TEST REPORT

1317A-LAUR REQUEST FOR CERTIFICATION – INDUSTRY CANADA

KQ9LAUR REQUEST FOR CERTIFICATION - FCC

SUBMITTED BY:

CONSOLIDATED SPECTRUM SERVICES
22 MERRILL DRIVE
ATKINSON, NH 03811

ON BEHALF OF:

SERCEL
17200 PARK ROW
HOUSTON, TEXAS 77084

1.00 GENERAL INFORMATION

This report references a new transceiver to be produced by Sercel. The new unit, Industry Canada 1317A-LAUR & FCC ID KQ9LAUR, will henceforth be referred to as LAUR.

1.10 COMPANY INFORMATION

SERCEL is a well recognized leader in the oil and natural gas exploration markets. SERCEL is an international firm based in France. They have additional manufacturing and business headquarters based in the United States, State of Texas, Alberta (Calgary) Canada and strategically placed around the globe.

1.20 DESCRIPTION OF EQUIPMENT TESTED

The LAUR radio telemetry transceiver is essentially fully compatible with the KQ9LRU & 1317A-LRU previously certified and is an upgrade to this system. It is used to collect geological information beneath the earth or ocean floor by triggering a measured seismic or air blast. The returned data is then characterized to look for oil and natural gas. The unit is utilized in both cable and wireless application. The LAUR is waterproof and floats.

In the US and Canada the units are pre-programmed for specific operating frequency ranges.

The LAUR in transmit mode is programmable from 1.0 to 6.0 Watts, nominal. It transmits in very short bursts during normal operation. The LAUR has data storage capability in its receiver section.

The system is powered by a 12 V DC deep cycle marine battery or DC source, as provided by others.

The system is intended, for operation by prospective licensees on a secondary basis to the maritime mobile and government services and will only be used in remote areas.

1.30 BUILDING BLOCKS OF UNIT TESTED

The LAUR consists of two main building blocks, which are:

a) Radio Module Block (RMB) and
B) RF Module

The block diagrams are a separate attachment.

1.40 FCC APPLICABLE RULE PARTS AND STANDARDS

The LAUR falls under FCC rule parts 2, 15 and 90.

FCC rule part 2.1057 (a) (1) - specifies the measurement range over which harmonics are to be measured for equipment operating below 10 Ghz. It states in part "to the tenth harmonic of the highest fundamental frequency or to 40 Ghz, whichever is lower." Since the highest frequency contained in this unit is 300 Mhz maximum, ten (10) times this would be 3000 Mhz.

FCC rule part 15.101 (b) - since it is part of a transceiver and operates between 30 and 960 Mhz and is subject to verification.

FCC rule part 15.3 (k) - defines digital devices and unintentional radiators. It states in part, "Digital device. (Previously defined as a computing device). An unintentional radiator (device or system) that generates and uses timing signals or pulses at a rate in excess of 9,000 pulses (cycles) per second and uses digital techniques; inclusive of telephone equipment that uses digital techniques or any device or system that generates and uses radio frequency energy for the purpose of performing data processing functions, such as electronic computations, operations, transformations, recording, filing, sorting, storage, retrieval, or transfer. A radio frequency device that is specifically subject to an emanation requirement in any other FCC Rule part or an intentional radiator subject to subpart C of this part that contains a digital device is not subject to the standards for digital devices, provided the digital device is used only to enable operation of the radio frequency device and the digital device does not control additional functions or capabilities."

FCC rule part 90.203 (a) - requires the LAUR to meet the Certification for the transmitter.

FCC rule part 90.259 (a) (4) - the maximum power in the 217 - 220 Mhz band is 2 Watts. However, we are applying for RF Power Outputs of 1.0 to 6.0 Watts, nominal. A waiver of FCC rule part 90.259 (a) (4) would have to be written for anything above 2.0 Watts.

We do not see a problem with a waiver of said rule part because the transmitter operates in very short intervals (in the order of dozens of milliseconds, every 1/4 of a second over a 4 hour time period. Furthermore, it will be only used in remote locations. After that the test it is removed from the site.

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1.50 INDUSTRY CANADA APPLICABLE DOCUMENTS

Radio Standards Procedure (RSP)-100 - Radio Equipment Certification Procedure

Radio Standards Specification (RSS)-102 - Evaluation Procedure for Mobile and Portable Radio Transmitters with to Health Canada's Safety Code 6 for Exposure of Humans to Radio Frequency Fields.

Radio Standards Specification (RSS)-119 - Land Mobile and Fixed Radio Transmitters and Receivers, 27.41 to 960 Mhz

RSS-119 Section 5.5.10 contains the requirements for certification in the 217-218 Mhz and 219-220 Mhz bands. A channel plan is specified. The LAUR does not comply with this. However, aggregated channel plans are allowed on a case-by-case basis pursuant to section 5.5.13. The LAUR applies to this in that it utilizes emission designators of 200KD1D for QPSK and 16QAM and 800KD1D for 1024 DQPSK, modulation.

Radio Standards Specification (RSS)-212 - Test Facilities and Test Methods for Radio Equipment which is based upon ANSCI 63.4-2001.

1.60 CONTACT IN CANADA

The contact in Canada is as follows:

Sercel Canada Ltd.
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Calgary, Alberta TZE6Y4

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1.70 GENERAL TECHNICAL INFORMATION, SITE NUMBER & TEST DATES

The following tests and measurements were performed in the engineering laboratories of Sercel Inc., with the exception of Electromagnetic Compatibility Testing which was recorded on a characterized test open area test site (OATS), herein referred Industry Canada number 4344.

The antenna range was re-calibrated due to the fact that it was torn down and redesigned.

All tests were performed under the direction of Howard Epstein of Consolidated Spectrum Services from Dec 06 - Dec 11, 2004.

The updated data is shown in Appendix "C".

1.80 STANDARDS & CALIBRATION DATA

All equipment utilized was calibrated with accuracy traceable to the National Bureau of Standards and American National Standards Institute (ANSI) C63.4-2001. Antennas were calibrated per ANSI 63.5 by both Emco and Antenna Research Systems in both Vertical and Horizontal.

The manner in which EMI measurements were made on the IFR A7750 is shown in Appendix A.

The RHODE & SCHWARZ FSI Analyzer was used to automatically calculate the output spectrum 99% bandwidth, reference Appendix B.

1.90 LIST OF EQUIPMENT UTILIZED

A List of Equipment used for the tests is contained below along with the calibration due dates.

