2000-DSS COMBINED SONAR

USER HARDWARE MANUAL

0009335_REV_E

3/26/2021

EdgeTech
4 Little Brook Road
West Wareham, MA 02576

Tel: (508) 291-0057
Fax: (508) 291-2491
www.EdgeTech.com

ATTENTION – READ THIS FIRST!

All personnel involved with the installation, operation or maintenance of the equipment described in this manual should read and understand the warnings and cautions provided below.

CAUTION! This equipment contains devices that are extremely sensitive to static electricity. Therefore, extreme care should be taken when handling them. Normal handling precautions involve the use of anti-static protection materials and grounding straps for personnel.

WARNING! High voltage may be present in all parts of the system. Therefore, use caution when the electronics are removed from their containers for servicing.

CAUTION! Operation with improper line voltage may cause serious damage to the equipment. Always ensure that the proper line voltage is used.

Warnings, Cautions, and Notes

Where applicable, warnings, cautions, and notes are provided in this manual as follows:

WARNING! Denotes a potential hazard that could cause injury or death.

CAUTION! Denotes a potential hazard that could damage equipment or data.

NOTE: Recommendations or general information that is particular to the material being presented.

ABOUT THIS DOCUMENT

We, the employees at EdgeTech, would like to thank you for purchasing 2000-DSS Combined Sonar. At EdgeTech, our policy is to provide high-quality, cost-effective products and support services that meet or exceed your requirements. We also strive to deliver them on-time and to look for ways to improve them continuously. We take pride in the products we manufacture and want you to be entirely satisfied with your equipment.

Purpose of this Manual

The purpose of this manual is to provide the user with information on the setup and use of EdgeTech's 2000 Series. Although this manual encompasses the latest operational features of the 2000 Series, some features may be periodically upgraded. Therefore, the information in this manual is subject to change and should be used for reference only.

Liability

EdgeTech has made every effort to document the 2000 Series in this manual wholly and accurately. However, EdgeTech assumes no liability for errors or for any damages that result from the use of this manual or the equipment it documents. EdgeTech reserves the right to upgrade features of this equipment and to make changes to this manual without notice at any time.

Revision History

REV	DESCRIPTION	DATE	APPROVAL
A	Release to Production	05/22/20111	RM
B	Revamp for 2000-DSS Exclusively	11/18/2016	TS
C	Edited for Changes	02/03/2018	TS
D	Edited for updates and formatting	09/21/2018	TS
E	Compass Update	03/26/21	DMD

WARRANTY STATEMENT

All equipment manufactured by EdgeTech is warranted against defective components and workmanship for a period of one year after shipment. Warranty repair will be done by EdgeTech free of charge.

Shipping costs are to be borne by the customer. Malfunction due to improper use is not covered in the warranty, and EdgeTech disclaims any liability for consequential damage resulting from defects in the equipment's performance. No product is warranted as fit for a particular purpose, and there is no merchantability warranty. This warranty applies only if:

i. The items are used solely under the operating conditions and in the manner recommended in the Seller's instruction manual, specifications, or other literature.

ii. The items have not been misused or abused in any manner, nor have repairs been attempted thereon without EdgeTech Customer Service's approval.

iii. Written notice of the failure within the warranty period is forwarded to the Seller, and the directions received for properly identifying items returned under warranty are followed.

iv. The return notice authorizes the Seller to examine and disassemble returned products to the extent Seller deems necessary to ascertain the cause for failure.

The warranties expressed herein are exclusive. There are no other warranties, either expressed or implied, beyond those set forth herein. The Seller does not assume any other obligation or liability in connection with the sale or use of said products. Any product or service repaired under this warranty shall only be warranted for the remaining portion of the original warranty period.

Equipment not manufactured by EdgeTech is supported only to the extent of the original manufacturer's warranties.

HARDWARE VARIATIONS AND COMPATIBILITY

The 2000-DSS Combined Sonar contains both standard and proprietary hardware. At times, EdgeTech may change the standard components due to their availability or performance improvements. Although the component manufacturers and their models and styles may change from unit to unit, replacement parts will generally be interchangeable.

EdgeTech will make every effort to see that replacement components are interchangeable and use the same software drivers (if applicable). At times, however, direct replacements may not exist. When this happens, EdgeTech will provide the necessary drivers with the replacement part, if applicable.

EdgeTech may also change certain hardware per customer requirements. Therefore, portions of this manual, such as parts lists and test features, are subject to change. These sections should be used for reference only. When changes are made that affect system operation, they will be explicitly noted. Some options and features may not be active in the customer's unit at the time of delivery. Upgrades will be made available when these features are implemented.

Contact **EDGETECH CUSTOMER SERVICE** with any questions relating to compatibility.

SOFTWARE SERVICE OVERVIEW

EdgeTech provides software services free of charge. This software agreement does not address customer-specified modifications or enhancements. These services may be ordered separately. Furthermore, EdgeTech software upgrades are meant for the sole use of EdgeTech customers. Any reproduction of EdgeTech-supplied software or file sharing is strictly prohibited.

Software Updates and Enhancements

EdgeTech customers can download new software releases with all modifications and enhancements from the **EDGETECH WEBSITE**. Major software bugs, should they occur, will be reported directly to the customer. New software releases consist of the following:

- Software enhancements
- Software fixes and changes
- Product integration
- Documentation updates to on-line help
- Tests for compatibility with other modules

Software patches consist of software that has undergone the following:

- Minor software enhancements
- Software fixes and changes
- Software Telephone, Facsimile, and E-mail Support

EdgeTech customers are entitled to contact **EDGETECH CUSTOMER SERVICE** by telephone, facsimile, or e-mail to report a difficulty, discuss a problem, or receive advice on the best way to perform a task. When contacted, EdgeTech Customer Service will do the following:

- Calls made to the 24-hour tech support line will be answered the same day
- Email inquiries will be answered within 24 hours
- Immediately attend to serious problems affecting operations
- Attempt to find an immediate workaround

RETURNED MATERIAL AUTHORIZATION

Prior to returning any equipment to EdgeTech, a Returned Material Authorization (RMA) Number must be obtained from CUSTOMER SERVICE.

RMA Purpose

The RMA Number identifies returned equipment when it arrives at our receiving dock and enables tracking while at our facility. Refer to the RMA number on all documentation and correspondences.

All returned materials must be shipped prepaid. Freight collect shipments will not be accepted. All equipment should be adequately insured for shipping, but equipment belonging to EdgeTech must be insured for full value.

If there is more than one item per consignment, include a packing with the shipment. An invoice can double as a packing slip only when the contents are clearly numbered and identified on the invoice.

CAUTION! Never attempt to ship a Portable Topside in its Storm Case™ alone. Although rugged, these cases are not intended to be used as shipping containers, and the delicate internal components could be damaged. Shipping in this manner will void any warranties.

NOTE: All shipping charges shall be the customer's responsibility, unless under warranty, as EdgeTech will pay for return shipping.

NOTE: For International Shipments valued over $1000, the following Shipper's oath must be sent with the invoice.

Shipper's Oath:

"I, _____, declare that the articles herein specified are the growth, produce, or manufacture of the United States; that they were exported from the United States from the port of _____, on or about _____; that they are returned without having been advanced in value or improved in condition by any process of manufacture or any other means; and that no drawback, or allowance has been paid or admitted hereof."

Signed _____

CUSTOMER SERVICE

Customer service personnel at EdgeTech are always eager to hear from users of our products. Your feedback is welcome and is a valuable source of information that we use to improve these products continually. Therefore we encourage you to contact EdgeTech Customer Service to offer any suggestions or to request technical support:

> **NOTE:** Please have your system Serial Number available when contacting Customer Service.

E-mail:	service@edgetech.com
Mail:	4 Little Brook Road West Wareham, MA 02576
Telephone:	(508) 291-0057
Facsimile:	(508) 291-2491
24-Hour Emergency Technical Support Line:	(508) 942-8043

For more information, please go to **WWW.EDGETECH.COM**.

COMPANY BACKGROUND

EdgeTech (formerly EG&G Marine Instruments) traces its history in underwater data acquisition and processing back to 1966. EdgeTech has designed, developed, and manufactured products, instruments, and systems—for the acquisition of underwater data, including marine, estuarine, and coastal applications—for over 45 years.

The company has responded to the scientific, Naval, and offshore communities' needs by providing equipment—such as sub-bottom profilers, side scan sonar, acoustic releases, USBL positioning systems, and bathymetric systems—that have become standards in the industry.

EdgeTech has also consistently anticipated and responded to future needs through an active research and development program. Current efforts are focused on the application of cutting-edge CHIRP and acoustic technology.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1.0 OVERVIEW

The EdgeTech 2000-DSS Combined Side Scan Sonar and Sub-Bottom Profiling System is a combination frequency modulated (FM) dual-frequency side scan sonar and a high-resolution FM sub-bottom profiler that uses EdgeTech's proprietary Full Spectrum "chirp" technologies to simultaneously generate both longer-ranged high-resolution side scan imagery and high-resolution cross-sectional sub-bottom imagery of the seabed at deeper penetrations than conventional continuous wave (CW) systems.

The 2000-DSS Combined Side Scan Sonar and Sub-Bottom Profiling System is available with a choice of two dual-frequency configurations for the side scan sonar: 100/400 kHz and 300/600 kHz. The 2000-DSS uses a high frequency, 2–16 kHz sub-bottom sonar for higher resolution sub-bottom imaging in water depths up to 2000 meters.

The two side scan frequencies and the sub-bottom frequency are transmitted simultaneously as linearly swept wideband high energy acoustic pulses (also called "chirp pulses") over a full spectrum frequency range. The received echoes are processed into high signal-to-noise (SNR) images, which can be directly displayed as shades of gray or color on a computer monitor and printed on a continuous feed thermal printer. The data can also be stored in real-time onto a large capacity hard drive and archived onto a DVD.

1.1 2000 Series Applications

Applications for the 2000 Series Combined Side Scan Sonar and Sub-Bottom Profiling System are many, a few of which are the following:

- Archeological surveys
- Geological/geophysical surveys
- Sediment classification
- Buried cable and pipeline surveys
- Dredging and coastal studies
- Pre/post dredging surveys
- Scour/erosion investigation
- Marine construction surveys

Figure 1-1: 2000-DSS Tow Vehicle being Prepared for Deployment

1.2 Main System Components

The 2000-DSS Combined Side Scan Sonar and Sub-Bottom Profiling System consists of two main components: the Rack Mount Topside and the 2000-DSS Tow Vehicle. The Rack Mount Topside is made up of a Topside Processor and a 2000 Digital Telemetry Link installed in a 19-inch rack enclosure, along with a keyboard, a trackball, and two LCD monitors. These components are shown in **FIGURE 1-2**. The 2000-DSS Tow Vehicle is shown in **FIGURE 1-3**. An optional tow cable up to 6000 meters in length can be purchased. (Contact **EDGETECH CUSTOMER SERVICE** for cable type versus length).

1.2.1 Topside Processor

The Topside Processor is a PC contained within a ruggedized 19-inch 4U chassis. It controls the tow vehicle sonars and processes, stores, and displays received side scan and sub-bottom data, sensor data, and status information. A keyboard, a trackball, two LCD monitors, a DVD/RW drive, a 1-TB hard drive for data storage, and a 500-GB hard drive for the operating system are included with the Topside Processor. An optional printer can also be connected. The Topside Processor interfaces with the 2000 Digital Telemetry Link over a 10/100/1000BaseT Ethernet connection and includes EdgeTech's DISCOVER 2000-C Dual Frequency Side Scan Sonar software and DISCOVER Sub Bottom software preinstalled along with the Windows operating system.

1.2.2 2000 Digital Telemetry Link

The 2000 Digital Telemetry Link provides downlink telemetry to the tow vehicle for sonar control and receives uplink side scan and sub-bottom data, sensor data, and status information from the tow vehicle. It interfaces with the Topside Processor over a 10/100/1000BaseT Ethernet connection and includes tow vehicle and DC power supplies, an asynchronous digital subscriber line (ADSL) modem, and an Ethernet switch, all within a single 19-inch 2U chassis.

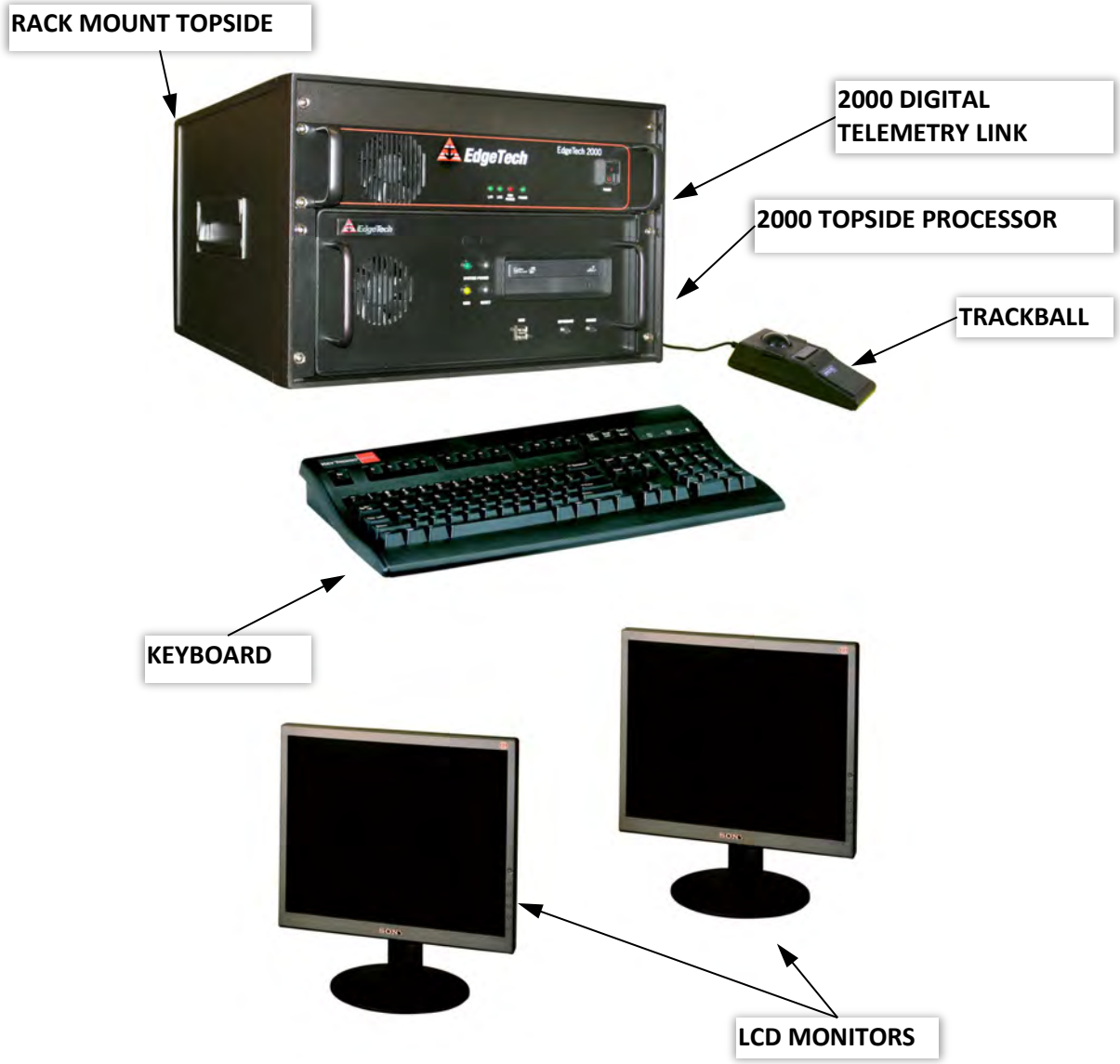

Figure 1-2: 2000 Topside Processor with Keyboard, Trackball, and two LCD Monitors

1.2.3 2000-DSS Tow Vehicle

The 2000-DSS Tow Vehicle contains the side scan transducer arrays, the sub-bottom transducer, and the sub-bottom hydrophone arrays along with the electronics required to transmit and to receive the sonar signals, to receive the downlink commands from the 2000 Topside Processor, and to provide the uplink side scan data, sensor data, and status information to the 2000 Topside Processor. The tow vehicle is available with a choice of 100/400 kHz or 300/600 kHz dual-linear FM chirp operating frequencies for the side scan sonar.

The sonar electronics are contained inside a single electronics bottle that is sealed by double O-ring end caps. The aft end cap includes bulkhead connectors for connecting the transducers, the hydrophone arrays, and optional equipment. The tow vehicle interfaces with the 2000 Topside Processor over an Ethernet connection using digital subscriber line (ADSL) modems in both the tow vehicle and the processor. The 2000-DSS Tow Vehicle is shown in **FIGURE 1-3**.

The 2000-DSS Tow Vehicle sub-bottom sonar operates over a frequency range of 2–16 kHz, has a 2000-meter depth rating, and is designed primarily for applications requiring higher resolution sub-bottom imagery. It is hydrodynamically stabilized and includes the sub-bottom transducer and two sub-bottom hydrophone arrays mounted under an acoustic baffle.

This assembly, along with the connecting cable harnesses and the electronics bottle, is mounted to a wing plate and contained inside a two-piece fiberglass shell. The upper and lower halves of the shell bolt directly to the wing plate. The aft section of the wing plate forms the horizontal tail fins, and a vertical tail fin is attached to the upper half of the shell. Lead ballast is included inside the lower half. The port and starboard side scan transducer arrays are mounted to the lower half of the shell, and a hinged tow bridle provides the mechanical connection for the tow cable. The bridle can be adjusted fore and aft along a pair of tow brackets, one port, and one starboard to accommodate different tow vehicle speeds and depths.

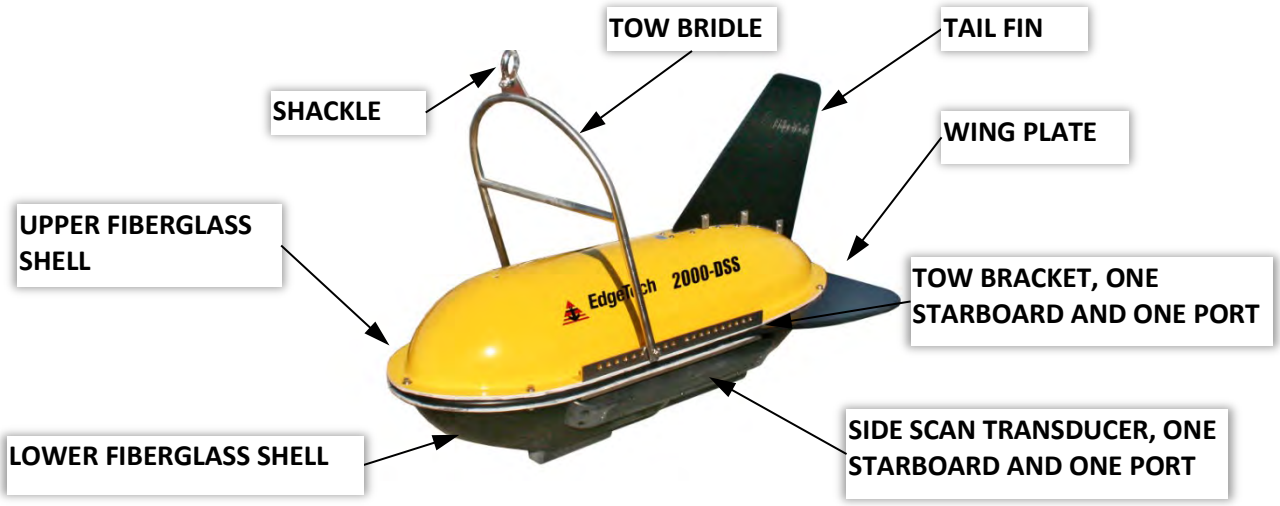

Figure 1-3: 2000-DSS Tow Vehicle

1.2.4 Tow Cables

Both Kevlar reinforced, and armored tow cables are available separately, terminated at both ends or just at the tow vehicle end. The tow cables are used to connect to and tow the tow vehicle. A Kevlar-reinforced tow cable is shown in **FIGURE 1-4**.

Figure 1-4: Kevlar Reinforced Tow Cable

Both cable types include a single conductor, shielding and are terminated with an MCIL6F female wet pluggable connector on the tow vehicle end. At the topside end, the Kevlar-reinforced tow cables include a 5-pin connector for connecting to the 2000 Digital Telemetry Link. The armored tow cables have either a MCIL4M input wet-pluggable connector or an open termination for connection to the slip rings of a winch. A cable grip is also included for attaching the tow cable to the tow vehicle's tow bridle. A tow cable adapter is required to connect an armored tow cable to the 2000 Digital Telemetry Link. The adapter is a jumper cable that connects from the MCIL4M connector on the tow cable to the 5-pin bulkhead connector on the back panel of the 2000 Digital Telemetry Link.

1.3 Optional Equipment

Optional equipment that can be installed and used with a 2000 Series Combined Side Scan Sonar and Sub-Bottom Profiling System include the following:

- Magnetometer
- Acoustic tracking system
- Pressure sensor
- Power loss pinger
- Responder

NOTE: The option connector provides 27 VDC @ 1 A maximum.

1.3.1 Magnetometer

A magnetometer can be user-specified or supplied and is available from a number of manufacturers.

1.3.2 Acoustic Tracking System

An acoustic tracking system, such as an ORE BATS or Trackpoint 3, can be used to provide tow vehicle position continuously. A responder is installed on the tow vehicle, and a ship-mounted hydrophone and deck unit are used to receive and process position data.

1.3.3 Pressure Sensor

A pressure sensor can be installed in the tow vehicle to provide tow vehicle depth data. This type of pressure sensor is designed for continuous use in a corrosive liquid environment and has a 3000-psi pressure range.

1.3.4 Power Loss Pinger

A power loss pinger activates when tow vehicle power is lost, and the tow vehicle is submerged. Should this event occur, the pinger will continuously transmit an acoustic pulse which a pinger locator can receive. The pinger is entirely self-contained in a stainless steel or aluminum housing and includes an internal battery.

1.3.5 Responder

The responder functions with an optional acoustic tracking system to provide tow vehicle positioning. The tracking system deck unit provides a trigger that is input to the 2000 Topside Processor. The 2000 Topside Processor outputs the trigger signal to the tow vehicle by combining the signal with the downlink command and uplink sonar data signals.

1.4 Full Spectrum Chirp Technology Overview

EdgeTech's Full Spectrum Chirp technology has several distinct advantages over conventional side scan and sub-bottom profiling systems. These benefits include the use of separate sub-bottom acoustic projectors and receivers to enable simultaneous transmission and reception of acoustic signals, high signal-to-noise ratio (SNR) for improved side scan and sub-bottom imagery, high repeatability of the transmitted signals from pulse to pulse for high signal definition, high-resolution for measurement of fine

sediment layering and display of along-track and across-track imagery, reduction of side lobes for minimal reception of undesired echoes, additional processing gain for energy efficiency, and a Gaussian-shaped amplitude spectrum of the outgoing pulse to preserve resolution and bandwidth with attenuation.

1.4.1 Separate Sub-Bottom Acoustic Projectors and Receivers

The sub-bottom sonar uses separate acoustic projectors and receivers. The projectors are wideband piston-type transducers, and the receivers are hydrophone arrays composed of lead piezoelectric *zirconate titanate* (PZT) crystals. The transducers are mounted in the forward section of the tow vehicle, and the hydrophone arrays are mounted aft. The use of separate transmitting transducers and receiving hydrophone arrays preserves linearity and allows the simultaneous transmission and reception of the acoustic signals. The transducers and hydrophone arrays are mounted beneath acoustic baffles, which minimize direct path, tow vehicle, and surface reflections.

1.4.2 High Signal-to-Noise Ratio

Full Spectrum Chirp technology does not use a conventional matched filter, the correlation filter that is widely used to compress FM signals, to process wideband signals. It instead uses proprietary amplitude and phase weighting functions for the transmitted pulse and a pulse compression filter that maximizes the SNR of the acoustic images over a wide band of operating frequencies. These functions provide a significant SNR improvement in the imagery over other pulse and chirp side scan and sub-bottom sonars with band-limited components that are limited in dynamic range.

1.4.3 High Repeatability

The frequency range of operation is determined by the transmitter and receiver's acoustic characteristics mounted in the towed vehicle. For the side scan sonar, the transmit frequency is selected based on the desired range and resolution required. For sub-bottom profiling, the frequency is selected based on the sub-bottom conditions at the survey site and the type of sub-bottom features that need to be imaged. The FM pulses are generated by a D/A converter with a wide dynamic range and a transmitter with linear components. Therefore, the energy, amplitude, and phase characteristics of the acoustic pulses can be precisely controlled. This precision produces high repeatability and signal definition.

1.4.4 High Resolution

Normally, when using long pulses, the resolution is reduced. However, after correlation processing the received signals, a very sharp wavelet is produced that has a duration equal to the inverse of the sweep bandwidth. Therefore, the more bandwidth that is used, the sharper this pulse will become. Side scan and sub-bottom signals received at the surface pass through a software-controlled programmable gain amplifier before being digitized with a 16-bit analog-to-digital (A/D) converter. The FM pulse is then compressed using a digital compression filter. This correlation process is implemented in real-time with forward and inverse Fast Fourier Transforms (FFTs). The compressed pulse has a time duration

approximately equal to the inverse of the FM pulse bandwidth, resulting in high-resolution across-track side scan sonar images and measurements of fine sediment layering in the sub-bottom profiles, an important factor for sediment classification.

1.4.5 Reduction of Side Lobes

The use of Full Spectrum chirp technology reduces the side lobes in the effective transducer aperture, enabling high along-track resolution and high attenuation of unwanted echoes. The wide bandwidth of the sweep frequency has the effect of smearing the transducer's side lobes and thus achieving a beam pattern with virtually no side lobes. The effective spatial beam width obtained after processing a full spectrum 2–10 kHz sub-bottom signal, for example, is 20 degrees measured at the -3db points.

1.4.6 Additional Processing Gain

In addition to the resolution improvement, correlation processing achieves a signal processing gain over the background noise by using a broad bandwidth transmission pulse that sweeps out over a range of frequencies instead of trying to operate with one very sharp acoustic peak pulse as is done with CW side scan and sub-bottom sonar systems. This technique generates a lot of acoustic energy in the water that results in a processing gain that is approximately ten times the time-bandwidth product log. This improvement is due to the signal having a time duration longer than the inverse of the bandwidth, thus increasing the signal energy without increasing the power of the outgoing pulse. To equal the full spectrum sonar pulse's typical performance, conventional pulse side scan and sub-bottom sonars would have to operate at a peak pulse power of 100 times greater than a full spectrum pulse.

1.4.7 Gaussian Shaped Amplitude Spectrum Outgoing Pulse

Another important feature of Full Spectrum Chirp technology is that the signal processing optimizes the side scan and sub-bottom sonars' performance. The sonar contains many components that have frequency-dependent dynamic range and linearity characteristic. In addition to this characteristic, the outgoing pulse's amplitude spectrum is chosen to be approximately Gaussian in shape to limit the side lobe level and temporal resolution losses due to attenuation. As a wavelet with a Gaussian-shaped spectrum is attenuated by the sediment, energy is lost, but its bandwidth is nearly preserved. Therefore, even after being attenuated, the acoustic pulse has approximately the same resolution as an unattenuated pulse.

2.0 SPECIFICATIONS

The specifications for the EdgeTech 2000 Series Combined Side Scan Sonar and Sub-Bottom Profiling System include electrical, mechanical, and environmental characteristics for the following components:

- Topside Processor
- 2000 Digital Telemetry Link
- 2000-DSS Tow Vehicle

> **NOTE:** All specifications are subject to change without notice.

2.1 Topside Processor

The specifications for the Topside Processor are shown in **TABLE 2-1**.

SPECIFICATION	VALUE
Size:	17.8 cm (7 in.) high 43.2 cm (17 in.) wide 48.3 cm (19 in.) deep
Weight:	19.5 kg (43 lbs.)
Case type:	EIA RS-310C 19-inch standard rackmount with a fully-enclosed frame, removable top access cover, and heavy-duty front handles
Case construction:	Aluminum 19-inch rack mount
Case finish:	Black powder coat
Mounting:	Standard 19-inch rack with provisions for mounting rack slides (not provided)
Shipping container type:	Sealed high impact polyurethane case[1]
Shipping container size:	81 cm (32 in) high 81 cm (32 in wide 8.1 cm (32 in) deep[1]

[1] Shipped in a sealed high impact polyurethane case with the 2000 Topside Processor and the 2000 Digital Telemetry Link mounted inside a 19-inch rack enclosure with the keyboard, the trackball and one monitor. The rack enclosure size is 38.1 cm (15 in.) x 50.8 cm (20 in.) x 55.9 cm (22 in.)

