EXHIBIT 1

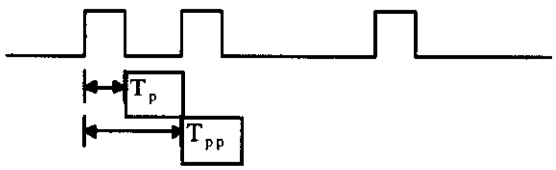
Particulars of Operation

A. The radar will transmit on a noninterference basis in the frequency band between 8 MHz and 20 MHz. For optimal performance, the radar must operate on a quiet channel. Hence, it is necessary to find a frequency where no one else is transmitting. In normal operations, a frequency is chosen for which propagation conditions will satisfy the experimental objectives. Near the chosen frequency, a 300 kHz band is searched, using reception only, to identify a clear channel. A series of pulses is then transmitted at the clear frequency for seven seconds. At the end of seven seconds, the beam direction is changed and the frequency search and transmission are repeated. The frequency search is done under computer control and various emergency bands are excluded from use. A table of restricted use frequencies is maintained that prevents transmission in forbidden bands. Before this new facility is put into operation, we will contact the various users in the area to obtain a list of forbidden bands. We have operated in this manner at another site, Goose Bay, Labrador, since about 1983. In the fourteen years of operation of that station, we have not received a single complaint from other users of the spectrum. All of the other SuperDARN radars operate in a similar manner. Complaints from other users of the radiowave spectrum have been rare and have been resolved by adding an additional entry to the restricted frequency table.

B. The phased array system is composed of sixteen transmitting antennas with a peak power of about 600W per transmitter. Hence, the total peak power is about 9600 W.

C. Each antenna has about 11 dBi of gain. The array factor for 16 antennas adds another 12 dB for a total gain of about 23 dB. This makes the effective radiated power about 1.9 MW.

F. The modulating signal is a complex series of pulses as illustrated below:



The actual pulse sequence is variable and changes from time to time. We transmit a sequence from which the auto-correlation function of the return signal can be calculated. T_p, the pulse length, is usually in the range of 100 μs to 500 μs. Normally 300 μs is used. T_{pp}, the spacing between pulses, is variable and ranges from a few milliseconds to tens of milliseconds. Currently, we use a seven pulse sequence with the spacing between pulses ranging from about 3 ms to 21 ms. A sequence of pulses is transmitted about every 100 ms.

G. The shortest transmitted pulse is 100 μs with a rise time of 20 μs for a bandwidth of about 22 kHz.

EXHIBIT 2

Description of System

The radar that we propose to build at King Salmon, Alaska, will act at the western end of the Super Dual Auroral Radar Network (SuperDARN) and is a joint project between the Geophysical Institute of the University of Alaska and the Communications Research Laboratory (CRL) of Tokyo, Japan. The cognizant official at CRL is Dr. Takashi Kikuchi (81-423-27-7526, or Kikuchi@crl.go.jp)

SuperDARN is an international HF radar network designed to measure global-scale magnetospheric convection by observing plasma motion in the Earth's upper atmosphere. Plasma convection is controlled by a series of interactions between the solar wind, the Earth's magnetosphere, and the high-latitude (Arctic and Antarctic) ionosphere. By measuring the global-scale plasma motions and studying their temporal evolution, we obtain a better understanding of the processes that couple the solar wind's energy and momentum to the upper atmosphere, and thereby obtain a better understanding of space weather processes at polar latitudes. SuperDARN is the only approach that will enable us to make direct measurements of these motions on a global scale for the foreseeable future.

The SuperDARN network has been developed by scientists in Canada, Finland, France, Great Britain, Japan, South Africa, Sweden, and the United States and has been in operation since 1993. The network has components in the northern and southern hemispheres. The northern hemisphere component consists of six radars with coverage extending from Finland westward to central Canada. Measurements are made continuously over nearly 12 hours of local time from 65°-85° magnetic latitude. It is truly a global-scale measurement system for studying physical processes occurring in the upper atmosphere and ionosphere in arctic and Antarctic regions. Table 1 lists the radars, their locations, the Principal Investigators, and the PI institutions. The table shows the international scope of the SuperDARN project.

