

NDB Systems for the Offshore Market

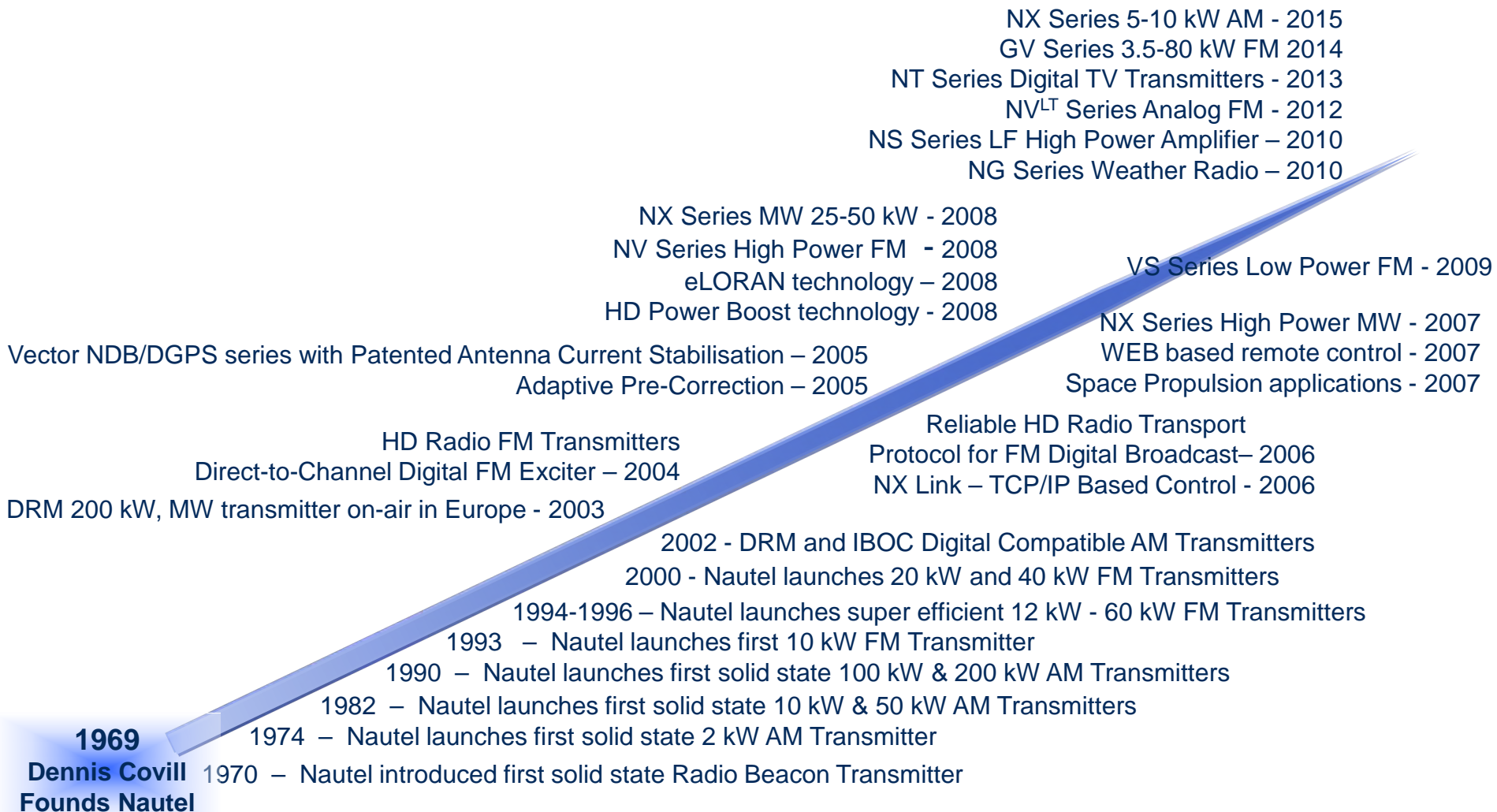
Gary Galbraith, P.Eng.
Technical Sales Representative,
Navigational Products



Corporate History

- Design, manufacture, sales and support of
Navigational products
AM and FM broadcast transmitters
Industrial RF & Communications products
Sonar
- Established in 1969 (**50th anniversary in 2019!**)
- Products installed in over 177 countries
- Exceptional field reputation for reliable products
- Dedicated, long-term staff
- Quality Management System audited by Bureau Veritas and registered/certified to **ISO 9001:2015**.

50 Year History of Innovation



Product Lines

- MF AM radio broadcast transmitters (both analog and digital)
- VHF FM radio broadcast transmitters (both analog and digital)
- **LF/MF Navigational non-directional radio beacon (NDB) transmitter systems**
- LF/MF Differential Global Positioning System (DGPS) transmitters
- MF NAVTEX transmitter systems
- HF amplifiers and tuning/matching networks for industrial applications and plasma rocket engines
- Next Generation eLORAN (Long Range Navigation) transmitters
- LF/VLF communications transmitters
- VHF FM weather radio transmitters
- LF Sonar amplifiers

Worldwide Navigation Customers

FAA

USCG

USAF

US FHWA

CCG

NAV Canada

**AirServices
Australia**



**World Wide Civil Aviation
Authorities**

ONGC

Shell

INFRAERO

SAIPEM

ICAO

**Worldwide Offshore
Systems Integrators**

Design Capabilities

- Multidisciplinary Research & Development team of over 40 technical staff
- In-house design skills:
 - Solid state amplifier design from 100 kHz to 200 MHz
 - Antenna Design and Computer Simulation
 - Analog and Digital Communications theory
 - RF matching, combining and filtering at high power and high voltages
 - RF Magnetics
 - Power Supplies
 - Digital Hardware Design
 - Digital Signal Processing
 - Data Communications Systems
 - Networking and TCP development

Facilities



Nautel Limited

Nova Scotia, Canada:

- Headquarters
- Design, Production
- + 70,000 sq. ft.



Nautel Maine, Inc.

Maine, USA:

- Production
- + 36,000 sq. ft.



Nautel C-Tech

Ontario, Canada:

- Sonar products
- Design, Production

Additional Parts Depots - Memphis, TN USA & Cranleigh, Surrey UK

Customer Service Center – Quincy, IL USA

Production Capabilities



Computerised Fabrication Shop



PWB Assembly



Light Assembly



Final Assembly



Final Production Test



Packing and Shipment

Quality Manufacturing

- Quality Management System registered/certified to the **ISO9001:2015** international quality standard
- products built to stringent quality standards with industry leading features, performance, and reliability
- products are the result of the pride and craftsmanship of dedicated professionals
- each product is assembled by a team of individual people - no assembly robots or fabrication lines
- production staff with an average of 15 years experience
- Nautel controls every aspect of production from workmanship to electrical components to sheet metal fabrication