SPECIFICATION	VALUE
Shipping weight:	70 kg (155 lbs.)[2]
Operating Temperature:	0–45°C (32–113°F)
Storage temperature:	-30–70°C (-22–158°F)
Operating relative humidity:	0–95% (non-condensing)
Non-operating storage relative humidity:	0–100%
Input voltage:	90–260 VAC, 50/60 Hz, auto-switching
Processor:	Intel P4, 2.4 GHz
Memory:	512 MB
Data storage:	DVD/RW drive 1-TB hard drive (data) 500-GB hard drive (OS)
Operating system:	Windows XP
Application software:	DISCOVER 2000-C and DISCOVER Sub-Bottom
Display:	(2) 21-inch LCD monitor
Keyboard:	High impact industrial
Pointing device:	High impact industrial trackball
I/O ports:	(1) Ethernet (4) RS-232 (3) USB (1) Parallel (2) PS2 (1) SVGA

Table 2-1: Topside Specifications

[2] Total shipping weight of the 2000 Topside Processor and the 2000 Digital Telemetry Link mounted inside a 19-inch rack enclosure with the keyboard, the trackball and one monitor. Shipped in a sealed high impact polyurethane case. Rack enclosure weight is 41 kg (90 lb).

2.2 2000 Digital Telemetry Link

The specifications for the 2000 Digital Telemetry Link are shown in **TABLE 2-2**.

SPECIFICATION	VALUE
Size:	8.3 cm (3.25 in.) high, 48.3 cm (19 in.) wide; 43.2 cm (17 in.) deep
Weight:	6.4 kg (14 lbs.)
Case type:	EIA RS-310C 19-inch standard rackmount
Case construction:	Aluminum 19-inch rack mount
Case finish:	Anodized
Mounting:	Standard 19-inch rack with provisions for mounting rack slides (not provided)
Shipping container type:	Sealed high impact polyurethane case[3]
Shipping container size:	81 cm (32 in) high 81 cm (32 in wide 8.1 cm (32 in) deep[3]
Shipping weight:	70 kg (155 lbs.)b
Operating Temperature:	0–40°C (32–104°F)
Storage temperature:	-20–60°C (-4–140°F)
Operating relative humidity:	0–80% (non-condensing)
Non-operating storage relative humidity:	0–100%
Input voltage:	90–260 VAC, 50/60 Hz, auto-switching
External trigger:	5 VDC TTL positive or negative leading edge-triggered, selectable in DISCOVER (used to trigger external device attached to 2000 DSS Tow Fish)
I/O ports:	(1) Ethernet (1) Trigger
Output voltage and Current:	90 to 132 VAC and 180 to 260 VAC

Table 2-2: 2000 Digital Telemetry Link Specifications

[3] Total shipping weight of the 2000 Topside Processor and the 2000 Digital Telemetry Link mounted inside a 19-inch rack enclosure with the keyboard, the trackball and one monitor. Shipped in a sealed high impact polyurethane case. Rack enclosure weight is 41 kg (90 lbs.)

2.3 2000-DSS Tow Vehicles

The specifications for the 2000-DSS Tow Vehicle is shown in **TABLE 2-3**.

SPECIFICATION	VALUE
GENERAL SPECIFICATIONS	
Size:	145.0 cm (57.1 in.) long 74.0 cm (29.1 in.) wide, incl. tail fins 84.0 cm (33.1 in.) high, incl. tail fin
Weight in air:	145 kg (320 lbs.)
Weight in water:	78 kg (172 lbs.)
Construction:	Fiberglass shell with Delrin wing plate
Maximum tow cable length:	6000 m (19,680 ft.) Contact EdgeTech for cable type vs. length.
Depth rating:	2000 m (6560 ft.)
Tow cable type:	Coaxial
Maximum safe towing speed:	12 knots
Operating temperature:	0–45°C (32–113°F)
Storage temperature:	-20–60°C (-4–140°F)
Heading accuracy:	For Indicative Use Only
Pitch and roll accuracy:	For Indicative Use Only
Optional sensor port:	RS-232
Options:	Magnetometer Acoustic tracking system Pressure sensor Power loss pinger Responder
SIDE SCAN SONAR	
Frequencies:	100/400 kHz 300/600 kHz
Expanded Operating ranges (per side):	500 m (100 kHz) 230 m (300 kHz) 150 m (400 kHz) 120 m (600 kHz)

SPECIFICATION	VALUE
Output pulse energy:	4 j (100 kHz) 3 j (300 kHz) 2 j (400 kHz) 1 j (600 kHz)
Pulse length:	Up to 20 ms (100 kHz) Up to 12 ms (300 kHz) Up to 10 ms (400 kHz) Up to 5 ms (600 kHz)
Across track resolution:	6.3 cm (100 kHz) 2.8 cm (300 kHz) 1.8 cm (400 kHz) 1.4 cm (600 kHz)
Along track resolution:	1.9 m @ 100 m (100 kHz) 1.0 m @ 100 m (300 kHz) 0.96 m @ 100 m (400 kHz) 0.45 m @ 100 m (600 kHz)
Horizontal beam width:	1.08° (100 kHz) 0.6° (300 kHz) 0.56° (400 kHz) 0.26° (600 kHz)
Transducer array depression angle:	26° downward
Dynamic range:	24 bits
Vertical beam width:	50°
SUB-BOTTOM SONAR	
Frequency range:	0.5–12 kHz
Pulse bandwidth/pulse length:	0.5–8.0 kHz/5 ms 0.5–2.7 kHz/40 ms 0.5–6.0 kHz/20 ms 0.5–4.5 kHz/50 ms 0.5–6.0 kHz/9 ms 0.5–6.0 kHz/18 ms 0.5–7.2 kHz/30 ms 0.7–12.0 kHz/20 ms 2.0–12.0 kHz/20 ms

SPECIFICATION	VALUE
Vertical resolution[4]:	19 cm (1–5.0 kHz) 12 cm (1.5–7.5 kHz) 8 cm (2–12 kHz)
Penetration in coarse and calcareous sand[5]:	30 m (typ)
Penetration in soft clay[5]:	250 m
Beam width[6]:	41°, 0.5–5 kHz 32°, 1–6 kHz 24°, 1.5–7.5 kHz 16°, 2–12 kHz
Optimum tow vehicle pitch/roll:	<16°, 0.5–5 kHz <13°, 1–6 kHz <10°, 2–8 kHz <8°, 2–10 kHz <7°, 2–12 kHz
Optimum tow height:	3–5 m above the sea floor
Transmitters:	1
Receive arrays:	4

Table 2-3: 2000-DSS Towfish Specifications

2.4 Cables

For cable specifications, see the following diagrams in section **4.0**:

- **FIGURE 4-6**
- **FIGURE 4-7**

[4] Vertical resolution is the smallest distinguishable distance between the peaks of two reflections that can be displayed on the screen as separate reflectors. Sound energy is reflected back to the sonar system when the transmitted pulse encounters a change in density. The resolution of a sonar system is measured by its ability to distinguish between two adjacent targets. The vertical resolution is dependent on the transmitted chirp pulse bandwidth. It is theoretically calculated by the product of the transmitted pulse length (inverse of the bandwidth) and half the speed of sound in water (approximately 750 m/s). For example, a full bandwidth pulse from an SB-424 Tow Vehicle has a vertical resolution of 3.75 cm (1/20,000 x 750).

[5] The value for sub-bottom penetration is the maximum distance beneath the sea floor that a step change of 10% in density can be seen on the sub-bottom display. This assumes that the sediment is gas free (no organic materials), that the lowest frequency of the pulse spectrum is transmitted and that the vehicle is within 5 meters of the seabed (range for maximum penetration). Lower frequencies reduce attenuation (absorption of sound). Towing the vehicle close to the sea floor reduces the acoustic footprint thereby reducing scattering (interfering reflections) from the sea floor and within the sediments.

[6] At the -3 dB points, depending on the center frequency.

3.0 SETUP AND ACTIVATION

Setup and test of the EdgeTech 2000-DSS Combined Side Scan Sonar and Sub-Bottom Profiling System encompasses unpacking, inspecting, and connecting the system components, including an optional printer; connecting a navigation system and external sonar systems if required; activating the system; and verifying operation using the EdgeTech DISCOVER software. This section provides instructions on how to perform these tasks and how to deploy, tow, and recover the tow vehicle.

3.1 Unpacking and Inspection

The 2000 Topside Processor, along with one LCD monitor, the keyboard, the trackball, software, and system documentation, are shipped in a reusable heavy-duty transport case. The tow vehicle, the second LCD monitor, a test cable, and tow vehicle accessories are shipped in a wooden shipping crate. Before unpacking the system components, inspect the shipping containers for any damage. Report any damage to the carrier and to EdgeTech.

If the shipping containers appear free of damage, carefully unpack the components and inspect them for damage. Also, check the packing list and verify that all the items on the list are included. Again, if any damage is found, report it to the carrier and to EdgeTech. If any items are missing, immediately contact EdgeTech. Do not install or operate any equipment that appears to be damaged. Although the items shipped will vary, depending on the customer requirements, the 2000 Series Combined Side Scan Sonar and Sub-Bottom Profiling System typically includes, as a minimum, the items listed below.

- 2000 Topside Processor
- 2000-DSS Tow Vehicle
- LCD Monitor (2)
- Keyboard
- Trackball
- Ethernet patch cable
- AC power cords (4)
- Video cable (2)
- Tow cable adapter
- Software CDs with electronic manuals

In addition to the listed components, the following optional items may be included:

- Tow cable
- Test cable

After unpacking the system components, be sure to safely store the shipping containers, including any packing materials, for later use. When transporting or storing the system, all items should be packed in their original shipping containers in the same manner in which they were originally shipped, and always store the system in a dry environment when not in use.

3.2 Power Requirements

Power to the system comes in through the Rack Mount topside, which requires 90–260 VAC, 50/60 Hz. The unit is auto-switching.

3.2.1 Use of an Uninterruptable Power Supply

The AC power source should be continuously free of high amplitude, high-frequency transients, as this type of interference could cause degraded performance or damage to the equipment. An uninterruptable power supply (UPS) with power surge protection is recommended for powering the equipment. However, whether or not a UPS is used, the AC power source should never be the same as that being used to power electric motors, such as pumps and winches, on the survey vessel. In addition, switching type battery chargers or DC to AC converters with square wave outputs also should not be used.

3.2.2 Changing to a Non-US Power Plug

AC power cords is provided for connecting the equipment to a standard U.S. 3-pronged outlet. For non-U.S. power outlets, you can modify this cord by cutting off the 3-pronged plug and attaching the appropriate plug. Refer to **TABLE 3-1** for connection information.

AC POWER CORD WIRE COLOR	FUNCTION
Black	AC line
White	AC neutral
Green	Earth ground

Table 3-1: AC Power Cord Wiring

> **NOTE:** The 2000 Topside Processor is shipped configured for the end user's country voltage requirements.

3.3 Navigation Interface

The 2000-DSS Combined Side Scan Sonar and Sub-Bottom Profiling System accepts most standard National Marine Electronics Association (NEMA) 0183 message sentence formats from a connected global positioning system (GPS) or integrated navigation system.

3.4 Topside Location—Best Practices

The Rack Mount topside should be located and set up in a dry, sheltered area that is protected from weather and water spray and where the temperature is consistently between 0°C and 40°C (32°F and 104°F). Avoid areas of direct sunlight, especially in tropical environments, as heat buildup could occur, and the viewing of indicators could be difficult.

The Rack Mount topside location should also enable direct communications with the deck crew that is handling the tow vehicle. Secure the equipment in place, using tie-downs if necessary, near the required AC power source. Also ensure that there is ample room behind the rack for connecting the cables.

3.5 Rack Mount Topside Connections, Controls, and Indicators

The Rack Mount Topside is composed of the 2000 Topside Computer and the 2000 Digital Telemetry Link. While reading the descriptions to follow, refer to **FIGURE 3-1** and **FIGURE 3-2** for the locations of these components.

3.5.1 Topside Computer Connections

The Topside Processor connections are made using connectors on both the front and back panels and include the following:

COM 5 THRU 8: DB-9 male connector. Available RS-232 ports to connect additional peripheral sensors/instruments requiring a serial communication interface.

ETHERNET 1: RJ-45 connector. Provides the 10/100/000BaseT Ethernet connection to the 2000 Digital Telemetry link.

ETHERNET 2: RJ-45 connector. Available 10/100/1000BaseT Ethernet connection.

USB: (5) USB connectors. Four USB 2.0 ports, two on the back panel and two on the front. One USB 3.0 port on the back panel

VAC INPUT: CEE-type AC input, In addition, COM5–COM8 serial ports are available for use as required, each with DB-9 male connectors. These connectors are located on the back panel.

Figure 3-1: Rack Mount Topside Front Panel

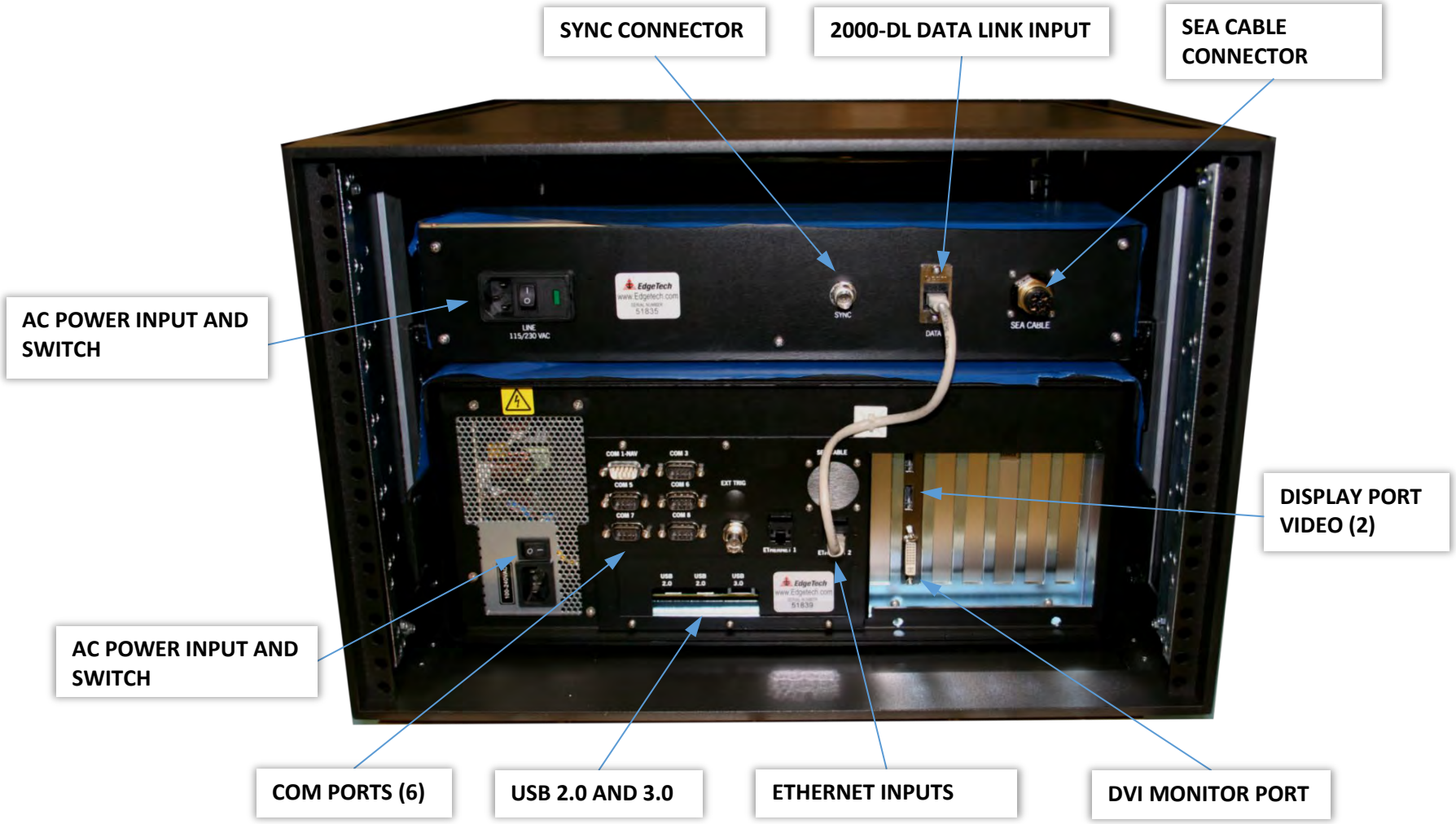

Figure 3-2: Rack Mount Topside Back Panel

3.5.2 Topside Computer Controls and Indicators

The Topside Computer controls and indicators are the following:

POWER: Rocker switch. Switches AC power to the Topside Processor. This switch can be left in the on position at all times.

SYSTEM POWER (*switch*)**:** Push-button toggle switch. Turns the Topside Processor on or off.

SYSTEM POWER (*indicator*)**:** Green indicator. Illuminated when the Topside Processor is on.

RESET: Momentary push button switch. Resets the Topside Processor.

HDD: Yellow indicator. Flashes when a hard drive on the Topside Processor is being accessed.

3.5.3 2000 Digital Telemetry Link Connections

The 2000-DL connections are as follows:

SEA CABLE: SubConn MCBH4F female connector to the sea cable that goes down to the towfish.

SYNC: Provides an input connection for a TTL external trigger that is sent to the towfish (used to trigger external device attached to 2000 DSS Tow Fish).

DATA: RJ-45 Standard ETHERNET connection used for connecting to the topside computer below it.

LINE VAC: CEE-type AC input connector. Connects to 90–260 VAC, 50/60 Hz power.

3.5.4 2000 Digital Telemetry Link Controls and Indicators

The 2000 Digital Telemetry Link includes controls and indicators include the following:

LINE: Rocker switch. Switches AC power to the POWER switch on the front panel of the 2000-DL. This switch can be left in the on position at all times.

POWER: Rocker switch. Turns the 2000-DL on or off.

PWR: Green indicator. Illuminated when the 2000-DL is on.

LAN: Green indicator. Flashes continuously when an Ethernet connection is established.

LINK: Green indicator. Flashes while the 2000-DL is establishing a reliable communications link with the side scan sonar. Illuminates continuously when a reliable communications link with the sonar is established.

FISH POWER: Red indicator. Illuminated when the 2000-DL is on, and the side scan sonar is pulsing.

> **NOTE:** The 2000 Digital Telemetry Link will automatically switch off power to the tow vehicle should it be disconnected from the tow vehicle for an extended period. The power will also be turned off if an overcurrent or undercurrent condition exists. To reactivate the power to the tow vehicle, turn the POWER switch off and then on again.

3.6 TCP/IP Address Settings

The 2000 Series Combined Side Scan Sonar and Sub-Bottom Profiling System includes many Ethernet devices connected on a common local area network (LAN). Each of these devices has a factory set TCP/IP address which under normal circumstances does not require changing. However, should any of these devices be replaced, or if upgrades are later installed, it may be required that the TCP/IP addresses be reconfigured. In addition, any computer that is to be connected to the 2000 Digital Telemetry Link must have its IP address set to 192.9.0.nnn, where nnn is any integer from 1 to 100—except for the following reserved addresses:

- 192.9.0.22
- 192.9.0.23
- 192.9.0.225
- 192.9.0.101
- 192.9.0.102

The factory IP address setting of the Topside Processor Ethernet connection is 192.9.0.99. For a list of the 2000 Digital Telemetry Link Ethernet devices and their TCP/IP addresses, refer to **TABLE 3-2**, and for the tow vehicle, to **TABLE 3-3**.

DEVICE	TCP/IP ADDRESS
Net Burner board	192.9.0.102
ASDL Modem board	192.9.0.22
Wireless bridge	192.9.0.225

Table 3-2: Topside Computer TCP/IP Addresses

DEVICE	TCP/IP ADDRESS
CPU Board	192.9.0.101
ASDL Modem board	192.9.9.23

Table 3-3: 2000 Digital Telemetry Link Devices TCP/IP Addresses

3.7 Connecting the System Components

Most of the system components, including some optional components, such as a printer and a navigation system, connect to the Topside Processor. The tow vehicle and any optional external sonar systems connect to the 2000 Digital Telemetry Link.

> **WARNING!** Do not connect the tow cable to the 2000 Digital Telemetry Link before connecting it to the tow vehicle. Injury or death can occur if the exposed connector on the tow cable is energized. Always connect the tow cable to the tow vehicle first.

When connecting the system components, refer to sub-section **3.5.1** for the location and description of the connectors. The cables used with the system are shown in **FIGURE 3-3**.

Figure 3-3: System Cables

3.7.1 Connecting and Attaching the Tow Cable to the Tow Cable

A tow cable is shown connected and attached to a 2000-DSS Tow Vehicle in **FIGURE 3-4**. For shallow water surveys, a tow rope with a working load of 2000 lbs. or more and a breaking strength of at least 6000 lbs. can be used to tow the tow vehicle. It should also have an eyelet for attaching to the shackle on the tow vehicle's tow bridle. A safety grip should also be used to relieve strain on the tow cable. An armored tow cable should be used for deeper surveys.

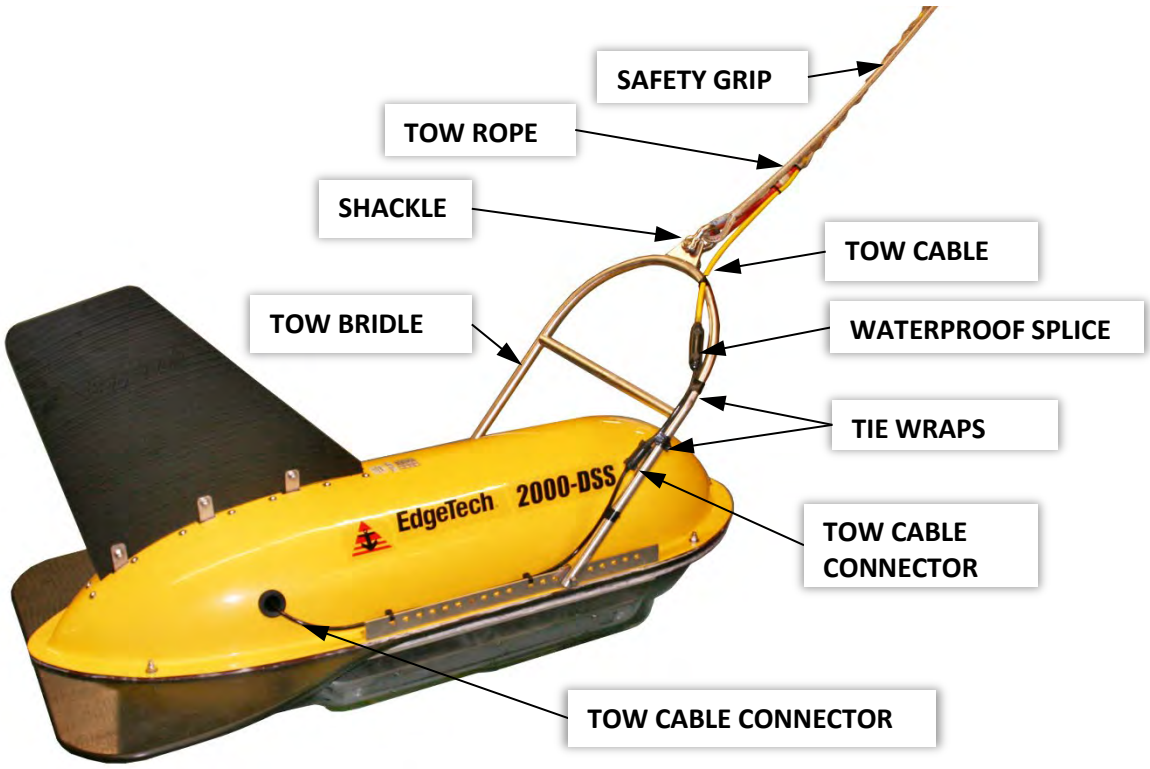

Figure 3-4: Tow Vehicle with Tow Cable Connected and Attached

To connect and attach the tow cable to the tow vehicle:

1. Verify that the tow cable is not connected to the 2000 Topside.
2. Verify that the tow cable connector on the tow vehicle and the mating input connector on the tow cable are free of corrosion or dirt. If dirty, clean them with an alcohol wipe.
3. Apply a thin film of silicone grease to the tow cable connector's pins on the tow vehicle.
4. Mate the connectors by pressing them firmly together. Do not wiggle the connectors.
5. Secure the connector locking sleeve.

6. Attach the tow rope's eyelet and the loop of the safety grip to the shackle on the towing arm and secure the shackle bolt with seizing wire or a tie wrap.
7. Lay the tow cable over the tow bridle and secure it in three or more places with tie wraps.

3.7.2 Connecting the 2000 Topside Processor

To connect the 2000 Topside Processor:

1. Verify that the Topside Processor and the 2000 Digital Telemetry Link are not connected to AC power.
2. Verify that the tow cable is properly connected and attached to the tow vehicle. Then, connect the tow cable adapter to the tow cable and the SEA CABLE connector of the 2000 Digital Telemetry Link.
3. If an external source will be used to trigger an external device attached to 2000 DSS Tow Fish, connect the trigger output of this source to the SYNC connector.
4. Connect one LCD monitor to the MONITOR 1 connector of the Topside Processor and the second LCD monitor to the MONITOR 2 connector.
5. Connect the trackball to the USB connector.
6. Connect the keyboard to the USB connector.
7. If a printer is used, connect it to a free USB port. For information on the printers that can be connected to the Topside Computer, refer to appendix **B.0**.
8. If a navigation system will be used, connect the navigation system output to the COM 1-NAV connector.
9. Connect the Ethernet patch cable to the DATA connector of the 2000 Digital Telemetry Link and to the ETHERNET 1 connector of the Topside Processor. This cable may be extended up to 100 feet using a Category 5 Ethernet crossover or straight patch cable.
10. Connect an AC power cord to the VAC INPUT connector of the Topside Processor and to the AC power source.
11. Connect an AC power cord to the LINE VAC connector of the 2000 Digital Telemetry Link and to the AC power source.
12. Connect an AC power cord to each of the LCD monitors and to the AC power source.

3.8 System Activation and Test

After the connections to the 2000 Topside Processor and the 2000 Digital Telemetry Link have been completed, the 2000 Series Combined Side Scan Sonar and Sub-Bottom Profiling System can be activated, and some pre-deployment checks performed before deployment of the tow vehicle as a test to verify that the system is operating properly.

When performing the system activation and test, refer to sub-section **3.5 RACK MOUNT TOPSIDE CONNECTIONS, CONTROLS, AND INDICATORS** for the location and description of the controls and indicators. In addition, should the system not activate properly or the pre-deployment checks fail, refer to section **6.0** for assistance on how to isolate and correct the problem.

> **NOTE:** The DISCOVER software requires license activation, which is performed either directly in the tow vehicle or by inserting a dongle into an available USB port on the Topside Processor. If in the tow vehicle, no action is required.

3.8.1 Activating the System

To activate the system:

1. Turn on the LCD monitors.
2. Turn on the POWER switch on the back panel of the Topside Processor. This switch can be left in the on position at all times if desired.
3. Turn on the SYSTEM POWER switch on the front panel.

The SYSTEM POWER indicator should illuminate, and the HDD indicator should flash while the Windows desktop opens. Then the EdgeTech DISCOVER 2000-C Dual Frequency Side Scan and DISCOVER Sub Bottom software open to the Main windows as shown in **FIGURE 3-5**.

4. Turn on the LINE switch on the back panel of the 2000 Digital Telemetry Link. This switch can be left in the on position at all times if desired.

