

Quiz-5 on Chapters 8 and 9 (June 11, 2001)

Problem 5-1 Based upon the "Continuous Gaussian Plume Model," for the elevated release," the atmospheric dispersion factor is given by:

$$\frac{\bar{X}}{Q}(x,y,z) = \frac{1}{2\pi\sigma_y\sigma_z u} \exp\left(-\frac{y^2}{\sigma_y^2}\right) \left\{ \exp\left[-\frac{1}{2}\left(\frac{z-h}{\sigma_z}\right)^2\right] + \exp\left[-\frac{1}{2}\left(\frac{z+h}{\sigma_z}\right)^2\right] \right\}$$

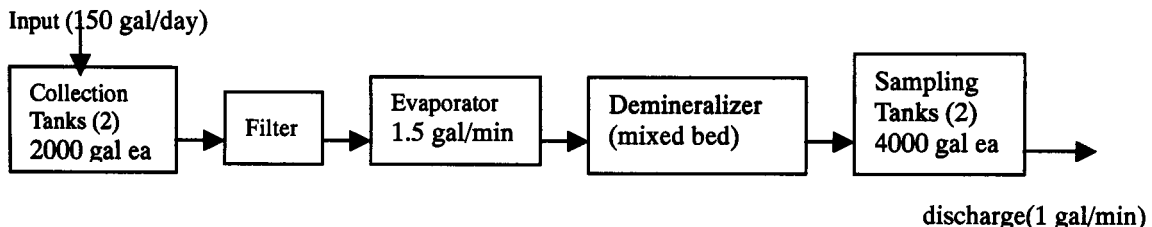
- 1) Assuming the ground level release of gaseous effluent, derive the atmospheric dispersion factor at a location (x,y,z) in the air away from the release point located at the origin.
- 2) Find the maximum (or centerline) chi-over-cue on the ground at x-meter away from the release point.
- 3) Assuming the average wind speed of 2m/sec, compute the maximum chi-over-cue at the EAB (Exclusion Area Boundary) distance of 700 meters from a nuclear power plant. The horizontal and vertical standard deviations, $\sigma_y(x)$, $\sigma_z(x)$ at x=700 meters are 25 m, and 10 m, respectively.

Problem 5-2 In a 3,400 MWt PWR, the equilibrium activity of I-133 in the core is 2 million curies during normal operation. Following a postulated design basis accident (maximum credible accident in this case) for site evaluation, we assume that 25% of I-133 activities release into the containment atmosphere immediately following the accident, and then subsequently release to the environment via containment leakage with the leak rate of 0.1%/day. The half-life of I-133 is 20 hours.

- 1) Compute the integrated I-133 release into the environment for the first 2 hours following the accident.
- 2) If the average release rate of I-133 via the containment leakage is 20 Ci/hour, assuming the atmospheric dispersion factor of $3.5 \times 10^{-4} \text{ sec/m}^3$ at EAB, compute the average I-133 concentration in the air at EAB.

Problem 5-3 Let's assume the average I-133 concentration in the air at EAB is estimated to be $2 \times 10^{-3} \text{ Ci/m}^3$. The breathing rate of a human is $3.5 \times 10^{-4} \text{ m}^3/\text{second}$, and the dose conversion factor of I-133 to thyroid through inhalation is $2.69 \times 10^{-4} \text{ mrem per pCi inhaled}$. If the critical organ for iodine is thyroid, compute the thyroid dose commitment for a person exposed by this contaminated air at EAB for 2 hours immediately following the postulated accident.

Problem 5-4 A process system of clean waste is given as follows:



- 1) Find the system DF for I-133.
- 2) Find the credit for decay time of this liquid waste processing system.