Product Families

AM



J1000



NX3



NX5



NX10



NX15



NX25



NX50



NX100 to 2 MW

FM



VS Series



NVLT Series



GV Series

Navigation



Vector Series NDB/DGPS/Navtex



NDB/DGPS/Navtex Antenna Tuning Units



NL Series Next Generation Loran



LF Antennas



Industrial RF



HF Amplifier



LF/VLF Comms



NG Series
Weather Radio Transmitters

SONAR

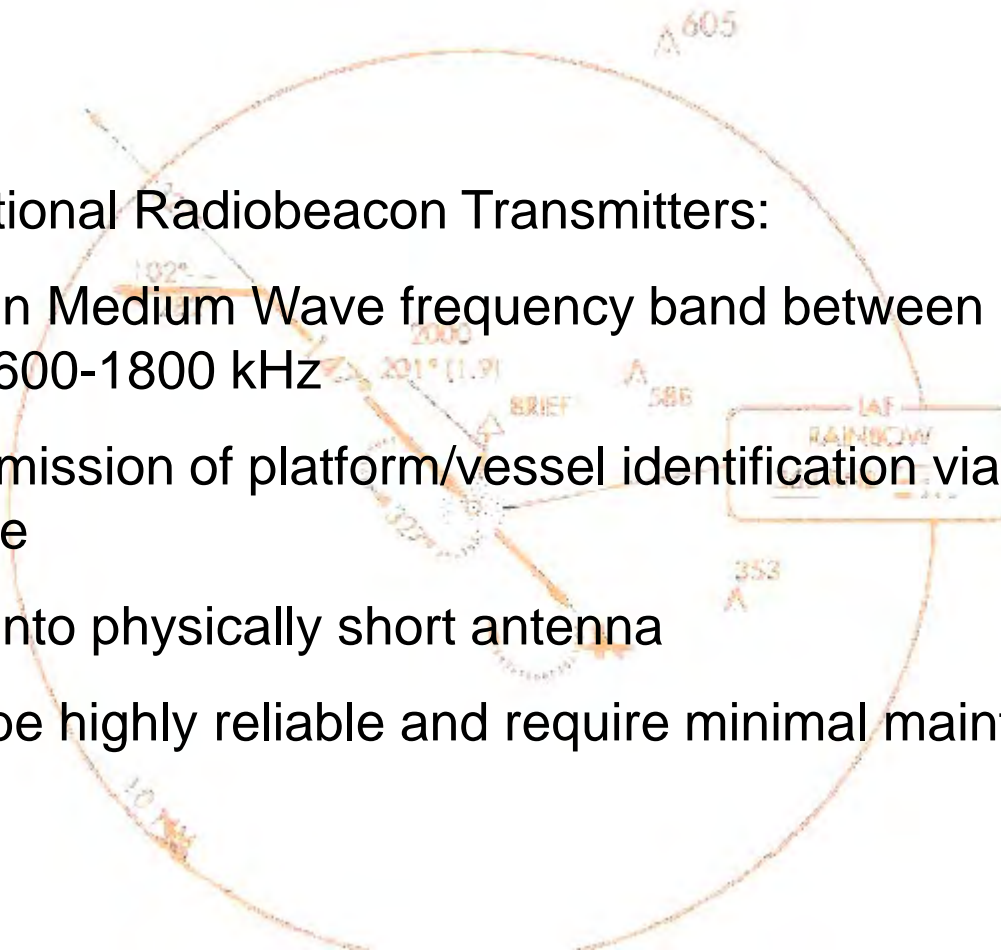


NS Series
LF High Power Amplifier

NDB Overview

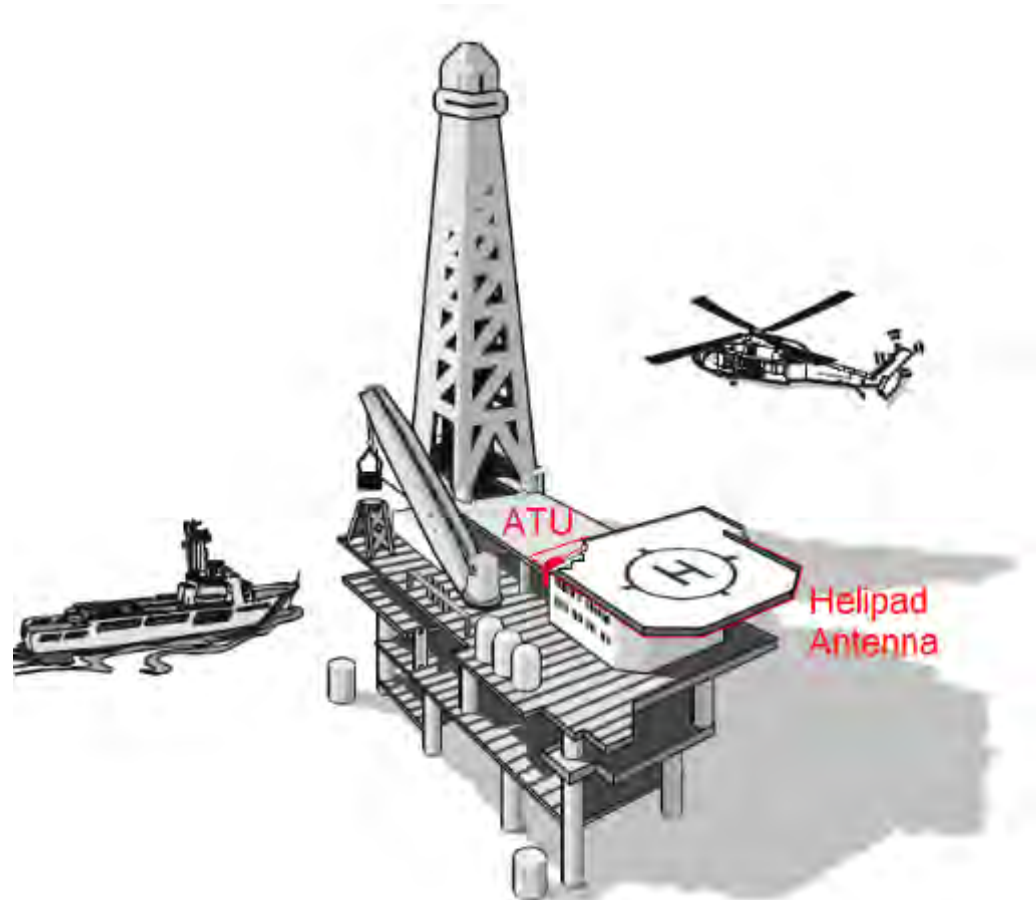
Non-Directional Radiobeacon Transmitters:

- Operate in Medium Wave frequency band between 190-1250 kHz and 1600-1800 kHz
- AM transmission of platform/vessel identification via keyed Morse code
- Operate into physically short antenna
- Need to be highly reliable and require minimal maintenance



NDB Overview

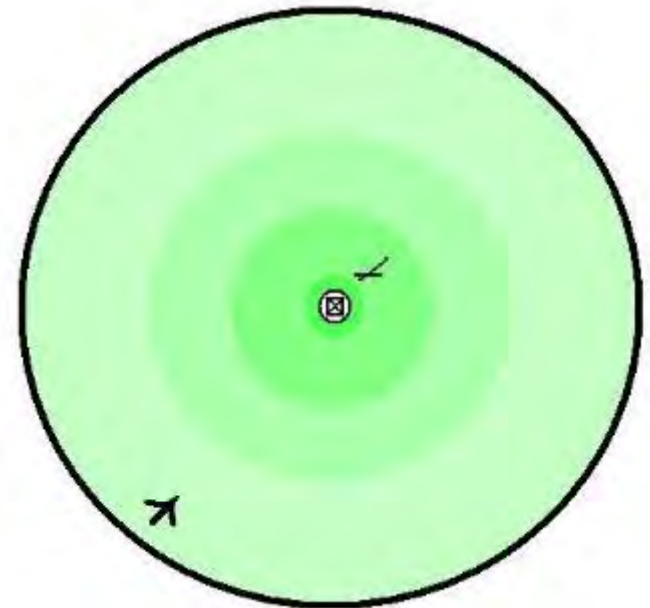
- Used to guide helicopters to offshore platforms and vessels
- Helipad antenna provides reasonably efficient radiation, with no vertical obstruction



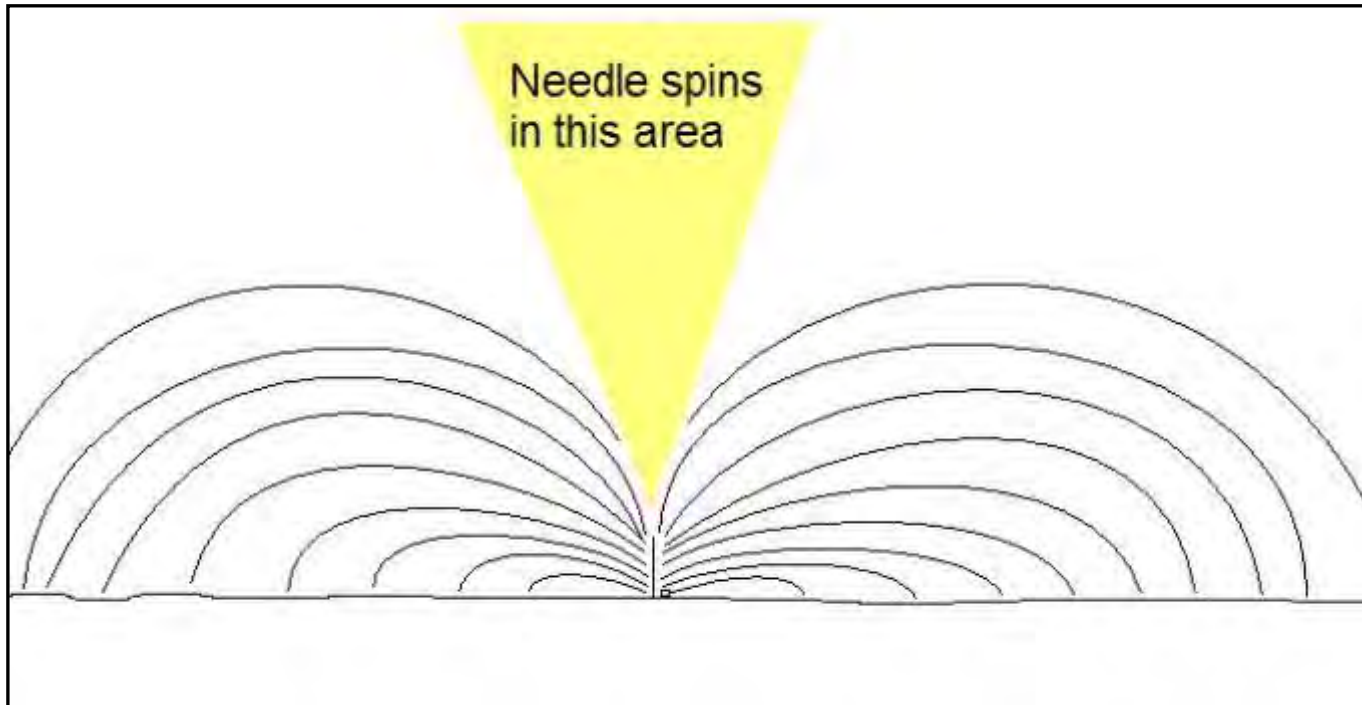
NDB Overview

ADF Receiver:

- Located in helicopter, consisting of simple frequency selectable receiver, indicator, and rotating antenna
- Acts as a field strength meter, with a direction finding needle
- Needle points toward strongest indicated source of selected frequency, based on antenna position
- As the helicopter approaches the NDB, the signal strength increases and the needle indicates the direction of the platform or vessel