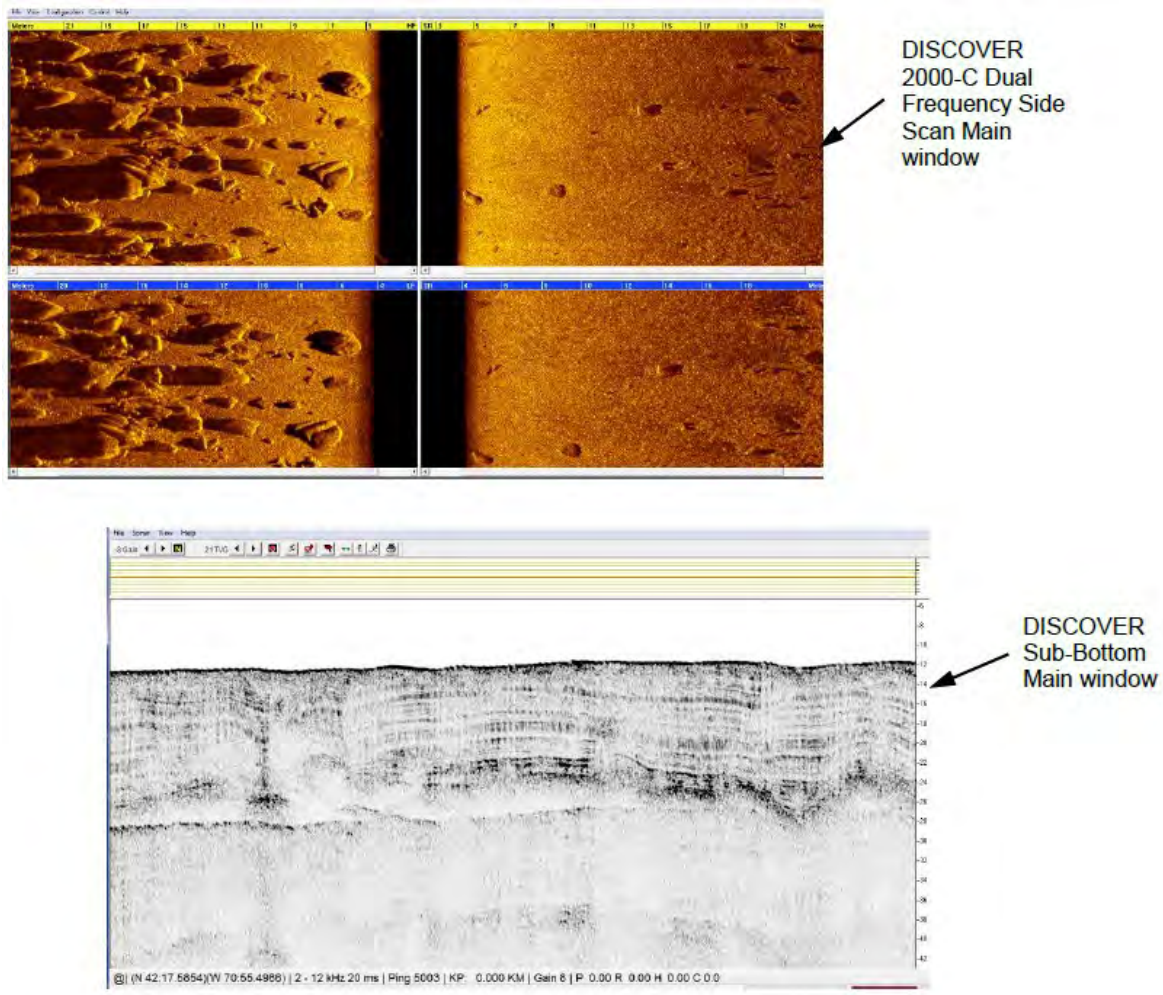

Figure 3-5: DISCOVER 2000-C Dual Frequency Side Scan & DISCOVER Sub-Bottom Windows

5. Turn on the POWER switch on the front panel.

The FISH POWER indicator should illuminate; the LAN indicator should flash continuously, and the LINK indicator should flash while a reliable communications link with the tow vehicle is being established and then illuminate continuously when the link is found. In addition, the NET indicator on the Status bar at the bottom of the Main window should indicate as follows:

NET: ON

3.8.2 Performing the Pre-Deployment Checks

The pre-deployment checks should be performed after the system is activated and before the tow vehicle is deployed. These checks are performed for both the side scan and sub-bottom sonars and involve verifying that data can be recorded and played back in DISCOVER; rubbing your hand on the side scan transducer arrays, and tapping the sub-bottom hydrophone arrays while observing the Sonar displays in the DISCOVER Main windows; verifying correct heading, pitch, and roll outputs; and zeroing the optional pressure sensor if installed.

To perform the pre-deployment checks:

1. Activate the system as described in sub-section **3.8.1**.
2. In the DISCOVER 2000-C Dual Frequency Side Scan Main window, click the Transmit tab in the Lower Control panel. This tab is shown in **FIGURE 3-6**.

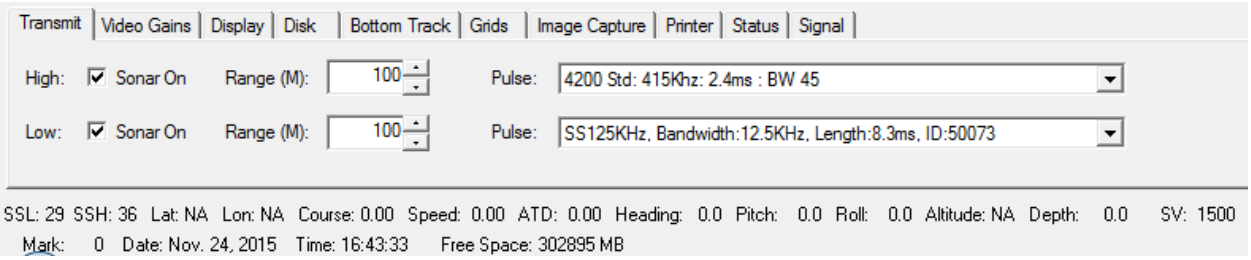

Figure 3-6: Lower Control Panel, Transmit Tab—DISCOVER Side Scan

> **CAUTION!** Do not allow the side scan transducers on the tow vehicle to continuously transmit in the air for an extended period as damage to the transducers could occur.

3. Select the High Sonar On and Low Sonar On checkboxes.

The side scan transducer arrays on the tow vehicle should begin transmitting, and data should begin scrolling on the Sonar display in the DISCOVER 2000-C Dual Frequency Side Scan Main window.

4. Record a few minutes of data, then playback the data, and verify that data can be recorded and played back.
5. Rub the port and starboard side scan transducer arrays while observing the Sonar display in the Main window.

You should observe streaks or noise spikes in the waterfall display.

6. Verify that the heading, pitch, and roll sensors are working correctly by rotating, tilting, and rolling the tow vehicle and observing the Heading, Pitch, and Roll displays in the Lower Indicator bar in the Main window.

7. If a pressure sensor is installed, verify that the Pressure display indication is at or nearly zero. The Pressure sensor can be zeroed on deck under External Device Controls.

8. In the DISCOVER Sub-Bottom Main window, choose Control Panel from the Sonar menu.

The Options dialog box shown in **FIGURE 3-7** opens to the Sonar Control tab.

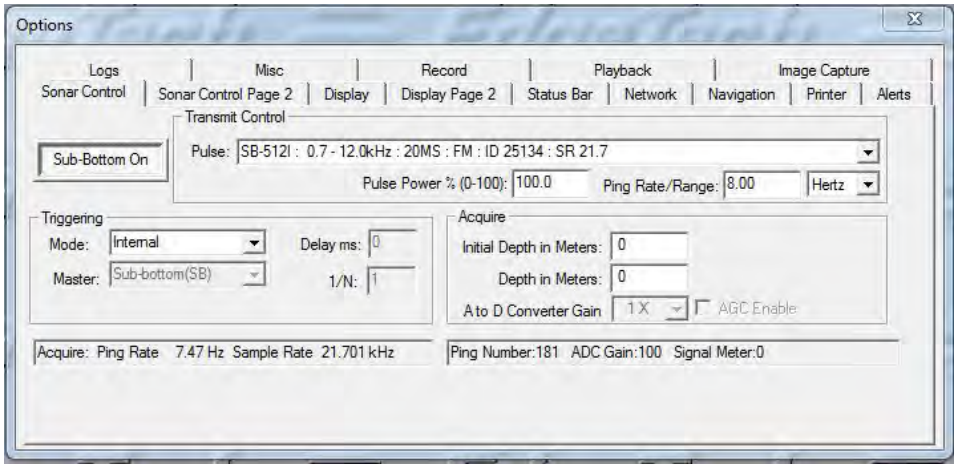

Figure 3-7: Options Dialog Box, Sonar Control Tab—DISCOVER Sub Bottom

9. On the Sonar Control tab, make the required settings.

10. Click the Display tab.

The Display tab shown in **FIGURE 3-8** opens.

11. On the Display tab, set the Gain to either 0 or -3 dB, and then click Norm.

12. Close the Options dialog box.

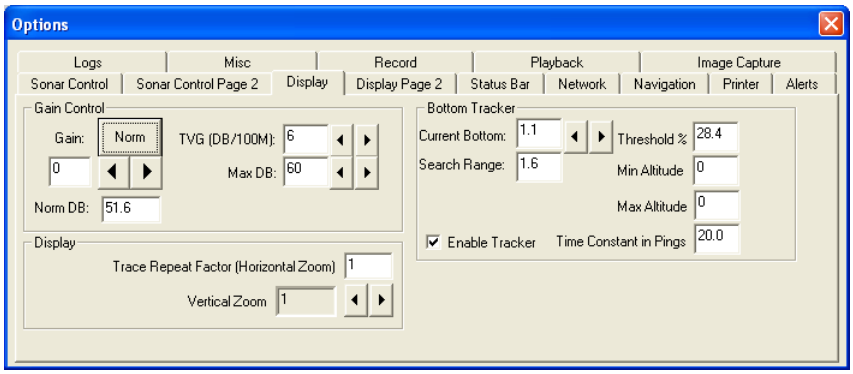

Figure 3-8: Options Dialog Box, Display Tab—DISCOVER Sub-Bottom

> **CAUTION!** Do not allow the sub-bottom transducer on the tow vehicle to continuously transmit in the air for an extended period as damage to the transducer could occur.

13. From the Sonar menu, choose Sonar On. When the sonar is on, a checkmark appears next to the menu item.

The tow vehicle's transducers should begin transmitting, and data should begin scrolling on the Sonar display in the DISCOVER Sub-Bottom Main window.

14. Listen for transmissions from the sub-bottom transducer and verify that they are present.

15. Tap the tow vehicle's underside near the hydrophones with the screwdriver's handle while observing the Sonar display in the DISCOVER Sub-Bottom Main window.

You should observe streaks or noise spikes in the waterfall display.

3.9 Compass Usage

2000-DSS Towfish compasses are pure magnetic field measuring devices that provide a heading relative to magnetic North. The intent is to provide the operator with real-time towfish heading, pitch, and roll data to know how the towfish's motion impacts data collection quality. This helps the operator make informed decisions for the best survey results.

The standard magnetic compass data is not suitable for processing raw data. This is due to the inaccuracies caused by local magnetic declination and the variable magnetic influences of materials in the towfish, towfish equipment, tow vessel hull construction, the environment, and targets. Our suggestion to overcome these issues is to use *course-made-good* to process and mosaic side scan data and accurately position targets.

The factory acceptance and verification tests for these magnetic field measurement devices include running hard iron and soft iron compensations at a magnetically quiet site once the sensor is installed in the towfish and again at a magnetically quiet site, a verification to check the output relative to magnetic north.

If compass calibration is needed, please refer to the **CALIBRATING THE COMPASS** section of this manual and contact **EDGETECH CUSTOMER SERVICE** for assistance.

3.10 Tow Vehicle Deployment

Shown in **FIGURE 3-9** is a 670D Tow Vehicle being deployed.

CAUTION! When lowering the tow vehicle in an area where the bottom topography is unknown, be careful not to strike the bottom or a submerged object, otherwise, damage to the tow vehicle may occur. In addition, at all times during the survey, be sure to monitor the tow vehicle's altitude carefully, as failure to do so may result in the tow vehicle hitting bottom or becoming snagged.

CAUTION! Do not tow the tow vehicle too close to the survey vessel. Towing in this manner can cause the tow vehicle to be pulled in against the hull of the ship due to the low pressure of the propeller wash and the effect of the water flowing by the hull. In addition, sonar reflections from the hull may be evident in the records.

CAUTION! Do not tow the tow vehicle with the nose angled up or down. Doing so can degrade the sonar imagery. Verify that the tow vehicle is as level as possible when towing it.

NOTE: For detailed towing characteristics for the 2000-DSS Tow Vehicle with several tow cable types and lengths and tow vehicle speeds, refer to appendix **C.0**.

NOTE: For detailed information about the EdgeTech DISCOVER software, including how to record data, refer to the “DISCOVER 2000-C Dual Frequency Side Scan Software User’s Manual” or to the “DISCOVER Sub-Bottom Software User’s Manual.”

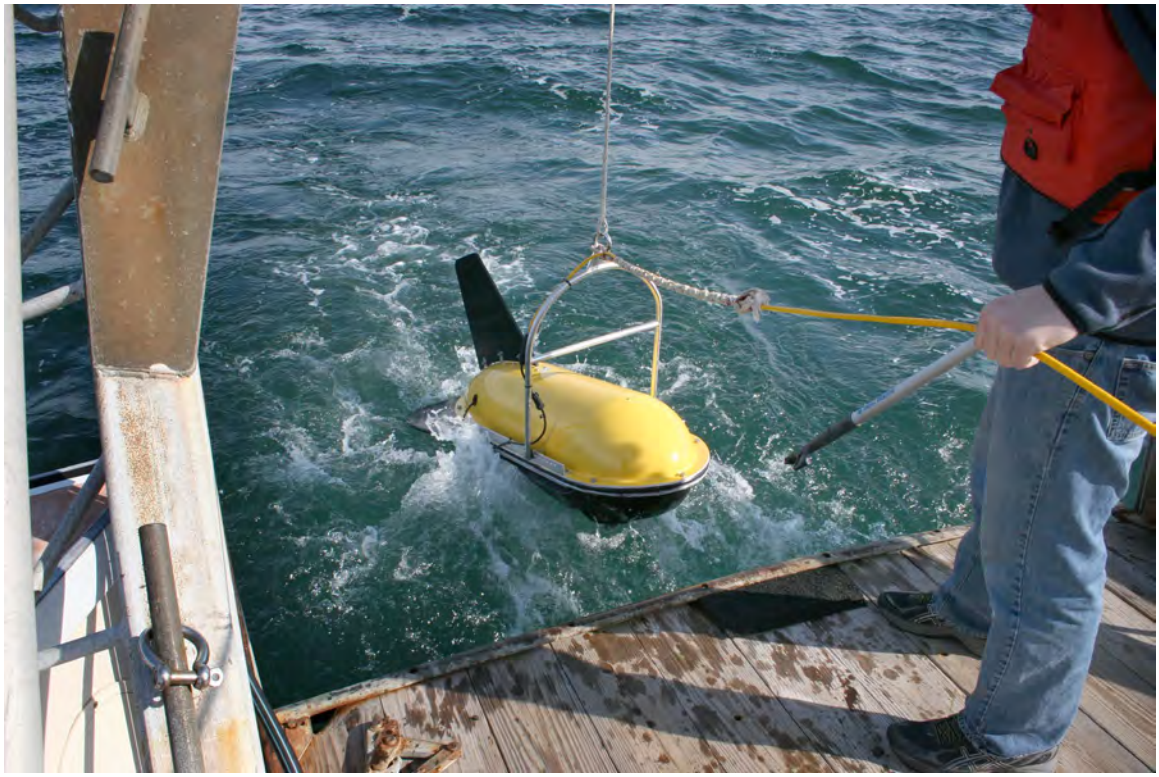

Figure 3-9: 2000-DSS Tow Vehicle being Deployed

To deploy the tow vehicle:

1. With the survey vessel underway at up to two knots, slowly and carefully lower the tow vehicle into the water, well away from the propeller. Do not let the tow vehicle strike the hull of the survey vessel.
2. Lower the tow vehicle to a depth of about three meters or just below the propeller wash.
3. In the DISCOVER 2000-C Dual Frequency Side Scan Main window, click the Transmit Tab in the Lower Control Panel and add range for each frequency. This tab is shown in **FIGURE 3-6**.
4. Click the Bottom Track tab. This tab is shown in **FIGURE 3-10**.

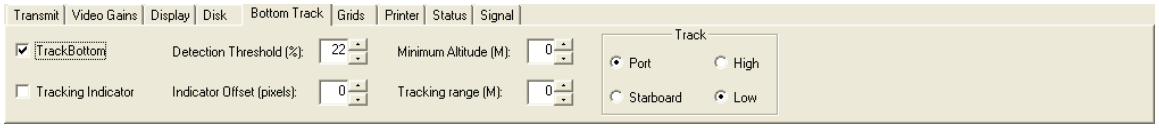

Figure 3-10: Lower Control Panel, Bottom Track Tab—DISCOVER 200-C Dual Frequency Side Scan

5. On the Bottom Track tab, make the required settings to track the bottom and note the tow vehicle altitude in the Altitude display.
6. Lower the tow vehicle such that its altitude is 10–15% of the range selection.

7. Increase the survey vessel speed to the desired survey speed and adjust the amount of cable out such that the altitude of the tow vehicle remains at 10–15% of the range selection.
8. If a pressure sensor is installed, verify that the Pressure display indication is correct.
9. Secure the tow cable to the survey vessel.
10. Begin recording data.

3.11 Tow Vehicle Recovery

To recover the tow vehicle:

11. In the DISCOVER 2000-C Dual Frequency Side Scan Main window, click the Transmit tab and clear the High Sonar On and Low Sonar On checkboxes. This tab is shown in **FIGURE 3-6**.

The side scan transducers should stop transmitting.

12. In the DISCOVER Sub-Bottom Main window, choose Sonar On from the Sonar menu. When the sonar is off, no checkmark should be present next to the menu item.

The sub-bottom transducer should stop transmitting.

13. Slowly pull in the tow cable until the tow vehicle is just below the surface.
14. Slow the survey vessel speed to under two knots. However, if practical, the survey vessel should be put in neutral while the tow vehicle is brought on board.
15. Retrieve the tow vehicle from the water and carefully lower it on deck.
16. Disconnect the tow cable from the tow cable connector.
17. Install the dummy plug on the tow cable connector.
18. Refer to sub-section **5.1** for instructions on cleaning and inspecting the tow vehicle, the tow cable, and the underwater connectors after use.

4.0 TECHNICAL DESCRIPTION

This section provides an overall general description of the hardware elements comprising the 2000 Topside Processor and the 2000-DSS Tow Vehicle of the 2000 Series Combined Side Scan Sonar and Sub-Bottom Profiling System. This information, including block diagrams, board descriptions, chassis photos, component callouts, and wiring diagrams, can be useful for troubleshooting purposes and installing optional equipment.

4.1 2000 Topside Processor

The 2000 Topside Processor is composed of the Topside Processor and the 2000 Digital Telemetry Link installed in a 19-inch rack enclosure along with a keyboard, a trackball, and two LCD monitors.

4.1.1 Topside Processor

The main hardware elements in the Topside Processor include the following components and circuit boards:

COMPUTER POWER SUPPLY Provides DC power for the CPU Board and the hard drives.

CPU The CPU board runs the Microsoft Windows operating system and the DISCOVER software on an Intel Pentium 4, 2.4 GHz processor and includes 512 MB of RAM. The CPU board outputs downlink commands to the tow vehicle over the Ethernet connection to the 2000 Digital Telemetry Link while it inputs the tow vehicle's uplink sonar data over the same connection. A 500-GB hard drive contains the operating software, and a 1-TB hard drive is used for data storage. Both hard drives interface with the CPU board, as do the LCD monitor, the keyboard, and the trackball. The Computer Power Supply provides power for the CPU board.

4-PORT RS-232 SERIAL BOARD The 4-Port RS-232 Serial board plugs directly into the CPU and provides four RS-232 serial ports on RJ45 connectors. A cable connects from each connector to one of four DB-9 connectors, COM5–COM8, on the back panel.

HARD DRIVES A 160-GB hard drive (*C:\ drive*) stores the Windows XP operating system and the application software. A 1 TB hard drive (*D:\ drive*) is used for data storage.

4.1.2 2000 Digital Telemetry Link

A block diagram of the 2000 Digital Telemetry Link electronics is shown in FIGURE 4-2. The wiring diagram is shown in FIGURE 4-3. The main hardware elements in the 2000 Digital Telemetry Link include the following components and circuit boards:

POWER: The Power board inputs +24 VDC on J1 from the 24 VDC Power Supply and generates the 400 VDC tow vehicle power, which is output to the tow vehicle on J13 combined with the frequency shift keyed (FSK) responder trigger signal input on J10 and the ADSL downlink command and uplink data signals. The command signals are input and the data signals are output on J14. The Power board also includes +5, +12, and +15 VDC power supplies, where +12 VDC is output on J4 to the fan and on J6 to the ADSL Modem board.

24 VDC POWER SUPPLY: The 24 VDC Power Supply inputs AC power from the Power Entry module to generate +24 VDC, which is output to the Power board.

POWER ENTRY: The Power Entry module filters the AC power and connects it to the 24 VDC Power Supply through the front panel power switch.

ADSL MODEM: The ADSL Modem board converts the uplink data ADSL signals received from the tow vehicle and input on the ADSL connector from the Power board into Ethernet 10/100/1000BaseT signals which are output to the 2000 Topside Processor. Similarly, the ADSL Modem board converts the downlink Ethernet 10/100/1000BaseT based command signals from the 2000 Topside Processor into the ADSL downlink command signals which are output on the ADSL connector to the Power board for transmission to the tow vehicle. The ADSL Modem board also serves as an Ethernet switch to provide Ethernet connections on J1 to the 2000 Topside Processor, on J3 to the Wireless Router, and on J4 to the Net Burner board on the Power board, placing all of these devices on the same LAN. +12 VDC power is input on the DC connector from the Power board.

NET BURNER: The Net Burner board mounts to and connects directly to the Power board to provide Power board diagnostics, tow vehicle power control, positive and negative trigger edge selection, and sensor monitoring. An Ethernet connection to the Net Burner board is provided on J3 from the ADSL Modem board. Power is input from the Power board.

4.1.2.1 Selecting Negative Edge Triggering for the Optional Responder

The 2000-DSS system has the ability to be configured with an optional responder in the tow vehicle. If ordered from the factory with a responder installed, the 2000-DL digital telemetry link will have a jumper installed in the location shown in **FIGURE 4-1**, and the customer does not need to take any further steps.

However, if a responder is installed later, a jumper, selecting for negative edge triggering, needs to be added to JP6 on the power board of the 2000-DL, as shown in **FIGURE 4-1**.

Figure 4-1: Location of Jumper JP6 on the Power Board of the FSIU

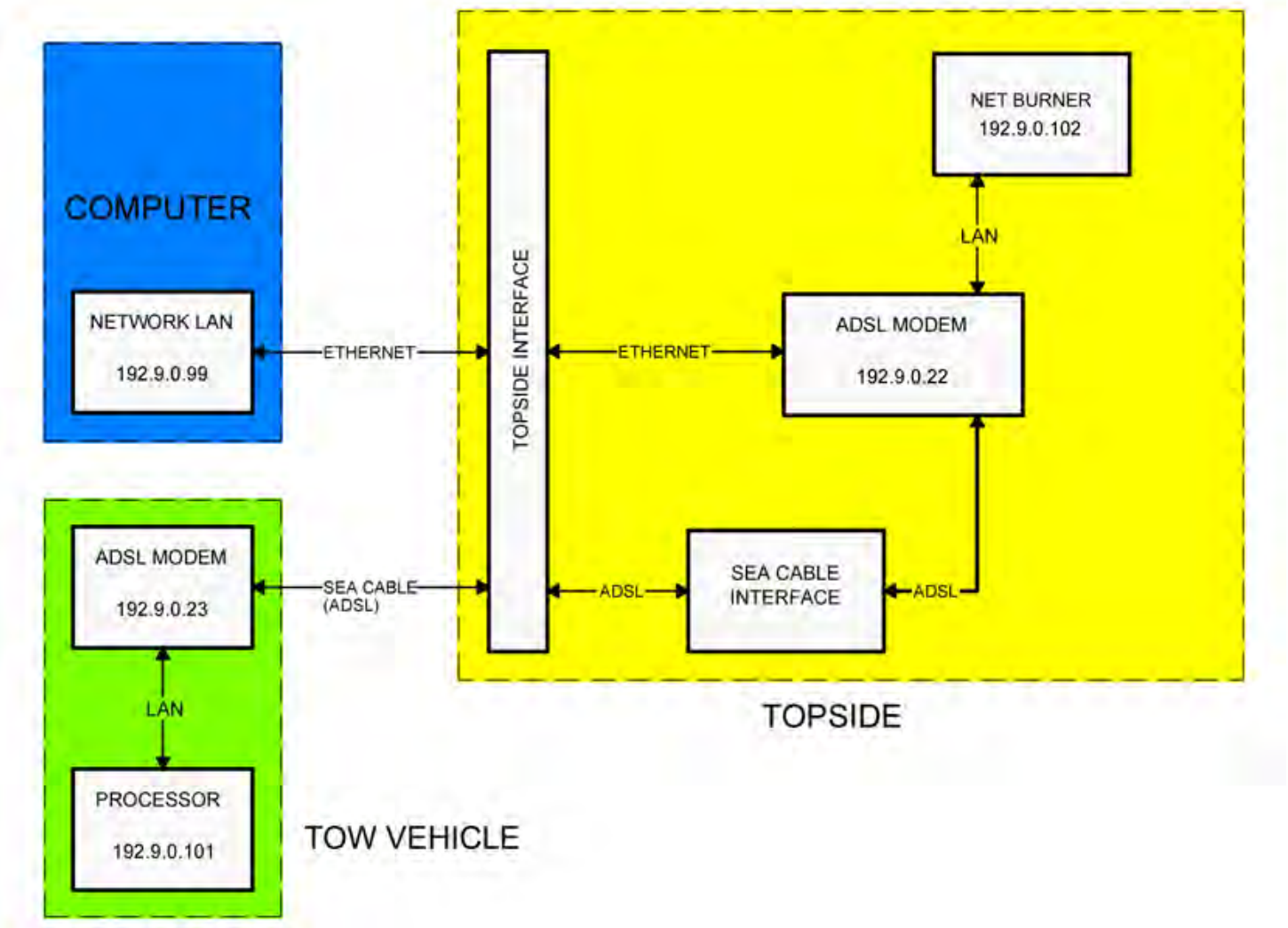

Figure 4-2: 2000 Digital Telemetry Link Electronics Block Diagram

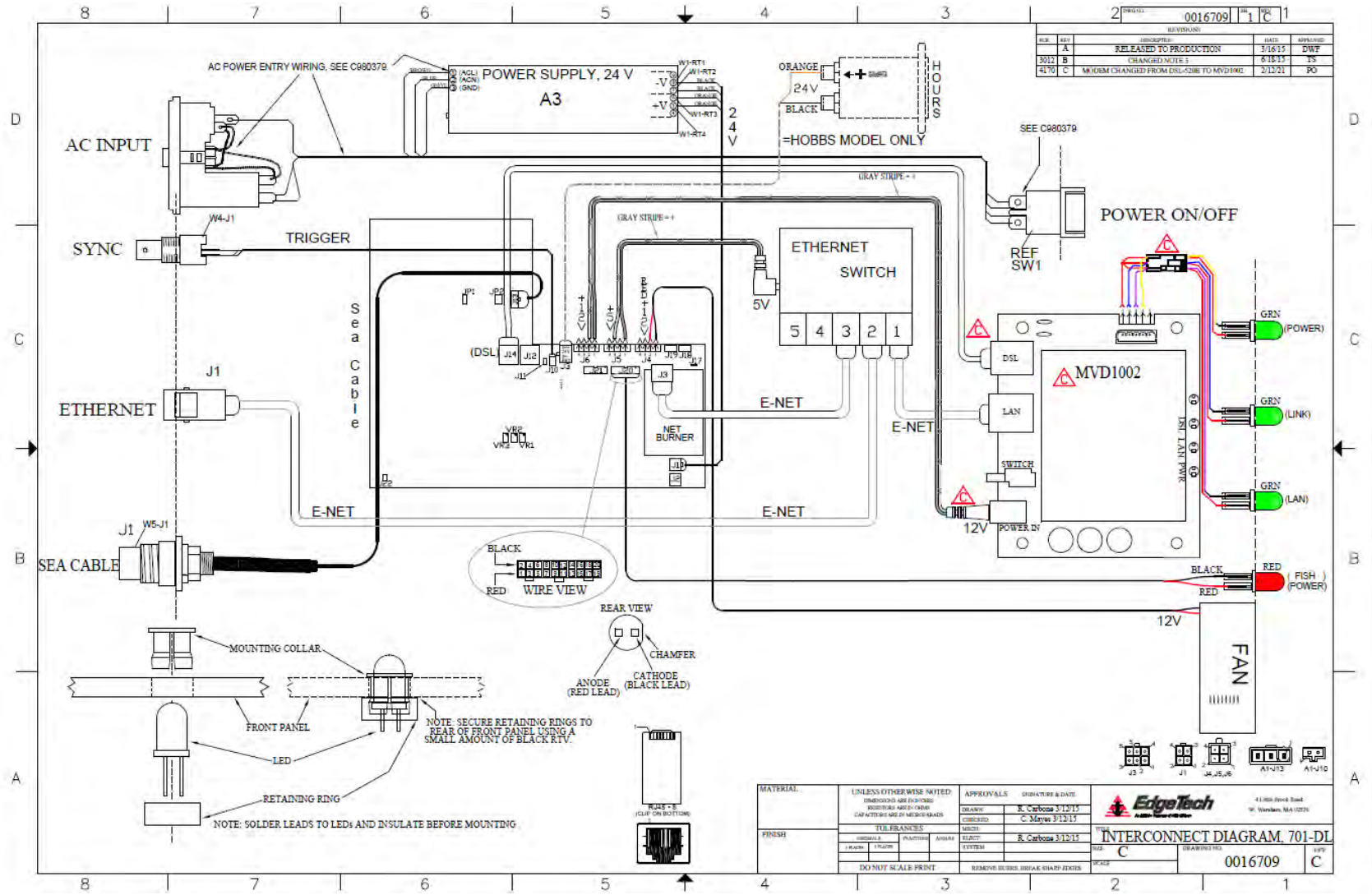

Figure 4-3: 2000 Digital Telemetry Link Wiring Diagram

4.2 Tow Vehicle

A photo of the 2000-DSS Tow Vehicle electronics chassis is shown in **FIGURE 4-4**, and a block diagram and interconnect drawing are in **FIGURE 4-5** and **FIGURE 4-5**, respectively. The electronics chassis contains all of the tow vehicle circuit boards along with the optional pressure sensor. The circuit boards are the following:

POWER DISTRIBUTION

The Power Distribution board inputs the tow vehicle 400 VDC power on J1 from the 2000 Topside Processor over the coaxial tow cable and filters it from the frequency shift keyed (FSK) responder trigger signals and the ADSL downlink command and uplink data signals. The command signals are input and the data signals are output on J2. The Power Distribution board also includes DC to DC converters which convert the 400 VDC to +48, +12, 12, and -5 VDC. The +48 VDC is output on J4 to the Amplifier boards. The other voltages are output on J6 to the ADSL Modem board, J5 to the CPU board, J7 to the Sonar Interface board, J8 to the Option connector, and J9 and J11 to the fans.

