

Equations for final rise of a bouyant plume
(Corrected 10/29/2017)

Neutral-Unstable

$$dh = 1.3 \frac{F}{u u^{*2}}$$

Stable (windy)

$$dh = 2.6 \left(\frac{F}{u s} \right)^{1/3}$$

Stable (calm)

$$dh = 5.3 \frac{F^{1/4}}{s^{3/8}}$$

Bouyancy Flux ($L^4 T^{-3}$)

$$F = \frac{g Q_h}{\pi C_p r T} = 3.7 \times 10^{-5} Q_h$$

$$\text{constant} = \frac{[m^4/s^3]}{[cal/s]}$$

$$F = 3.7E-05 Q_h \text{ (cal/sec)}$$

$$F = 2.6E-06 Q_h \text{ (btu/hr)}$$

$$F = 8.8E-06 Q_h \text{ (watts)}$$

Heat Emission (cal/s)

$$\text{cal/sec} = 0.07 \text{ btu/hr}$$

$$\text{btu/hr} = 3.4129 \text{ watts}$$

$$C_p = 0.238 \text{ cal/gm/C}$$

$$\text{BlueSky} \sim 35 \times 10^9 \text{ btu over 6 hour burn duration}$$

$$\text{Average} = 6 \times 10^9 \text{ btu/hr} = 1760 \text{ Mw}$$

Stability (T^{-2})

$$S = g \frac{dO}{T dz}$$

References

Arya, S.P., 1999, Air Pollution Meteorology and Dispersion, Oxford University Press, New York, 310 p.

Briggs, G.A., 1969, Plume Rise, U.S. Atomic Energy Commission, TID-25075, NTIS, Springfield, VA, 81p.