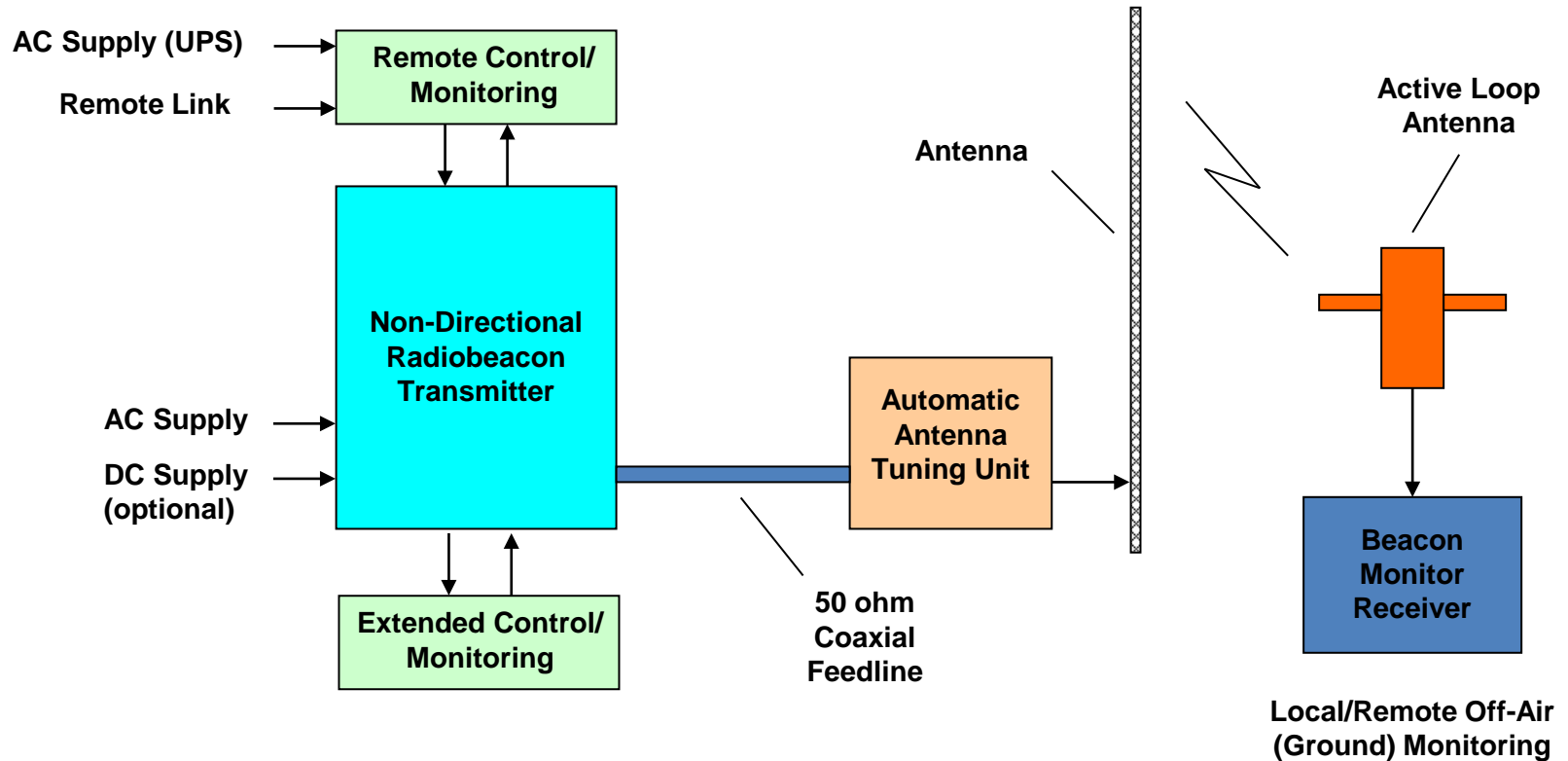
NDB Overview



- In almost all cases, radiation is omnidirectional
- Structures can cause reflections and false readings on cockpit instruments

NDB Overview

TYPICAL NDB SYSTEM



Offshore NDB System Components

VR125



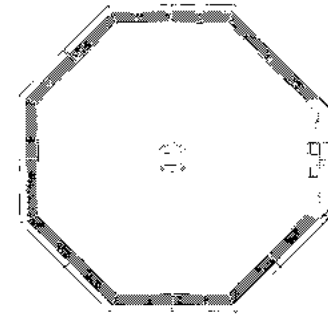
125 W NDB Transmitter

ATU500SROS



Antenna Tuning Unit

CL-HD



Antenna

VR-Link2 with ECMP3



*Remote Control/Monitor with
Extended Control/Monitor Panel*

NRB4



Beacon Monitor Receiver

NLA/2



Active Receiving Loop Antenna

Product Application

VR125 (NDB Transmitter)

- 125 watt transmitter used to guide helicopters to offshore oil drilling platforms or vessels with a bearing via ADF (compass)

ATU500SROS (Automatic Antenna Tuning Unit)

antenna tuning unit used to match the 50 ohm output impedance of the transmitter to the impedance of the antenna system (typically a lower resistance and some value of capacitance base on the geometry of the antenna)

Antenna

- used to radiate the required signal and may be either a whip antenna or Helideck antenna configuration

Product Application

ECMP3 (Extended Control/Monitoring Panel)

- used to provide extended remote control and monitoring of the NDB system with connection to the transmitter via parallel wiring

VR-Link2 (Remote Control/Monitoring Unit)

used to provide remote control and monitoring of the NDB system, at greater distances than that provided by the ECMP3, via a hosted web page and via ECMP3 over serial connection

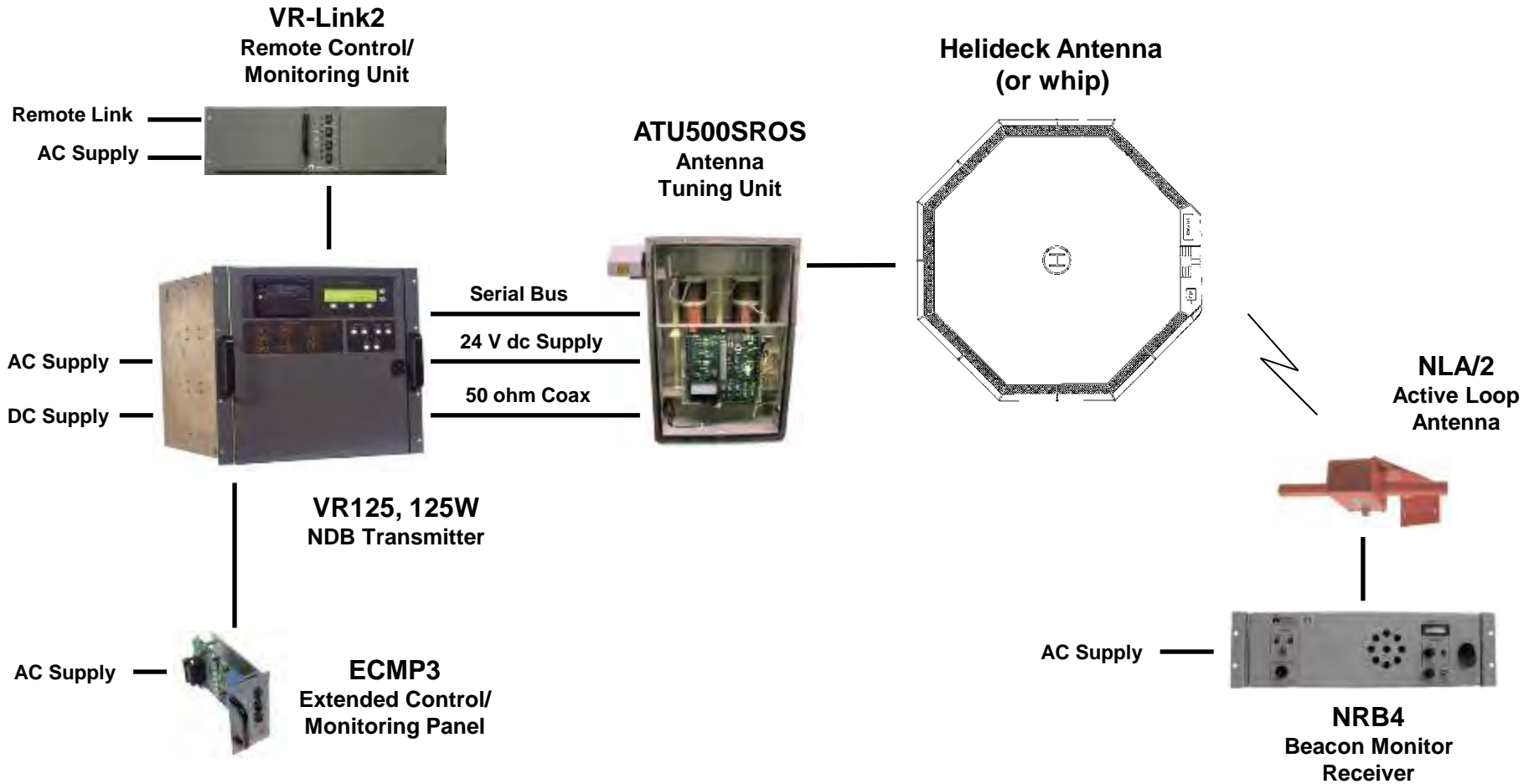
NRB4 (Beacon Monitor Receiver)

- used to provide “off-air” monitoring of the NDB system by receiving and monitoring key parameters of the transmitted signal

NLA/2 (Active Receiving Loop Antenna)

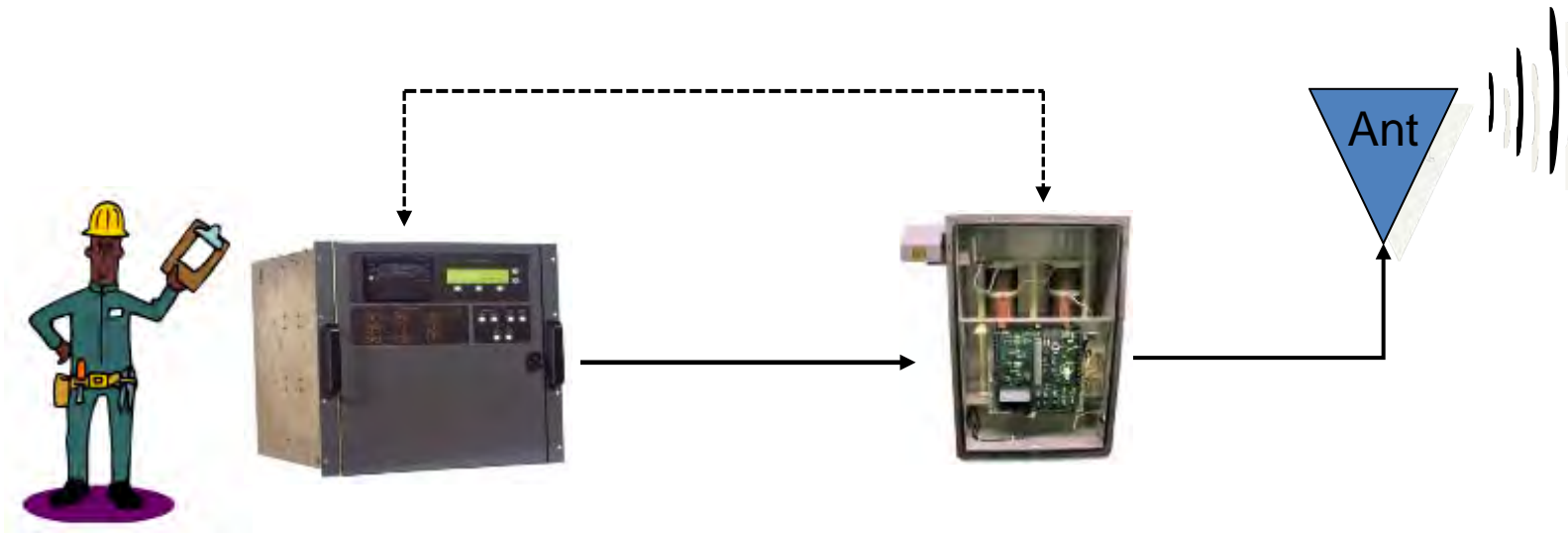
- use in conjunction with the NRB4 to receive and monitor the “off-air” signal from the NDB system