Each radar consists of a phased-array antenna system, sixteen transmitters, a receiver, a phasing matrix, and a computer system for control and data logging. The antenna system consists of two rows of log periodic antennas covering the frequency range from 8 MHz to 20 MHz. One row, of sixteen antennas, is used for transmission and reception, a second row, of four antennas, is used for reception only. Both arrays are steered into sixteen viewing directions by an electronic phasing matrix. The two rows of antennas are separated along their array normal direction and are used as an interferometer to derive angle-of-arrival information from the received signals. The sixteen transmitters, each providing ~600 W of output power, are mounted at the base of each antenna.

Table 1. Radar locations and Principal Investigators.

Radar	**Location**	**Lat (°N)**	**Lon (°E)**	**PI**	**Institution**
Saskatoon	Saskatchewan	52.16	-106.53	G. Sofko	University of Saskatchewan
Kapuskasing	Ontario	49.39	-83.32	R. A. Greenwald	JHU/APL
Goose Bay	Labrador	53.32	-60.46	R. A. Greenwald	JHU/APL
Stokkseyri	Iceland	63.86	-20.02	J-P Villain	LPCE/CNRS
Pykkvybaer	Iceland	63.86	-19.20	T. B. Jones	Leicester University
Hankasalmi	Finland	62.32	26.61	T. B. Jones	Leicester University
Halley	Antarctica	-75.52	-26.63	J. R. Dudeney	British Antarctic Survey
Syowa	Antarctica	-69.02	39.56	N. Sato	NIPR

The radars operate remotely under computer control. They run continuously; 24 hours a day, 365 days a year. Remote access to the radars is available through a modem connection. Data from the radars can be displayed in real time anywhere in the world. In addition, any radar operating parameter can be changed in real time, including: the transmitted frequency, the scan sequence, and the pulse pattern.

In the standard operating mode, measurements are made over a 52° azimuth sector extending from 185 km to 3285 km from each radar. A multi-pulse signal pattern is transmitted and the autocorrelation function (ACF) of the received signal is found as a function of range from the radar along each beam. The ACFs are fitted and various signal parameters are estimated, including: the received power, the plasma drift velocity, and the spectral width of the return signal.

Currently, there is no SuperDARN coverage of the region extending from central Canada westward through Alaska and into Siberia. A SuperDARN radar is being installed on Kodiak Island, Alaska, and we are proposing to build an additional radar at King Salmon. Since the radar measurements will extend 3000 km poleward from the radar location, data from this radar will complement data from all other geophysical monitoring instruments located in Alaska and will extend beyond Alaska's Arctic slope into the region over Siberia and the Arctic Ocean where no other ground-based sensors are available. This new radar will enhance significantly the ability of the SuperDARN network to conduct research in support of the U.S. Arctic Research program.

Among the research priorities outlined in the January 1995 Biennial Statement of the Arctic Research Commission are the goals for studies of the upper atmosphere in Arctic regions. The goals are "...to improve the predictability of disturbances in space and their effects on high latitude communications, electric power grids, satellite orbital stability, and defense systems.", i. e., to study space weather, and to "trace the flow of energy, momentum, and mass, from the sun to the earth, and understand the interactions within and between the intervening regions." To achieve these goals, we must improve our understanding of the solar wind-magnetosphere-upper atmosphere system and develop predictive models that describe how the system evolves in response to changing IMF and solar wind conditions. To advance our understanding, and to test these new models, we must have global-scale measurements that characterize the physical parameters controlling the magnetosphere-ionosphere system.

