FPL Energy

Duane Arnold Energy Center

Dose Consequences Analysis for Control Rod Drop Accident without Automatic Trip of Mechanical Vacuum Pump at DAEC

April 14, 2006

History

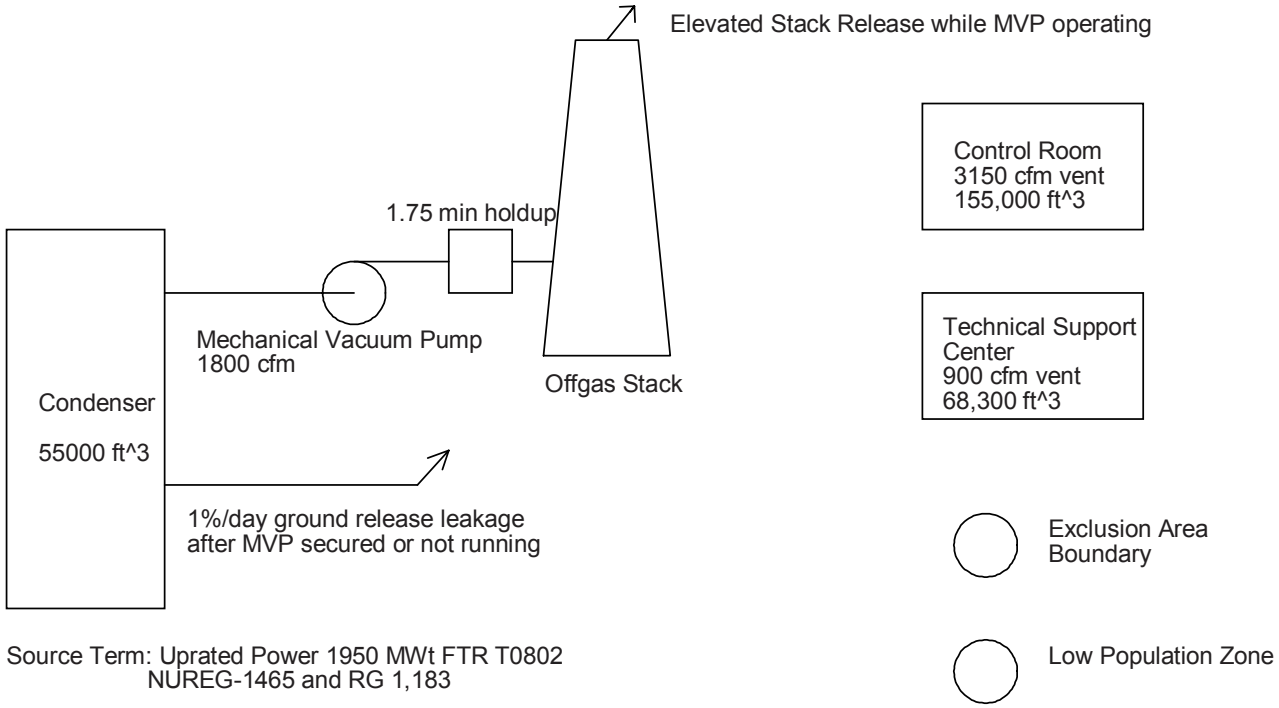
- DAEC submitted Full Scope Adoption of AST during Power Uprate dated 10/19/2000
- CRDA AST Analysis performed by Vendor as CAL-R00-PUP-008.
  - Used Gap Release Fractions from Draft Guide DG-1181 that were revised in RG 1.183
  - CRDA analysis did not calculate TSC Dose – bounded by other events
  - CRDA Ground Level Release Point assumed as Turbine Building Exhaust with slant range to CR and TSC
- In application DAEC committed to update calc when revised to full RG 1.183. NRC Reviewer concurred results were conservative.
- Amendment 240 was issued on 7/31/2001

History

- Subsequent review of original vendor analysis by DAEC personnel following training on RADTRAD code identified Release Timing was over one hour rather than instantaneous puff release
- New Calculation CAL-R02-001 was performed
  - Revised GAP Release Fractions to RG 1.183
  - Revised Release timing to 5 seconds
  - Revised Release Point to Condenser
  - Calculated TSC Dose
  - Superseded applicable section of CAL-R00-PUP-008
  - Results were acceptable under 10 CFR 50.59

History

- CAL-R05-001 prepared to support Amendment to eliminate MSL Radiation Monitors.
  - Added Mechanical Vacuum Pump Release Path through Offgas Stack.
  - Calculated Dose Consequences of manual trip of MVP at 10 minutes.
  - Calculated Dose Consequences of failure to trip MVP as sensitivity case.