DESCRIPTION	CALIBRATION DUE
LAUR S/N 000022 PRODUCTION UNIT	N/A
HP5313A FREQUENCY COUNTER	03/29/2005
HP778D DUAL DIRECTIONAL COUPLER, 20 DB	05/17/2005
HP435A POWER METER WITH HP8481A SENSOR	05/21/2006
LAMBDA DC VARIABLE POWER SUPPLY	05/21/2006
WEINSCHEL 30 DB 25 W COXIAL ATTENUATOR	10/08/2005
WEINSCHEL 10 DB 25 W COXIAL ATTENUATOR	10/08/2005
TENNEY TTC TEST CHAMBER	02/02/2005
MOTORIZED MAST	02/21/2005

IFR A7550 SPECTRUM ANALYZER	11/21/2005
RHODE & SCHARWZ SPECTRUM ANALYZER FSIQ7 S/N 1119.5005K17-100223	12/06/2005
AGILENT SPECTRUM ANALYZER AT-E44002B	11/08/2005
ANTENNA RESEARCH LPB 2520/A BICON LOG PERIODIC ANTENNA - TWO UNITS - S/N 1221 AND S/N 1189	 11/23/2005 & 11/10/2005
MARCONI 2022E SIGNAL GENERATOR	05/28/2005
SERCEL DESIGN FLUSH CONDUCTIVE TURNTABLE	11/20/2005
WOOD TRIPOD	N/A
LOW PASS FILTERS	03/04/2005
HIGH PASS FILTERS	03/04/2005
SONOMA INSTRUMENTS Model 317 Amo	03/07/2005

2.00 TEST DATA DIVISION

The Test Data is divided into six main sections, as follows:

a) General
b) Environmental,
c) Modulation Characteristics
d) Necessity for OATS Recalibration
e) Electromagnetic Compatibility
f) Summary

2.10 GENERAL

For those the portions of the test dealing with the transmitter, the transmitter was operated one hundred (100) percent of the time.

For those the portions of the test dealing with the receiver, the receiver was operated one hundred (100) percent of the time.

2.20 ENVIRONMENTAL INFORMATION

Pursuant to FCC rule parts 2 and 90 and RSS-119 the LAUR was subjected to environmental testing. These tests are subdivided into two sections, as follows:

a) RF Output Power Stability and
b) Frequency Stability

For all units, the temperature range over which testing occurred was -40 to +55 degrees Celsius. Testing exceeded the range of -030 to +55 degrees celsisus as specified by the Industry Canada and the FCC. This range was spanned in increments of 10 degrees or less. The voltage was varied from 10.2 to 13.8 V DC, which are considered to be the battery "end point voltages".

No frequency pulling effects were noted as a result of varying the input voltages.

All tests were made using the test setup shown in Figure 1. The results of these is shown in figure 2.

2.30 RF OUTPUT POWER STABILITY

The highest power output of concern, occurred at a temperature of plus 20 degrees Celsius. This level was recorded at 6.16 watts.

The requested RF output power is 1.0 - 6.0 watts, nominal, as measured at the RF output connector of the units.

Canadian RSS-119 Section 6.2 specifies that "the maximum power shall be within plus and minus 1.0 db of the manufacturers rated power. The LAUR easily complies with these specifications.

2.40 FREQUENCY STABILITY

The general limits for frequency tolerance between the United States and Canada is plus and minus 0.00025%. The KQ9LAUR meets these specifications.

2.50 EFFECTS OF BATTERY END POINT & ENVIRONMENTAL TESTING

No difference was noted in occupied bandwidth between the "battery end point" voltages.

The output spectrum was monitored over -40 to +55 degrees centigrade, for all three modulation types. No change was noted.

2.60 SPECTRUM INTEGRITY

The modulated spectrum was monitored from -40 to +55 degrees centigrade for all modulation schemes. No differences were noted.

```
                 FIGURE 1 - ENVIRONMENTAL TEST SETUP


      ......................            .........................
      .                    .        ..... IFR SPECTRUM ANALYZER .
      . LAMBDA VARIABLE DC .        .   .........................
      .       SUPPLY       .        .
      ......................        .    ....................
                                  ....... HP5313A FREQUENCY.
                                  .     . COUNTER          .
                                  .     ....................
                                ******
                WEINSCHEL 10 DB ******
                                  .              ....................
                                ......           .    ...........   .
  .....****** ...................    ........... .    .         .   .
  .    ******                   ......           .    . LAUR    .   .
  .  WEINSCHEL 30 DB          HP 778D 20 DB      .    ...........   .
  .                           DUAL DIRECTIONAL   ....................
  .                                                 TENNEY MODEL TTC
  .                                                TEMPERATURE CHAMBER
  .
....................
. HP8481A SENSOR   .
. HP435A PWR METER .
....................
```

LAUR ENVIRONMENTAL TEST - FIGURE NUMBER 2

Temperature (°C)	Carrier frequency stability CW mode Reading (MHz)	Measured output power CW mode Reading (W)	Check transmission				Stability
			Cw	QPSK 256 kbps	16QAM 512 kbps	DQPSK 1024 kbps	217.49945625-217.50054375 Mhz
-40	217.5000	5.5840	Y	Y	Y	Y	Y
-30	217.499902	5.7370	Y	Y	Y	Y	Y
-20	217.49983	5.6169	Y	Y	Y	Y	Y
-10	217.49998	5.9795	Y	Y	Y	Y	Y
0	217.499841	6.0390	Y	Y	Y	Y	Y
10	217.4999836	6.0040	Y	Y	Y	Y	Y
20	217.499983	6.1600	Y	Y	y	y	Y
27	217.499864	5.9795	Y	Y	Y	Y	Y
30	217.499862	5.9795	Y	Y	Y	Y	Y
40	217.499866	5.8880	Y	Y	Y	Y	Y
50	217.499866	5.8800	Y	Y	Y	Y	Y
55	217.4998286	5.88	Y	Y	Y	Y	Y

PHOTOGRAPH OF LAUR IN TEST CHAMBER

2.70 MODULATION CHARACTERISTICS

The modulation characteristics are subdivided into two sections, they are:

a) General
b) Occupied Bandwidth, 25 and 35 db points & data rate

2.80 SPECTRUM MEASUREMENTS

The modulation for the LAUR is software programmable by a laptop computer to one of three modulation schemes. The three modulation schemes are:

a) QPSK, emission designator 200KD1D, date rate 256 kilo bits per second

b) 16QAM emission designator 200KD1D, date rate 512 kilo bits per second

c) DQPSK, emission designator 800KD1D, data rate 1024 kilo bits per second

The output spectrum was measured using the test setup shown in Figure 3. The modulated signal with the respective data rights are shown in turquoise while the un-modulated signal is in yellow, reference figures 4 A, 4 B & 4 C.

2.90 OCCUPIED BANDWIDTH, 25 AND 35 DB POINTS & DATA RATE

ANSI C63.4-2001 Annex I paragraph 6 discusses this subject. It states "The bandwidth of the measuring instrument shall be small when compared to the maximum allowable bandwidth to accurately measure the bandwidth of the transmitter with respect to the limit. Too narrow a bandwidth would result in inappropriate measurements in certain cases; therefore the measuring bandwidth shall be set to a value greater than 5% of the allowable bandwidth". It goes on to give specifications when no bandwidths are given. All occupied bandwidths were taken with this in mind and for easy comparison between the three modulation schemes.