125 Watt Offshore NDB System



Vector System

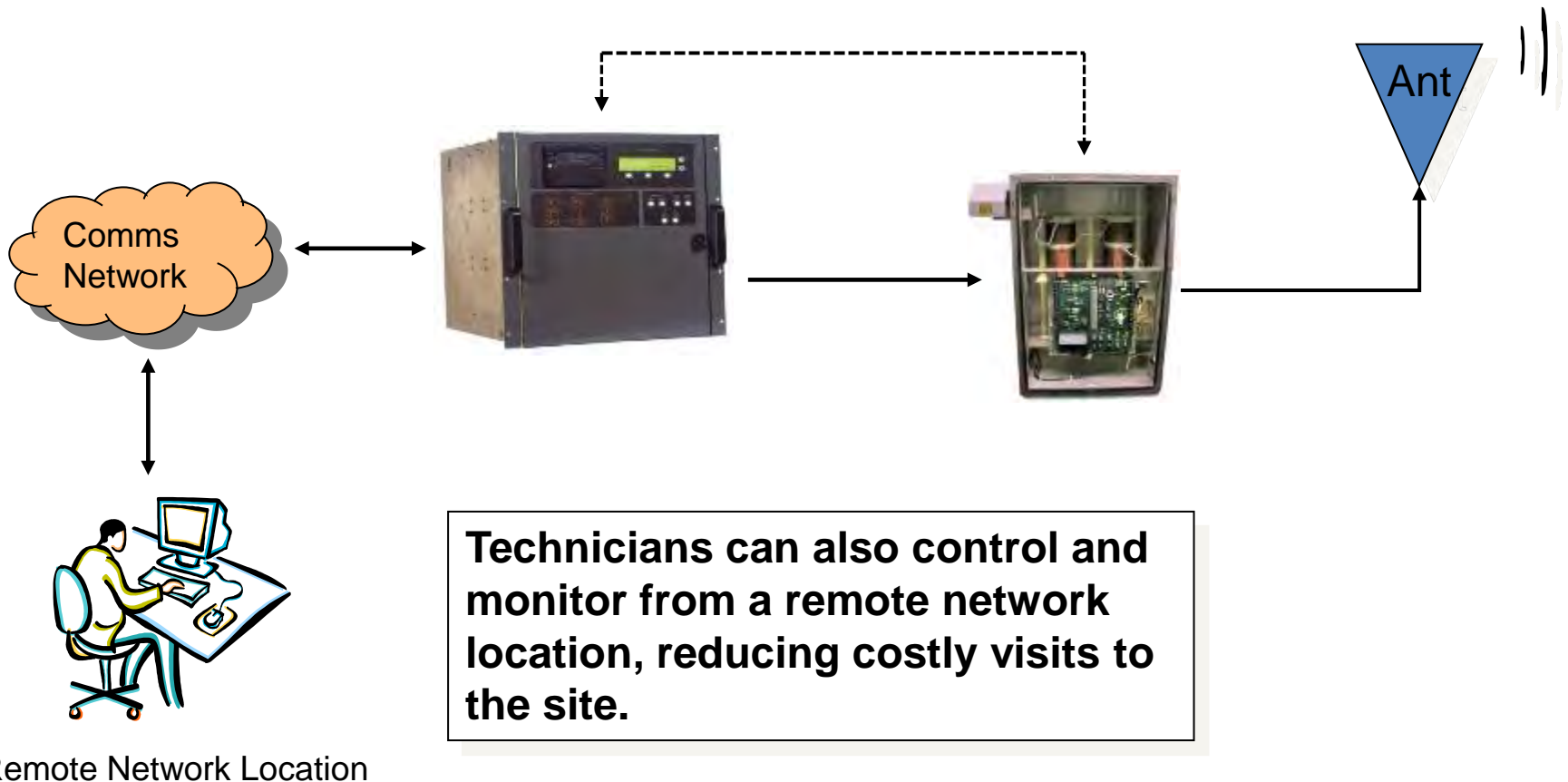
Vector Remote Control and Monitoring



Serial interface bus allows a technician to control and monitor the ATU from the transmitter, where the RF field is well below unsafe levels.

Vector System

Vector Remote Control and Monitoring



VR125 NDB Transmitters

- Built in Diagnostics allows the user to easily identify fault to Lowest Repairable Unit locally or remotely
- Non operational side can be tested locally or remotely without need for dummy load while main side remains on air
- Available in Single and Dual Configurations
- Remote control and monitor of the ATU limits worker exposure to strong RF fields
- Enhanced Remote Control/Monitor to extended and remote control/monitoring locations



VR125 (125 W) NDB Transmitter

Exciter/Monitor

- Available with Single or Dual Direct Digital Synthesizer, LVPS, modulator driver, keyer, monitor
- Analog and digital metering
- Remote Interface with several standard and optional configurations
- Simple LCD graphical user interface



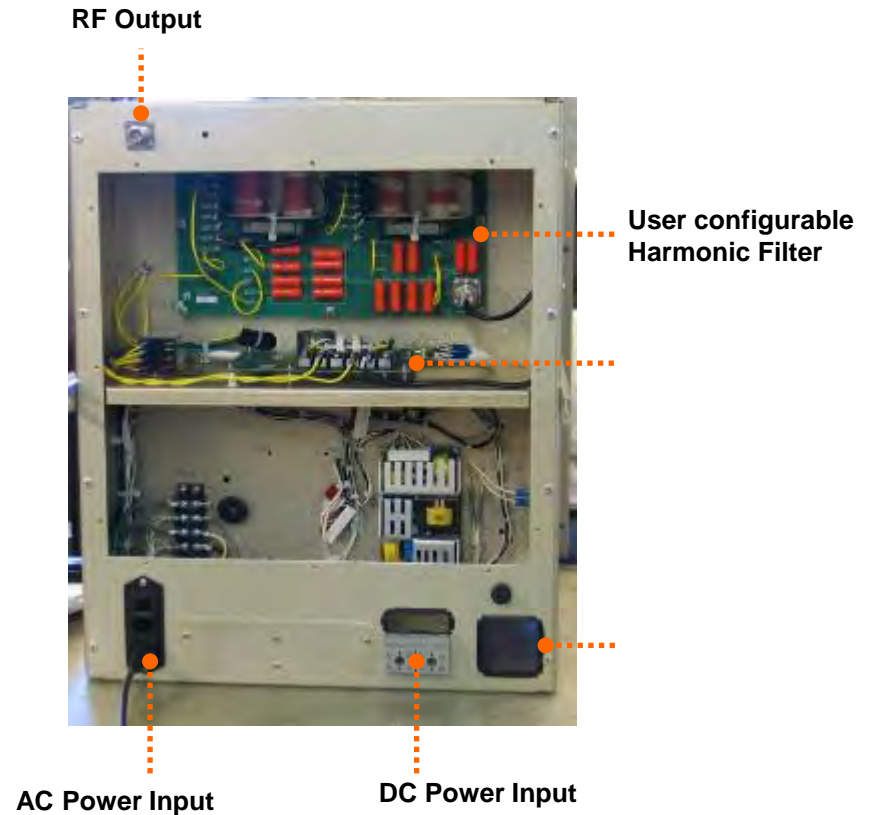
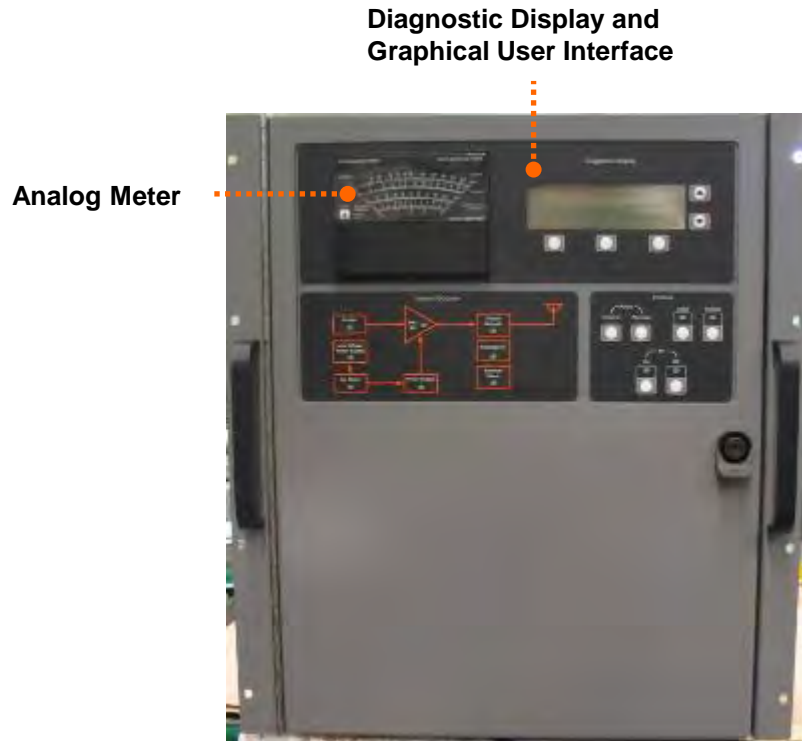
125 W RF Power System