ADSL MODEM

The ADSL Modem board converts the downlink command ADSL signals received from the 2000 Topside Processor and input on J2 from the Power Distribution board into Ethernet 10/100/1000BaseT signals which are output on J1 to the CPU board. Similarly, the ADSL Modem board converts the uplink Ethernet 10/100/1000BaseT based data signals from the CPU board into the ADSL uplink data signals, which are output on J2 to the Power Distribution board for transmission to the 2000 Topside Processor. The ADSL Modem board also outputs the FSK responder trigger signals on J5 to the Sonar Interface board and to the optional Responder board. +12 and -12 VDC power is input on J8 from the Power Distribution board.

T/R SWITCH

The T/R Switch board provides the transmit/receive function for the side scan transducer arrays, allowing them to be used both as acoustic transmitters and as acoustic receivers simultaneously. Transmit signals are input from the Power Amplifier board as follows:

- J1: Port low-frequency transmit
- J2: Port high-frequency transmit
- J3: Starboard high-frequency transmit
- J4: Starboard low-frequency transmit

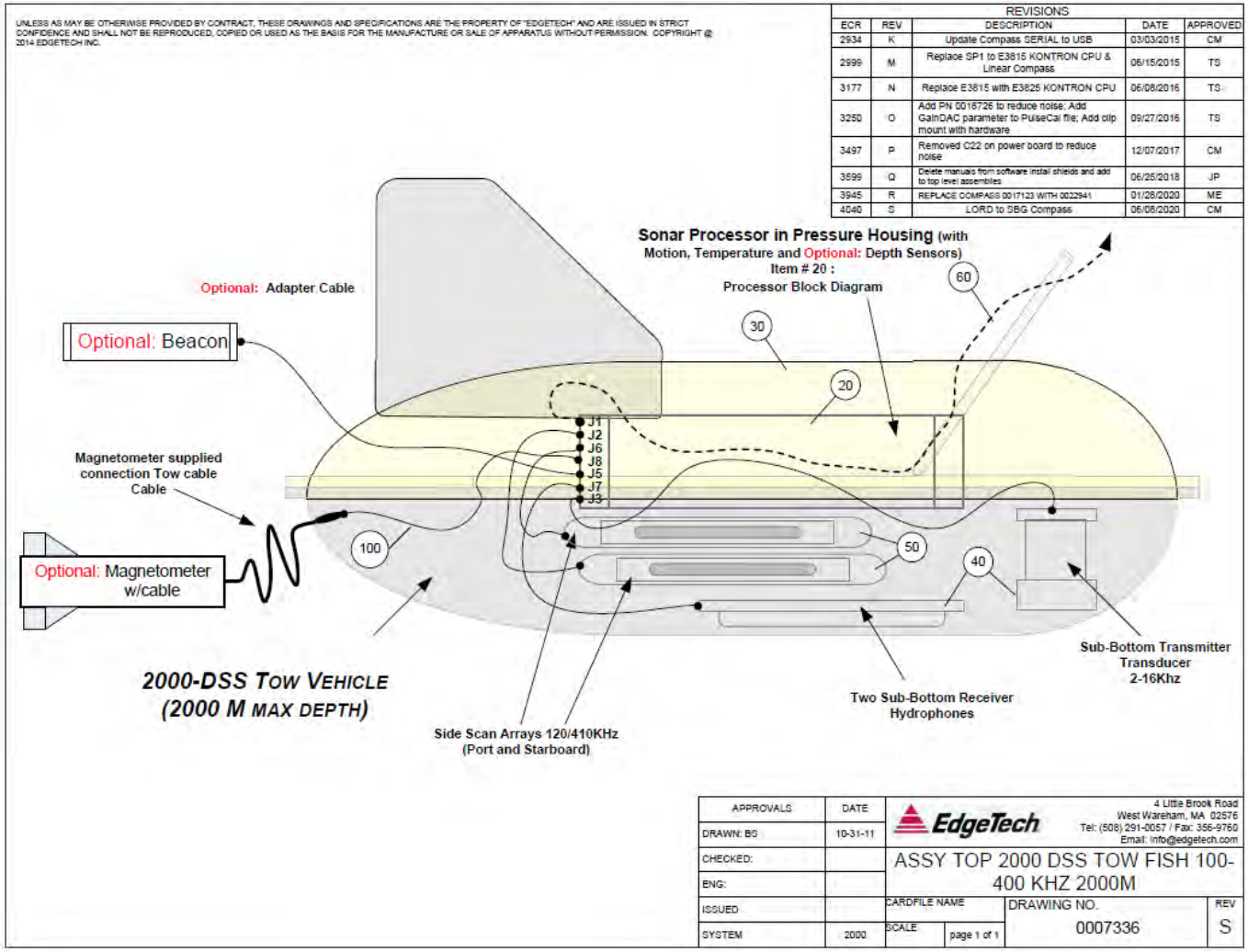

Figure 4-4: Tow Vehicle Electronic Block Diagram

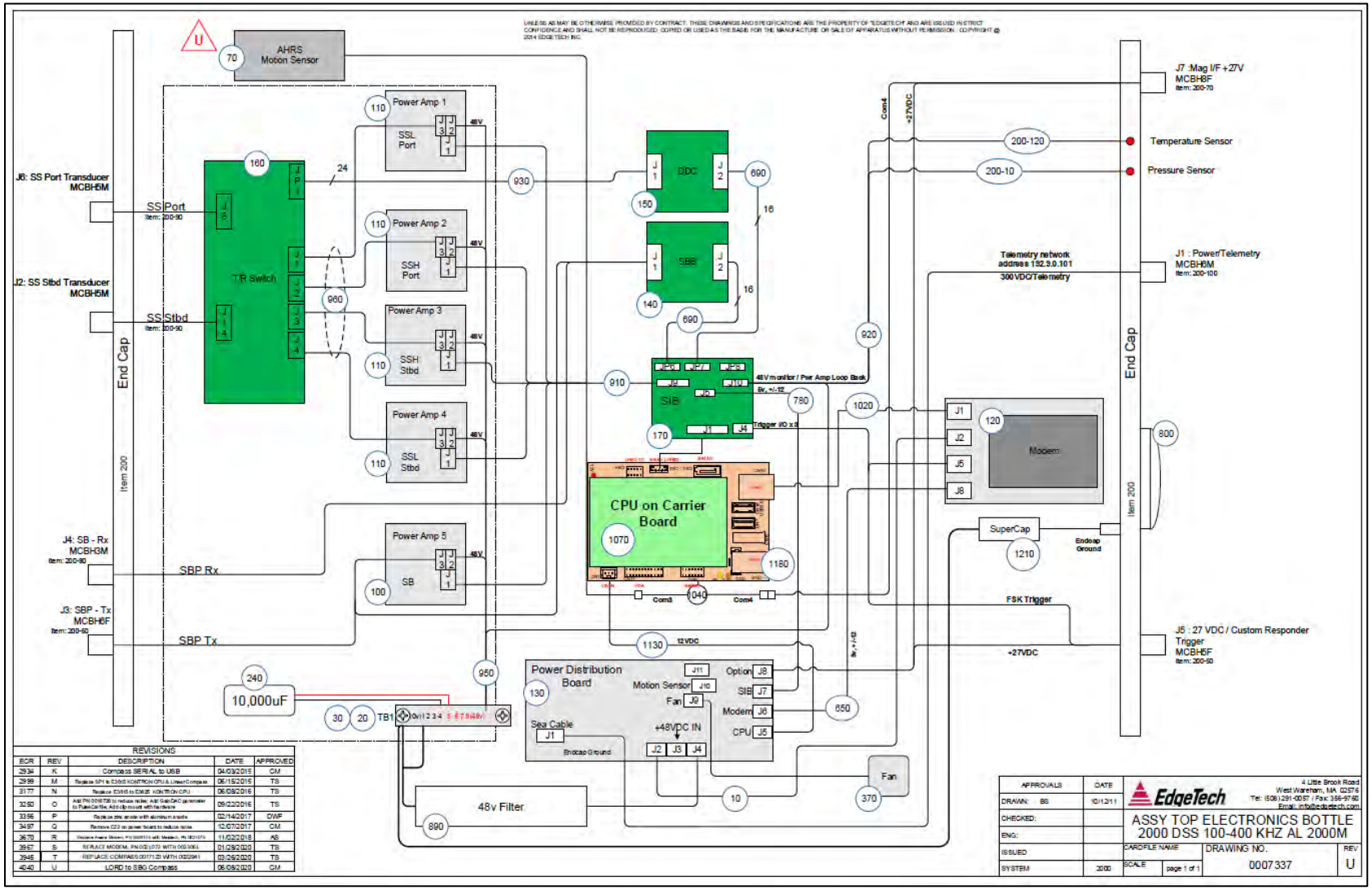

Figure 4-5: Tow Vehicle Interconnect Drawing

Amplified transmit signals are output to the transducer arrays, or received signals are input from the transducer arrays as follows:

- J8: Port transducer array receive
- J14: Starboard transducer array receive

The T/R Switch board includes four noise-reducing receiver preamplifiers, one each for the high and low-frequency port transducer arrays and one each for the high and low-frequency starboard transducer arrays.

POWER AMPLIFIER

There are four identical Power Amplifier boards, one each for the port high (SSH) and low (SSL) frequency transmit signals and one each for the starboard high and low frequency transmit signals. +48 VDC is input on J2 from the Power Distribution board, and the amplified outputs are output on J3 to the T/R Switch board to drive the transducer arrays. On/off control signals, along with the low-level transmit signals, are input on J1 from the Sonar Interface board.

CPU

The CPU board runs an embedded version of the Microsoft Windows operating system and includes a 512-MB flash memory with C and D partitions. The C partition contains the operating system, and the D partition contains the sonar application software. The CPU board inputs downlink commands from the 2000 Topside Processor over the Ethernet connection on J1 with the ADSL Modem board while it outputs the uplink sonar data to the 2000 Topside Processor over the same connection. In addition to these functions, the CPU provides the chirp-matched filter processing, power up diagnostic self-tests, and pointing device and keyboard inputs for factory test. The COM1 serial port of the CPU board interfaces with an optional magnetometer, and the USB port interfaces with the Compass board. +12 VDC power is input from the Power Distribution board.

SONAR INTERFACE

The Sonar Interface board converts the digital chirp high, and low frequency transmit signals for the 100/400-Khz frequency systems into corresponding low-level analog signals that are output on J9 Power Amplifier boards. In addition, signals from an optional pressure sensor and an internal temperature sensor are input on J10, the FSK responder trigger signals are input on J4, and the digitized received sonar signals from the Side Scan board are input on J7. Test points and indicators for the transmit signals and IDE interface logic for the Side Scan board are also included.

	+5, +12, and -12 VDC power is input on J5 from the Power Distribution board.
DDC	The DDC board is used in place of the Sonar Interface board for the 300/600 kHz system.
SIDE SCAN	The Side Scan board is a four-channel receiver that provides analog to digital conversion of the received sonar signals, which are input on J1 from the T/R Switch board. The digitized signals are output on J2 to the Sonar Interface board. Indicators on the Side Scan board illuminate when signals are being received.
SUB-BOTTOM	The Sub-bottom board is a single channel receiver that provides analog to digital conversion of the received sonar signals, which are input from the hydrophones on J4 on the electronics bottle connector end cap. The digitized signals are output on J2 to the Sonar Interface board. Indicators on the Sub-Bottom board illuminate when signals are being received.
COMPASS	The Compass board provides heading, pitch, and roll outputs to the USB port of the CPU board.

4.3 Cables

Outline drawings of the optionally available tow cable and test cable are listed below, along with their corresponding figure numbers.

- FIGURE 4-6: ARMORED CABLE, PMI GRIP, UNTERMINATED TOPSIDE
- FIGURE 4-7: TEST CABLE

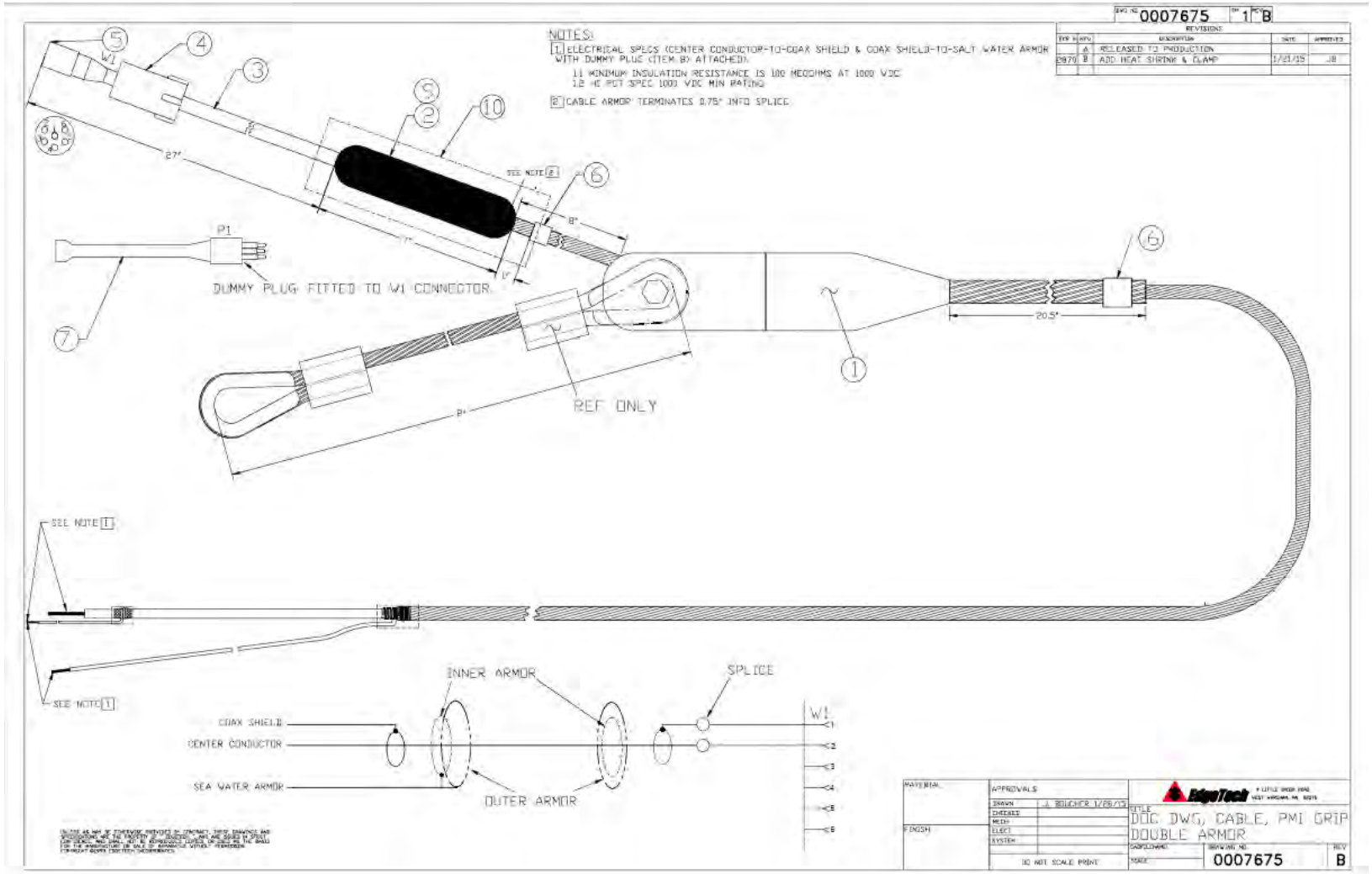

Figure 4-6: Armored Cable, PMI Grip, Unterminated Topside

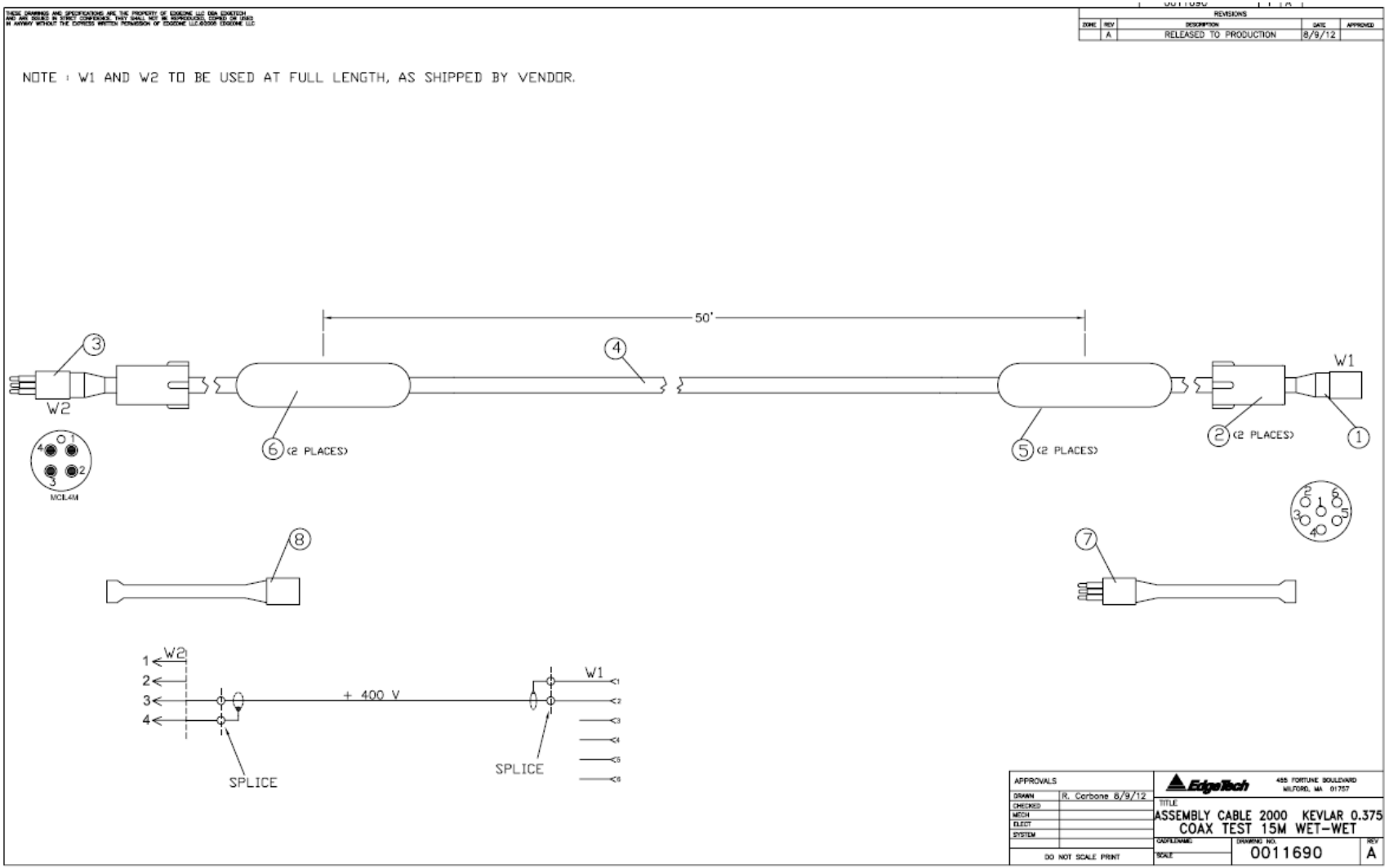

Figure 4-7: Test Cable

5.0 MAINTENANCE

The 2000 Series Combined Side Scan Sonar and Sub-Bottom Profiling System is ruggedly designed and built and requires little maintenance. However, to ensure long-lasting and reliable service, some periodic maintenance is recommended.

This section provides some maintenance recommendations and includes instructions on disassembling and reassembling the 2000-DSS Tow Vehicle should it be required to access and remove the electronics chassis in the electronics bottle. In addition, lists of major components for the 2000 Topside Processor and the 2000-DSS Tow Vehicles are included.

5.1 Periodic Maintenance

Maintenance on the 2000 Series Combined Side Scan Sonar and Sub-Bottom Profiling System should be performed regularly. Most maintenance is performed after each deployment and recovery cycle of the tow vehicle. No periodic maintenance is required for the 2000 Topside Processor.

5.1.1 Inspecting and Cleaning the Tow Vehicle and Tow Cable after Use

After retrieving the tow vehicle from the water, use a hose to wash it down, along with the tow cable, with clean, freshwater. Thoroughly spray the transducer arrays and remove any buildup of debris. Inspect the cables and connectors for any damage and check for loose connections. Also inspect the tow cable and the connectors on each end.

After washing down the tow vehicle, clean the transducer arrays using a mild, non-abrasive detergent and water. Do not use any abrasive detergents or ammonia-based cleaners. After cleaning, thoroughly spray the transducer arrays again with fresh water.

5.1.2 Inspecting and Cleaning the Underwater Connectors

Regularly inspect the contacts on each underwater connector's pins in the tow vehicle and the tow cable for corrosion or oxidation. To remove any oxidation, rub the contacts lightly with 800 grit emery cloth cut into strips equal to or less than the width of a contact. A pencil eraser can also be used for this purpose. The input sockets can be cleaned using a cotton swab and rubbing alcohol. A .22 caliber bore brush with only nylon bristles can be used to remove light oxidation.

To extend the life and increase the connectors' reliability, apply a thin film of silicone dielectric grease, such as Novagard G624 general purpose silicone grease or an equivalent, to the entire surface of each pin. A small amount of grease should also be applied to the opening of each input socket.

NOTE: Remember to always install dummy connectors on the tow cable's connectors and the tow vehicle's tow cable connector.

5.1.3 Storage

When not in use, all the 2000 Series Combined Side Scan Sonar and Sub-Bottom Profiling System components should be packed in their original shipping containers, in the same manner they were originally shipped and stored in a dry area.

5.1.4 Recommended Spares

Spares, such as circuit boards, power supplies, cables, and other critical items should be purchased at the same time as the system is purchased, as some original equipment manufactured (OEM) components may change. All spares are optional. For a list of recommended spares at the time of the system purchase, contact EdgeTech sales.

5.2 Restoring the Operating System to the Hard Drive

The Topside Processor contains a 160-GB hard drive for both the operating system and the application software. A separate 1-TB hard drive is also included for data recording. An image file of the 160-GB hard drive is provided on a CD. This CD can be used to completely restore the 160-GB hard drive to its original shipped factory configuration in the unlikely event of its failure. For instructions on how to restore the operating system, refer to **APPENDIX B: "SYSTEM BACKUP AND RESTORE."**

5.3 Disassembling and Reassembling the Tow Vehicle

The procedures below describe how to disassemble and reassemble the tow vehicle to access and remove the electronics chassis. The tools required are a 9/16-inch wrench, a 7/16-inch wrench, and a ½-inch Allen key.

WARNING! High voltages that can cause injury or death are present in the tow vehicle. Turn off both the Topside Processor and the 2000 Digital Telemetry Link and disconnect the tow cable before disassembling the tow vehicle.

5.3.1 Disassembling the Tow Vehicle

Instructions to disassemble the tow vehicle and bottle are as follows:

1. Place the tow vehicle on a clean, dry, flat surface.
2. Use the 9/16-inch wrench and remove the three sets of bolts, washers, and self-locking nuts in the bow.
3. Remove the eight sets of bolts and split lock washers from the port and starboard tow brackets and remove the tow bridle, tow brackets, and bar nuts.
4. Remove the two sets of bolts, washers, and self-locking nuts at the tow vehicle's stern and remove the upper half of the fiberglass shell.

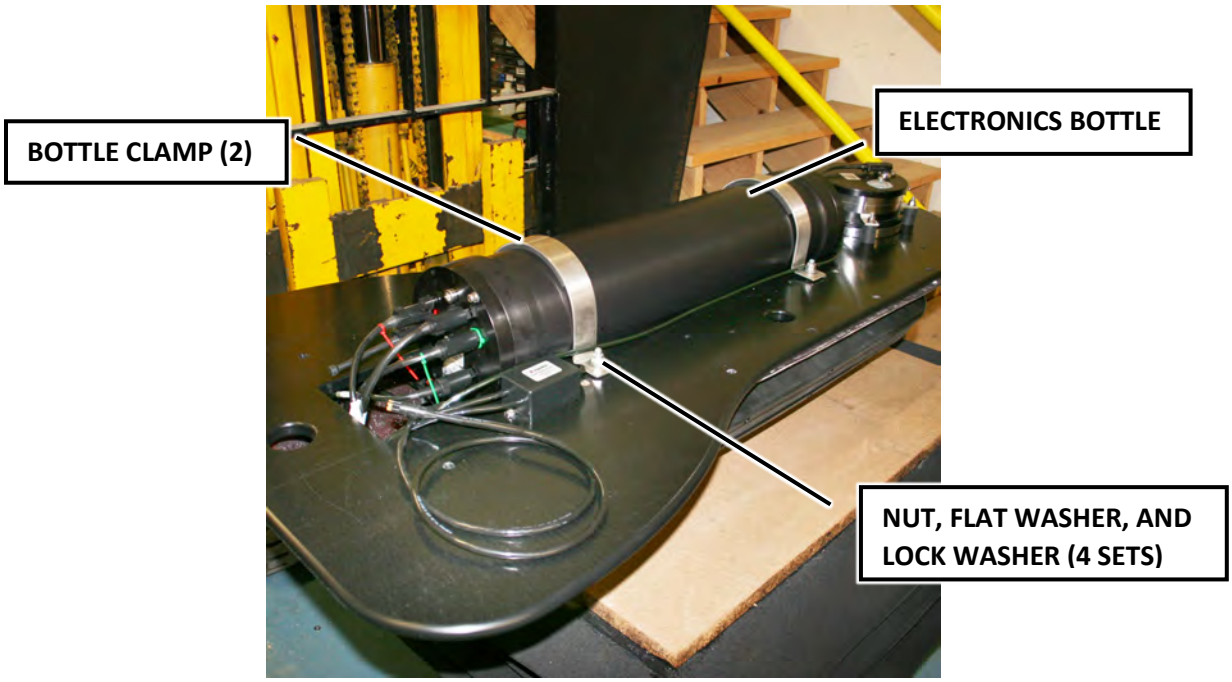

Figure 5-1: 2000-DSS Tow Vehicle with Upper Half of Fiberglass Shell Removed

5. Using the 9/16-inch wrench, remove the four sets of nuts, flat washers, and lock washers securing the two bottle clamps, and remove the clamps.
6. Disconnect all the cables from the connector end cap of the electronics bottle and remove the bottle from the tow vehicle.
7. Using the ¼-inch Allen key, remove the three socket head cap screws from the connector end cap.
8. Insert the socket head cap screws into the three end cap removal holes on the connector end cap.
9. Using the ¼-inch Allen key, evenly screw each of the socket head cap screws into the end cap to extract it.

10. When the end cap is free of the housing, carefully slide the electronics chassis completely out of the housing and lay it on a clean flat surface.

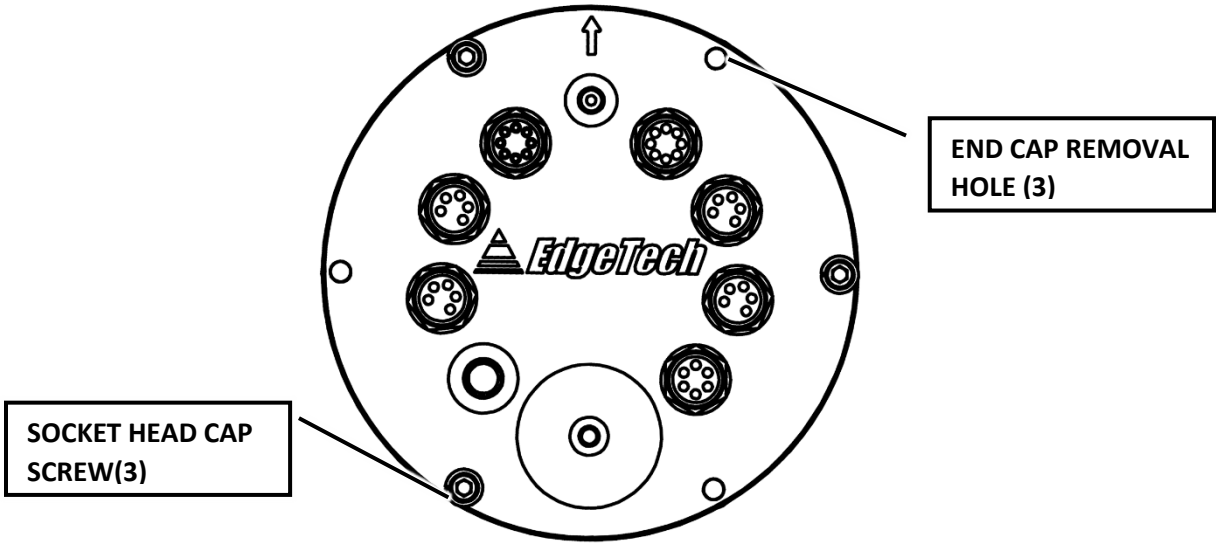

Figure 5-2: Electronics Bottle Connector End Cap

> **WARNING!** With the tow vehicle powered, high voltages that can cause injury or death are present on the electronics chassis. Use caution when working on the electronics chassis with the tow vehicle-powered.

