discussion:

The calculation was performed to address a fuel handling accident (FHA) in the containment and in the Spent Fuel Pool (SFP) area of the Auxiliary Building. For the containment accident, the containment equipment hatch and the personnel airlock are presumed to be open and no credit is taken to close them. The open containment airlock could allow areas around the Control Room (CR) to become contaminated, so the calculation accounts for dose impacts of ingress/egress of the CR through the CR doors. Also, a small amount of CR envelop wall is only 1 foot thick, so the shine from the contaminated area through the wall is added to the CR operator dose. Doses in the CR are accumulated over an 8 hour shift. Releases from the failed fuel are completed in 2 hours.

For the accident in the SFP area of the Auxiliary Building, the accident releases also are completed in 2 hours. The activity is released to the environment through the plant vent stack, and credit is taken for filtration of the iodine isotopes through the Penetration Room Filtration System. Doses from this accident are bounded by the doses from an accident in containment.

Results and Acceptance Limits:

Release	**EAB (rem TEDE)**	**LPZ (rem TEDE)**	**Control Room (rem TEDE)**
Containment	2.4	0.9	1.0
Spent Fuel Pool	0.5	0.2	0.2
Acceptance Limit	6.3	6.3	5

(Note that rounding is applied to all values)

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Key Assumptions and Inputs:

Source Term Parameters

Parameter	Value
Reactor Power Level:	2775 MWt (+2% uncertainty = 2831 MWt)
Reactor Peaking Factor:	1.7
Fuel Movement Time:	100 hours post shutdown.
Number of Fuel Assemblies:	157
Number of Failed Assemblies:	1
Number of Failed Fuel Rods:	264
Core Cycle-to-Cycle Augments:	

Isotope	Factor
Kr-85	1.15
Xe-133	1.05
Other Noble Gases	1.03
Other Iodines	1.03

Core Source Term:

Isotope	Core Activity at 100 hours post Shutdown (curies)
Kr-85	7.2E+05
Xe-131m	8.1E+05
Xe-133	1.0E+08
Xe-133m	2.0E+06
Xe-135	2.0E+05
I-131	5.4E+07
I-132	4.6E+07
I-133	5.7E+06
I-135	4.1E+03

Fraction of Fission Product Inventory in Gap

I-131	0.08
Kr -85	0.10
Other Noble Gases	0.05
Other Halogens	0.05

Overlaying Pool Depth	23 feet
Pool Decontamination Factor	Elemental: 500 Organic: 1
Iodine Chemical Form	0% Aerosol, 99.75% Elemental, 0.25% Organic

Net Decontamination Factor 200

Net Scrubbed Release Activities:

Group	Isotope	100-hr Core Inventory (Ci)	Design Margin	Gap Fraction	Release to Water (Ci/MWt)	DF	Scrubbed Inventory (Ci/MWt)
Noble Gases	Kr-85	7.2E+05	1.15	0.10	3.2E-01	1	3.2E-01
	Xe-131m	8.1E+05	1.03	0.05	1.6E-01	1	1.6E-01
	Xe-133	1.0E+08	1.05	0.05	2.0E+01	1	2.0E+01
	Xe-133m	2.0E+06	1.03	0.05	3.9E-01	1	3.9E-01
	Xe-135	2.0E+05	1.03	0.05	3.9E-02	1	3.9E-02
Halogens	I-131	5.4E+07	1.03	0.08	1.7E+01	200	8.5E-02
	I-132	4.6E+07	1.03	0.05	9.1E+00	200	4.5E-02
	I-133	5.7E+06	1.03	0.05	1.1E+00	200	5.6E-03
	I-135	4.1E+03	1.03	0.05	8.1E-04	200	4.0E-06

$$C_{release} = \frac{\text{Core Inventory} \times \text{Design Margin} \times F_{N\,\Delta H} \times \text{Gap Fraction}}{N_{assembly} \times 2775 \times 1.02}$$

Containment Release:

Parameter	Value
Containment Volume	2.03E6 Cubic Feet
Mixing Volume in Containment	1.0E6 Cubic Feet
Release Duration	2 hours
Containment Hatch Flow Rate	55,000 cfm
Containment Release Filtration	0%
Personnel Airlock Flow Rate	1515 cfm
Auxiliary Building Mixing Volume	37,875 cubic feet
Personnel Airlock Release Filtration	0%
Auxiliary Building Ventilation	1505 cfm to plant vent, 10 cfm to CR for ingress/egress

Spent Fuel Pool Area Release:

Parameter	Value
Fuel Handling Volume:	72,150 cubic feet
Overlaying Pool Depth:	23 feet
Fuel Handling Area Release Rate:	5,000 cfm
PRF Filtration:	89.5% for iodine isotopes

CR Parameters

Parameter	Value
CR Volume	114,000 ft^3
CR Isolation Mode Initiation	Automatic at 60 Seconds
CR Pressurization Mode Initiation	Manually at 21 minutes
CR Ventilation System Normal Flow Rate	2340 cfm < 60 seconds
CR Ventilation Isolation Mode Flow Rate	600 cfm (1 minute to 21 minutes)
CR Ventilation Pressurization Makeup Rate	375 cfm > 60 seconds
CR Ventilation System Recirculation Flow Rate	2700 cfm > 60 seconds
CR Ventilation System Charcoal Filter Efficiencies	
Pressurization Filters	98.5% all iodines
Recirculation Filters	94.5% elemental and organic 98.5% particulate
CR Pressurization Mode Unfiltered Inleakage	325 cfm
CR Ingress/Egress Unfiltered Inleakage	10 cfm throughout (location changes)
CR Breathing Rate	3.5E-4 m^3/sec
Occupancy Factors	
0-8 hours	1.0

CR Ventilation Summary:

Time	Filtered Flow (CFM)	Unfiltered Flow (CFM)
0 to 1 minute	0	2340
1 minute to 21 minutes	0	600
21 minutes to 8 hours	375	325

Note: For the FHA in Containment, the 10 CFM for ingress and egress to the CR goes from the Auxiliary Building to the CR through the CR door. For the FHA in the SFP area, the 10 cfm for ingress and egress is conservatively added to CR through the ventilation system and is unfiltered. This unfiltered inleakage starts at time 0 and continues through the entire accident (8 hours).

Atmospheric Dispersion Factors (sec/m^3) :

Containment Releases:

Time (hr)	EAB	LPZ	CR
0 – 2	7.6E-4	2.80E-4	8.79E-04
2 – 8	-	1.10E-4	6.77E-04

Plant Vent Releases:

Time (hr)	EAB	LPZ	CR
0 – 2	7.6E-4	2.80E-4	1.62E-03
2 – 8	-	1.10E-4	1.37E-03