- Available with Dual or Single Highly efficient power modules containing PAs, modulators, SMPS
- Frequency agile harmonic filter

Back-up DC Supply Option

- +24 V dc or + 48 V dc Input is optional with reverse polarity protection and low voltage disconnect
- External +24 V dc or + 48 V dc Battery charger available

VR125 Front and Rear View



VR125 Graphical User Interface and Display

Analog Meter

User configurable display including, but not limited to, any one of any one of the following parameters: Forward Power, Reflected Power, Antenna Current, Modulation Percentage, DC Voltages, DC Current, VSWR, AC Voltage, Transmitter Temperature and PA Volts

System Diagram

Provides user with local display of the status of the critical blocks within the transmitter



Diagnostic Display

Allows complete local transmitter and ATU control, status and local/remote health monitoring and provides a 256 event log

VR125 - 125 W Power Module



Highly Efficient
Pulse Duration Modulator (PDM)

PDM Filter

Highly Efficient
Class D Power Amplifier

Impedance Matching
RF Transformer

Switch Mode Power Supply

90 V ac to 270 V ac (Vector 125),
47 Hz to 63 Hz without need for
adjustment

VR125 Exciter



Direct Digital Synthesizer

Single channel with 100 Hz steps having a Frequency Stability of $\pm 0.0003\%$ over full environmental range

Exciter Interface

Contains circuitry to switch exciters when dual and provides interface between exciter pwbs and the other blocks contained in the transmitter

Exciter/Monitor/Generator

Monitors critical ICAO parameters and contains microprocessor controlled keyer for ease of programming of 1,2,3,4,5 or 6 Morse letters or numbers, Frame lengths of 4 to 20 seconds, Sequence repetitions, standby codes and Keyed Tone Frequencies of 400 Hz or 1,020 Hz $\pm 5\%$

Modulator Driver Pwb

Creates the low level drive signal for the Pulse Duration Modulator which includes line voltage compensation

+24 VDC Supply Output for ATU

VR125 Control/Monitor

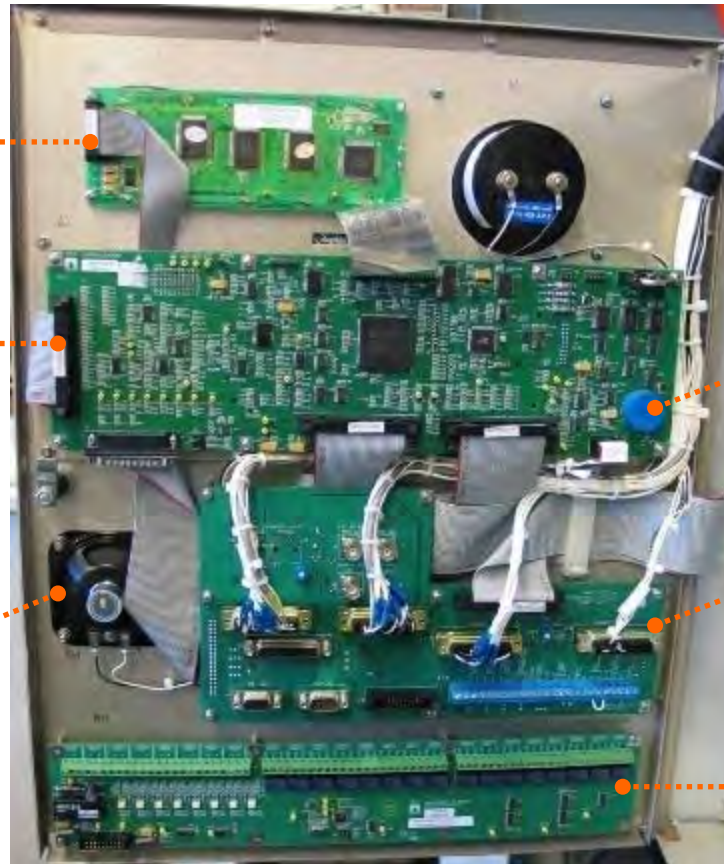
Liquid Crystal Display

Control/Display Pwb

Performs most of the operations associated with control, monitor, protection and display for the transmitter. It is essentially the "brain" for the Vector.

Speaker

Allows user to audibly monitor the Identification Code



Sonalert

Provides user capability to configure alarms to be audible

Remote Interface

Contains user interface connections for ATU Control/Monitor and Remote Control/Monitor

Site Control/Monitor

Contains 16 optically isolated monitor inputs and 16 form C contact relay closure control points to allow the Vector local or remote control/monitor to control/monitor other equipment at the site

Carrier Frequency and Emission Modes

- Standard NDB carrier frequency band (190 kHz – 535 kHz) or Extended band (536 kHz – 1250 kHz and 1600 kHz - 1800 kHz) for VR125
- NON (CW no modulation)
- A2A (MCW double sideband keyed tone)
- A2A & A3E (Simultaneous AM double sideband telephony and MCW double sideband keyed tone)

Monitor Failure Thresholds

Adjustable threshold normally set so that changeover can occur if:

- Carrier power reduces more than 3 dB
- Carrier power increases more than 2 dB
- Modulation level reduces more than 4 dB
- Incorrect or no identification code

Harmonics, Hum & Noise, Distortion

- Harmonic Levels not exceeding -70 dB relative to carrier when used in conjunction with an ATU500SR into a standard antenna load
- Hum and Noise not exceeding -50 dB relative to 1,020 Hz at a modulation level of 95%
- Audio Distortion Less than 3% at 95% modulation

Reliability & Repair Time

MTBF Transmitter

- Greater than or equal to 12,590 hours for single and 17,640 hours for dual using MIL_HDBK 217E calculation methods

MTTR Transmitter

- Less than or equal to ½ hour at PWB/module level

Environmental

Environmental Limits

Operating: -30°C to +55 °C
 0% to 95% relative humidity

Storage: -30°C to +70 °C
 0% to 95% relative humidity

Climate

Any including tropical

Altitude

Up to 3, 048 m (10, 000 ft)

Input Power Requirements

VR125

Single phase 90 V ac to 270 V ac, 50/60 Hz, 500 VA maximum;
24 V dc @ 12.6A max or 48 V dc @ 6.3A max

Compliances

- Designed with intent to comply with Safety Code 6, IEEE C95.1-1999
- Industry Canada RSS-117
- ICAO Annex 10, Volume 1, Part 1, Section 3.4
- R&TTE 1999/5/EC
- ISTA Procedure 1A/1B
- Compliance with EN60215:1996 safety requirements for radio transmitting equipment
- Green Passport requirements
- ANATEL
- SIRIM
- FCC

Warranty

Standard Warranty

- 36 months from date of shipment

Extended Warranty

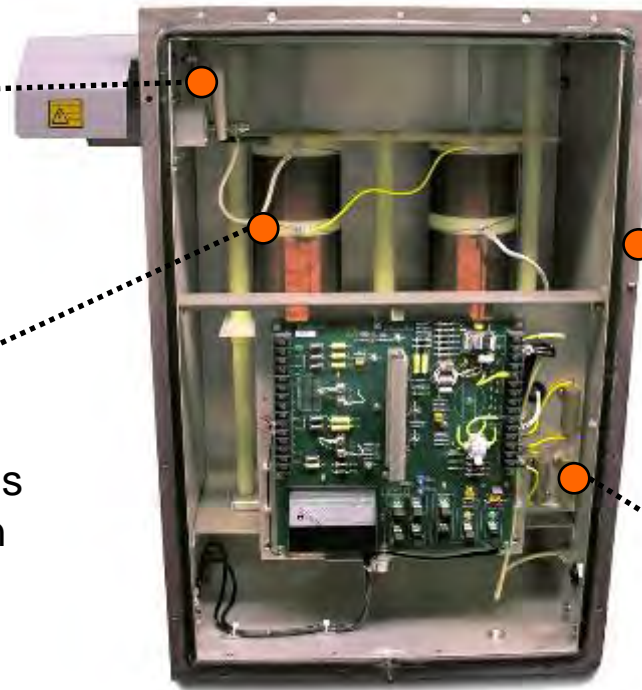
- available option

Options

- Dual operation
- + 48 V dc back-up operation
- + 24 V dc back-up operation
- External Battery charger
- Extended warranty
- Extended frequency band (536 kHz – 1250 kHz and 1600 kHz – 1800 kHz)
- Extended and/or remote control/monitoring
- CSA Special Inspection
- 19 inch deluxe [185.9 cm H (73.2 in) and 104 cm H (40.9 in) available] or IP66 Cabinet

ATU500SROS Antenna Tuning Unit

ATU500SROS



Adjustable Spark Gap
with intrinsic static drain

Servo Controlled and
Automatic Fine Tuned
Astatic pair of Loading coils
which can be connected in
series or parallel for
maximum agility

IP66 rated enclosure
manufactured from Marine
Grade Aluminum with
protective finish suitable for
global environments

Bandwidth Optimization to
minimize VSWR, sideband
attenuation and distortion as
compromise between bandwidth
and range

125 W Antenna Tuning Unit

ATU500SROS Features

Remote Control/Monitor

- May be controlled and monitored at the VR125 transmitter and remotely via the VR-Link2 remote control/monitor unit

Bandwidth Limitation Solution

- Selectable series resistance
- Optimize range/bandwidth
- Minimize VSWR, sideband attenuation and distortion

ATU500SROS Specifications

Technical Specifications:

Maximum Carrier Power: 200 Watts

Maximum Peak Envelope Power: 500 Watts

Carrier Frequency Range: 190 kHz to 1800 kHz

Input Impedance: 50 ohms, nominal

Antenna Capacitance: 125 pF to 3,000 pF (with optional loading coil set)

Antenna System Resistance: 2 to 60 ohms

Automatic Tuning Range: $\pm 5\%$ antenna capacity variation

Maximum Series Loss Resistance: Not greater than $1/200$ x antenna reactance

ATU500SROS Specifications

Technical Specifications:

Maximum VSWR after Fixed Resistive Match and Auto Reactive Tune: <1.25:1 at carrier frequency

Power Requirements: 24 V dc $\pm 5\%$ at 1 A dc (supplied by VR125 transmitter)

Environmental Limits: (Operating) -50°C to +55°C, 0% to 100% relative humidity

Cooling and Heat Flushing: Cooled by radiation from the sealed enclosure

Metering: Forward power, Reflected power, Antenna current

Options: Sunshield

ATU500SROS Reliability & Repair Time

MTBF ATU500SROS

- Greater than or equal to 99,844 hours using MIL_HDBK 217E calculation methods

MTTR ATU500SROS

- Less than or equal to ½ hour at PWB/module level

Extended & Remote Control/Monitoring

VR-Link2 with ECMP3



ECMP3



Extended Control/Monitor Panel

NRB4



Beacon Monitor Receiver

NLA/2



Receiving Loop Antenna



Remote Control/Monitor with
Extended Control/Monitor Panel

ECMP3 – Extended Control/Monitor



- Extended control and monitor functions within a maximum distance of 152 m (500 ft) from the VR125 NDB transmitter.
- 7 visual system indicators (LEDs) and indicator Test switch. LED brightness is adjustable to one of three levels.
- 2 switches for remote command and 1 user configurable spare command switch.
- User configured and enabled timer and audible alarm.
- User configurable to remotely control/monitor any of the Vector System's remote control/monitor points.
- Site Interface PWB for VR125 transmitter required.