Per FCC rule part 90.209 (a) and Industry Canada RSS-119 section 5.5.2 occupied bandwidths were calculated automatically by the RHODE & SCHWARZ FSIQ7 Spectrum Analyzer, reference Appendix "B" attached.

The LAUR with QPSK modulation 200KD1D, 25 and 35 Db points occurred at 73 Khz and plus 80 Khz, respectively, reference Figure 4 A. The occupied bandwidth is 144 Khz as determined by the spectrum analyzer for a data rate of 256 kilo bits per second.

The LAUR with 16QAM modulation 200KD1D, 25 and 35 Db points occurred at 73 Khz and 89 Khz, respectively, reference Figure 4 B. The occupied bandwidth is 145 Khz as determined by the spectrum analyzer, for a data rate of 256 kilo bits per second.

The LAUR with DQPSK modulation 800KD1D, 25 and 35 Db points occurred at 290 Khz and 320 Khz, respectively, reference Figure 4 C. The occupied bandwidth is 578 Khz, as determined by the spectrum analyzer for a data Rate is 1024 Kilo bits per second.

FIGURE 3 - MODULATION TEST SETUP

```
......................               ....................
.  RHODE & SCHWARZ   .      .....    .                  .
.  FSIQ7 SPECTRUM    .  .....   ......     LAUR         .
.  ANALYZER          .      .....    .                  .
......................     30 dB     ....................
                         ATTENUATOR
                                                :
                                     .....................
                                     . LAPTOP USED TO    .
                                     . PROGRAM LAUR FOR  .
                                     . MODULATION SCHEME .
                                     . THEN IT IS REMOVED.
                                     .....................
```

