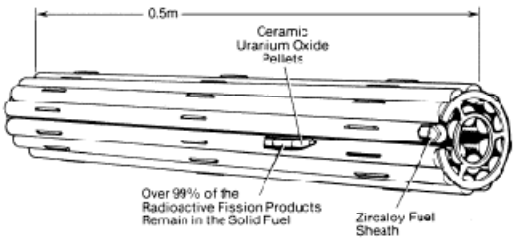
Accidental Releases

UN0805
Dave Tucker
2006 November

Figure 7
Fuel Bundle



From "Fundamentals of Power Reactors", AECB

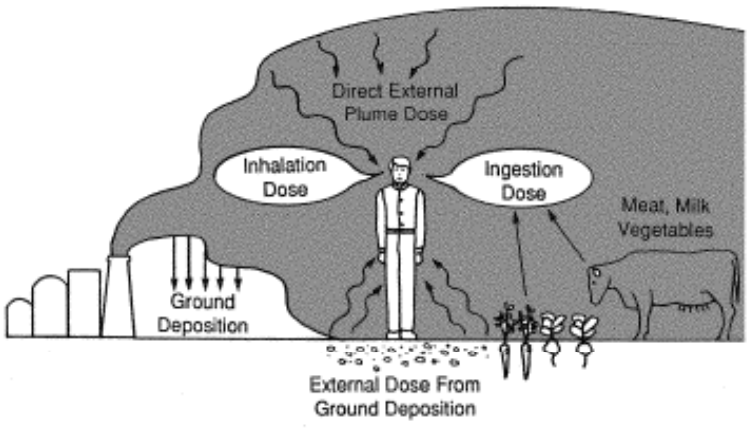
Fuel Rod Failure

The most important consequences radiologically are the leakage of rare gases and the solution of iodine and caesium. Some of the rare gases of importance are:

Noble Gas	Half Life	Typical Fuel Bundle Inventory[1] (Ci)
^{85m}Kr	4.5 h	5.2E3
^{88}Kr	2.8 h	1.7E3
^{133}Xe	5.2 d	3.6E3
^{135}Xe	9.2 h	2.4E3
^{138}Xe	17 m	3.8E4

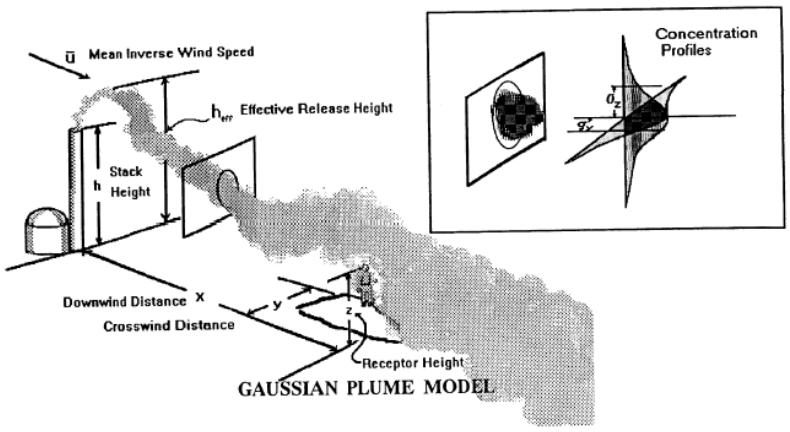
[1] Pickering A Inventories from "Fundamentals of Power Reactors", AECB

Principal Exposure Pathways Following an Accidental Radioactive Release from a Reactor



From "Fundamentals of Power Reactors", AECB

Gaussian Plume Model



From Health Physics and Radiological Health Handbook

Elevated Source, Elevated Receptor

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

Elevated Source, Elevated Receptor, Centreline

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

Elevated Source, Ground Level Receptor, Centreline

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

Note: Approximate maximum concentration:

$$\chi(x,y,z) = \frac{2\dot{Q}}{\pi\, e\,\bar{u}\, h^2}\left[\frac{\sigma_z}{\sigma_y}\right]$$

$$\text{At } \sigma_z = \frac{h}{\sqrt{2}}$$

Example: Q8 From 1994 ABHP Exam