5.3.2 Reassembling the Tow Vehicle

Before reassembling the tow vehicle, clean the two O-rings on the end cap with a lint-free paper towel and inspect them for scratches, nicks, or dirt. If any of these conditions exist for an O-ring, discard the O-ring and install a new one. When installing a new O-ring, first clean the O-ring surfaces on both the housing and the end cap with the paper towel, and then apply a light coating of silicone lubricant to the new O-ring around its entire surface and install it. If no scratches, nicks, or dirt are found when cleaning the O-rings, leave them installed and apply a light coat of silicone grease only.

To reassemble the tow vehicle, reverse the disassembly procedure. However, when reassembling the end cap to the housing. The arrow on the end cap should be pointed up.

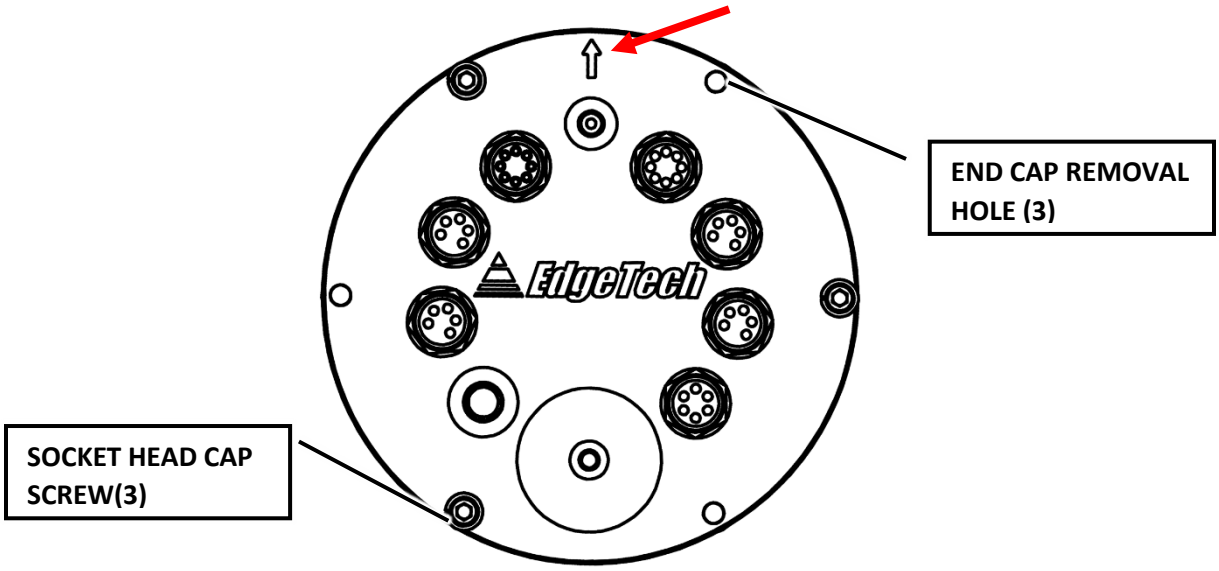

Figure 5-3: Correct Endcap Orientation- Arrow Pointed Up

5.4 Calibrating the Compass

The compass is calibrated at the EdgeTech manufacturing facility. Should the compass in the towfish lose its calibration for any reason in the field, it may be necessary to recalibrate it. This is accomplished by accessing the embedded Windows installation in the towfish itself via a remote desktop application on the Rack Mount Topside.

Furthermore, it is necessary to physically move the towfish around in different positions for the compass within it to establish the necessary reference points. The support of at least two survey technicians and a rotating table (as shown in the procedure to follow) or winch for hoisting and rotating the towfish are essential.

> **NOTE 1:** Compass calibration for the 2000-TVD should only be done under the advisement of **EDGETECH CUSTOMER SERVICE**.
>
> **NOTE 2:** The following procedure is accomplished with the towfish's electronics bottle (which contains the compass). This requires the towfish to be disassembled and the bottle removed, and then connected to the topside.

1. Power up the topside with towfish's electronics bottle connected.

2. Click on the Remote Desktop icon (**FIGURE 5-4**) and click Connect on the splash screen (**FIGURE 5-5**).

Figure 5-4: Remote Desktop Icon

Figure 5-5: Remote Desktop Splash Screen

3. If a warning pops up, as shown in **FIGURE 5-6**, click Yes before proceeding.

Figure 5-6: Remote Desktop Warning Screen

4. In the remote desktop program, the embedded Windows installation in the towfish will become accessible. Shut down the Sonar.exe application running (see **FIGURE 5-7** below):

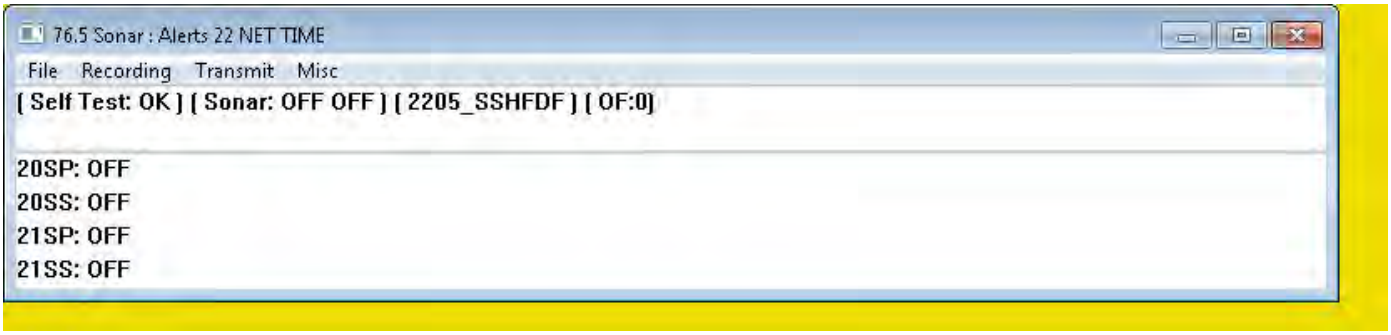

Figure 5-7: Closing Sonar.exe

5. On this desktop, click on the *Tera Term* command console icon (**FIGURE 5-8**). At the splash screen (**FIGURE 5-9**), click OK.

Figure 5-8: Tera Term Icon

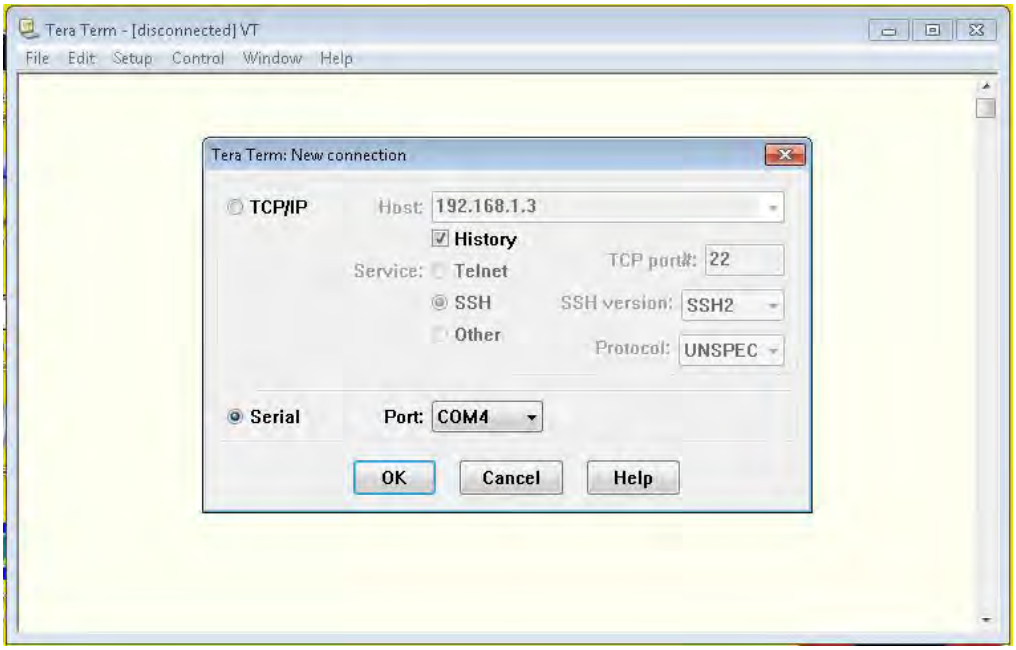

Figure 5-9: Tera Term Splash Screen

6. Establish communications with the SSAHRS and verify via a serial console.

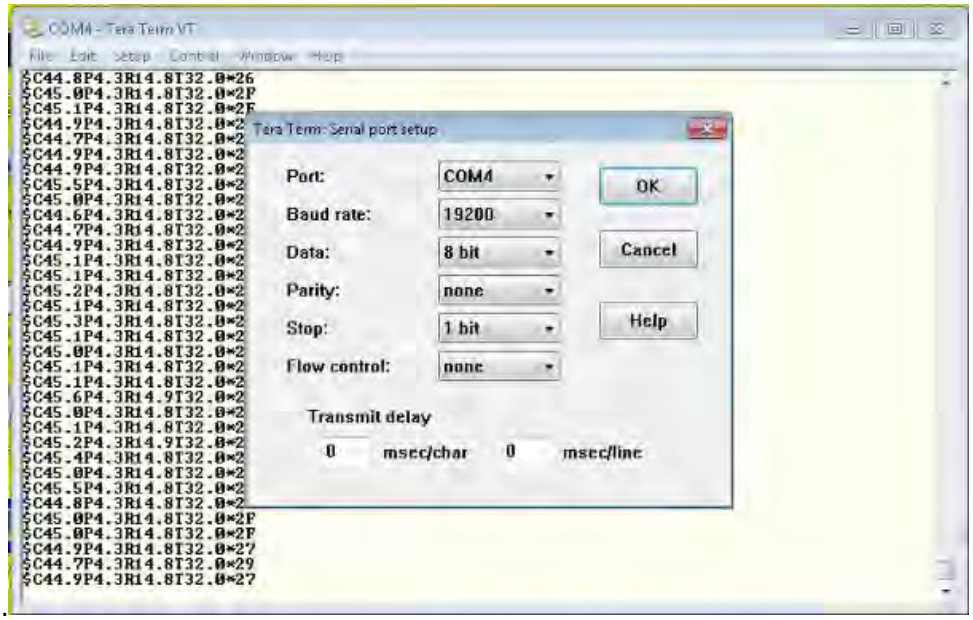

Figure 5-10: Terra Term Port Set-up

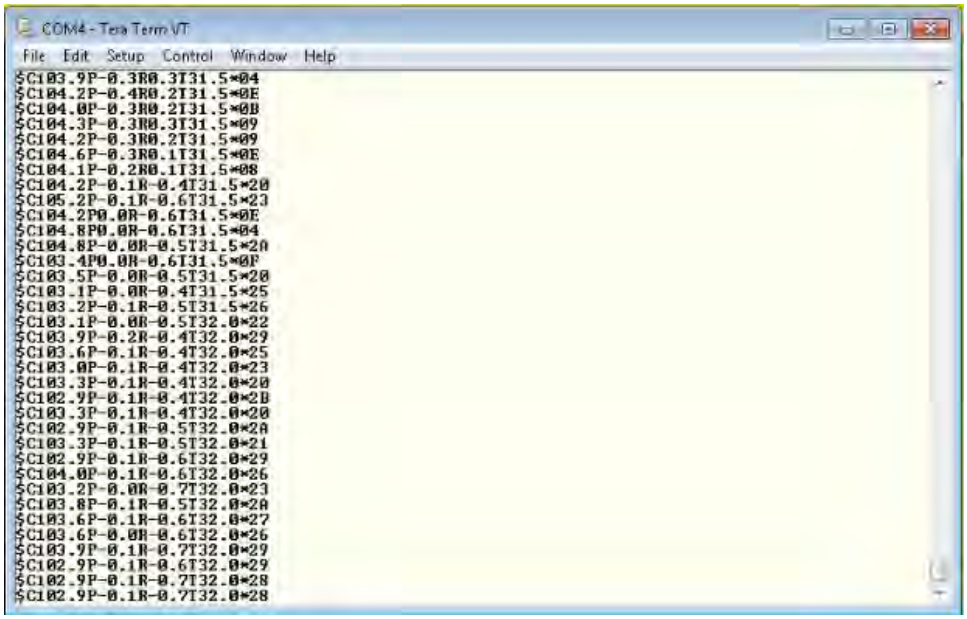

Figure 5-11: Motion Sensor Serial Output

7. Stop the device and retrieve the current level 2 (factory) calibration using the following two commands.

```
stop <CR>
getLevel2CompassCalibration <CR>
```

8. Ensure that the points are 0, the error percentage is 100.0%, the hard iron values are all 0.0, and that the soft iron values are an identity matrix (see **FIGURE 5-12**).

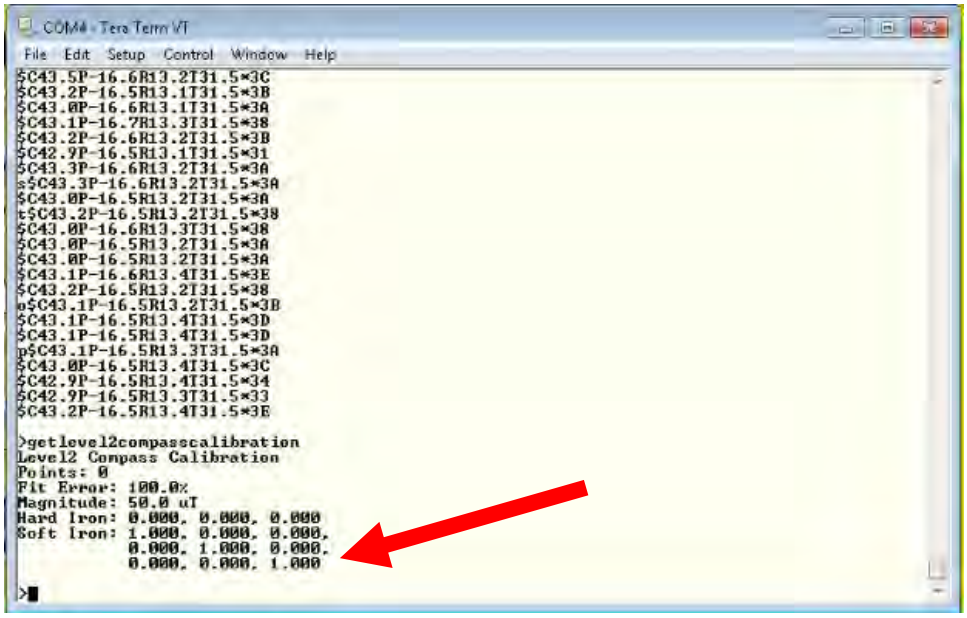

Figure 5-12: Motion Sensor Calibration Result

If for some reason they are not; reset SSAHRS with the following command and then cycle power.

```
setLevel2CompassCalibration,factory2015,0,100.0,50.0,0,0,0,
1,0,0,0,1,0,0,0,1 <CR>
```

9. Restart the SSAHRS by issuing the following command, to start compass data:

```
start <cr>
```

Heading, Pitch, Roll, and Temperature should begin to scroll.

Figure 5-13: Motion Sensor Serial Output

10. Slowly move the electronics bottle around in such a fashion as to position the compass in as many possible orientations as possible for pitch, roll, and heading directions.

    a. UUT in a neutral position: Pitch/Roll ~0 degrees, rotate device through 360 degrees of heading (10 times)

    b. UUT in Pitch/Roll ~-90 degrees rotate device through 360 degrees of heading (10 times)

    c. UUT in Pitch/Roll ~+90 degrees rotate device through 360 degrees of heading (10 times)

11. At the serial console, execute the following commands.

    stop <CR>
    getCurrentCompassCalibration <CR>

12. The compass solution will be displayed to the user and the number of points, magnitude of the magnetic field at this location, and the fit error. If the solution is not viable, the device should be returned to streaming with the **start <CR>** command, and steps 8 through 10 should be repeated until the fit error is ≤ 1.0% and Points is > 100.

    a. Valid solution:

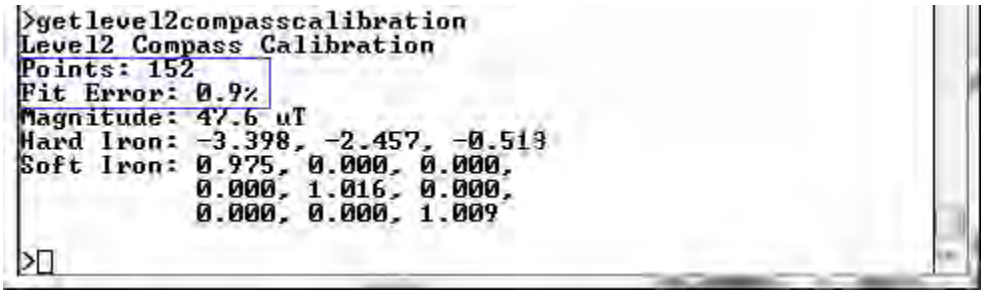

Figure 5-14: Compass Calibration Table

    b. If the solution was acceptable, Fit Error ≤ 1.0 % record and provided product engineer along with the vehicle type. Finally, save the data into the factory calibration (level2) portion of the device with the following command then cycle power:

    setLevel2CompassCalibrationFromCurrent, factory2015 <CR>

    c. Verify Factory Compass Calibration has been set by issuing the following commands:

    Stop <CR>
    getLevel2CompassCalibration

13. At this point, the SSAHRS calibration is complete. Close out of remote desktop.

5.4.1 Changing the Angle of Declination

The compass's angle of declination is set to true north at the EdgeTech facility. However, to provide a more accurate target location, it is necessary to enter the known magnetic declination for the survey location into the compass as follows:

14. Repeat steps 1 through 6 in the Calibration procedure in section **5.4**.

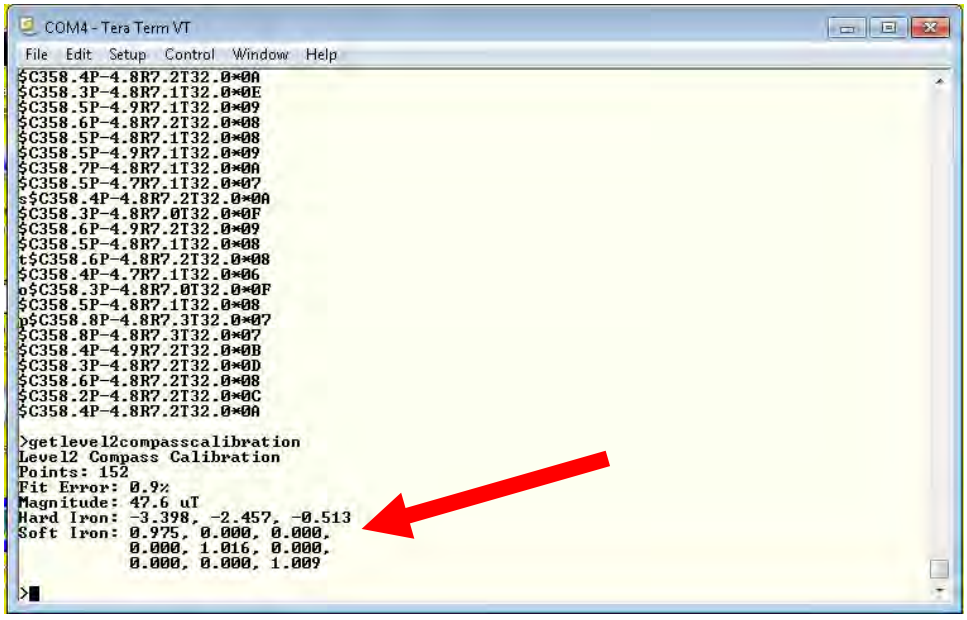

Figure 5-15: Tera Term Calibration Procedure Result

15. Verify current Declination Angle of Deviation using the following command:

`getDeclination <CR>`

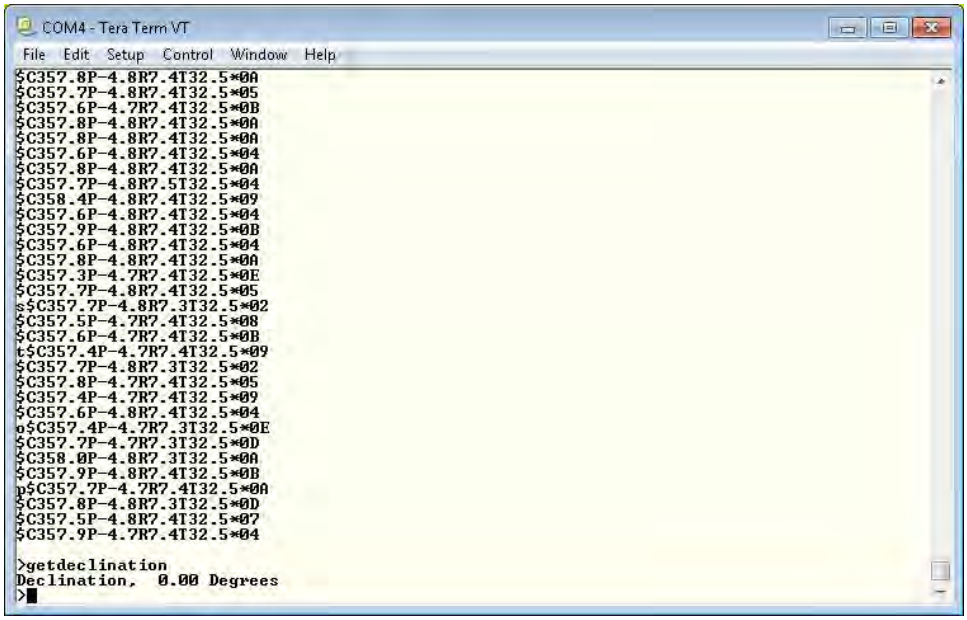

Figure 5-16: Tera Term Declination Angle of Deviation Check

16. Enter the set declination command to get help for command:

`setDeclination <CR>`

Help for command:

`setDeclination, [D]`

[D]: Declination angle (degrees), which is the correction between magnetic north and true north. This value depends on geographic location.

Declination for your location can be found by going to the following website:

http://www.ngdc.noaa.gov/geomag-web/#declination

Here is an example of how using this website can help you to determine your angle of deviation:

Zipcode 02360 was inserted, then "Get & Add Lat/Lon" was selected:

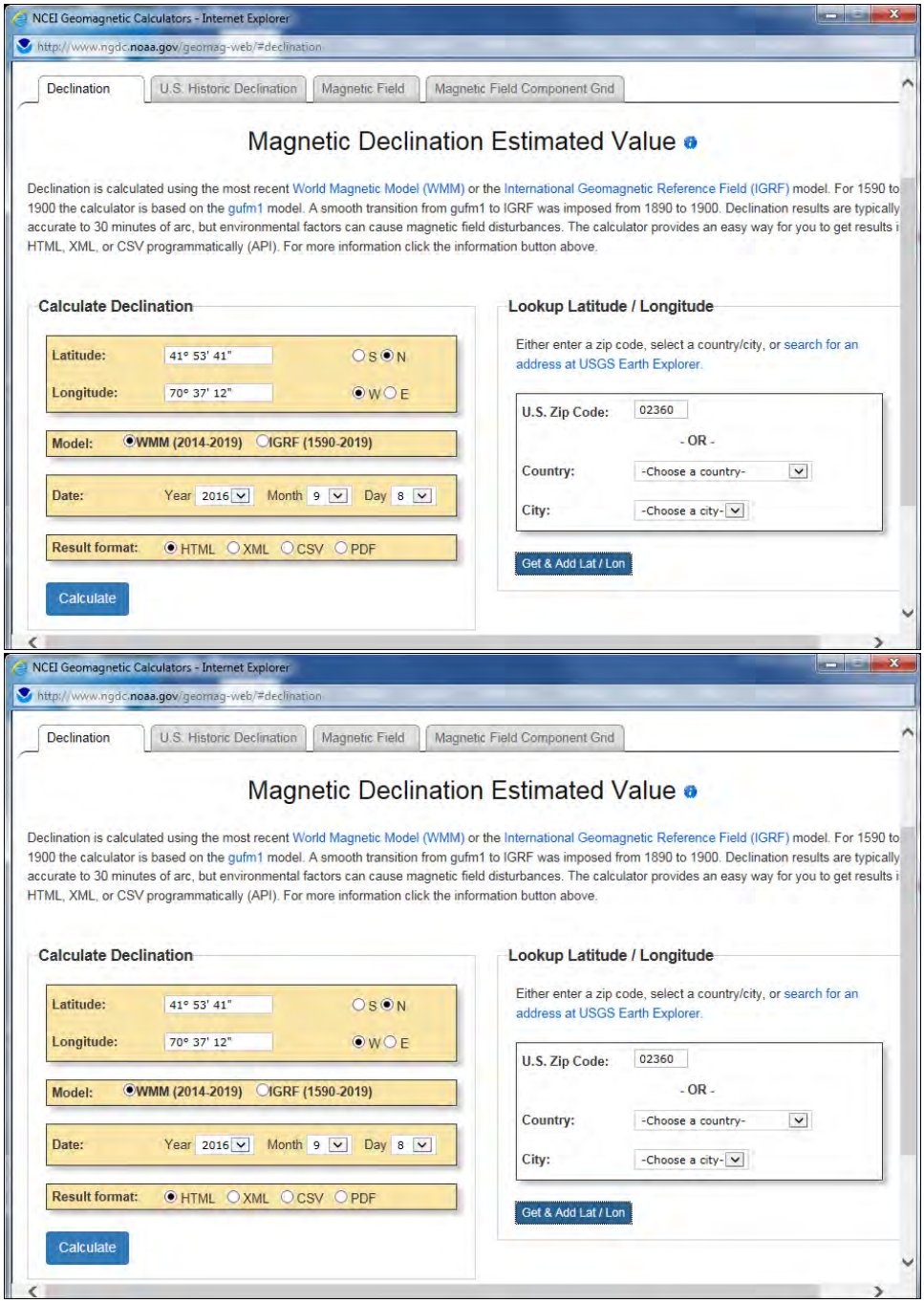

Figure 5-17: Magnetic Declination Estimated Value Screen

- "Calculate" is then selected:

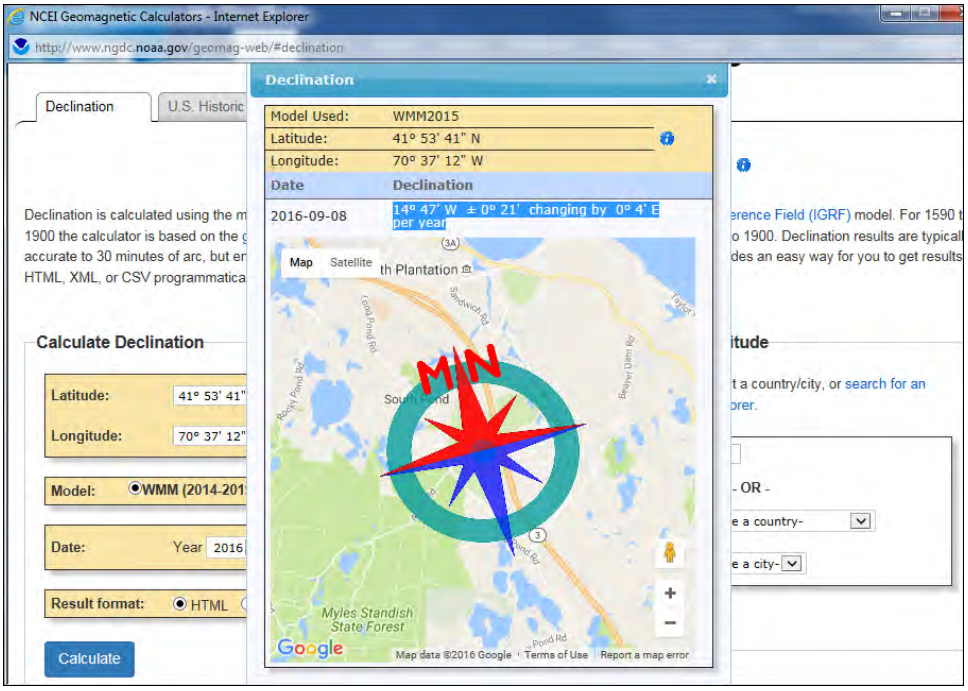

Figure 5-18: Angle of Declination Calculated

- The Declination Angle received was 14.47 degrees. This is the angle that will be entered into the TeraTerm command screen.
- Enter the Declination Angle using the command:

`setDeclination, 14.47 <CR>`

Verify entry of declination Angle using the command:

`getDeclination <CR>`

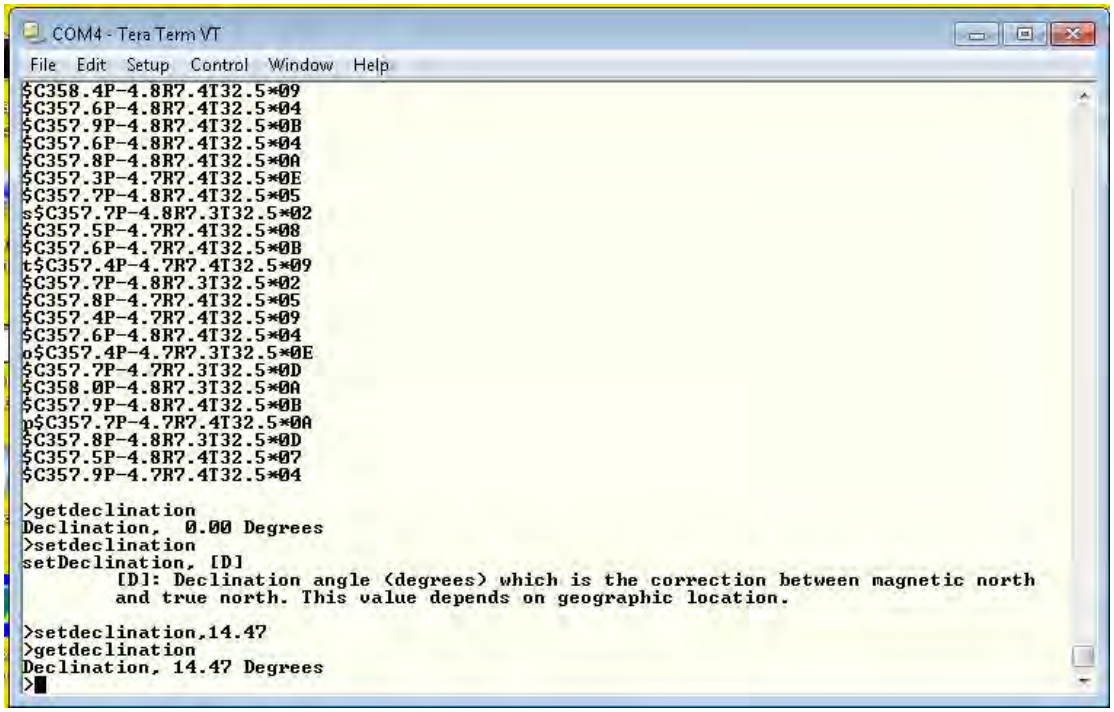

Figure 5-19: Terra Term Declination Angle Verification

6.0 TROUBLESHOOTING

In the unlikely chance that some operational or performance problems occur with the 2000 Series Combined Side Scan Sonar and Sub-Bottom Profiling System, it may be possible to correct them using the troubleshooting guides in the following pages. For the Topside Processor and the 2000 Digital Telemetry Link, tabular troubleshooting guides are provided in**TABLE 6-1** and **TABLE 6-2**. These troubleshooting guides identify some symptoms that could occur and present one or more possible causes and the recommended corrective action. Perform the corrective action for any given symptom in the order of possible causes, which generally corresponds to the degree of troubleshooting difficulty, from the simple to the more complex.