FIGURE 4 A – LAUR OUTPUT SPECTRUM – 256QPSK

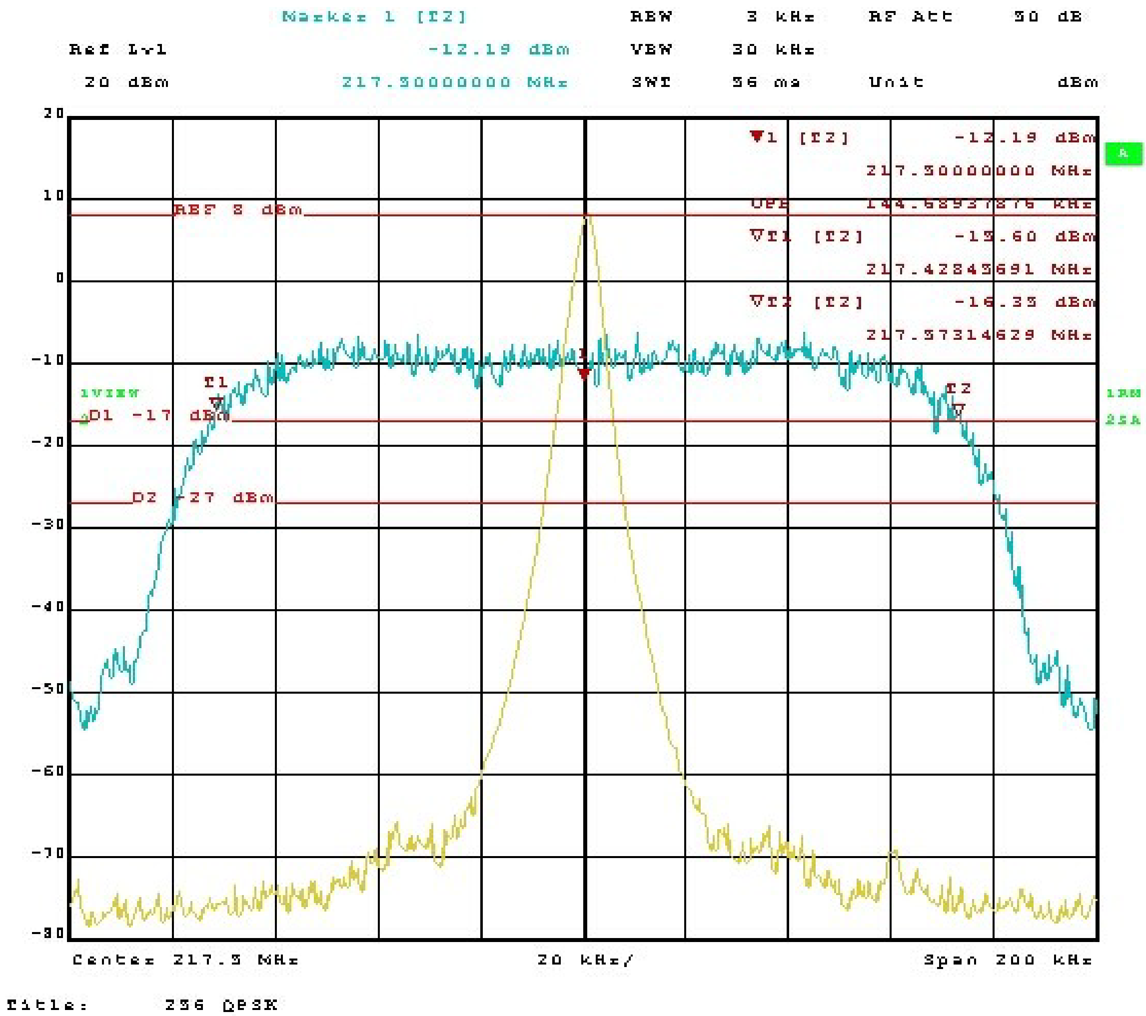


FIGURE 4 B – LAUR OUTPUT SPECTRUM – 512QAM16

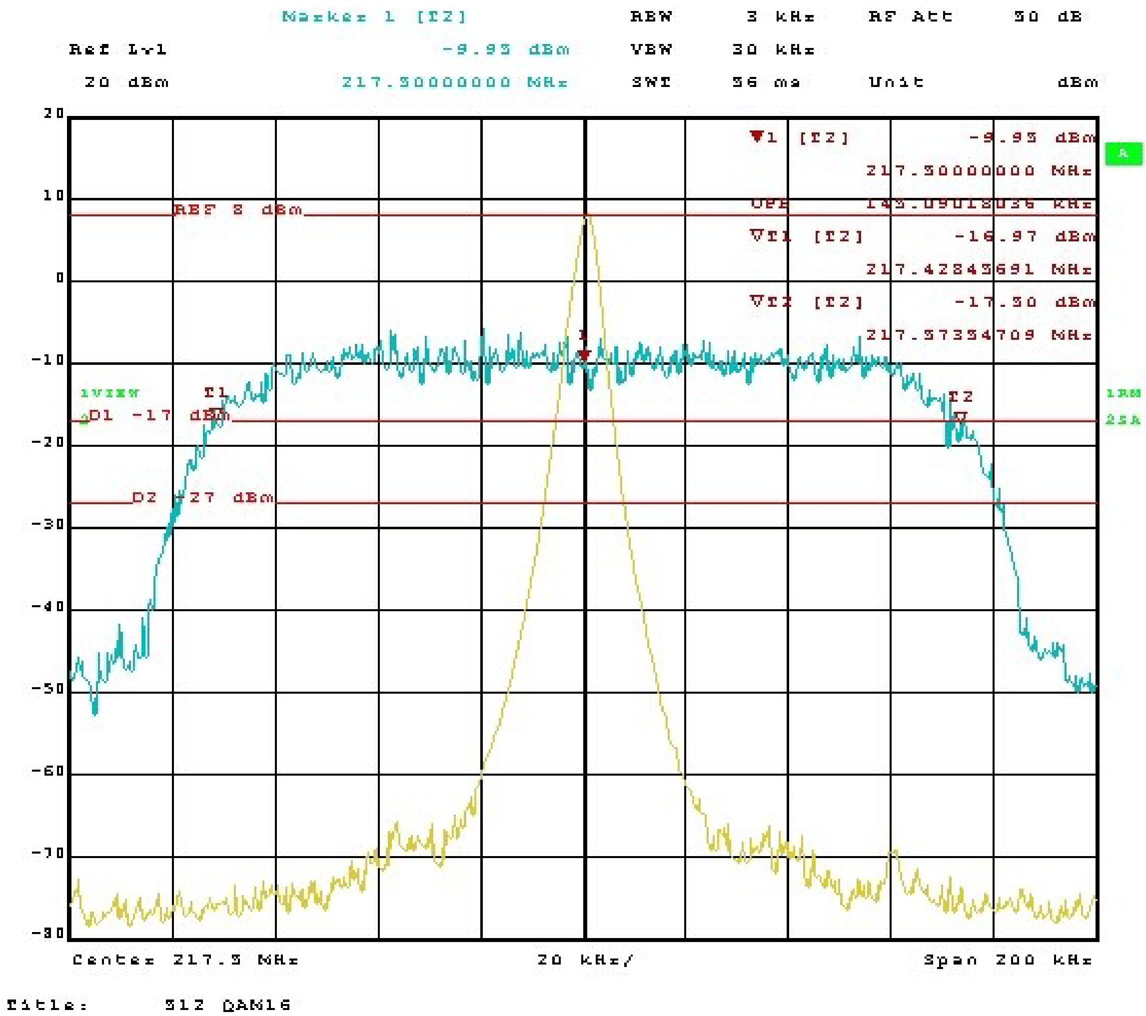
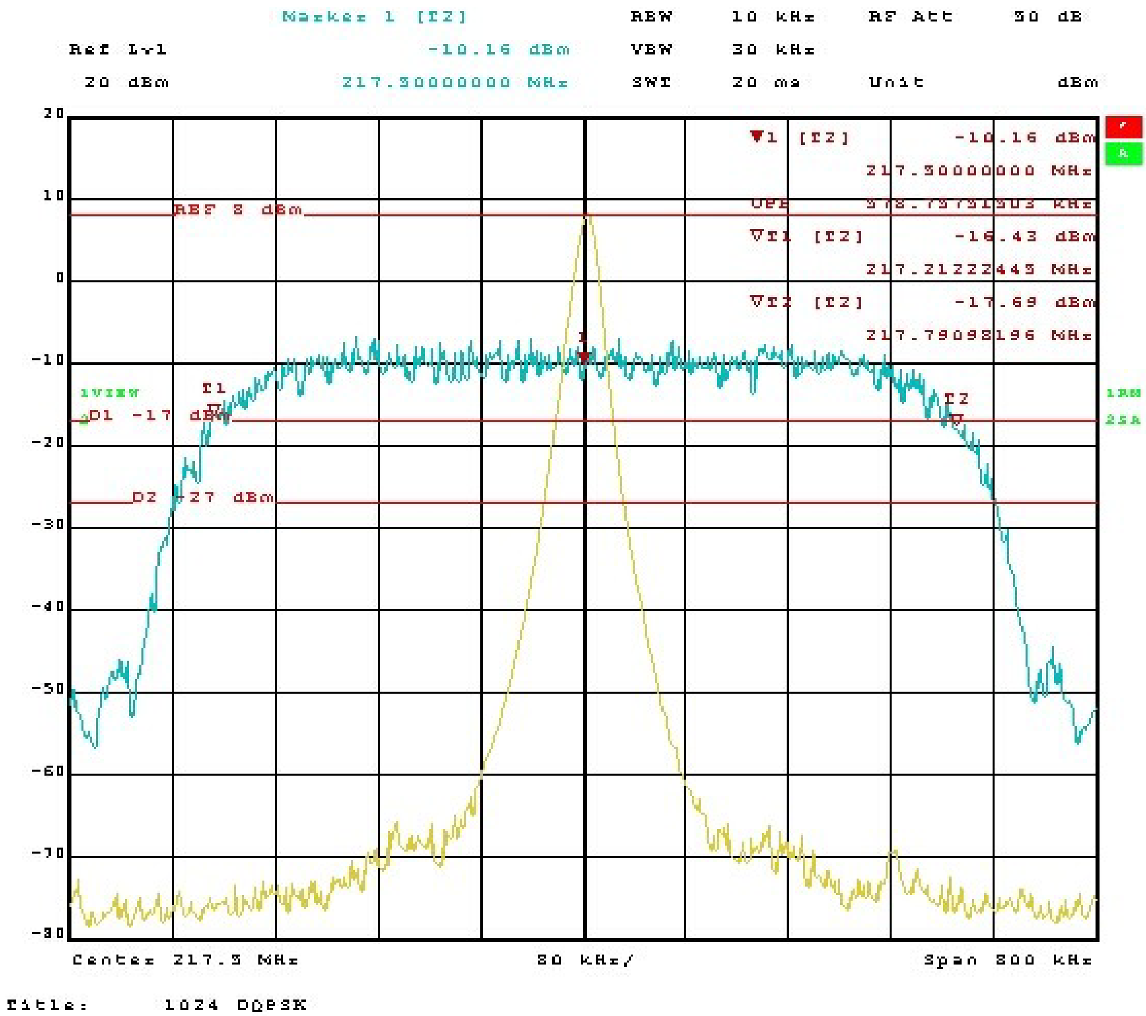


FIGURE 4 C – LAUR OUTPUT SPECTRUM – 1024QPSK



3.00 NECCESSITY FOR OATS RE-CALIBRATION

Since this site, Industry Canada 4344, was taken down after our last tests and upgraded at the same location two years later, re-calibration was necessary.

The upgrades include the turntable which is flush conductive. The ANSI C63.4-2001 paragraph 5.4.4 requires that "for floor standing EUT's, the turntable shall be metal covered and flush with the conducting ground plane". The EUT in this case is the LAUR which is floor standing.

A new motorized mast with 1 and 4 meter limits was setup.

