

QUESTION 8 – 1994 ABHP Exam

You have responsibility for managing health physics concerns for work on irradiated fuel assemblies in a spent fuel pool facility. One assembly recently removed from the core has a leaking fuel rod that must be replaced prior to the assembly's return to the reactor vessel. The assembly had been out of the core for 72 hours. You must determine the offsite dose consequences should the cladding on the leaking pin rupture while reconstituting the assembly.

GIVEN:

Iodine decontamination factor through water: 100
 Wind speed: 2.5 m s^{-1}
 Air temperature at 60 m: 21° C
 Air temperature at 10 m: 21.5° C
 Distance to site boundary: 1500 m

Dose Conversion Factors ($\text{rem cm}^3 \mu\text{Ci}^{-1} \text{ h}^{-1}$)		
Nuclide	Total Effective Dose Equivalent	Deep Dose Equivalent
^{131}I	5.3×10^4	220
^{133}Xe	20	20

Temperature Gradient $\Delta T(^{\circ} \text{ C})/50 \text{ m}$	Stability Class
$< -0.95^{\circ}$	A
-0.95° to -0.86°	B
-0.85° to -0.76°	C
-0.75° to -0.26°	D
-0.25° to $+0.74^{\circ}$	E
$> +0.75^{\circ}$	F

Activity at Time of Release		
	^{131}I	^{133}Xe
Gap Activity	760	1600
Total Fuel Pin Activity	76,000	160,000

POINTS

- 30 A. Assuming the available activity is released at ground level over a two hour period, calculate the maximum downwind ^{133}Xe concentration at the plume centerline at the site boundary. **Show all work.**
- 40 B. Assume that the activity was released through a stack with a height of 65 meters over a two hour period. Calculate the maximum downwind ^{131}I concentration at the plume centerline at the site boundary. **Show all work.**
- 30 C. Field monitoring teams at the site boundary wear standard pocket ionization chamber dosimeters and TLDs. the individual team members are each limited to a total effective dose equivalent of 1 rem before they are required to leave the plume area. At what pocket ionization chamber reading should the team members evacuate the plume area? Assume that the activity is released instantaneously, the maximum expected ^{131}I concentration is $5.0 \times 10^{-8} \text{ Ci m}^{-3}$ and ^{133}Xe is $1.0 \times 10^{-5} \text{ Ci m}^{-3}$. **Show all work.**

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