For the tow vehicle, detailed information is provided in the "**TOW VEHICLE TROUBLESHOOTING GUIDE**."

Before proceeding with any corrective action, verify that the 2000 Topside Processor is plugged into an appropriate AC or DC power source and that the unit is switched on.

> **NOTE:** Verify that all the cables on the 2000 Topside Processor and the tow vehicle are mated and are not loose or damaged. Most causes of operational or performance problems are a result of poor connections.

6.1 2000 Topside Processor Troubleshooting Guide

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
The green SYSTEM POWER indicator on the 2000 Topside Processor does not illuminate when the processor is turned on.	The POWER switch is not turned on.	Verify that the POWER switch on the back panel is on.
	No AC power.	Verify that the 2000 Topside Processor is connected to AC power. Check the AC power source.
	The indicator is not operating.	Open the 2000 Topside Processor and check the indicator and wiring.
The yellow HDD indicator on the 2000 Topside Processor does not flash when the processor is turned on.	The operating system is not booting.	Open the 2000 Topside Processor and verify that the 160-GB hard drive is connected to power and that the ribbon cable is properly plugged in. Also, verify that the ribbon cable is properly plugged into the CPU board.
	The indicator is not operating.	Open the 2000 Topside Processor and check the indicator and wiring.
The DISCOVER/ETSI reports, "Cannot ping towfish."	Tow cable disconnected.	Check tow cable connections.

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
	LAN settings are not properly setup.	Refer to sub-section **3.6** for TCP/IP address settings.
	Modem settings are incorrect.	Check modem settings per subsection **3.6 TCP/IP ADDRESS SETTINGS**
	Modem disconnected internally on the topside.	Check modem settings per subsection **3.6 TCP/IP ADDRESS SETTINGS**
	Improper settings in DISCOVER.	In **DISCOVER 2000-C Dual Frequency Side Scan**, choose Network from the Configuration menu and verify that the Sonar IP Address is 127.0.0.1 and the Sonar Port Number is 1602. In **DISCOVER Sub-Bottom**, choose Control Panel from the Sonar menu and select the Network tab from the Options dialog box. Verify that the TCP/IP Address is 127.0.0.1 and the TCP/IP Socket is 1600.
	The tow vehicle is faulty.	Verify tow vehicle on a different 2000 Topside Processor. Verify 2000 Topside Processor with another tow vehicle.

Table 6-1: 2000 Digital Telemetry Link Troubleshooting Guide

6.2 2000 Digital Telemetry Link Troubleshooting Guide

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
The green POWER indicator on the 2000 Digital Telemetry Link does not illuminate when the unit is turned on.	The POWER switch is not turned on.	Verify the POWER switch is on.
	No AC power. When using an AC power connector.	Verify that the 2000 Topside Processor is connected to AC power. Check the AC power.
	5-amp fuses on the rear panel of 2000 Topside Processor AC connection bad.	Check fuses for continuity. Replace if necessary.
	The indicator is not operating.	Open the 2000 Digital Telemetry Link and check the indicator and wiring.
The green LAN indicator on the 2000 Digital Telemetry Link does not illuminate when the unit is turned on.	There is no connection between the 2000 Digital Telemetry Link and the Topside Processor.	Check LAN connections between the 2000 Digital Telemetry Link and the Topside Processor.

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
	The indicator is not operating.	Open the 2000 Digital Telemetry Link and check the indicator and wiring.
The green LINK indicator on the 2000 Digital Telemetry Link flashes when the unit is turned on. After 1 minute, the flashing should stop, and the indicator should remain lit.	The tow cable between the 2000 Digital Telemetry Link and the tow vehicle is disconnected or faulty.	Check connections and tow cable.
	Modem settings on the topside are incorrect.	Check modem settings per subsection **3.6 TCP/IP ADDRESS SETTINGS**
	The tow vehicle is faulty.	Check the 2000 Digital Telemetry Link on a different tow vehicle.
The red FISH POWER indicator on the 2000 Digital Telemetry Link illuminates after 10 seconds, then after 20 seconds turns off.	Tow cable is not connected between the 2000 Digital Telemetry Link and the tow vehicle.	Check tow cable connections to the 2000 Digital Telemetry Link and connection to the tow vehicle.
	The tow cable is faulty.	Check continuity between connectors and proper wiring.
	The power board is faulty.	Verify that RED LED D2 turns on after 10 seconds.
	The tow vehicle is faulty.	Verify tow vehicle on a different 2000 Topside Processor. Verify 2000 Topside Processor with a different tow vehicle.
The DISCOVER reports, "Cannot ping towfish."	LAN cable disconnected.	Check LAN cable connection.
	Tow cable disconnected.	Check tow cable connections.
	LAN settings are not properly setup.	Refer to sub-section **3.6** for TCP/IP address settings.
	Modem settings are incorrect.	Check modem settings per subsection **3.6 TCP/IP ADDRESS SETTINGS**
	Modem disconnected internally on the topside.	Check modem settings per subsection **3.6 TCP/IP ADDRESS SETTINGS**
	Improper settings in DISCOVER.	Check that under "Configuration" pull-down "Network," the displayed address is 192.9.0.101 with "Port" set to 1700.

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
	The tow vehicle is faulty.	Verify tow vehicle on a different 2000 Topside Processor. Verify 2000 Topside Processor with a different tow vehicle.

Table 6-2: 2000 Digital Telemetry Link Troubleshooting Guide

6.3 Tow Vehicle Troubleshooting Guide

The tow vehicle is a computer-controlled device. Therefore, to troubleshoot such a complex piece of equipment to a sub-module level, one must have the proper test equipment and thorough knowledge of the unit's electrical operation plus hardware aspects. The purpose of this section is not to develop those techniques nor provide a step-by-step procedure where one may start and end up at the point of failure. It is to give an operator some familiarity with the electronic hardware. The following sections provide some specific areas to check which are easily identifiable and certain clues as to what to look for in making an educated guess as to the source of the problem. This is only down to the module or PCB level.

The tow vehicle is a software-controlled computer system. Some analog sections interface with the tow vehicle transducers. Being a digital device, many operating portions use the same data and address lines, and a failure of one may result in a failure of all. This makes it very hard to isolate some digital problems without the proper equipment and a thorough knowledge of the data flow. This equipment is not normally found on a vessel.

The troubleshooting objective is to ascertain which system component is at fault. First, ensure that the system is properly installed with all connections mated. Next, check that the line voltages for the topside components are within specified limits and any fuses have not blown. Fuses may fail if a wrong connection has been made during setup. They have also been known to fail for no apparent reason. Always replace fuses with those of the same value. If a fuse fails again within a short time, there are more serious problems within the corresponding unit.

Open the topside electronics cover and check that all the cards are seated, especially if the unit has been in transit. After checking the cards, ensure that the cable connectors are properly mated. If the problem persists, disengage and then re-engage all PC boards and do the same for all board cable connections before any electrical testing.

All calibration adjustments are preset at the factory and should not require any modifications in the field unless certain mechanical and/or electrical components are changed or the adjustments are inadvertently altered.

If the above checks do not identify or remedy the problem, attempt to isolate the failure to one of the major system components: the sonar processor, the modem/power unit, the tow vehicle, or the tow cable. The following presents various operational problems and general comments on where to look and what to look for.

The main objective is to get the basic system working. Therefore, it is good practice to disengage any optional circuit cards installed in the unit and optional external system components to reduce the number of possible trouble sources.

6.3.1 Equipment Required

Except for the topside processor/power unit, only common laboratory test equipment and tools are required for field troubleshooting. No special equipment is necessary. Typical test equipment includes:

- Digital multi-meter, Fluke, or equivalent
- Oscilloscope
- Hi-pot tester
- Capacitance meter

6.3.2 Transmission Verification

The 512C and 670D Tow Vehicles are different from conventional side scan sonars used for many years. The early sonars were driven with a high-powered energy burst similar to hitting a bell with a hammer. The transducers are driven with a smooth rising lower power signal that matches the transducer response. Because of this, there is no pronounced clicking noise emanating from the transducers when they are firing. Therefore, the 'listen for the clicking noise' test cannot be used to verify sonar transmission during bench or on-deck testing.

Sniffing with an oscilloscope can be used as a substitute to check transducer firing. One way is to attach the scope probe's ground to the tow vehicle body and hold the open probe next to the transducer under test. Set to about 20 to 50mV /Div.

A second method is to connect a several-turn wire loop across the scope probe and move it over the transducer face. Electrical pickup should be noticed on the scope screen at each transmission burst. Remember that the transducers and elements within the transducer may be firing together or in sequence. One must make sure that the electrical pickup is not from an adjacent string.

6.3.3 Sonar Processor and Data Link

It is assumed that the sonar processor is up and working to complete system tests and troubleshooting. Refer to the sonar processor's manual for its troubleshooting and diagnostic information.

The other thing is that the high-speed data must be up and running so that the topside and sub-sea units communicate with each other. If the tow vehicle boots up correctly and passes its internal self-test, there will be a smooth sequence of rising tones going from 2 to 3.9 kHz. A set of tones jumping from 2 to 3 kHz means that the self-test has failed. These tones are generated in the tow vehicle's software and replicated on the surface when an EdgeTech topside processor is used to access the Tow vehicle computer subsystem using the Remote Desktop application. The Self-Test PASS tones repeat until data linkup has occurred between the topside DISCOVER software and tow vehicle. Self-Test FAIL tones repeat indefinitely.

There will also be a video acknowledgment of successful self-test and linkup in the topside processor's DISCOVER display window. Self-test status will also be displayed on an external video monitor if attached directly to the tow vehicle's CPU board's VGA connector.

If the topside processor is unavailable and the tow vehicle is dismantled, an external keyboard, mouse, and video monitor may be connected to the tow vehicle's CPU board to provide some diagnostic testing. An external power unit will still be required.

6.3.4 Topside Power Unit

Tow vehicle power is supplied either from an individual power/modem unit or from an integrated topside processor. Voltage and current to the tow vehicle are important parameters. They must be within acceptable limits for the tow vehicle to work properly. Check the tow cable output voltage with the system connected and, if possible, the current drain with an inline connection. Cable current should be between 120mA (Idle) and 250mA.

The topside units supply 400VDC to the tow cable. The voltage at the cable's tow vehicle end must be not less than 300VDC to start the system and not be less than 200V during operation.

6.3.5 Command and Data Link

To check that the command and data link over the tow cable is operational, start the Remote Desktop application on the topside control computer. There is normally a Remote Desktop shortcut on the EdgeTech Desktop. When launched and connected, the tow vehicle's yellow PC screen should appear in a window on the Topside computer. This will appear as a yellow desktop with the sonar application dialog box visible. If this is successful, then the command link is working.

6.3.6 Data Link

A good, quick qualitative test of the data link and tow vehicle electronics is to perform a rub test on each transducer. Set the Range to 200 meters for both frequencies and start the system running in HDM mode for both. Set screen gain to +30dB for both frequencies and briskly rub each aft transducer face one at a time. A dark band should appear on the sonar processor screen corresponding to the side rubbed.

Data throughput rates on the uplink (vehicle to topside) can be critical in getting smooth data from the tow vehicle. The data throughput rate can be checked using EdgeTech supplied utilities at each end of the link

The sockBlast application is used to test network throughput between the tow vehicle and the Topside Processor. This application is normally kept in the *C:\EdgeTech\Utilities* folder on the topside unit, and D:\EdgeTech\Utilities folder on the tow vehicle.

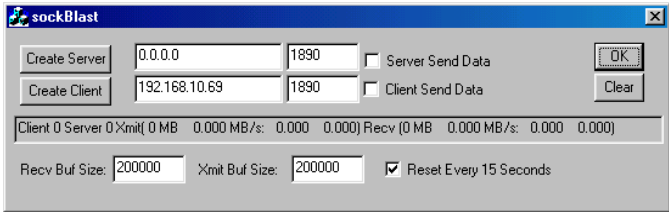

Figure 6-1: sockBlast Window

Two copies must be run, one on each computer. One serves as the client (topside) and the other as the server (tow vehicle). Since the client connects to the server, the Create Client (topside) address must be the TCP/IP address of the server (tow vehicle) machine, which is 192.9.0.99. The tow vehicle Create Server address should be 0.0.0.0. The client should connect to the server. A successful connection is verified as connected when the Client count on the tow vehicle increments from 0 to 1, and the Server count on the topside should increment to 1.

Check the Server Send Data box on the tow vehicle. A performance in MB/second will be displayed. This should be more than 0.35Mbyte/s.

6.3.7 Tow Vehicle

First, verify that the command and data links between the tow vehicle and topside are working per above.

> **NOTE:** It is recommended that all attempts be made to see if a problem is external to the tow vehicle before opening it.
>
> **WARNING!** High voltage (400 VDC) is always present in the electronics assembly when powered.

6.3.7.1 Preliminary

When the electronics have been removed:

1. Check that all boards are still secured to their mountings.
2. Check the matings of all connectors.
3. Check that the terminal board screw connections are tight.
4. Check for obvious hot / burn spots by sight and smell.

6.3.7.2 No Sonar Data

If the sonar display doesn't scroll, use the 'scope sniffing' approach as outlined in the "TRANSMISSION VERIFICATION" section of this manual. If the transducers are firing and the data link is working, the problem is most likely related to the topside processor and/or data modem.

If the display scrolls but is blank, and the transducers are firing, the problem most likely lies with either or a combination of the tow vehicle receiver, transducer, or its signal processing circuitry. Establish if the problem is on a single channel or all channels.

If data is absent in all or individual channels, check the T/R Switch and SSB boards. If the problem is with a particular channel, also check the respective power amplifier and transducer element.

Connect to tow vehicle using the Remote Desktop application to connect to 192.9.0.101, login: *administrator*, and password: *admin*. The Sonar application on the tow vehicle processor should be running, and there should not be any errors posted to the window. Errors reported could be: "No Sonar Device Found," this will indicate that the CPU does not connect to the sonar processor card. "IF_DIAG" the sonar processor has detected an error and will not run. Cycle power on the tow vehicle to recheck the error. If the error is still present, check the cables running to and from the sonar interface card. "HM_Sensors" this reports the 48 volts. If this error is found, check the power distribution board's output in the tow vehicle and the power on the power amps.

6.3.7.3 Power Supplies

Several power supplies and voltage regulators are located throughout the tow vehicle assembly. The main ones are located on the Power Distribution board. The first supply converts the 400VDC tow cable voltage to the operating +48VDC supply. Other DC/DC converters running off the 48 volts generate the low-level operating supply voltages. No supplies are adjustable.

The following are the main voltage test points on the Power Distribution board.

Supply	Test Point	Return
+5 VDC +/-0.2V	TP7	TP12
+12 VDC +/-0.6V	TP8	TP12
-12 VDC +/-0.6V	TP9	TP12
+27 VDC +/-0.6V	TP10	TP12
+48 VDC +/-2.0V	TP4	TP5

Other voltages to check on the SSB board and labeled as such are:

Supply
+3.3 VDC +/-0.1
+5 VDC +/-0.2V

+12 VDC +/-0.6V

-12 VDC +/-0.6V

Test Lights:

1. Power Distribution Board.

Monitor the +400 volt D4 and +48 volt D8 LEDs. They should be on steady.

2. SSB Board.

There are two LED's of interest. 'LED A' flashes when 120 kHz is transmitting. 'LED B' flashes when 410 kHz is transmitting.

3. SIB Board.

There are four LED's of interest. They have the following status when the system is operating properly.

D1 Off	D3 (Orange)	Flashes at 2 Hz
D2 Off	D4	(Green) On

6.3.7.4 SSB Board Test Points

1. GAIN A and B test points show the positive-going TVG ramp voltage for the low and high-frequency sonar channels.
2. Four test points monitor the TVG'd analog sonar data. They are:

ADC 0 Port	SSL	ADC2 Stbd SSL
ADC 1 Port	SSH	ADC3 Stbd SSL

These test points are useful when doing a rub test.

6.3.7.5 DDC Test Points

This board does not have any test points. LEDs monitors display the channels on the card that are running. Side A and Side B. In a normally operating vehicle with both channels collecting data, the lights will alternate.

6.3.7.6 Modem Board Test Points

1. FSK.

Monitors the 3200 kHz to 2800 kHz frequency-shift-keyed signal from the topside unit. This signal is used for optional commands. It May not be present in all systems.

2. Trig.

A TTL signal that synchronizes the topside and sub-sea units with other topside equipment. Follows the SYNC signal input on the topside unit. It is not used in all system configurations.

6.3.7.7 Other Checks

Periodically check the integrity of the sea ground capacitor attached to the rear bulkhead.

6.3.8 Tow Cables

Historically, most system problems occur in the tow cable and their connectors. Before proceeding, verify cable continuity from the shipboard end of the cable to the tow vehicle. The presence of a shorted or open wire in a tow cable can be determined by using a multi-meter. An open or shorted wire can be located using the techniques described in the following subsections.

6.3.8.1 Shorted Wire

The following procedure may be used to approximate the distance to a single short or a point of high leakage between a conductor pair or from a conductor to a shield.

1. Disconnect both cable ends.

2. Short the two connector pins (or wires if un-terminated) of the shorted pair at both ends and measure the total resistance between the ends.

R1+R2 =_____

3. Remove the shorts.

4. Measure the resistance between a shorted pair on one end with an ohmmeter on the Rx1 scale.

R1+Rs =_____

5. Measure the resistance from the other end.

R2+Rs =_____

6. Add the measurements of 4) and 5) above, subtract the measurement of 2), and divide the result by 2.

Rs =_____

7. Subtract the value of 6) from the measured values of 4) and 5).

R1 =_____

R2 =_____

8. The distance to the short from end #1 is the ratio of (R1/R1+R2) times the total cable length. Recheck from end #2, which is (R2/R1+R2) times the cable length.

6.3.8.2 Open Wire

An open wire in a cable is much more challenging to locate than a short circuit; therefore, a capacitance bridge is recommended. Measuring the open wire's capacitance to the shield on both ends allows two different capacitance readings to be recorded. This represents a direct ratio related to cable length and distance of break from each end. Before cutting the cable, double-check the same capacitance ratio using an adjacent good wire in a multi-conductor cable. The capacitance may vary from wire to wire, depending on their separation.

Most breaks occur around the tow cable termination or where a previous repair has been made. A cable break may be found or confirmed by laying out the cable and attaching an ohmmeter across each end of the open wire. Then flex the cable first near the termination or repaired section and then along its entire length until the break is reached. When flexing, the broken wire ends may touch, giving a continuity reading on the meter.

6.3.8.3 Insulation Resistance Breakdown

Insulation breakdown is the most difficult fault to locate. Cable leakage is not necessarily located near the end terminations. However, the area near each termination receives the most abuse and is, therefore, subject to suspicion. Successive cutting of the cable end until leakage disappears will prove successful in many cases.

> **CAUTION!** Before cutting the cable for any of the above reasons, a careful visual examination should be made for any signs of physical damage.

The tow cables should measure between 100 Mega-ohms and infinity between conductors with a 500 VDC Megohmmeter with both ends disconnected. When using a Simpson 260 Multi-meter, all cables wire-to-wire or wire-to-shield should measure infinity. Any leakage on the multi-meter indicates cable leakage.

6.3.8.4 Damaged Tow Cable Connector

The tow vehicle has a trip line that prevents the vehicle from hanging up on a snag. When the line trips, the cable connection to the vehicle disconnects, exposing the high voltage pins to seawater. Pin corrosion will start to occur as long as power is still applied. If the power is not immediately removed, and the cable is not immediately retrieved, and the connector flushed out with fresh water, there may be permanent damage to the connector. This will require cable re-termination.

6.4 Part Numbers for Major Topside Components

COMPONENT DESCRIPTION	EDGETECH PART NUMBER
TOPSIDE COMPUTER	
CPU	0018399
500GB HDD	0004983
1TB HDD	0007408
Graphics Card	0018397
Motherboard	0018398
Power Supply	0008453
2000-DL DIGITAL LINK	
Modem Assembly	0012635
Assembly Top Power Supply	0011860
Power Supply	0006372
Ethernet Switch	0005088

Table 6-3: Major Topside Components and Part Numbers

6.5 Part Numbers for Major 2000-DSS Tow Vehicle Components

COMPONENT DESCRIPTION	EDGETECH PART NUMBER
RUDDER 2000 DSS	0006596
BRACKET RUDDER 2000 DSS	0003403
BRIDLE TOW 2000 DSS	0003431
WING 2000 DSS	0007922
BRACKET MOUNTING 2000 DSS	0003396
BRACKET MOUNTING 2000 DSS	0003396
FOOT AFT 2000 DSS RUBBER	0007345
PLATE SUB BOTTOM 2000 DSS HYDROPHONE	0006336
RAIL 2000 DSS TOW	0006389
SHELL SET 2000 DSS	0007442
ASSY TOP CABLE 2000 KEVLAR 0.375 COAX TEST 15M WET-WET	0011690
BALLAST LEAD 2000 DSS	0005830
PLATE BACKING TOW POINT 2000 DSS	0006310
ASSY SUB SUB BOTTOM 2000 DSS 02-16 KHZ	0007338
ASSY SUB SIDESCAN 2000 DSS 100-400 KHZ	0007339
ASSY TOP ELECTRONICS BOTTLE 2000 DSS 100-400 KHZ	0007337

COMPONENT DESCRIPTION	EDGETECH PART NUMBER
ELECTRONICS BOTTLE PARTS	
PCB ASSY TOP POWER AMP ANALOG SUB BOTTOM	0006128
PCB ASSY POWER AMP ANALOG	0006125
PCB ASSY TOP INTERFACE MODEM DSL	0006104
PCB ASSY SUB 2000 DSS POWER DISTRIBUTION BOARD MODIFIED	0009188
PCB ASSY TOP ACQUISITION PCI 2CH SUB BOTTOM TIGER DEEP	0014232
PCB ASSY TOP DDC 4CH AQUISITION 2.5X BOARD	0014358
PCB ASSY TOP TR SWITCH 4200 SP 100-400 KHZ	0006168
PCB ASSY TOP SONAR INTERFACE BOARD / USB SIBU 2000 2200 SERIES SYSTEMS	0011638
CHASSIS 2000 05 INCH 26 INCH AL	0008673
ASSY SUB END CAP 2000 DSS ELECTRONICS	0009231
HOUSING PRESSURE 05 INCH DIA 26 INCH AL 3000M	0007084
END CAP REAR 05 INCH 3000M AL	0005069
PCB ASSY SUB CAPACITOR BANK 2000 DSS	0009230
ASSY SUB BOARDSET CPU COMX ATOM MBT10 E3825	0018350
MEMORY FLASH GENERIC R-DRIVE IMAGE KONTRON E3815 CPU	0017144

Table 6-4: Major 2000-DSS Tow Vehicle Components and Part Numbers

A.0 SYSTEM RESTORE

The following section outlines the procedures for backing up and restoring the system drive.

> **CAUTION!** All data will be lost upon restoring the system to factory settings. Be sure to backup all data before performing the procedure below.

1. Ensure that the topside is off.
2. Insert USB3 flash drive in the blue USB3 port.
3. Start topside and be prepared to press F⋆⋆ key when prompted:
4. If the topside is rack mount, press F11.
5. If the topside is a laptop, press F12.
6. Under Please select boot device: Using up/down arrow keys, select EUFI: Corsair Voyager 3.0 000A, then press Enter.
7. Wait for Paragon Backup & Recovery 14 Home screen to appear, then click the Restore icon.
8. On Welcome to the Restore Wizard screen, click Next.
9. On Browse for Archive screen, drag down menu and click on ⊞ to the left of (E:). Click on the folder named as a variation of V⋆.⋆.⋆_⋆⋆⋆⋆R for rack mounts, or V⋆.⋆.⋆_⋆⋆⋆⋆P for laptops. When the Archive File Details window appears, click Next.
10. At What to restore window, click Basic MBR Hard Disk 0, click Next.
11. At the Where to restore window, ensure that Basic MBR Hard Disk 0 is already selected (brown box around it). If it is not, use up/down arrow keys to select. Click Next.
12. At the Restore results window, make no selection and click Next.
13. At the Ready to restore from the archive window, select ʘ Yes, apply the changes physically. Click Next. Restoring will begin.
14. At Completing the restore wizard, click Finish. Click Shutdown.
15. Remove USB3 flash drive and restart topside.

B.0 PRINTERS

A number of different printers are available for connecting to the 2000 Series Combined Side Scan Sonar and Sub-Bottom Profiling System. All of these printers connect to the USB connector on the back of the Topside Computer.

Of the available printers, the following are recommended for best results:

- iSys V8.5
- iSys V12
- Ultra 200
- Ultra 120
- Ultra 200HD
- Ultra 120HD
- EPC HSP 100
- EPC 1086-NT
- EPC 1086
- EPC 1086-old
- TDU 850
- EPC 9026
- Geoprinter 975

Listed in **TABLE B-1** are the required settings to properly interface a printer with the 2000 Series Combined Side Scan Sonar and Sub-Bottom Profiling System:

REQUIREMENT	SPECIFICATION
Trigger	Internal
Data input	USB
Sweep	Forward
LPI	200
Width	2048
Data type	6 bits
Shades	64
Image	Positive
Contrast	40%

Table B-1: Printer Requirements

C.0 TOWING CHARACTERISTICS

This section includes graphical plots representing the towing characteristics of the 2000-DSS Tow Vehicle for various cable lengths, tow vehicle speeds, and tow vehicle depths. There are a total of 32 plot configurations, as listed in **TABLE C-1**. These plots are available for equipment selection purposes only. In addition, when selecting a particular plot, it should be verified prior to being used for detailed survey planning.