3.10 ELECTROMAGNETIC COMPATABILITY

The Electromagnetic compatibility testing and discussion is divided into two sub-sections, as follows:

a) Receiver Emissions at Antenna Terminals
b) Receiver Emission on OATS at 3 meters
c) Transmitter Antenna Conducted Spurious Emissions
d)) Transmitter on OATS at 3 Meter Case Radiated Spurious Emissions

Measurements were made from 30 Mhz to 3.0 Ghz using an IFR A-7550 Spectrum Analyzer, SN 2347 and an AGILENT AT-E4402B Spectrum Analyzer. The IFR A-7550 was used for measurements below 1000 Mhz.

3.20 RECEIVER EMISSIONS AT ANTENNA TERMINALS

Verification was initially performed on the receiver per 15.111 (a) which states in part "with a shielded and resistive termination equal to the impedance specified for the antenna, the power at the antenna terminal at any frequency within the range of measurements specified in Sec. 15.33 shall not exceed 2.0 nanowatts." Two nanowatts calculates to –86.989 db below a watt or –56.989 dbm.

Frequency (Mhz)	Level (dbuv)	Level (dbm)	Limit (dbm)
434.9	18	-89	-56.989

From FCC rule part 15.33 (b) (1) the maximum upper frequency measurement for a receiver in the 108 - 500 Mhz, as the EUT. It is 2000 Mhz.

Test equipment was set up per figure 5.

It should be noted that a calibrated coaxial cable was used from 30 - 1000 Mhz and semi rigid line from 1000 - 3000 Mhz.

The unit does not connect to the power lines. Therefore testing with a Line Impedance Stabilization Network is not required. It is designed to operate off a 12 V Marine Battery or other user provided DC source.

3.30 RECIVER EMISSION ON OATS THREE METERS

No signals were noted due to the EUT in the receive mode when the receiver was properly terminated in a load equal to the antenna, on a three meter OATS.

The measurements were made with the CISPR Quasi-Peak filter over the frequency range 30 to 1000 Mhz. A peak filter was used for measurement to 3,000 Mhz.

The turntablewas slowly and continuously rotated as we made our observations.

From 30 Mhz - 2000 Mhz we scanned from 1 - 4 meters with a calibrated Antenna Research LPB2520. We further re-looked at the spectrum from 2000 to 3000 Mhz with a EMPIRE APN101A, calibrated from 1000 Mhz to 10,000 Mhz. This latter antenna was used at a fixed height of one meter above the ground plane and connected it with semi-rigid cable. No emissions were seen with the antenna pointed directly at the EUT.

3.40 TRANSMITTER ANTENNA CONDUCTED SPURIOUS EMISSIONS

The test equipment was setup as shown in Figure 5. The Spectrum Analyzer was first tuned for a reference carrier level at the fundamental operating frequency. The output spectrum was then slowly scanned upward from 30 Mhz to 3 Ghz and back down again. Special attention was given to those frequencies which corresponded to possible harmonics and sub-harmonics.

The FCC limit for Antenna Conducted Spurious Emissions is 43 + 10 log P below the main carrier. For the KQ9LAUR with P = 6, watts nominal, (7.7815 Dbw/37.815 dbm), this corresponds to 50.7815 Db below the main carrier or a relative level of -13 Dbm. No emissions were detected within 20 Db of the FCC limit. The only emissions detected in fact were as follows:

Frequency (Mhz)	Level (dbuv)	Level (dbm)	FCC Limit (dbuv)
434.990	35.17	-71.83	94
652.490	25.41	-81.59	94

3.50 TRANSMITTER CASE RADIATED SPURIOUS EMISSIONS

Case Radiated Spurious Emission tests were conducted on the OATS Observations were made at one meter initially from the unit, and formally at three meters from the unit. Both polarizations, Vertical and Horizontal were studied, one to 4 meter height of receive antenna. The LAUR was also rotated 360 degrees on the turntable during these tests. The output spectrum, as received at one meter, was slowly scanned upward from 30 Mhz to 3000 Mhz back down again. Special attention was given to those frequencies which corresponded to possible harmonics and sub-harmonics.

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FIGURE 5 - ANTENNA CONDUCTED EMISSIONS TEST SETUP

```
********************* _____ BYPASSED IN RX MODE_____ *****************
*SPECTRUM ANALYZER  *                                *  LAUR         *
*                   **** ***** ********************* *               *
*  (SEE NOTE 1)     *    *****.                      *****************
*********************    FIXED
                         ATTENUATOR
                        AND/OR HIGH/
                      LOW PASS FILTERS
```

NOTES:

1.0 - IFR A-7550 SPECTRUM ANALYZER, SN 2347 AND RHODE & SCHWARZ ANALZER

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FIGURE 6 - CASE RADIATED SPURIOUS EMISSIONS TEST SETUP & VERIFICATION TEST SETUP

```
......................                     ....................
. SPECTRUM ANALYZER  .                     .                  .
.                    .-|-|               . .  EUT           .
.    (SEE NOTE 1)    . *Note 2           . .                  .
......................                     ....................
                                            ********************
                       |                    FLUSH CONDUCTIVE TURNTABLE
                       |
                       |-----1 meter----|
                       |-----3 meter----|
```

NOTES:

1.0 - IFR A-7550 SPECTRUM ANALYZER, SN 2347 AND AN HP141T SPECTRUM ANALYZER, SERIAL NUMBER 2205A21383.
RHODE & SCHWARZ ANALYZER

3.60 ANTENNAS & MAST UTILIZED FOR CASE RADIATED TESTS

AR SYSTEMS MODEL LPB-2520 LOG PERIODIC/BICONICAL ANTENNAS
APN101A PYRAMIDAL LOG PERIODIC
MOTORIZED WITH WITH EXTERNAL CONTROLLER,
1-4 METERS HEIGHT VARIATION

For the one meter test only:

G = 1.64 (gain of dipole over isotropic),
P = 6 watts and
R = 1 meters

therefore:

e = SQURT(30 x 1.64 x 6)/1 = 17.18138 volts/meter
= 144.702 Dbuv/m.

The FCC rules require case radiated signals to be attenuated by a factor of 43 + 10 log p or 43 + 10 log 6 = 50.7815 Db. Thus 144.702 Dbuv/m attenuated 50.7815 Db equals 93.92 Dbuv/m, or approximately 94 Dbuv/m.

3.70 SUMMARY OF ONE & THREE METER CASE RADIATED DATA

In the transmit mode, the LAUR had no case radiated emissions, other then the fundamental, at one or three meters. One must remember that the LAUR contains an EMI Gasket and is watertight.

