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Exhibit 1 – Program of Research

The transmitting equipment (radios and antennae) specified in this application will be used for RF laboratory experiments for a senior/graduate-level course in antenna theory and design (EE 5477, Antennas and Transmission Lines) in the Department of Electrical Engineering at the University of Minnesota Duluth. Radios will be used as a signal source for measuring far-field radiation patterns in conjunction with field strength meters. Students will construct several types of antennas that will attach to the transmitting radios via coaxial cable pigtails. The types of antennas that are anticipated for construction and testing include vertical monopoles, Yagi's, simple dipoles, and folded dipoles. It is anticipated that antennas will be constructed using a dielectric substrate on which copper tape elements are positioned, which minimizes cost and provides students with an easy method for optimizing their designs. Directional antennas will be rotated through 360° as a method for measuring field strength. The use of this equipment in such experiments contributes to the radio art by exposing students to hands-on experience with antenna gain, directivity, polarization, feedpoint impedance, behavior in various field zones around antennas, and the processes of tuning antennas for resonance and matching antennas to a source. Each of the four radios in this application would be used by a small team of students.