ECMP3 – Extended Control/Monitor

SONALERT

The ECMP3 contains a Sonalert, which can be configured to provide an audible indication that a monitor point is asserted.

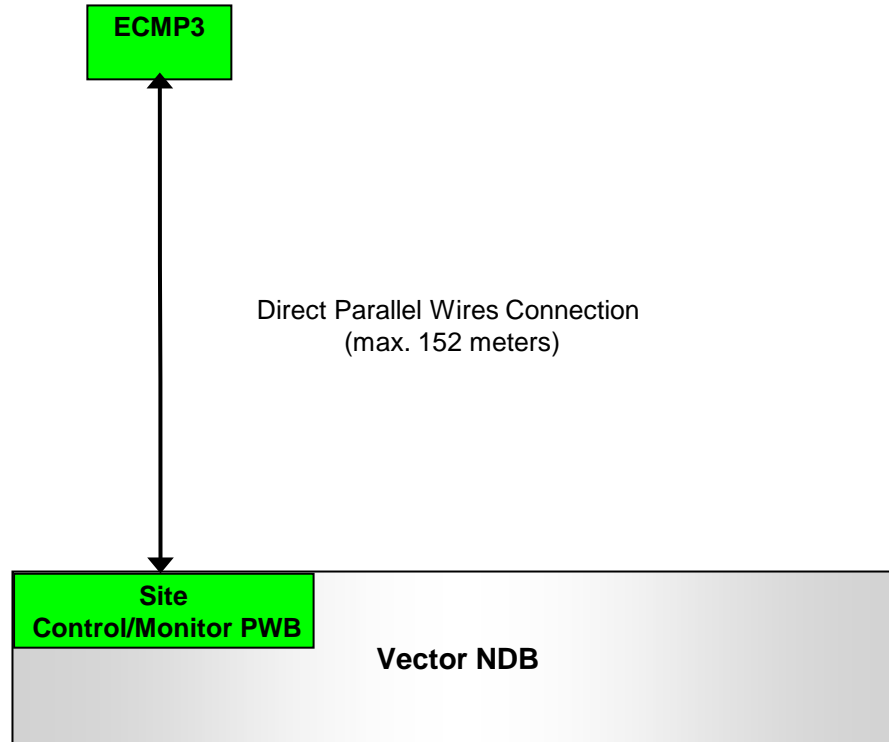
Each monitor point can be configured to independently activate the Sonalert.

Sonalert volume is adjustable to one of three levels.

The Sonalert may be configured to sound when a monitor point activates or when a monitor point activates or de-activates (alarm occurs or alarm disappears).

The Acknowledge momentary push button switch is used for silencing an audible alarm event.

VR125 & ECMP3 Interconnection



VR125 RCMS via VR-Link2



- Economical means of remote control/monitor of one VR125 NDB system.
- Standard VR-Link2 connections to the NDB include RS232, RS422.
- Complete control/monitor of the NDB transmitter and ATU using a text based display via hosted web page.
- ECMP3 (Extended Control/Monitor Panel) can be integrated into VR-Link2 or a total of 3 ECMP3's can be connected externally to the VR-Link2 via RS-485 serial communication.

VR-Link2 - Web Based RCMS

- Web based remote monitoring and control of NDB system
- Remote access to alarm/information logs

The screenshot displays the Nautel VR-Link2 web-based Remote Control and Monitoring System (RCMS) interface for a Vector device. The interface is divided into a left-hand navigation menu and a main control area.

Navigation Menu (Left):

- Lab NxLink**
 - Home
- Equipment**
 - Vector
- Administration**
 - Site Configuration
 - User Administration
- You are logged in as root
- Logout

Main Control Area (Right):

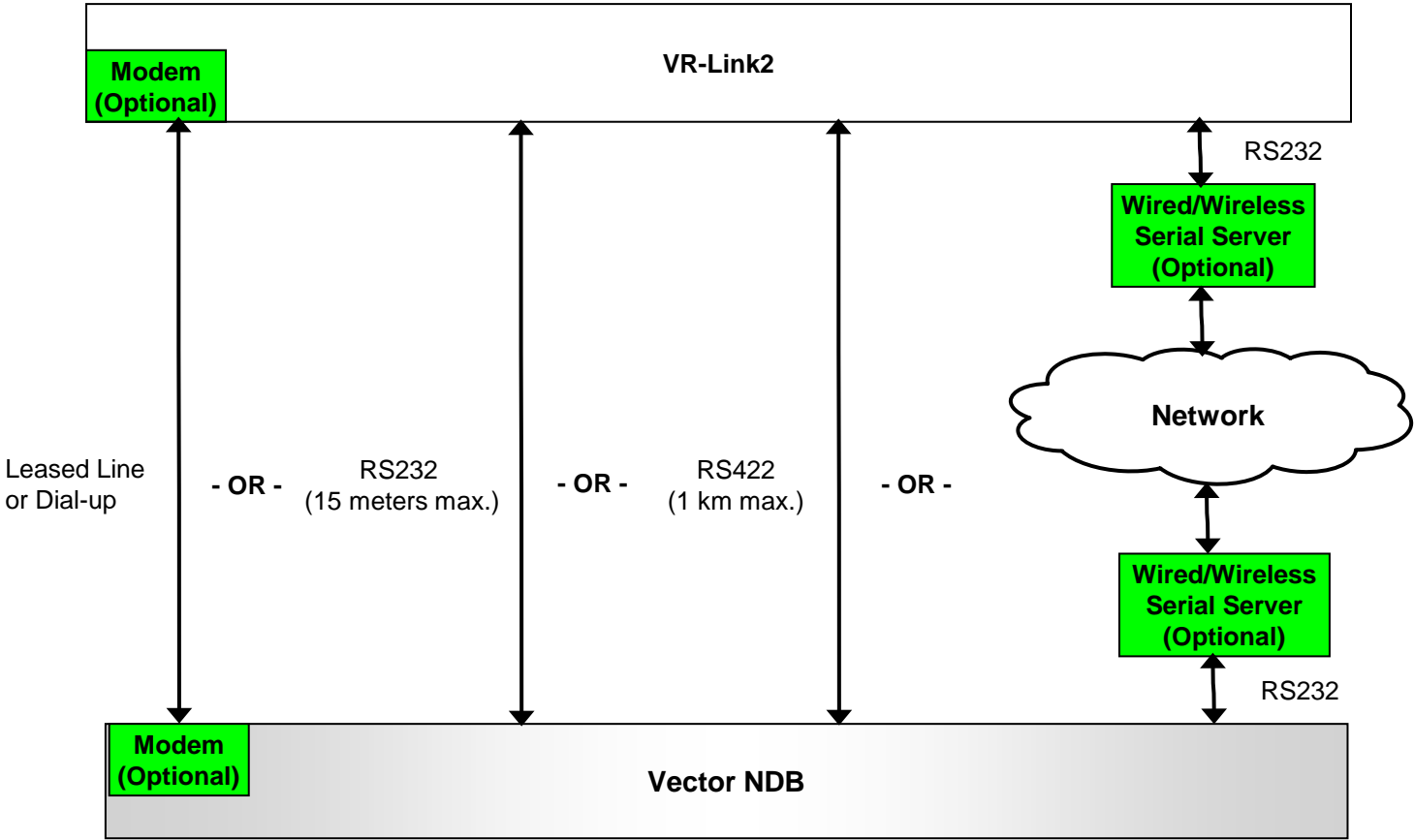
Device: Vector
Data retrieved 2008-05-07T14:56:58

Navigation Tabs: IX Status/Control, ATU Status/Control, Standby Test, History, Monitor Points, Control Points, Alarms