> **NOTE:** Some of the plots reference tow vehicle operating depths that are greater than the maximum depth rating of the 670D Tow Vehicle. These plots are for illustrative purposes only. The 670D Tow Vehicle should never be deployed at a depth that exceeds its 2000-meter depth rating.

The plots have been generated under the following assumptions:

- Sea State = 0 with no vessel heave motion
- Ocean current = 0
- Steady state tow vehicle speeds of 2–8 knots in 1-knot increments
- Armored cables A320327 - 0.32", A301241 - 0.68", and A302799 - 0.45"
- Cable lengths of 500–10,000 meters

Ocean currents will be a factor for virtually all cases in which the tow vehicle is used. Using the equations below to calculate tow vehicle relative speed, the existing plots can be used to approximate the tow vehicle depth when ocean currents are present and assuming that the current is uniform with depth.

For the tow vessel moving into the current:

Tow Vehicle Relative Speed = Tow Vessel Speed + Ocean Current

For example, for a tow vessel speed of 5 knots and an ocean current of 1 knot, the tow vehicle's relative speed is 6 knots. Therefore use the 6-knot plot in the selected graph.

For the tow vessel moving into the current:

Tow Vehicle Relative Speed = Tow Vessel Speed - Ocean Current

For example, for a tow vessel speed of 5 knots and an ocean current of 1 knot, the tow vehicle's relative speed is 4 knots. Therefore use the 4-knot plot in the selected graph.

CONFIGURATION	CABLE TYPE	DEPTH	PAGE NO.
1	A320327	500	C-3
2		1000	C-4
3		2000	C-5
4		3000	C-6
5		4000	C-7
6		5000	C-8
7		6000	C-9
8		7000	C-10
9		8000	C-11
10		9000	C-12
11		10000	C-13
12	A301241	500	C-14
13		1000	C-15
14		2000	C-16
15		3000	C-17
16		5000	C-18
17		6000	C-19
19		7000	C-20
20		8000	C-21
21		9000	C-22
22	A302799	500	C-23
23		1000	C-24
24		2000	C-25
25		3000	C-26
26		4000	C-27
27		5000	C-28
28		6000	C-29
29		7000	C-30
30		8000	C-31
31		9000	C-32
32		10000	C-33

