

Summary of Purpose

Our purpose is to create a microwave power transmission system to supply the required energy for a space elevator robotic climber prototype. This robotic climber will be used to compete in a NASA sponsored Centennial Challenge competition (<http://exploration.nasa.gov/centennialchallenge>).

The 2007 Beam Power Challenge is organized by the Spaceward Foundation (www.spaceward.org). This competition will take place in Farmington, Utah, October 19 through October 21, 2007. Centaurus Aerospace will require special temporary authority to perform testing and to compete in this competition. More information about this competition can be found at www.elevator2010.org.

Microwave energy transmitted from an antenna will be used to power the prototype climber, which will ascend a tether suspended by a crane to a height of 100 meters. The climber will require enough power to carry itself, plus a payload, at a minimum speed of 2 meters/second. We are constructing a rectenna (rectifying antenna) array to receive the transmitted microwave energy and convert it into DC electrical power.

Transmitting Equipment

The transmitter consists of a high-gain parabolic dish antenna with a diameter (D) of 3 meters, fed by a Chaparral style circular feed horn and a 15 kW Gerling microwave generator (Model GA412) operating at a frequency of 2450 MHz ($\lambda = 0.122$ meters). The microwave generator technical specifications are included as an additional exhibit.

The gain (G) of the transmitter is given by

$$G = 6 \times \left(\frac{D}{\lambda} \right)^2 = 3628 = 35.6 \text{ dB}$$

where D is the diameter of the parabolic antenna and λ is the wavelength. The beamwidth (B) is calculated with

$$B = 70 \times \left(\frac{\lambda}{D} \right) = 2.85^\circ$$

The Effective Radiative Power or ERP for each of the two beams is given by

$$ERP = G \times Power_{transmitted} = 3628 \times 15000 = 54.4 \text{ MW}$$

Because the microwave generator is continuously variable from 0 kW to 15 kW, 54 MW is the maximum ERP, but the transmitter will often operate at a much lower power.¹

¹ Equations from: Ulaby, Fawwaz T. "Fundamentals of Applied Electromagnetics" Prentice-Hall 1999

Testing

Prior to the actual competition, we will test the equipment near Logan, Utah beginning September 15, 2007. Testing will be done mostly in a horizontal manner, with a few vertical tests. To avoid interference, all horizontal testing will be performed in a rural area near Logan, UT. As an additional precaution, EM fields near the antenna will be measured and shielding material will be used as necessary to minimize the possibility of interference to other equipment. Figure 1 is a schematic of the horizontal test configuration. Each horizontal test will last from 10 to 90 seconds with a total of 20 to 30 tests. Each vertical test will last from 10 to 20 seconds with a total of 5 to 10 tests. The vertical testing will be similar to Figure 2, but with the climb height only 15m.

Competition

At the competition, the microwaves will be transmitted vertically, parallel to the tether that the climber will ascend. Figure 2 is a schematic of the competition configuration. The competition will be held at Farmington, Utah from October 19, 2007 to October 21, 2007. In addition, vertical testing (competition qualification) will be performed in Farmington prior to the competition, beginning as early as October 15, 2007.

During the competition we will be provided with three climb attempts, each with a maximum duration of 60 seconds. Prior to the competition, we will also be provided with three climb attempts, each with a maximum duration of 60 seconds. EM fields will be monitored during the transmitter operation, to ensure that microwave levels remain below the maximum exposure guidelines of ANSI and the FDA where people are present.

