ERP Calculation

In this calculation, we report ERP relative to a theoretical half-wave dipole. We intend to use approximately 400 ft of Andrew HJ9-50BC Heliax[1] cable which attenuates 0.055 dB per 100 ft at 50 MHz. A power divider splits the signal into an eight bay phased Yagi array. Each Yagi antenna is fed by Andrew HJ5-50 Heliax[2] The system gains and losses are as follows:

- maximum antenna gain (main lobe): 21.50 dBi $\Rightarrow 21.5$ dBi $+ 2.15$ dBi $= 23.65$ dBd
- cable loss, primary feed line: 0.00055 dB/ft $\cdot\ 400$ ft $= 0.22$ dB
- connector loss: $2 \cdot 0.03$ dB $= 0.06$ dB
- power divider: 0.05 dB
- cable loss, single antenna line: 0.0034 dB/ft $\cdot\ 40$ ft $= 0.14$ dB

From the standard definition of decibel

$$\Gamma \text{ dB} = 10 \text{ dB } \log_{10}\left(\frac{P_{\text{ERP}}}{P_{\text{TPO}}}\right) , \tag{1}$$

we obtain the formula[3] to calculate ERP

$$P_{\text{ERP}} = P_{\text{TPO}}\ 10^{\Gamma/10} . \tag{2}$$

The net gain is $\Gamma = 23.65 - 0.22 - 0.06 - 0.05 - 0.14 = 23.18$ dB. With $P_{\text{TPO}} = 40$ kW the ERP is 8.3 MW.

[1] http://awapps.commscope.com/catalog/andrew/product_details.aspx?id=1465

[2] http://antennasystems.com/product/cable-andrew-hj-series-heliax/HJ5-50.html

[3] P_{ERP} and P_{TPO} are Effective Radiated Power and Transmitter Power Output, respectively.