CRDA WITH/WITHOUT MVP OPERATION

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Other Isolations from MSLRM

- Main Steam Line Drains
  - Path also drains to condenser
  - not modeled due to rapid transport of source term to the condenser through MSIVs in shorter time than valve stroke
- Recirculation System Sample Valves
  - Small piping (0.5 in)
  - Crack Arrest Verification System leak checked on startup, not a likely release path
  - Inside secondary containment

New Assumptions since NRC Review of Amendment 240

1. Assumptions for the release of radioactivity from the fuel
   - Release of Other (non-halogen or Noble Gas) fission products from the fuel is *per RG 1.183 Table 3 for the gap release* and from Table 1 (Early in Vessel) for the pellet release (fuel melt). *Gap Release fractions changed since previous NRC review to reflect RG 1.183 changes from Draft Guide 1181.*

New Assumptions

2. *All radiological nuclides released from damaged or melted fuel are assumed to be transported to the condenser within 5 seconds in accordance with the timeline in GNF Standard Application For Reactor Fuel (US) (reference 7.8) S2.2.3.1.1. No credit for automatic or manual isolation of Main Steam Isolation Valves or Steamline Drains.*
3. *Per the US Supplement to the GESTAR II manual section S2.2.3.1.1 Sequence of Events, the gap release phase is conservatively modeled to begin at T = 0 seconds with a duration of 5 seconds and the fuel melt phase begins at T = 0 seconds with a duration of 5 seconds. Conservatively ignores transport time and assumes the full source term is transported to the condenser during the same period in which it is released from the fuel.*

New Assumptions

4. *Mechanical Vacuum Pump operation modeled at a constant 1800 cfm (design flow capacity).*

New Transport Path

- *Release point assumed from Main Condenser, previously assumed from turbine building exhaust point that used a slant range*
- *Added path for Mechanical Vacuum Pump discharge to offgas stack assumed design flow and 1.75 minute holdup.*
- *Post-accident meteorology atmospheric dispersion factors (X/Q's) from stack for the Control Room and TSC were calculated using inputs from CAL-R00-PUP-002 and the methodology described in RG 1.194 section C.3.2.2. The maximum X/Q using PAVAN or ARCON96 is used for the 0 – 2 hour interval. ARCON96 values are used for the intervals from 2 hours to 24 hours. The "1 – 4 Day" and "4 – 30 Day" intervals are calculated using a weighted average assuming 1 hour at the PAVAN value and 23 hours at the ARCON96 value.*

Control Rod Drop Accident Radiological Consequences

Accident Type		Exclusion Area Boundary (2 hr)	Low Population Zone (30 day)	Control Room (30 Day)	TSC (30 Day)
		TEDE (rem)			
Gap Release Dose	MVP Operating	7.0065e+00	3.3335e+00	8.5277e-01	6.6960e-01
	MVP Trip 10 Min	2.6990e+00	1.2172e+00	4.5996e-01	5.2669e-01
	MVP secured	6.3551e-02	3.8052e-02	3.5649e-01	5.1556e-01
Fuel Melt Release Dose	MVP Operating	3.9007e-01	1.8532e-01	2.8787e-02	2.2001e-02
	MVP Trip 10 Min	1.5098e-01	6.7943e-02	1.5133e-02	1.6889e-02
	MVP secured	3.4575e-03	1.8803e-03	1.1413e-02	1.6316e-02
Total Dose	MVP Operating (Sensitivity Case)	7.3966E+00	3.5188E+00	8.8156E-01	6.9160E-01
	MVP Manual Trip 10 Min (Proposed Design Basis Case)	**2.8500e+00**	**1.2851e+00**	**4.7509e-01**	**5.4358e-01**
	MVP secured (Expected Results Case)	6.7009E-02	3.9932E-02	3.6790E-01	5.3188E-01
RG 1.183 Acceptance Criteria Guideline		6.25 (25% Of 10 CFR 50.67 Limit)	6.25 (25% Of 10 CFR 50.67 Limit)	5	5
Standard Review Plan Limit		Well Within 10 CFR 50.67 Limit	Well Within 10 CFR 50.67 Limit	5	5
10 CFR 50.67 Limits		25	25	5	5
Fraction of 10 CFR 50.67 Limit for No MVP Trip Case		29.59%	14.08%	17.63%	N/A
Numerical precision of results is shown based on results of software. Some inputs are only specified to 2 significant digits, therefore results are not considered to be accurate beyond two significant digits.					