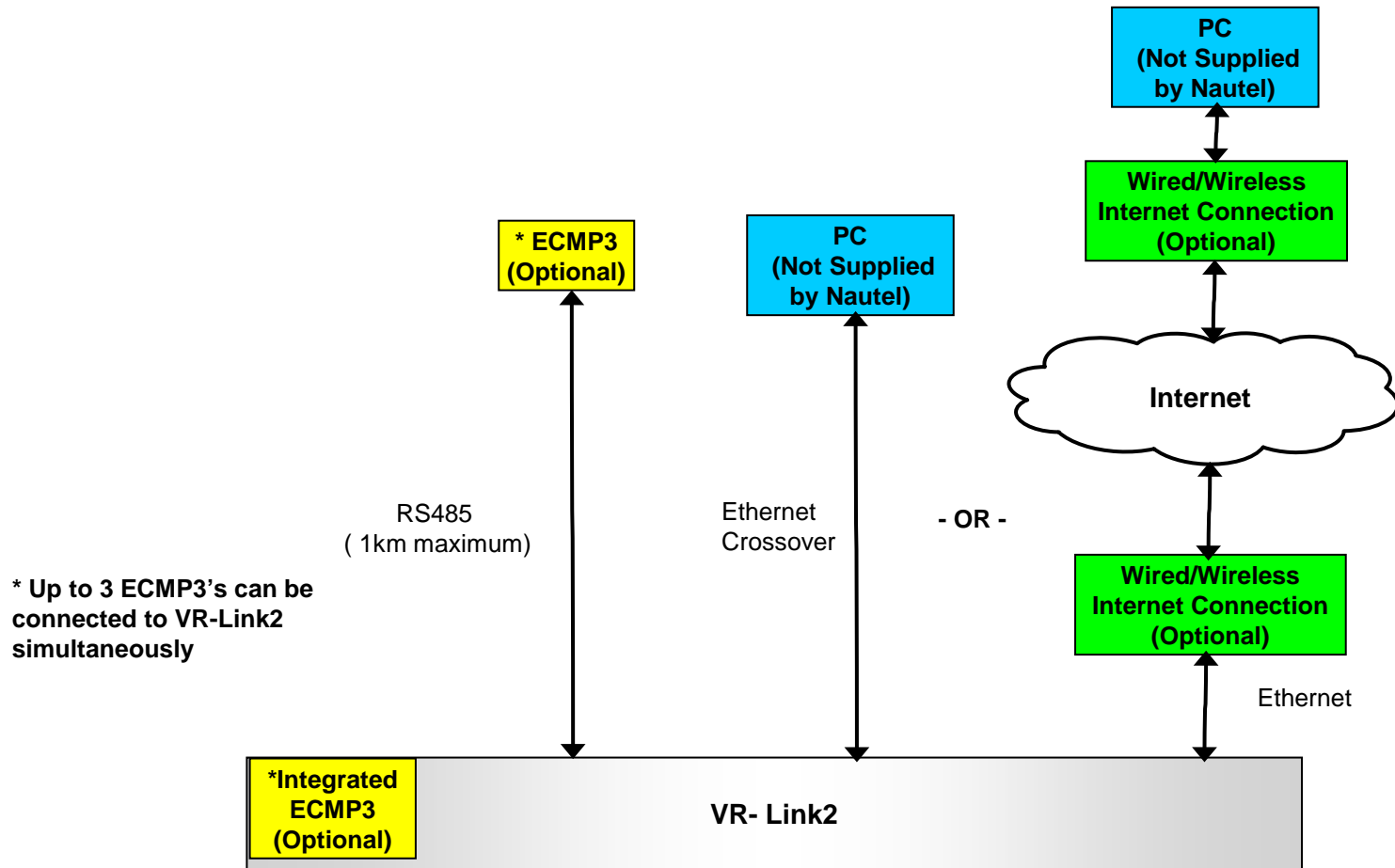
Control Buttons: Hardware Reset, About this equipment, Save, Event Log

RF Power	Off	<input type="button" value="Off"/>	<input type="button" value="On"/>
System Control	Remote		
Forward Power	0 W	<input type="button" value="Increase"/>	<input type="button" value="Decrease"/>
Reflected Power	0.0 W		
Antenna Current	0.0 A		
Antenna Current Feedback	Disabled	<input type="button" value="Disabled"/>	<input type="button" value="Enabled"/>
Active Side	A		
Main Side	A	<input type="button" value="A"/>	<input type="button" value="B"/>
Active Power Source	AC		
Automation Control			
Monitor Mode	Normal	<input type="button" value="Bypass"/>	<input type="button" value="Normal"/>
Automatic Shutdowns	Enabled	<input type="button" value="Disabled"/>	<input type="button" value="Enabled"/>
AC Power Supply	Enabled	<input type="button" value="Disabled"/>	<input type="button" value="Enabled"/>

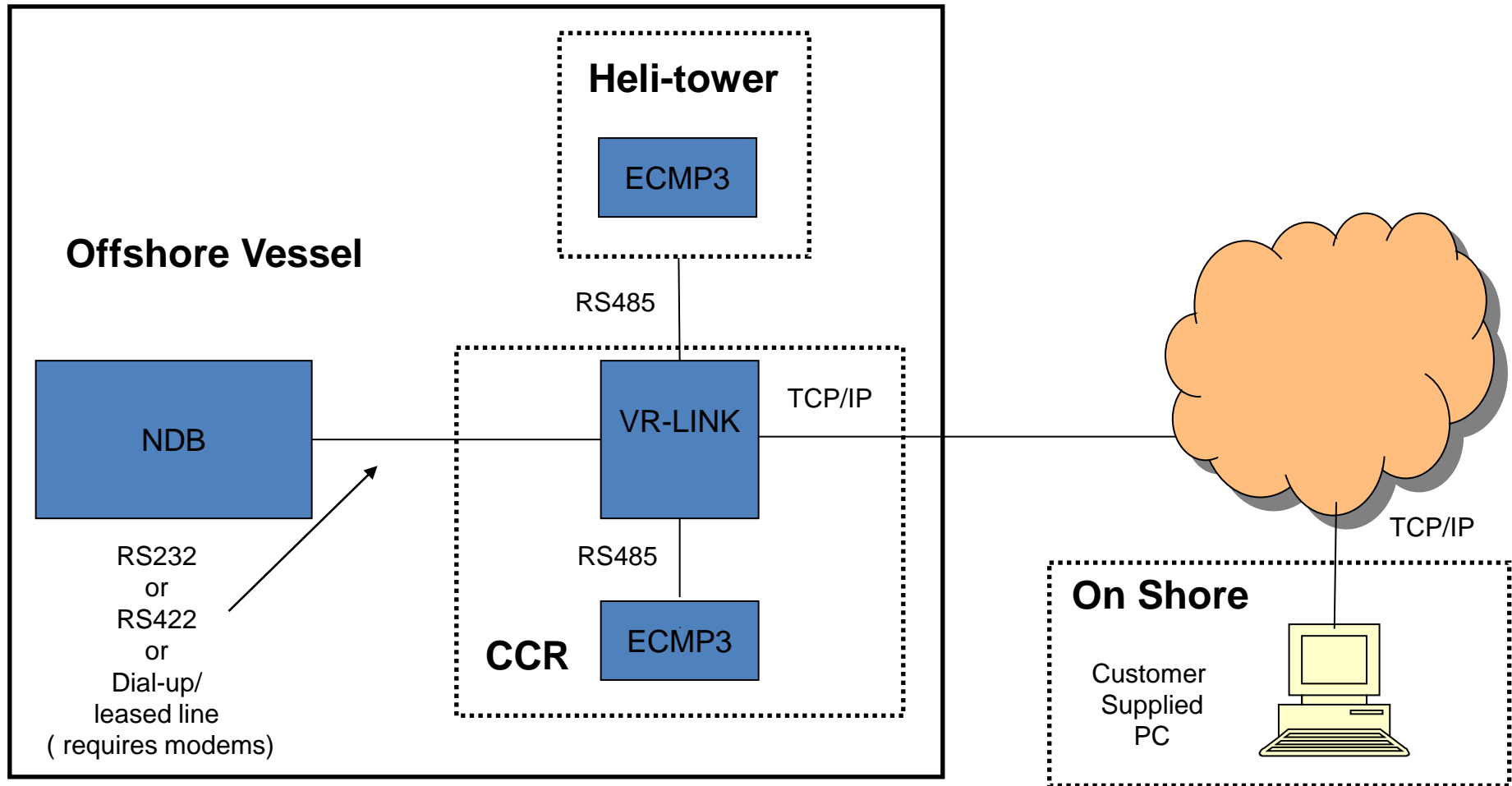
VR125 & VR-Link2 Interconnection



VR125 RCMS via VR-Link2



Typical Offshore RCMS Configuration



NDB Site Remote Control/Monitoring

Site Control/Monitor PWB (optional)

- Provides site control and status monitoring capability at the NDB site and via the Remote Control/Monitor system, if connected to the NDB
- 16 optically isolated inputs
- 16 form C relay contact outputs
- Can be used to control and monitor the status of ancillary equipment located at the NDB site

NRB4 & NLA/2 “OFF AIR” Monitor

NRB4



Beacon Monitor Receiver

NLA/2



Receiving Loop Antenna

NRB4 & NLA/2 “OFF AIR” Monitor

NRB4 Beacon Monitor Receiver



Monitors:

- Presence of Carrier
- Presence of Keyed Tone

Provides visible alarm if either carrier or modulation fall below thresholds.

NRB4 & NLA/2 “OFF AIR” Monitor

NRB4 Beacon Monitor Receiver



Provides:

- Transformer coupled audio output sample
- Contact closures for external carrier or mod fail alarms – these can be used to activate user supplied audible alarm if required

NRB4 & NLA/2 Features

Precise and Frequency Agile

- Direct Digital Synthesizer
- No additional parts required for change of frequency
- Excellent selectivity defined by stable IF crystal filter

Off-Air Monitoring of FAA and ICAO requirements

- Adjustable thresholds and Time delays for reduction in carrier power , reduction in modulation depth and loss of keying
- Local and Remote Audio Monitoring
- Calibrated Carrier Level Meter

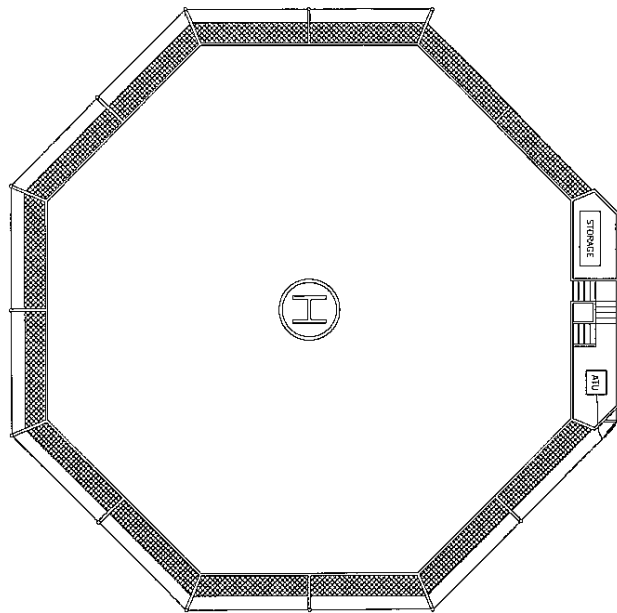
Offshore NDB Antennas

Product	Antenna Type
Whip Antennas	8 m (26 ft.) - 10.7 m (35 ft.)
Nautel CL-HD	Helideck Longwire antenna