3.80 SUMMARY

IC:	1317A-LAUR
FCC ID:	KQ9LAUR
APPLICANT:	SERCEL 17200 PARK ROW HOUSTON, TEXAS 77084
FREQUENCY RANGE:	215 – 250 MHZ US LIMITED TO 217 - 220 MHZ (and 216 TO 217 Mhz by licensees prior to January 01, 2002) CANADA LIMITED TO 217 to 218 and 219 –220 Mhz
FREQUENCY TOLERANCE:	PLUS AND MINUS .00025 PERCENT
RF POWER OUTPUT:	1.0 to 6.0 WATTS, NOMINAL Per FCC Rule Part 90.259 (a) (4) a waiver is required for operation above two (2) watts.
EMISSION DESIGNATOR:	200KD1D & 800KD1D
DESCRIPTION OF EMISSION:	THE MODULATING TECHNIQUE FOR THE LAUR IS CAN BE SET TO THE FOLLOWING BY SOFTWARE: 1. QPSK, EMSSION DESIGNATOR 200KD1D, DATA RATE 256 KILO BITS PER SECOND. 2. 16QAM, EMSSION DESIGNATOR 200KD1D, DATA RATE 512 KILO BITS PER SECOND. 3. DQPSK, EMSSION DESIGNATOR 800KD1D, DATA RATE 1024 KILO BITS PER SECOND.
USE:	FOR GEOLOGICAL EXPLORATION OF OIL AND NATURAL GAS BENEATH THE EARTH
OPERATING TEMPERATURE:	-30 TO + 55 DEGREES CENTIGRADE

3.90 **STATEMENT**

This equipment has been tested in accordance with the requirements contained in the appropriate Industry Canada and Federal Communications Commission regulations. To the best of my knowledge, these tests were performed using measurement procedures consistent with industry, the most up to date, ANSI FCC and Industry Canada standards and demonstrate that the equipment complies with the appropriate standards.

The manufacturer has been informed and understands that each unit marketed shall be manufactured to conform to the sample tested within the variations that can be expected due to quantity production and testing on a statistical basis.

All measurements were performed under the direction of Consolidated Spectrum Services, at Sercel Inc., 17200 Park Row, Houston, Texas 77084.

Respectfully Submitted,

Howard Epstein

Howard Epstein, President,
Consolidated Spectrum Services
22 Merrill Drive
Atkinson, NH 03811

On Behalf of:

Sercel INC.
17200 Park Row
Houston, Texas 77084

APPENDIX “A” – MANNER IN WHICH IFR A7550 WAS USED

IFR A7550 Spectrum Analyzer Detectors

For site calibration data from 30 - 1000 Mhz the peak detector was utilized, 200 Khz resolution bandwidth.

The guidelines for Verification are set by the American National Standards Institute (ANSI)in C63.4-2001. These guidelines were originally set by the Comite International Special Pertubations Radioelectroniques (CISPR) and call for quasi-peak detection.

On the A7550 Quasi-Peak measurements is valid only in the Linear Mode, with proper bandwidth. The quasi-peak detector utilized had a bandwidth of 120 Khz. The signal amplitude (in dbuv) is calculated from the formula A = T + X where:

A = value in dbuv
T = top of scale
X = value from table, attached

In conformance with the operating manual the A7550 was first used with the EUT turned off to null out the ambient spectrum. The ambient spectrum was nulled in steps of 30-100, 100 -200, 200-300 Mhz etc, as well as first looking at the entire band. We then stored the trace and subtracted it from the spectrum with the EUT on. Quasi-peak measurements were then made.

A-7550 SIGNAL AMPLITUDE VALUES IN LINEAR MODE

Table D-1 contains values calculated for measuring Signal Amplitudes in linear mode, in .05 division intervals. Table D-1 values for X are computed from the formula: X = 20 log (D ÷ 8); and are applied to the following formula to compute the Signal Amplitude (A): A = T + X.

T is the Top of Screen value in dBm, dBμW, dBV, dBmV or dBμV. D is the number of divisions from the <u>bottom</u> graticule of the screen.

Div	X	Div	X	Div	X	Div	X
8.00	0.00	6.00	-2.50	4.00	-6.02	2.00	-12.04
7.95	-0.05	5.95	-2.57	3.95	-6.13	1.95	-12.26
7.90	-0.11	5.90	-2.64	3.90	-6.24	1.90	-12.49
7.85	-0.16	5.85	-2.72	3.85	-6.35	1.85	-12.72
7.80	-0.22	5.80	-2.79	3.80	-6.47	1.80	-12.96
7.75	-0.28	5.75	-2.87	3.75	-6.58	1.75	-13.20
7.70	-0.33	5.70	-2.94	3.70	-6.70	1.70	-13.45
7.65	-0.39	5.65	-3.02	3.65	-6.82	1.65	-13.71
7.60	-0.45	5.60	-3.10	3.60	-6.94	1.60	-13.98
7.55	-0.50	5.55	-3.18	3.55	-7.06	1.55	-14.26
7.50	-0.56	5.50	-3.25	3.50	-7.18	1.50	-14.54
7.45	-0.62	5.45	-3.33	3.45	-7.31	1.45	-14.83
7.40	-0.68	5.40	-3.41	3.40	-7.43	1.40	-15.14
7.35	-0.74	5.35	-3.49	3.35	-7.56	1.35	-15.46
7.30	-0.80	5.30	-3.58	3.30	-7.69	1.30	-15.78
7.25	-0.86	5.25	-3.66	3.25	-7.82	1.25	-16.12
7.20	-0.92	5.20	-3.74	3.20	-7.96	1.20	-16.48
7.15	-0.98	5.15	-3.83	3.15	-8.10	1.15	-16.85
7.10	-1.04	5.10	-3.91	3.10	-8.23	1.10	-17.23
7.05	-1.10	5.05	-4.00	3.05	-8.38	1.05	-17.64
7.00	-1.16	5.00	-4.08	3.00	-8.52	1.00	-18.06
6.95	-1.22	4.95	-4.17	2.95	-8.67	0.95	-18.51
6.90	-1.28	4.90	-4.26	2.90	-8.81	0.90	-18.98
6.85	-1.35	4.85	-4.35	2.85	-8.96	0.85	-19.47
6.80	-1.41	4.80	-4.44	2.80	-9.12	0.80	-20.00
6.75	-1.48	4.75	-4.53	2.75	-9.28	0.75	-20.56
6.70	-1.54	4.70	-4.62	2.70	-9.43	0.70	-21.16
6.65	-1.61	4.65	-4.71	2.65	-9.60	0.65	-21.80
6.60	-1.67	4.60	-4.81	2.60	-9.76	0.60	-22.50
6.55	-1.74	4.55	-4.90	2.55	-9.93	0.55	-23.25
6.50	-1.80	4.50	-5.00	2.50	-10.10	0.50	-24.08
6.45	-1.87	4.45	-5.09	2.45	-10.28	0.45	-25.00
6.40	-1.94	4.40	-5.19	2.40	-10.46	0.40	-26.02
6.35	-2.01	4.35	-5.29	2.35	-10.64	0.35	-27.18
6.30	-2.07	4.30	-5.39	2.30	-10.83	0.30	28.52
6.25	-2.14	4.25	-5.49	2.25	-11.02	0.25	-30.10
6.20	-2.21	4.20	-5.60	2.20	-11.21	0.20	-32.04
6.15	-2.28	4.15	-5.70	2.15	-11.41	0.15	-34.54
6.10	-2.36	4.10	-5.81	2.10	-11.62	0.10	-38.06
6.05	-2.43	4.05	-5.91	2.05	-11.83	0.05	-44.08
						0.01	-58.06

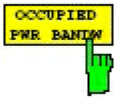
Table D-1 A-7550 Signal Amplitude (A) Values for X = 20 Log (D ÷ 8)

APPENDIX “B” – OCCUPPIED BANDWIDTH DETERMINATION BY RHODE & SCHWARZ ANALYZER

Occupied Bandwidth Measurement

An important characteristic of a modulated signal is the bandwidth which it occupies. The occupied bandwidth must be limited in a radio communications system so that disturbance-free transmission in adjacent channels is possible. The occupied bandwidth is defined as the bandwidth in which a defined percentage of the total transmitter power is contained. The percentage of the power can be set between 10 and 99% in the FSIQ.