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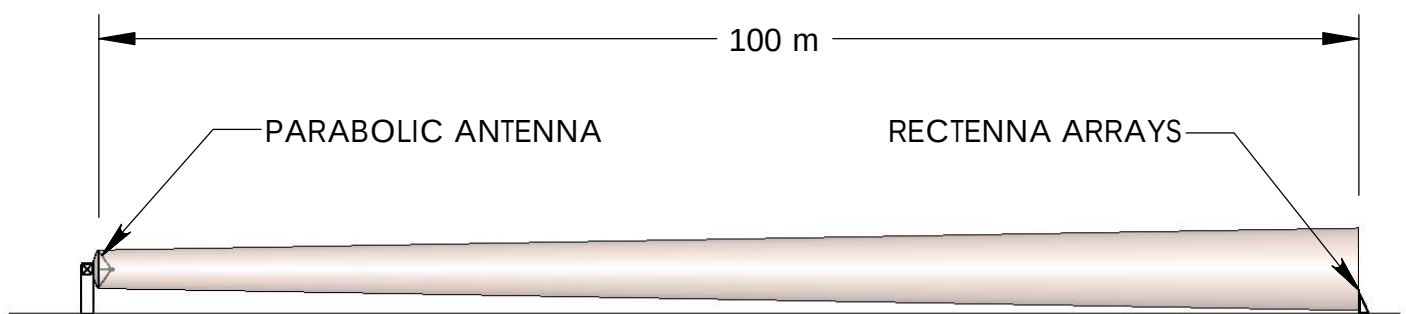
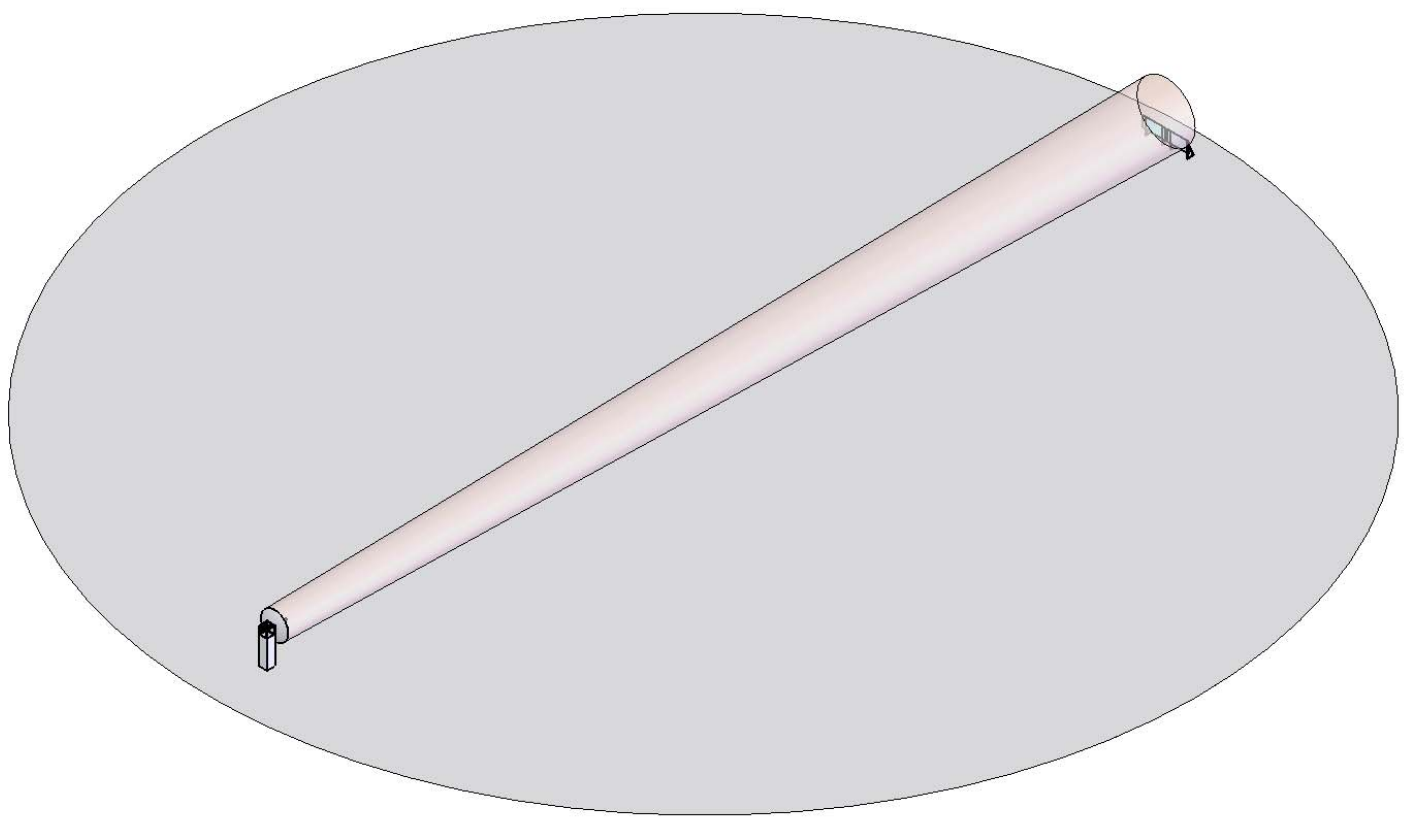