Whip Antennas

- 8 m (26 ft.) - 10.7 m (35 ft.) high
- Low Cost
- Frequency Agile
- Narrow Band can result in problems due to sideband attenuation and VSWR related issues
- Inefficient Radiator

CL-HD Helideck Antenna



- Designed to suit a variety of Helideck configurations
- Designed for Compliance to CAP437
- Frequency Agile
- Approx. 7.54 pF/m (2.3 pF/ft)
- Sold to suit Helideck configuration

Whip Antenna Performance

35 ft.(10.7m) whip antenna, 130 pF
 Transmitter RF Power: 125 watts
 ATU: ATU500SROS
 Required Signal Strength: 70 uV/m
 Conductivity over Saltwater: 5 mS/m

Physical Height at base of antenna above Sea Water	Range Estimate and Bandwidth @ 200 kHz	Range Estimate and Bandwidth @ 250 kHz	Range Estimate and Bandwidth @ 300 kHz	Range Estimate and Bandwidth @ 400 kHz	Range Estimate and Bandwidth @ 500 kHz
65 ft. (19.8 m)	N/A	220 km BW - 870 Hz	260 km BW - 1080 Hz	320 km BW - 1550 Hz	380 km BW - 2180 Hz
100 ft. (30.5 m)	N/A	280 km BW - 900 Hz	320 km BW - 1140 Hz	380 km BW - 1750 Hz	420 km BW - 2650 Hz
130 ft. (39.6m)	N/A	320 km BW - 940 Hz	380 km BW - 1210 Hz	420 km BW - 1970 Hz	460 km BW - 3190 Hz
160 ft. (48.8 m)	N/A	340 km BW - 980 Hz	400 km BW - 1290 Hz	440 km BW - 2240 Hz	480 km BW - 3840 Hz

CL-HD Helideck Antenna Performance

CL-HD: 100 - 300 ft (30.5 - 91.5 m), 2.3 pF/ft, 200 ft (61 m) used for estimate

Transmitter RF Power: 125 watts

ATU: ATU500SROS

Required Signal Strength: 70 uv/m

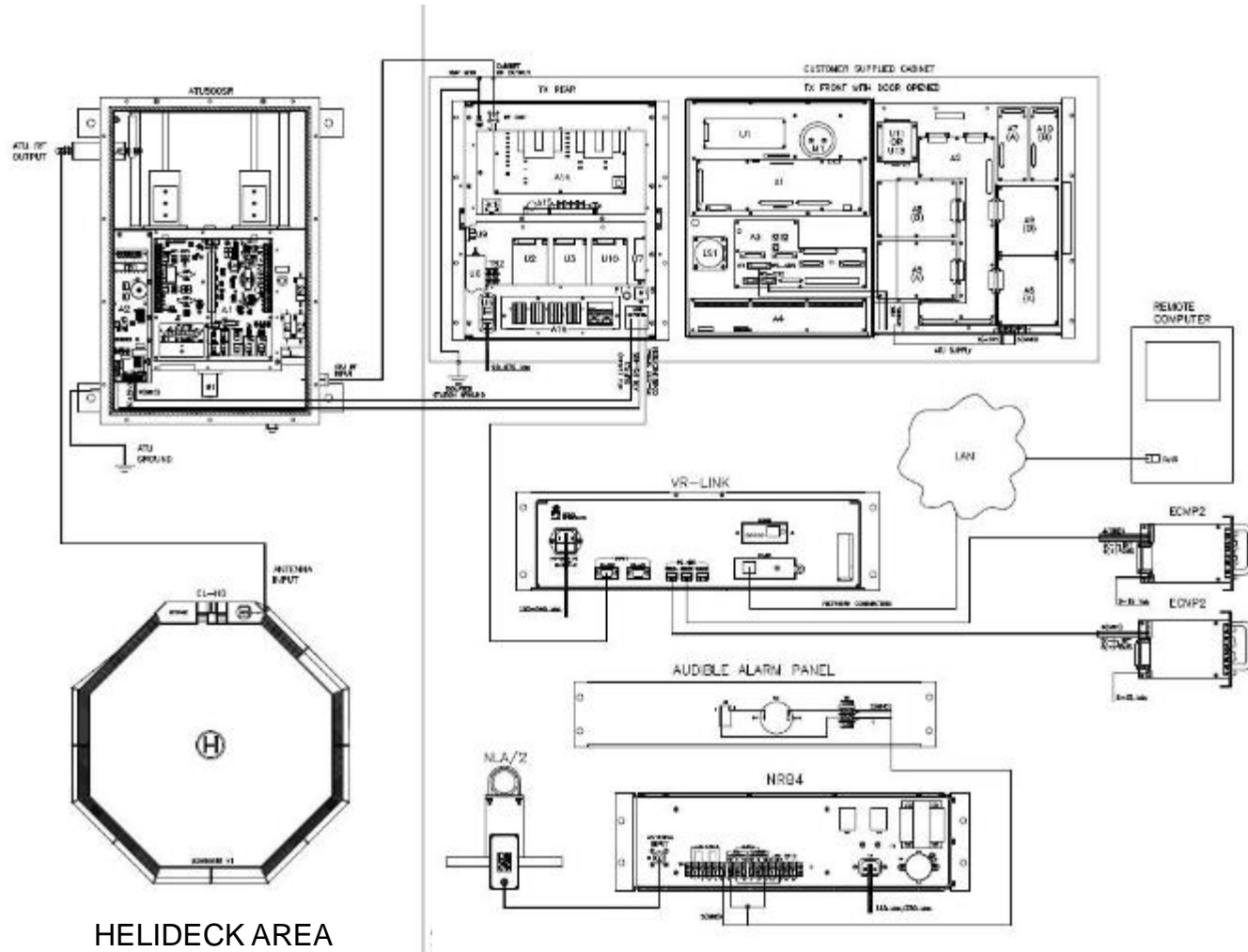
Conductivity over Saltwater: 5 mS/m

Physical Height at base of antenna above Sea Water	Range Estimate and Bandwidth @ 200 kHz	Range Estimate and Bandwidth @ 250 kHz	Range Estimate and Bandwidth @ 300 kHz	Range Estimate and Bandwidth @ 400 kHz	Range Estimate and Bandwidth @ 500 kHz
65 ft. (19.8 m)	240 km BW - 720 Hz	300 km BW - 940 Hz	340 km BW - 1210 Hz	380 km BW - 1910 Hz	440 km BW - 2990 Hz
100 ft. (30.5 m)	320 km BW - 760 Hz	380 km BW - 1040 Hz	400 km BW - 1410 Hz	440 km BW - 2570 Hz	460 km BW - 4590 Hz
130 ft. (39.6m)	380 km BW - 810 Hz	420 km BW - 1160 Hz	460 km BW - 1660 Hz	480 km BW - 3350 Hz	480 km BW - 6500 Hz
160 ft. (48.8 m)	400 km BW - 870 Hz	460 km BW - 1310 Hz	480 km BW - 1970 Hz	500 km BW - 4330 Hz	500 km BW - 8910 Hz

Antenna Performance Notes

- The minimum bandwidth required for 400 Hz modulation should be in excess of 800 Hz and for 1020 Hz modulation should be in excess of 2040 Hz.
- Modulating tone which exceeds the bandwidth will result in significant sideband attenuation, inability to achieve 95% modulation and VSWR at the transmitter.
- The addition of series resistance, available as standard in the ATU500SROS, can be used as a trade off between bandwidth and range if necessary
- The ATU500SROS will not tune most whip antennas below 250 kHz due to the low capacitance of the antenna.
- Increased length of radiating wire will increase the bandwidth and range. Decreased length of radiating wire will reduce the bandwidth and range. It is always best to install as close to the maximum supplied length of radiating wire (300 ft./91.5m) as possible. The minimum recommended length for the radiating wire of the CL-HD is 100 ft.(30.5 m).

Offshore NDB System Interconnection Diagram



Key NDB System Configuration Parameters

- Carrier frequency (kHz)
- Modulation frequency (400 Hz or 1020 Hz)
- Identification (Morse) Code
- Maximum carrier power (125 Watts typical for offshore applications)
- Transmitter configuration (single or dual)
- Transmitter enclosure requirement (customer cabinet, deluxe cabinet, or IP66 enclosure)
- DC operation requirement (DC or battery back-up)
- Remote control/monitoring requirement (number of locations and distances to the NDB)
- Off-air reception and monitoring requirement (NRB4 Receiver + NLA/2 Loop Antenna)
- Antenna style (whip or Helideck)

Other Considerations

- Training
 - Nautel factory
 - Nautel representative/distributor premises
 - end user premises
- Installation Supervision
 - end user technical staff
 - Nautel representative/distributor technical staff
 - Nautel technical staff
- Commissioning and Site Acceptance
 - end user technical staff
 - Nautel representative/distributor technical staff
 - Nautel technical staff
- Extended warranty (available in yearly increments after initial 36 month warranty)

Customer Service & Training

- Emergency technical support is available 24 hours a day, 7 days a week and is provided by Nautel Customer Service technical staff
- Facilities house a full inventory of parts, modules, and sub-assemblies to support customer's maintenance needs
- Nautel's first priority is getting customers back on the air, even if the model in question was shipped in 1970
- Installation Supervision and Commissioning Services are available
- RF Basics, System Specific Training and Certified Installer/Maintainer programs, comprised of classroom as well as hands-on practical instruction, are available from Nautel

Nautel User's Group

Membership includes:

- Online access to Nautel's NUG website
 - Technical FAQs
 - Technical manuals
 - Information sheets
 - Field upgrade documents

Contacts

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Thank You