MARKER NORMAL menu:



The *OCCUPIED PWR BANDW* (occupied power bandwidth) softkey starts the measurement for determining the occupied bandwidth.
In the spectrum display mode, the bandwidth is determined in which a predefined percentage of the power in the displayed bandwidth is contained. (selectable in the *POWER MEAS SETTINGS* sub-menu with the : *% POWER BANDWIDTH* softkey*)*. The occupied bandwidth is output to the marker display field and marked on the measurement curve with temporary markers.

Measurement principle:

For example, the bandwidth is to be found in which 99% of the signal power is contained. The routine calculates first the total power of all displayed points (pixels) of the measurement curve. In the next step, the measurement points from the right edge of the measurement curve are integrated until 0.5% of the total power is reached. Then the FSIQ integrates, in an analog fashion, from the left edge of the measurement curve until 0.5% of the power is reached. The delta marker is positioned at this point. Thus, 99% of the power is located between the two markers. The difference between the two frequency markers is the occupied bandwidth which is displayed in the marker info field.

A prerequisite for the correct operation of the measurement is that **only** the signal to be measured is visible on the display screen of the FSIQ. An additional signal would falsify the measurement.

In order to be able to perform correct power measurements, especially for noisy signals, and thus to achieve the correct occupied bandwidth, the selection of the following parameters should be observed:

RBW	<< occupied bandwidth (≤ approx. 1/20 of the occupied bandwidth, for voice communications, typ. 300 Hz or 1 kHz)
VBW	≥ 3 x RBW
detector	sampling
span	≥ 2 to 3 x occupied bandwidth

According to the application or other measurement guidelines, it may be necessary or reasonable to average a definite number of sweeps in order to achieve a usable value for the occupied bandwidth.
This is provided by the *TRACE* (1....4) key group and the averaging function. With the *SWEEP COUNT* softkey, the number of averages is defined.
Some measurement instructions (e.g. PDC, RCR, STD-27B) require the occupied bandwidth to be measured by means of a peak detector. In this case, the detector of the FSIQ must be corrected appropriately.

APPENDIX “C”

OATS CALIBRATION DATA

OATS LOCATION & SIZE

The OATS measured 8.5 meters by 14.6 meters. The OATS was constructed on a plywood platform with a metal ground plane over it. This was covered with a thin sheet of wood to protect the ground plane. At night we placed a tarp over the ground plane, purposely left visible in the photograph, to protect it from dew. It was located in a field adjacent to the Sercel Cable Manufacturing Plant, 17200 Park Row, Houston, Texas.

Hours of testing were 6:30 AM to 6:30 PM on December 06 – 11. The Temperature was roughly 60 degrees.

Additional development has occurred at this site. We were concerned that it would effect the calibration of the site. A photo is attached. The fence is roughly 18 meters beyond the edge of the test site. Our test position was roughly 6.5 meters toward the fence and beyond the ground plane.

OATS CALIBRATION

Two Bicolon Log Periodic Antennas were utilized. Both were Antenna Research LPB2520/A, Serial Numbers 1189 & 1221.

The mutual impedance correction factors for broadband antennas is zero.

A Marconi 2022E Signal generator was utilized to feed the transmit antenna. This antenna was kept at a fixed height and the receive antenna was varied between 1 and 4 meters.

The equation used to calibrate the site was:

An = Vdirect – Vsite – Txfactor – Rx factor

Where: An = Normalized Site Attenuation (db)

Vdirect = reading with the two cables disconnected from the antenna and connected to each other.

Vsite = reading with cable connected to antennas and receive antenna optimized 1-4 meters.

Txfactor – transmit antenna factor

Rxfactor – receive antenna factor

Frequency (Mhz)	Polarization V or H h_1=1, h_2=1-4 meters	Vdirect (dbuV)	Vsite (dbuV)	Adjusted Site Attenuation (db)	Aftx (db)	Afrx (db)	An Measured (db)	An Therotical (db)	An Deviation (db)
30	H	107.0	52.4	54.6	18.0	19.4	17.2	15.8	-1.4
35	H	107.0	57.0	50.0	16.8	18.6	14.6	13.4	-1.2
40	H	107.0	61.8	45.2	14.8	17.8	12.6	11.3	-1.3
45	H	107.0	64.0	43.0	15.9	16.3	10.8	9.4	-1.4
50	H	107.0	69.8	37.2	13.3	14.8	9.1	7.8	-1.3
60	H	107.0	79.4	27.6	10.4	10.4	6.8	5.0	-1.8
70	H	107.0	89.3	17.7	6.2	7.0	4.5	2.8	-1.7
80	H	107.0	91.8	15.2	7.2	8.6	-0.6	0.9	1.5
90	H	107.0	88.0	19.0	11.1	10.5	-2.6	-0.7	1.9
100	H	107.0	88.9	18.1	10.6	11.3	-3.8	-2.0	1.8
120	H	107.0	87.8	19.2	11.9	12.0	-4.7	-4.2	0.5
140	H	107.0	93.0	14.0	12.0	9.8	-7.8	-6.0	1.8
160	H	107.0	97.6	9.4	7.8	10.6	-9.0	-7.4	1.6
180	H	107.0	99.3	7.7	8.6	9.5	-10.4	-8.6	1.8
200	H	107.0	99.2	7.8	9.1	10.2	-11.5	-9.6	1.9
250	H	107.0	92.5	14.5	12.4	12.5	-10.4	-11.7	-1.3
300	H	107.0	94.0	13.0	13.8	13.5	-14.3	-12.8	1.5
400	H	107.0	92.3	14.7	14.7	15.8	-15.8	-14.8	1.0
500	H	107.0	91.6	15.4	16.4	17.1	-18.1	-17.3	0.8
600	H	107.0	90.0	17.0	18.1	18.6	-19.7	-19.1	0.6
700	H	107.0	88.2	18.8	19.4	20.3	-20.9	-20.6	0.3
800	H	107.0	87.5	19.5	19.7	20.8	-21.0	-21.3	-0.3
900	H	107.0	86.0	21.0	20.9	22.0	-21.9	-22.5	-0.6
1000	H	107.0	85.5	21.5	21.8	22.7	-23.0	-23.5	-0.5