A critical element of the system is the convection electric field; particularly the electric field associated with macroscale and mesoscale magnetospheric processes. When solar wind plasma is transferred onto geomagnetic field lines through the still poorly understood process of magnetic reconnection, it undergoes accelerations that are measurable along the entire magnetic flux tube even at its footpoints in the conjugate ionospheres. These accelerations lead to general circulation of magnetospheric and ionospheric plasma on both open and closed magnetic field lines. The immense size of the magnetosphere, more than 10^{16} km^3, makes it highly unlikely that the few high-altitude spacecraft that probe its volume will ever fully resolve its instantaneous global response to solar wind dynamics. Fortunately, due to the high conductivity along geomagnetic field lines, the electric potential distribution in the ionosphere is directly related to magnetospheric circulation. Hence, the structure and dynamics of magnetospheric convection are imaged in the high-latitude ionosphere where it may be observed with low-altitude satellites and radars.

The high-latitude electric field has a fundamental impact on the character of the high-latitude ionosphere at F-region altitudes. F-region electron densities evolve slowly, enhanced by source processes such as solar EUV production and particle precipitation and depleted by loss processes such as enhanced recombination through high-speed drift. Levels of production and loss can vary widely in the high-latitude region. Portions of the polar cap may contain density enhancements, whereas others may contain density depletions. This large-scale structuring, in concert with the convection electric field, leads to further structuring via plasma instabilities and redistribution. The result is a complex ionospheric environment that is not fully understood and yet is widely used as a medium for civilian and defense communication and radar surveillance.

U.S. arctic research will benefit significantly from expanding the SuperDARN network through construction of a new radar at King Salmon, Alaska. Any study of global-scale phenomena will benefit from observations obtained over the largest possible area. The expanded coverage of nearly 18 hours of MLT will enable simultaneous observations of large portions of both the dawn and dusk convection cells. The expanded network will enable observations over the entire nightside ionosphere, or from noon through midnight, allowing simultaneous observation of substorm activity and related dayside phenomena. The expanded network will enable simultaneous observations of plasma entry into the dayside polar ionosphere and plasma exit from the nightside polar ionosphere for as much as six hours each day. It will provide electric field measurements to complement the magnetic observations of the many northern-hemisphere magnetometers, including those in Alaska and Eastern Siberia. Together, these measurements will provide a global-scale electrodynamic description of the ionospheric footprint of magnetospheric processes.

In addition to acting as an integral part of the SuperDARN network, the King Salmon radar will provide benefits that are unique to its Alaska location. The following lists a few of these unique features:

Electric Field Measurements Over Alaska: Alaska is the only portion of the United States that regularly is located under the auroral oval and hence is especially susceptible to space weather effects. At present, there are no electric field measurements obtained over the state of Alaska other than brief measurements during satellite overflights or rocket campaigns. The King Salmon radar will provide these measurements.

Ionospheric Radiowave Propagation Over Alaska: Alaska's high-latitude location makes it susceptible to geomagnetic disturbances that cause changes to ionospheric structure and may disrupt high-latitude communications and military systems. HF radars are ideally suited to the study of such disturbances. Each beam of the radars represents a two-way radio propagation path over which we can observe space-weather effects on HF communications. In addition, the ionospheric irregularities observed by SuperDARN are generally coincident with irregularities that are responsible for scintillations on satellite-to-ground radio links and they are a source of clutter on military and civilian radar systems.

Poker Flat Collaborative Observations: The proposed King Salmon radar field of view will extend to the west from the Poker Flat Research Range and the rocket drop zone to the north. The radar will provide measurements of the spatial structure and dynamics of the ionospheric electric field during sounding rocket campaigns.

U.S. Sited Facility: SuperDARN is an international network with facilities located throughout the high-latitude regions. The King Salmon radar will be just the second SuperDARN component on U.S. soil.

EXHIBIT 3

The radar will be located on the Air Force Base at King Salmon, Alaska. The radar will be constructed in the large open area near the base fire station.

The possibility of EMF exposure to aircraft is thought to be minimal. If we assume 300 m as a closest approach, the exposure would be about 8×10^{-5} mW/cm^2. This is based upon 16 transmitters with a peak power of 600 W, a 2% duty cycle, and an antenna gain of 11 dBi. This exposure is well below the 4 mW/cm^2 maximum permissible exposure given by Table 1 of Appendix A of the FCC OET bulletin 65, edition 97-01.