FIGURE 1. HORIZONTAL BEAM TESTING

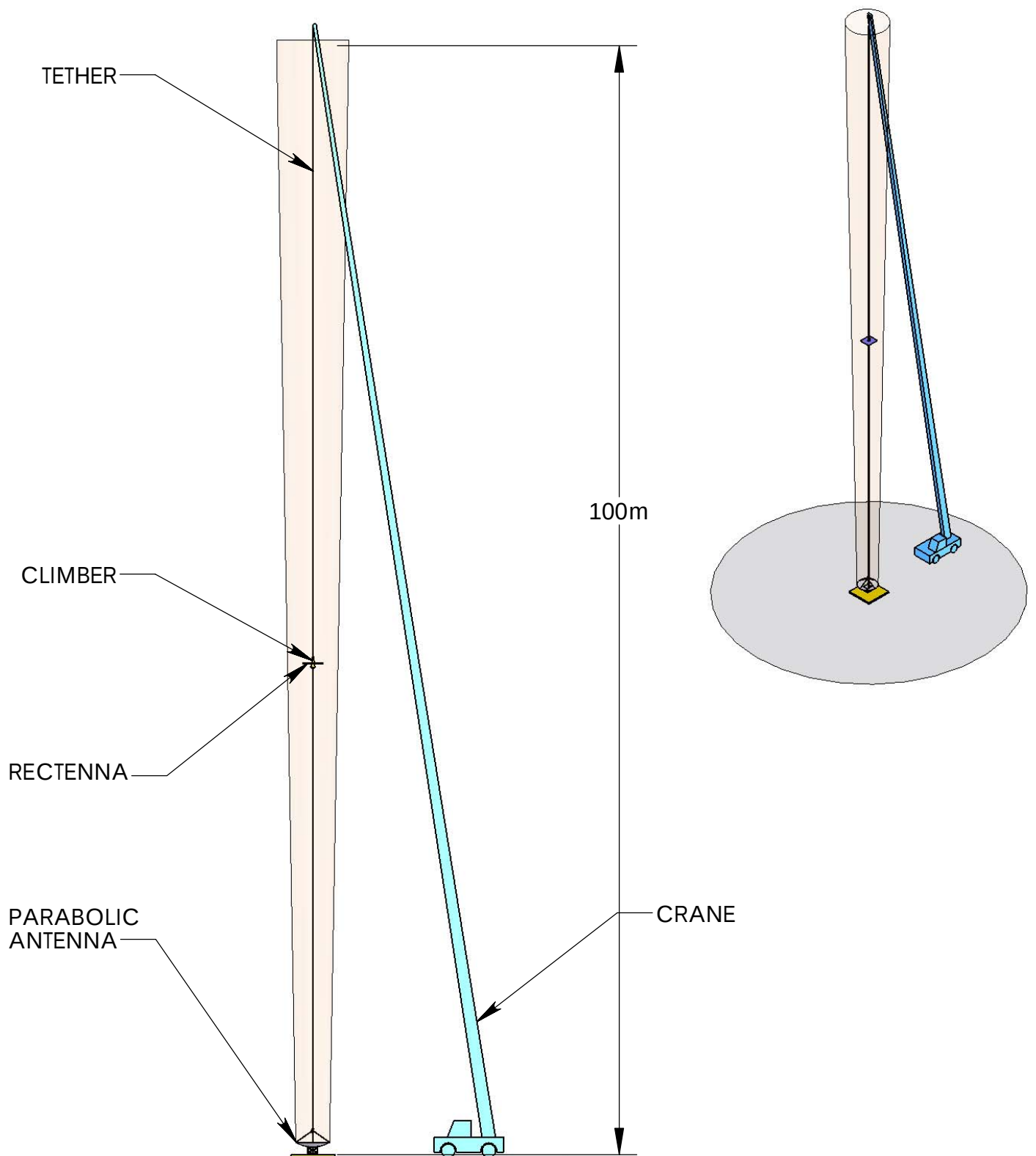


FIGURE 2. CONTEST VERTICAL BEAMING