Frequency (Mhz)	Polarization V or H h_1=1, h_2=1-4 meters	Vdirect (dbuV)	Vsite (dbuV)	Adjusted Site Attenuation (db)	Aftx (db)	Afrx (db)	An Measured (db)	An Therotical (db)	An Deviation (db)
30	V	107.0	61.0	46.0	17.4	18.5	10.1	8.2	-1.9
35	V	107.0	62.9	44.1	17.8	17.7	8.6	6.9	-1.7
40	V	107.0	67.6	39.4	15.0	16.8	7.6	5.8	-1.8
45	V	107.0	68.0	39.0	16.6	15.5	6.9	4.9	-2.0
50	V	107.0	72.7	34.3	13.6	14.2	6.5	4.0	-2.5
60	V	107.0	82.3	24.7	9.3	10.9	4.5	2.6	-1.9
70	V	107.0	89.4	17.6	7.2	8.2	2.2	1.5	-0.7
80	V	107.0	88.8	18.2	8.9	8.5	0.8	0.6	-0.2
90	V	107.0	87.1	19.9	9.8	9.7	0.4	-0.1	-0.5
100	V	107.0	85.9	21.1	11.5	10.7	-1.1	-0.7	0.4
120	V	107.0	86.7	20.3	11.5	10.6	-1.8	-1.5	0.3
140	V	107.0	86.3	20.7	13.9	9.2	-2.4	-1.8	0.6
160	V	107.0	90.9	16.1	7.8	9.7	-1.4	-1.7	-0.3
180	V	107.0	89.6	17.4	8.9	9.4	-0.9	-1.3	-0.4
200	V	107.0	91.1	15.9	9.2	10.7	-4.0	-3.6	0.4
250	V	107.0	88.9	18.1	12.9	12.8	-7.6	-7.7	-0.1
300	V	107.0	88.3	18.7	14.2	14.4	-9.9	-10.5	-0.6
400	V	107.0	89.6	17.4	14.7	15.6	-12.9	-14.0	-1.1
500	V	107.0	86.2	20.8	16.4	18.8	-14.4	-16.4	-2.0
600	V	107.0	86.5	20.5	18.7	18.7	-16.9	-16.3	0.6
700	V	107.0	86.1	20.9	19.8	20.0	-18.9	-18.4	0.5
800	V	107.0	85.2	21.8	20.3	21.9	-20.4	-20.0	0.4
900	V	107.0	83.4	23.6	21.2	22.8	-20.4	-21.3	-0.9
1000	V	107.0	84.2	22.8	21.5	23.4	-22.1	-22.4	-0.3

SITE PHOTOGRAPH

APPENDIX D – EXPOSURE OF HUMANS TO RF HAZARD

Exposure of Humans to RF Electromagnetic Fields

Applications to the FCC, or Industry Canada for the equipment construction permit, license to transmit or renewal thereof, and equipment authorization (certification) or modifications in existing facilities must have an RF evaluation confirming compliance with the limits for Maximum Permissible Exposure (MPE) by the certification applicant, based on the calculated or measured field strength value. The FCC's Rules and Regulations, 47 CFR 1.1311, 2.1091 and 2.1093 and the procedures of RSS-102 must be followed confirming human exposure levels to RF electromagnetic fields.

FCC polices, guidelines and requirements of OET Bulletin 65 (edition 97-01) and RSS-102 Industry Canada discuss the applicability of the standard in terms of the distance by which antenna is separated from the body of the users or nearby persons. Body-worn or push-to-talk devices must be evaluated for Specific Absorption rate (SAR) effects on users. (SAR is a measure of the rate at which the body absorbs RF energy.) Equipment for which radiating antenna is normally separated 20 cm or more away from users are not subject to SAR tests. If so desired in lieu of a RF evaluation of field strength limits. The FCC 's and Health Canada Safety Code 6's MPE limits for field strength and power density are given in Table 1 and Table 2.

TABLE 1

FCC and Health Canada Safety Limits for Maximum Permissible Exposure (MPE)

(A) Limits for Occupational/Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (Pd) (mW/square cm)	Averaging Time Pd or Square E and H
0.3 - 3.0	614	1.63	(100)*	6
3.0 - 30	1842/f	4.89/f	(900/square f)*	6
30 - 300	61.4	0.163	1.0	6
300 - 1500	- -	- -	f/300	6
1500 - 100,000	- -	- -	5	6

(B) Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (Pd) (mW/square cm)	Averaging Time Pd or Square E and H
0.3 - 1.34	614	1.63	(100)*	30
1.34 - 30	824/f	2.19/f	(180/square f)*	30
30 - 300	27.5	0.073	0.2	30
300 - 1500	- -	- -	f/1500	30
1500 - 100,000	- -	- -	1.0	30

f = frequency in MHz * Plane-wave equivalent power density

TABLE 2

FCC and Health Canada Safety Limits for localized (Partial-body) Exposure

Specific Absorption rate (SAR)			
Occupational/Controlled Exposure (100 kHz - 6 GHz)		General Uncontrolled/Exposure (100 kHz - 6 GHz)	
< 0.4 W/kg	whole-body	< 0.08 W/kg	whole-body
< = 8 W/kg	partial-body	< = 1.6 W/kg	partial-body

The RF evaluation must use the Maximum Exposure Limits given in Table 1. The table 1(B) specifies that in the 30 - 300 MHz portion of the spectrum, exposure shall be limited to fields of 27.5 V/m.

The installation instructions given in the Sercel 408UL Installation Manual (Chapter 7, LAUR Radio Acquisition Unit) indicates that all of the antennas are intended to be mast-mounted on a portable 8-meter telescopic mast. We may assume this would place them at least 6 meters from personnel on the ground while the system is in operation.

Worst-case exposures created by the Line Acquisition Unit Remote (LAUR) transmitter and associated antenna can be calculated using information taken from the 408UL Installation Manual and measurements performed.

The field strength in Volts/meter can be calculated using the expression:

$$Er = [(30\ Pt\ Gr)^{1/2}] / d$$

Where:

Pt = Transmit power including feed line loss in watt,
Gr = antenna gain over an isotropic source (numeric ratio, not dB), and
d = the distance from antenna at which a measurement would be made.

Based on the specification of the LAUR we have:

Transmitter output power Pt:	6.0 watts(37.78 dBm) maximum
Omnidirectional antenna gain Gr:	1.5 dBi (1.41 numeric ratio)
Antenna height:	1.68 (or 3.12) meters
Loss of feed line cable of 1 meters:	0.1 dB

Then the maximum field strength developed at 2 meters from the antenna will be 7.96 V/m. The power density is 0.168 W/square meter (0.016 mW/square center meter).

These calculations indicate that exposures to electric fields generated by the low-gain vertical antennas are within the limits prescribed by Tables 1 and 2.

CONCLUTION:

The Line Acquisition Unit Remote (LAUR) transmitter complies with the requirements of FCC and Canada, Exposure of Humans to RF Fields.
RF exposure from the LAUR is within the exposure limits established by FCC and Canada.