Using (4.71), $Pr[P_r(r) > \gamma]$ is given by

$$Pr[P_r(r) > \gamma] = Q\left(\frac{\gamma - \overline{P_r(r)}}{\sigma}\right) = \frac{1}{2} - \frac{1}{2}erf\left(\frac{\gamma - \overline{P_r(r)}}{\sigma\sqrt{2}}\right) \tag{4.74}$$

$$= \frac{1}{2} - \frac{1}{2}erf\left(\frac{\gamma - [P_t - (\overline{PL}(d_0) + 10n\log(r/d_0))]}{\sigma\sqrt{2}}\right)$$

In order to determine the path loss as referenced to the cell boundary ($r = R$), it is clear that

$$\overline{PL}(r) = 10n\log\left(\frac{R}{d_0}\right) + 10n\log\left(\frac{r}{R}\right) + \overline{PL}(d_0) \tag{4.75}$$

and Equation (4.74) may be expressed as

$$Pr[P_r(r) > \gamma] \tag{4.76}$$

$$= \frac{1}{2} - \frac{1}{2}erf\left(\frac{\gamma - [P_t - (\overline{PL}(d_0) + 10n\log(R/d_0) + 10n\log(r/R))]}{\sigma\sqrt{2}}\right)$$

If we let $a = (\gamma - P_t + \overline{PL}(d_0) + 10n\log(R/d_0))/\sigma\sqrt{2}$ and $b = (10n\log e)/\sigma\sqrt{2}$, then

$$U(\gamma) = \frac{1}{2} - \frac{1}{R^2}\int_0^R r\ erf\left(a + b\ln\frac{r}{R}\right)dr \tag{4.77}$$

By substituting $t = a + b\log(r/R)$ in Equation (4.77), it can be shown that

$$U(\gamma) = \frac{1}{2}\left(1 - erf(a) + \exp\left(\frac{1 - 2ab}{b^2}\right)\left[1 - erf\left(\frac{1 - ab}{b}\right)\right]\right) \tag{4.78}$$

By choosing the signal level such that $\overline{P_r}(R) = \gamma$ (i.e. $a = 0$), $U(\gamma)$ can be shown to be

$$U(\gamma) = \frac{1}{2}\left[\ 1 + \exp\left(\frac{1}{b^2}\right)\left(\ 1 - erf\left(\frac{1}{b}\right)\ \right)\ \right] \tag{4.79}$$

Equation (4.78) may be evaluated for a large number of values of $\sigma$ and $n$, as shown in Figure 4.18 [Reu74]. For example, if $n = 4$ and $\sigma = 8$ dB, and if the boundary is to have 75% boundary coverage (75% of the time the signal is to exceed the threshold at the boundary), then the area coverage is equal to 90%. If $n = 2$ and $\sigma = 8$ dB, a 75% boundary coverage provides 86% area coverage. If $n = 3$ and $\sigma = 9$ dB, then 50% boundary coverage provides 71% area coverage.