Table C-1: Tow Cable Characteristics

C.1 Configuration 1

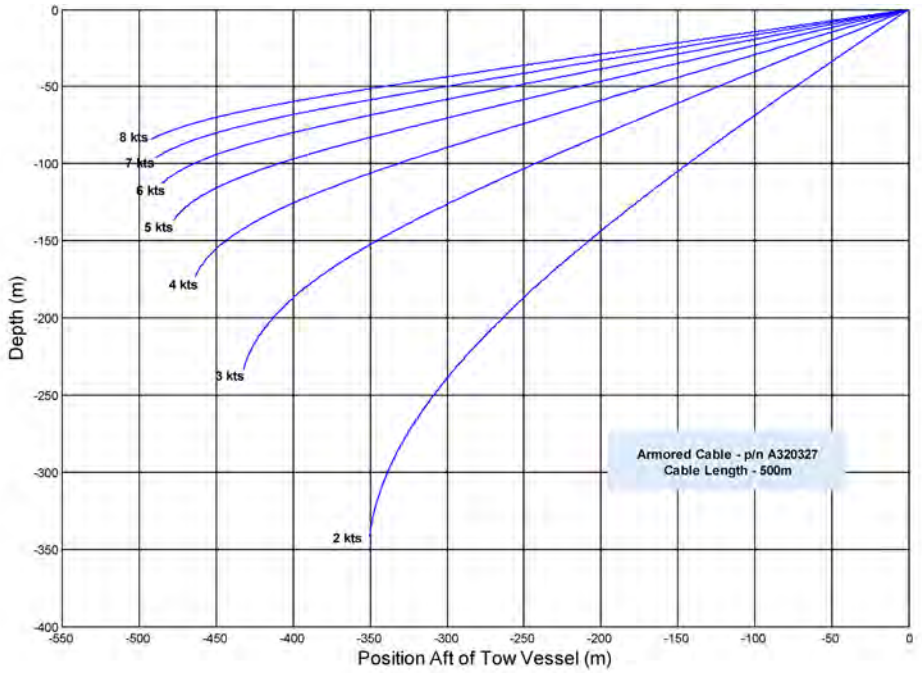

Figure C-1: Tow Cable Shape and Tow Vehicle Position—Cable A320327, 500 Meters

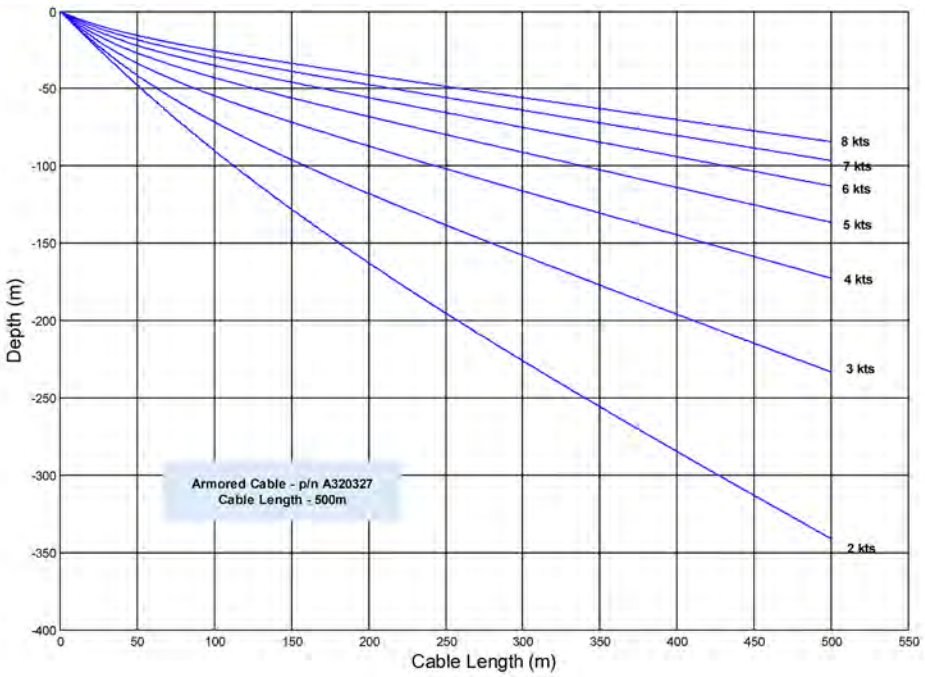

Figure C-2: Tow Cable Length Versus Depth—Cable A320327, 500 Meters

C.2 Configuration 2

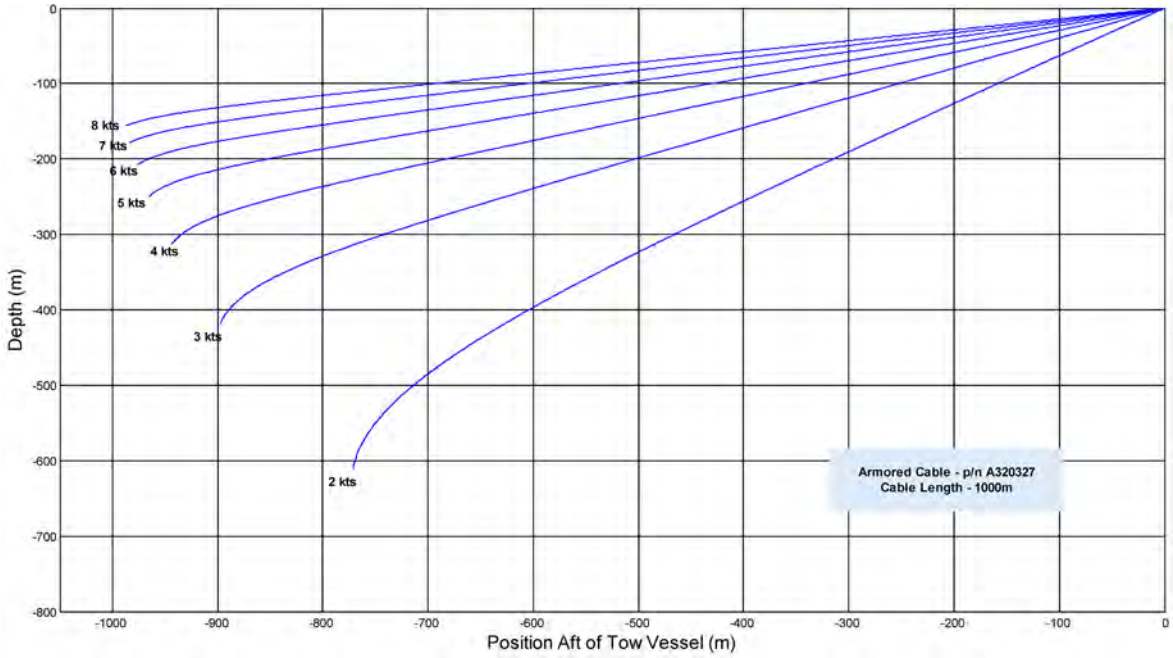

Figure C-3: Tow Cable Shape and Tow Vehicle Position—Cable A320327, 1000-Meters

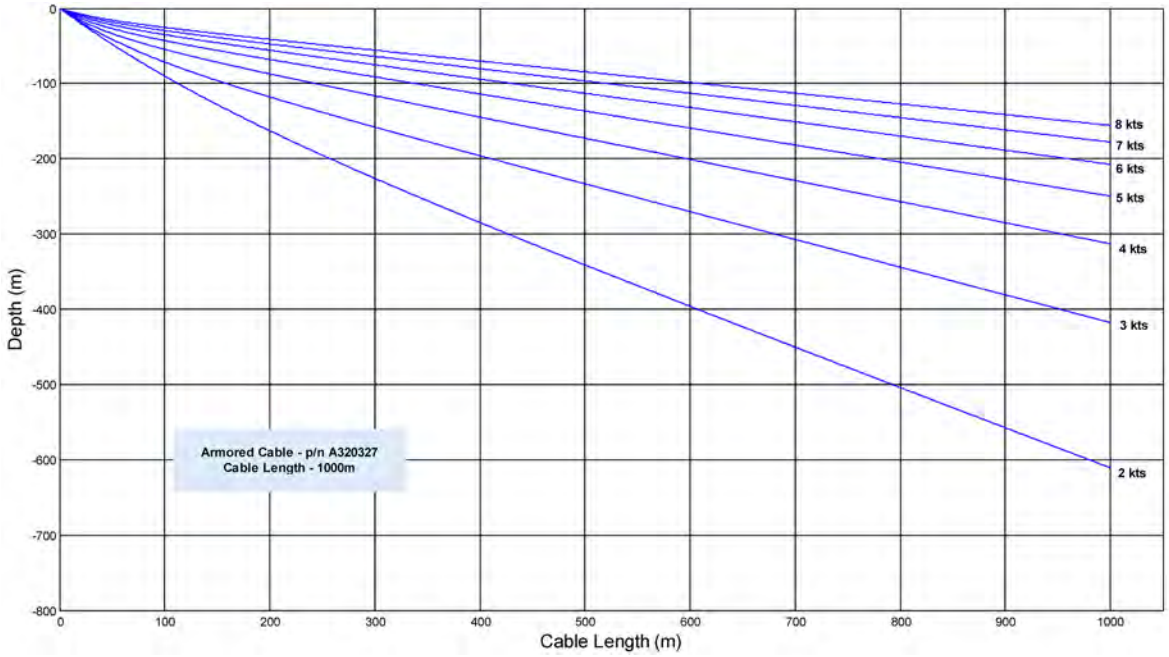

Figure C-4: Tow Cable Length Versus Depth—Cable A320327, 1000 Meters

C.3 Configuration 3

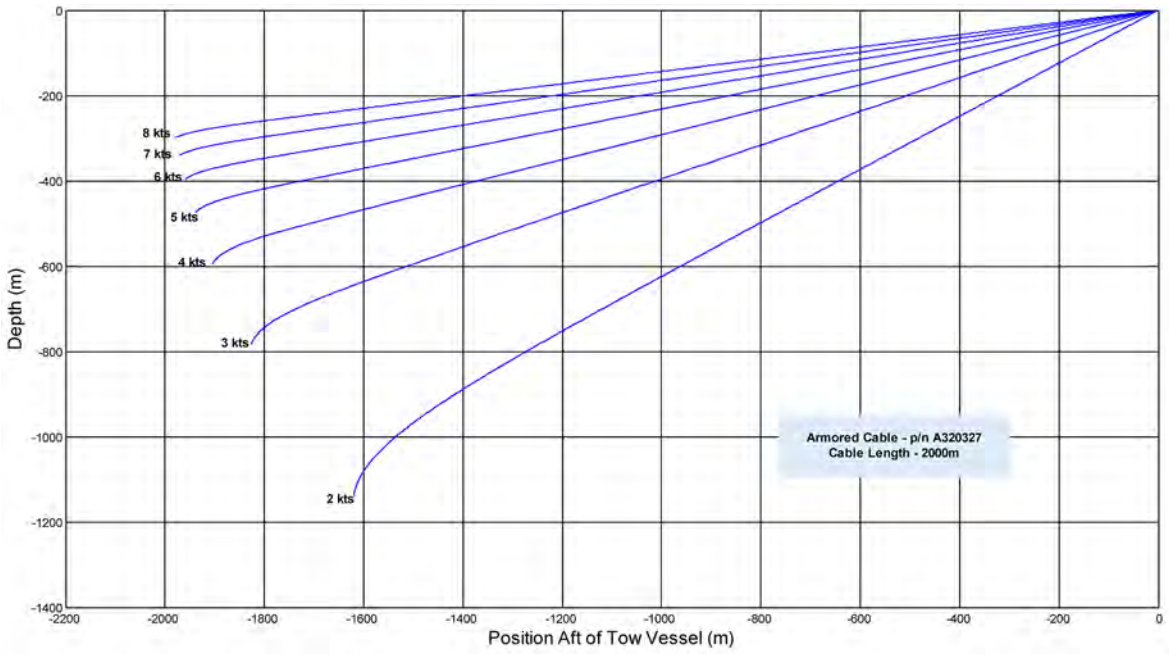

Figure C-1: Tow Cable Shape and Tow Vehicle Position—Cable A320327, 2000 Meters

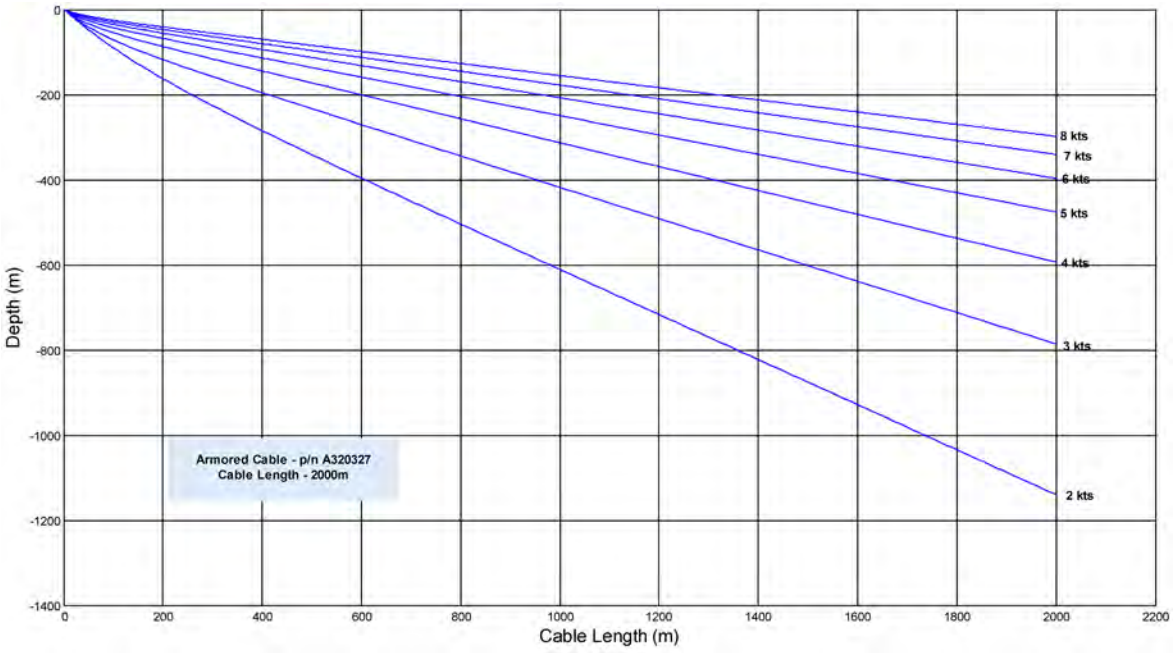

Figure C-2: Tow Cable Length vs. Depth—Cable A320327, 2000 Meters

C.4 Configuration 4

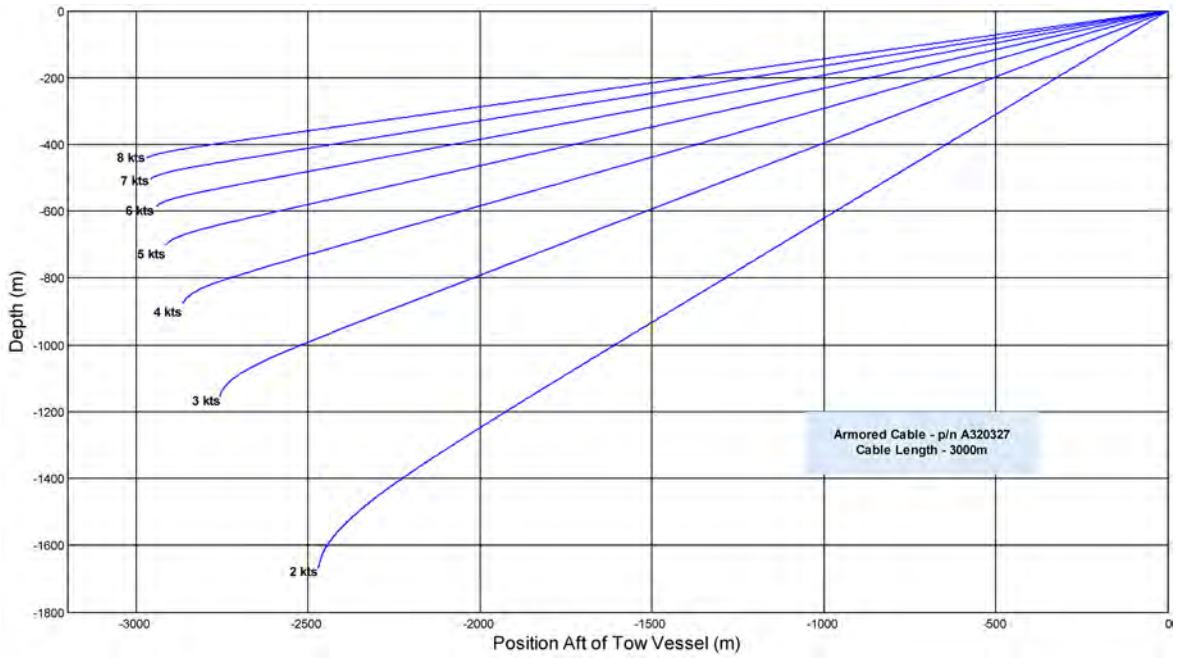

Figure C-3: Tow Cable Shape and Tow Vehicle Position—Cable A320327, 3000 Meters

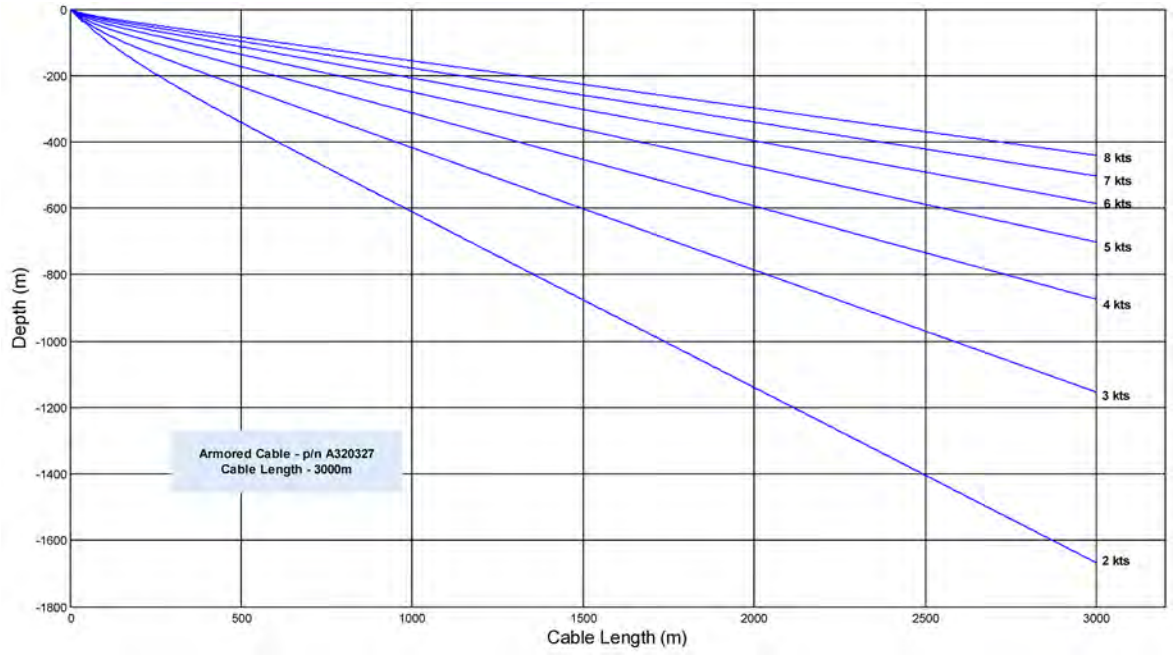

Figure C-4: Tow Cable Length Versus Depth—Cable A320327, 3000 Meters

C.5 Configuration 5

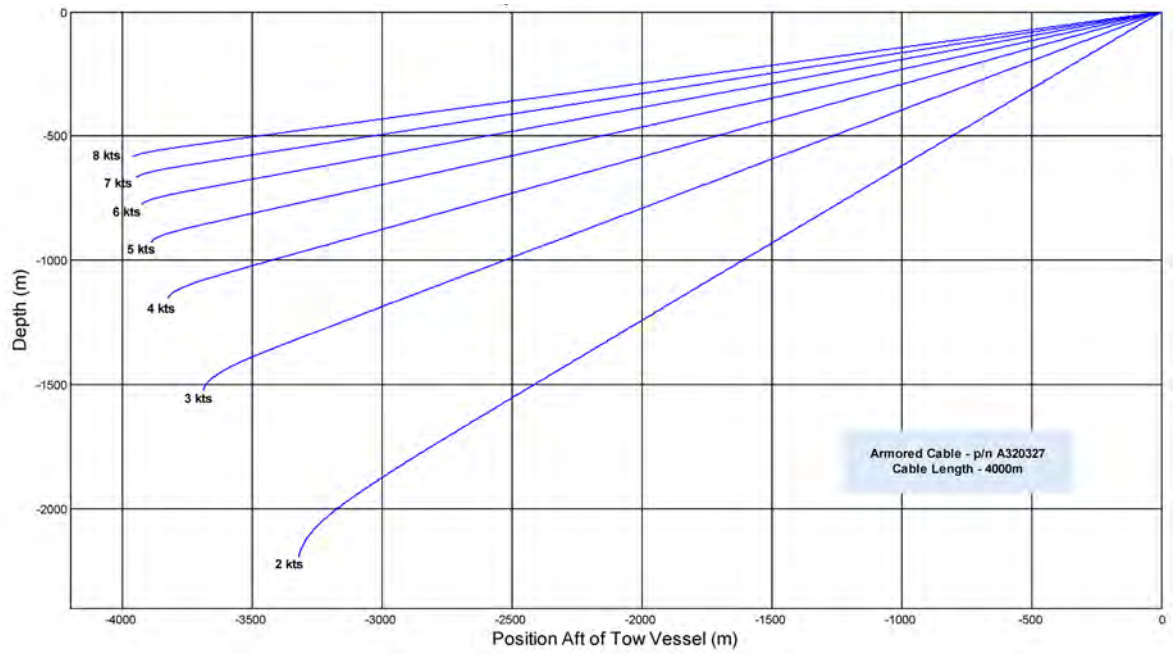

Figure C-5: Tow Cable Shape and Tow Vehicle Position—Cable A320327, 4000 Meters

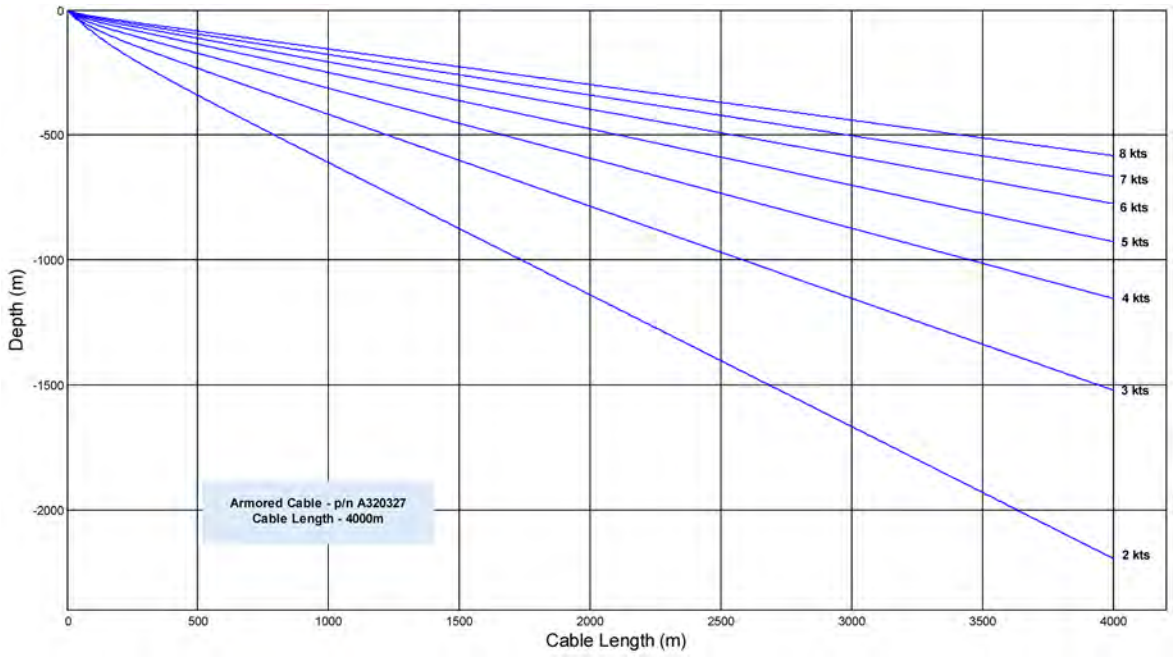

Figure C-6: Tow Cable Length vs. Depth—Cable A320327, 4000 Meters

C.6 Configuration 6

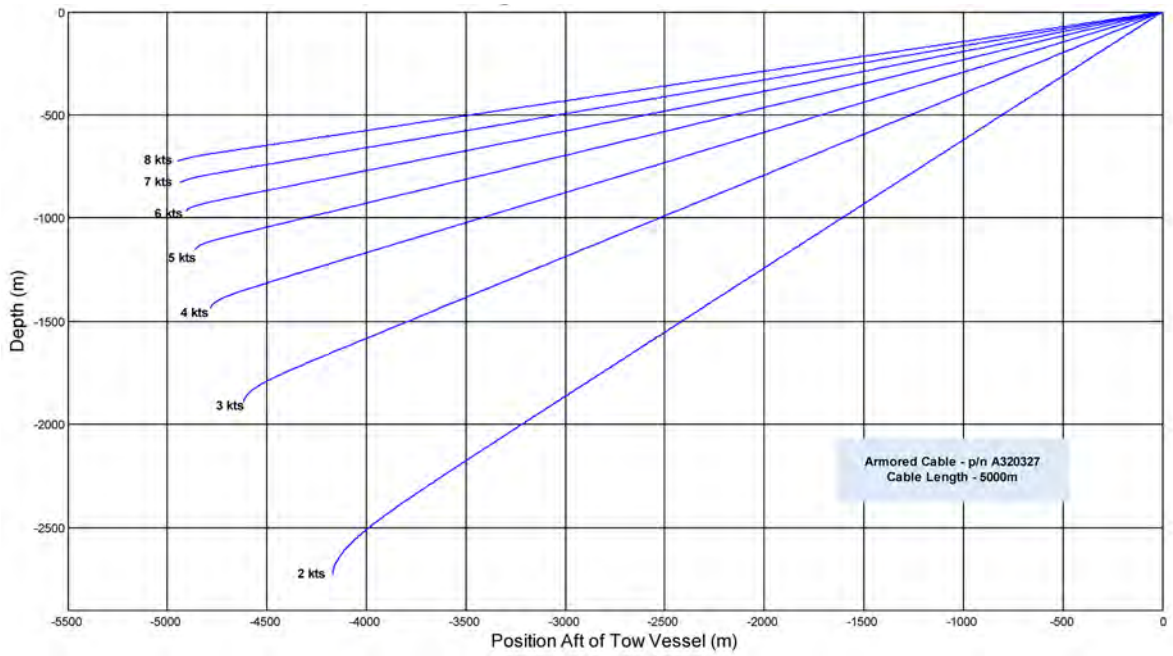

Figure C-7: Tow Cable Shape and Tow Vehicle Position—Cable A320327, 5000 Meters

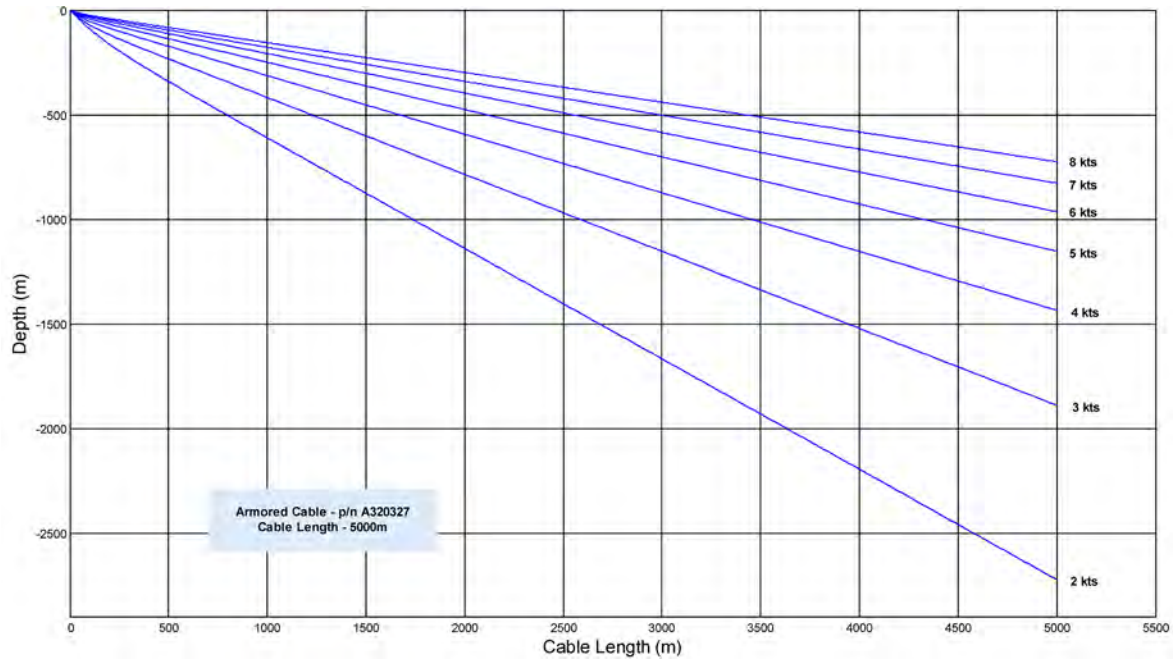

Figure C-8: Tow Cable Length Versus Depth—Cable A320327, 5000 Meters

C.7 Configuration 7

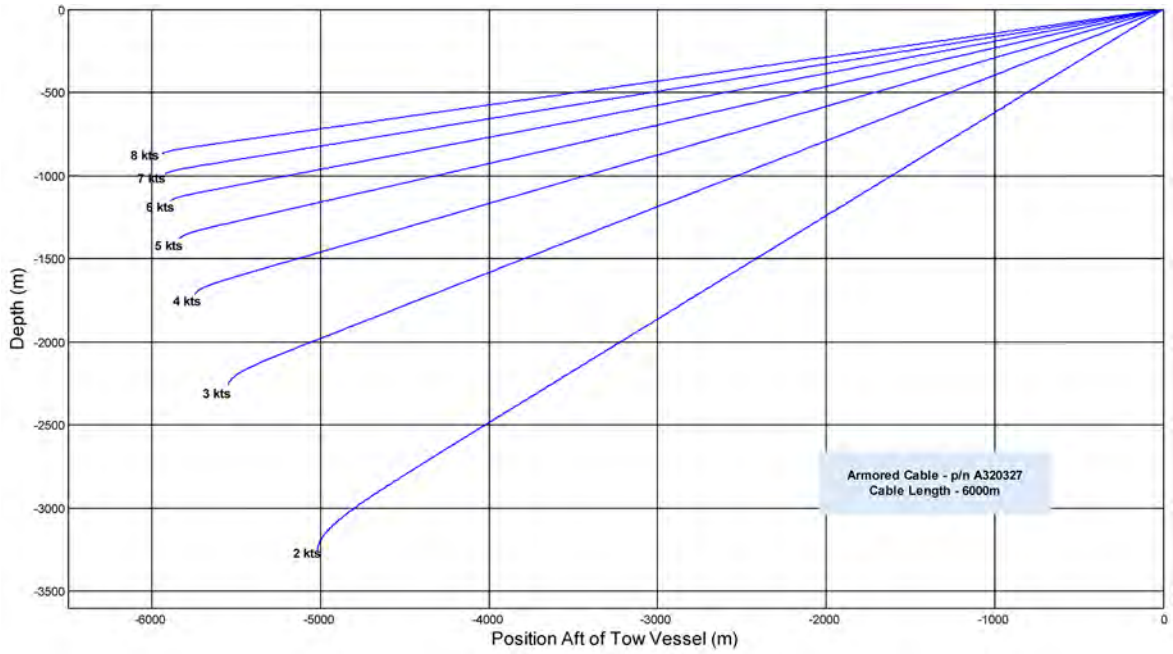

Figure C-9: Tow Cable Shape and Tow Vehicle Position—Cable A320327, 6000 Meters

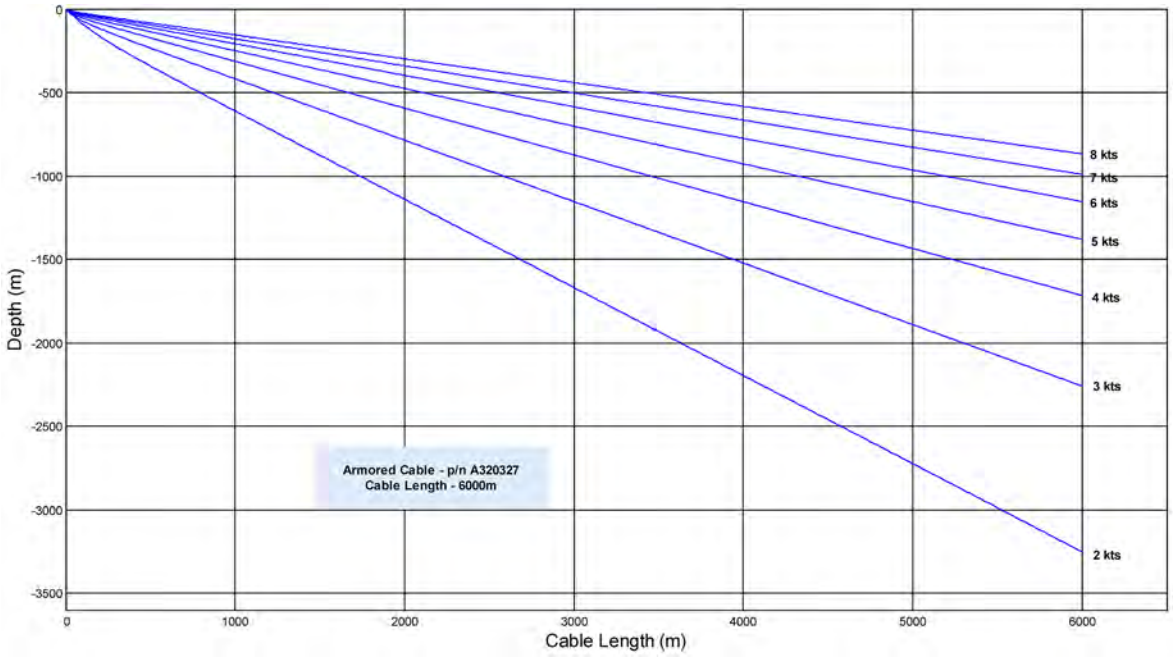

Figure C-10: Tow Cable Length Versus Depth—Cable A320327, 6000 Meters

C.8 Configuration 8

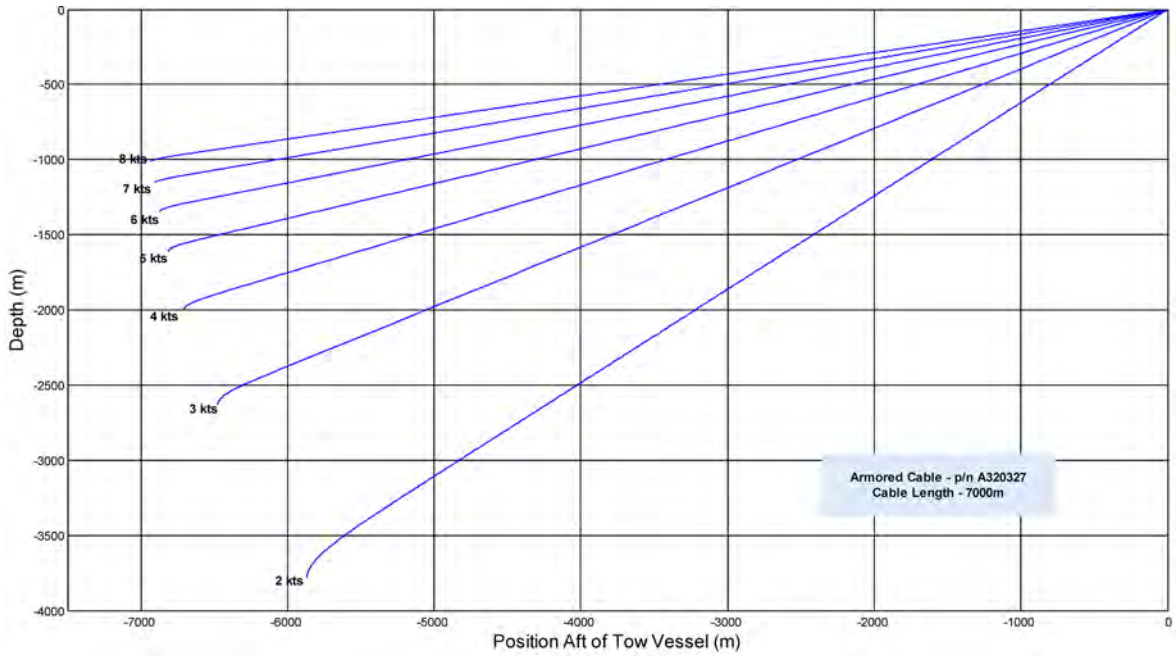

Figure C-11: Tow Cable Shape and Tow Vehicle Position—Cable A320327, 7000 Meters

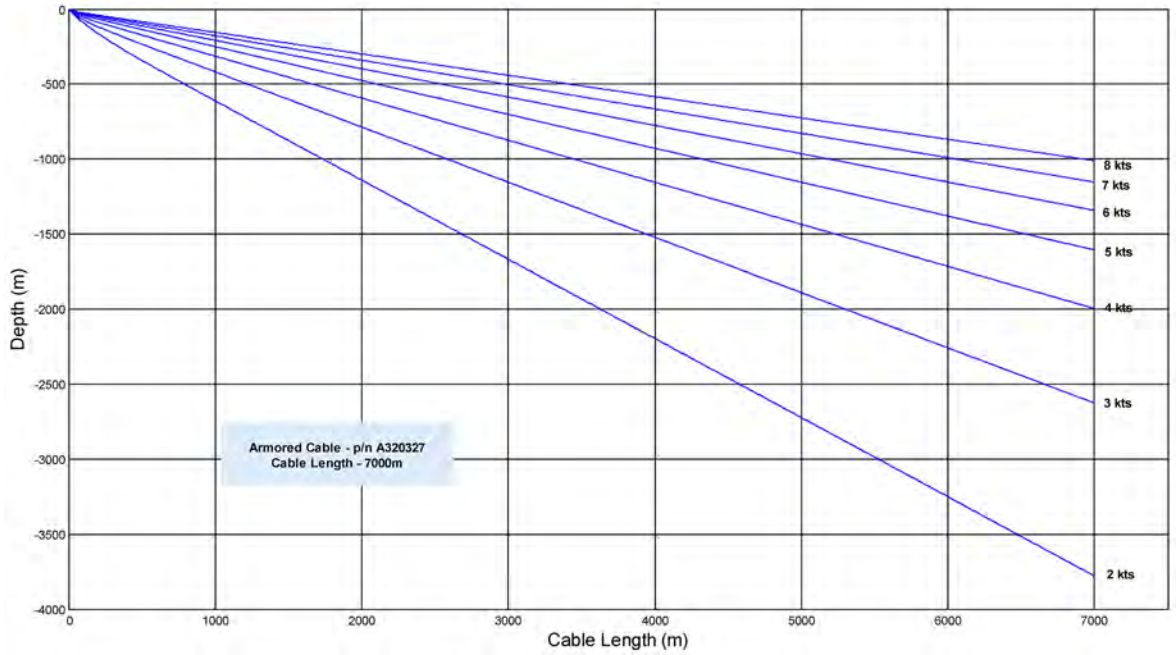

Figure C-12: Tow Cable Length Versus Depth—Cable A320327, 7000 Meters

C.9 Configuration 9

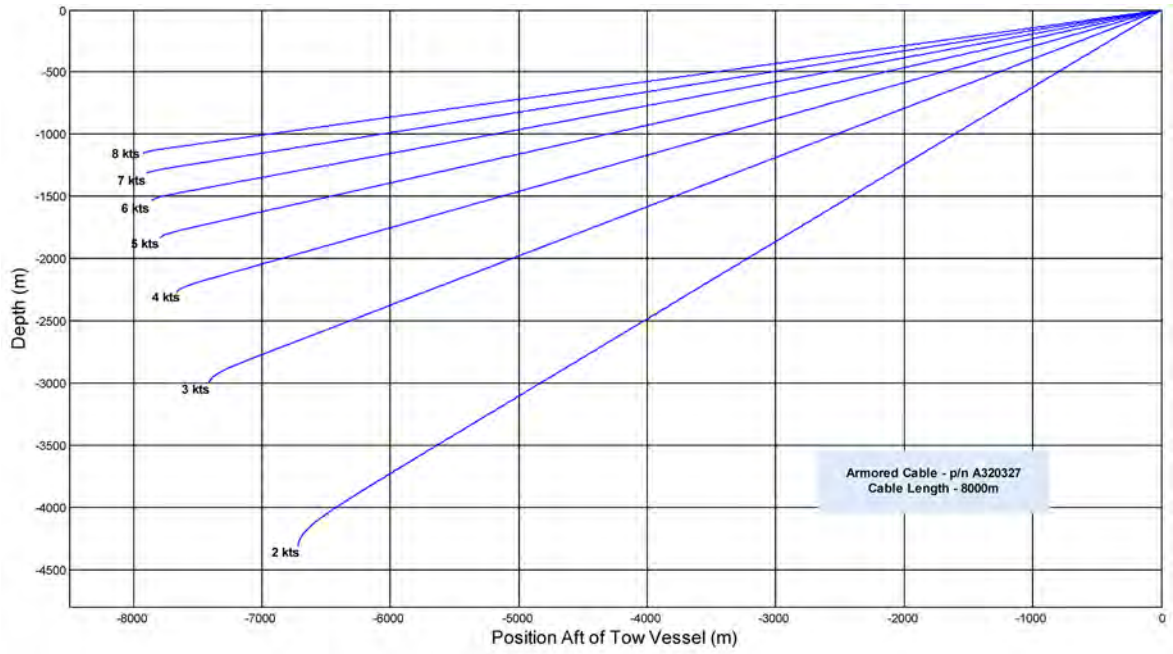

Figure C-13: Tow Cable Shape and Tow Vehicle Position—Cable A320327, 8000 Meters

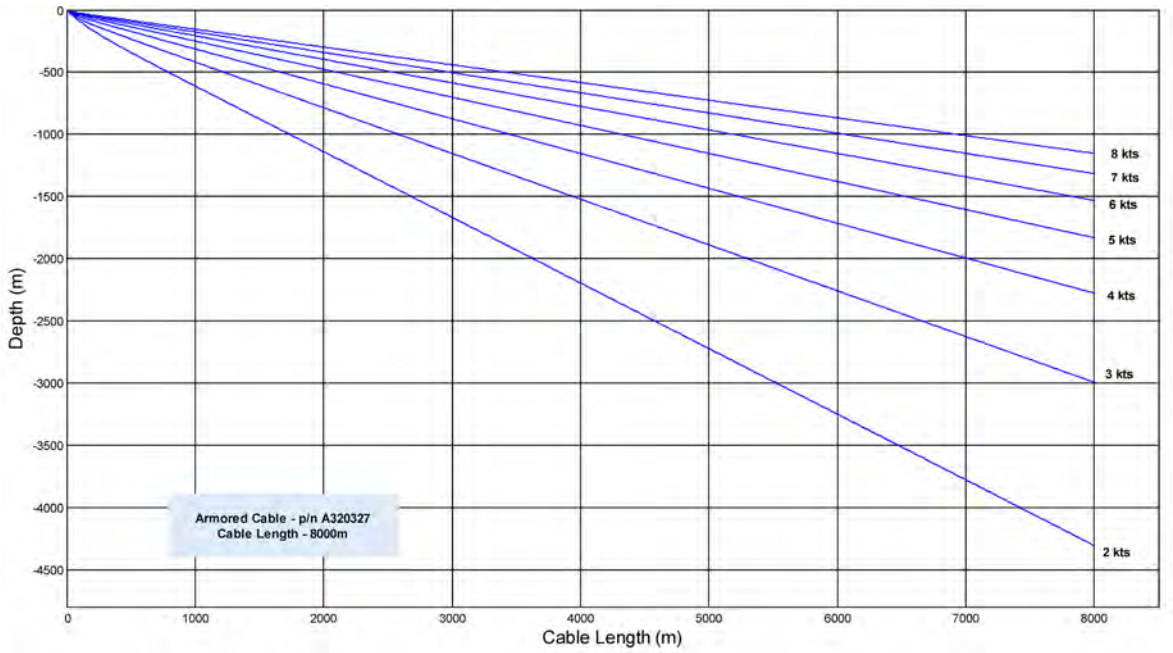

Figure C-14: Tow Cable Length Versus Depth—Cable A320327, 8000 Meters

C.10 Configuration 10

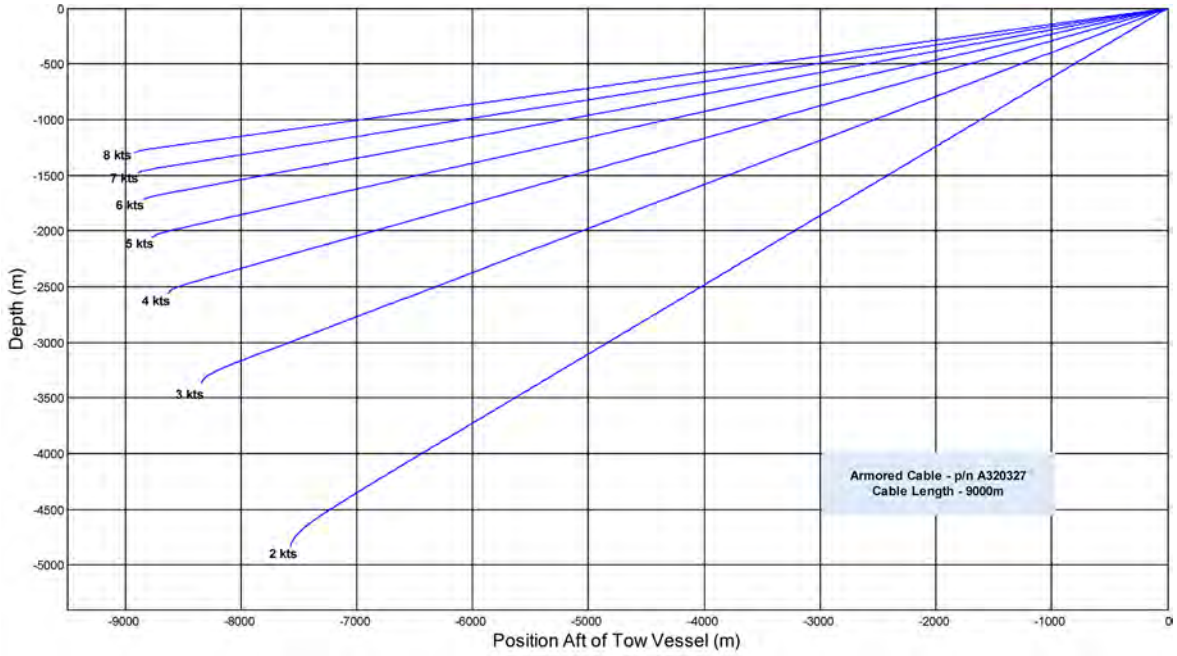

Figure C-15: Tow Cable Shape and Tow Vehicle Position—Cable A320327, 9000 Meters

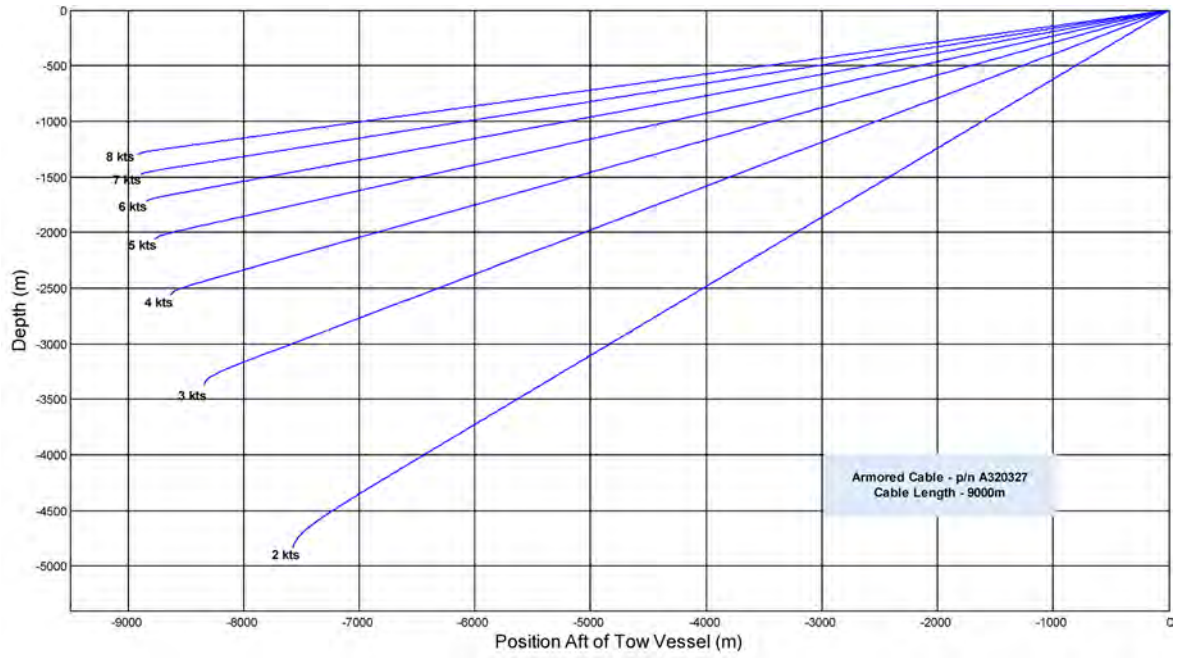

Figure C-16: Tow Cable Length Versus Depth—Cable A320327, 9000 Meters

C.11 Configuration 11

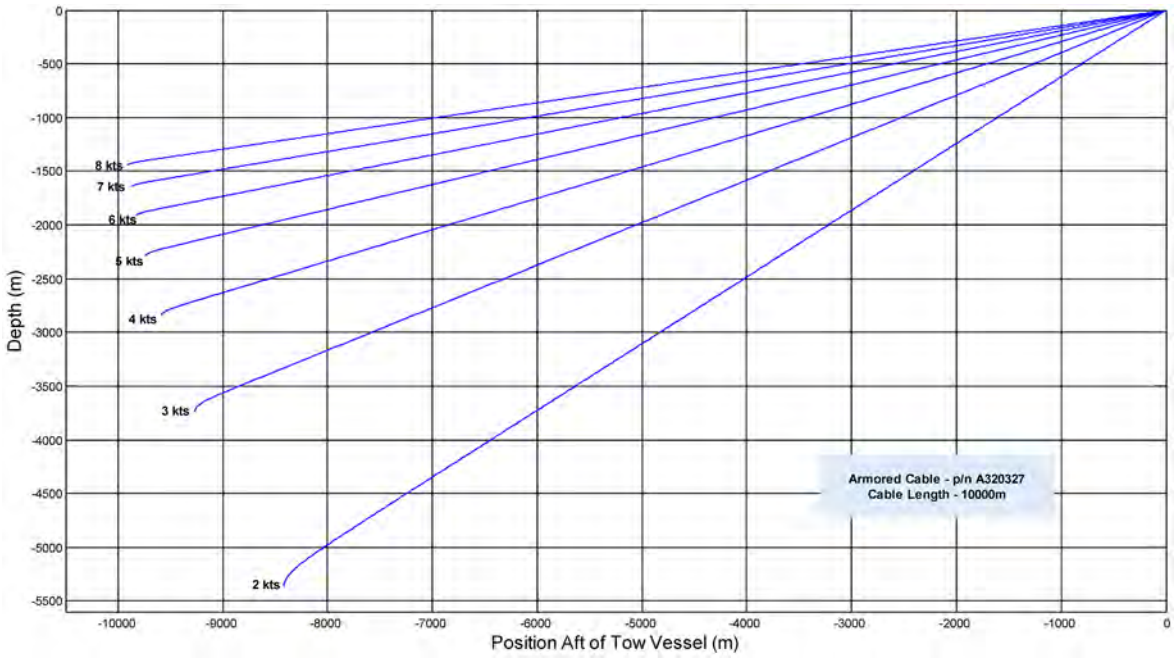

Figure C-17: Tow Cable Shape and Tow Vehicle Position—Cable A320327, 10000 Meters

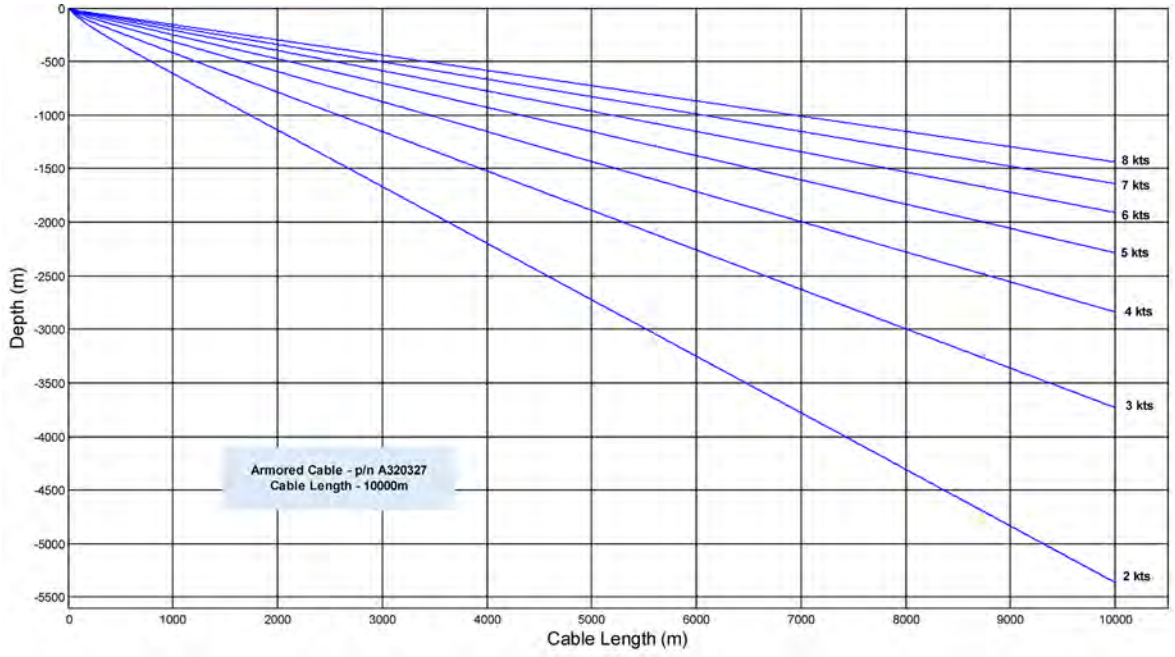

Figure C-18: Tow Cable Length Versus Depth—Cable A320327, 10000 Meters

C.12 Configuration 12

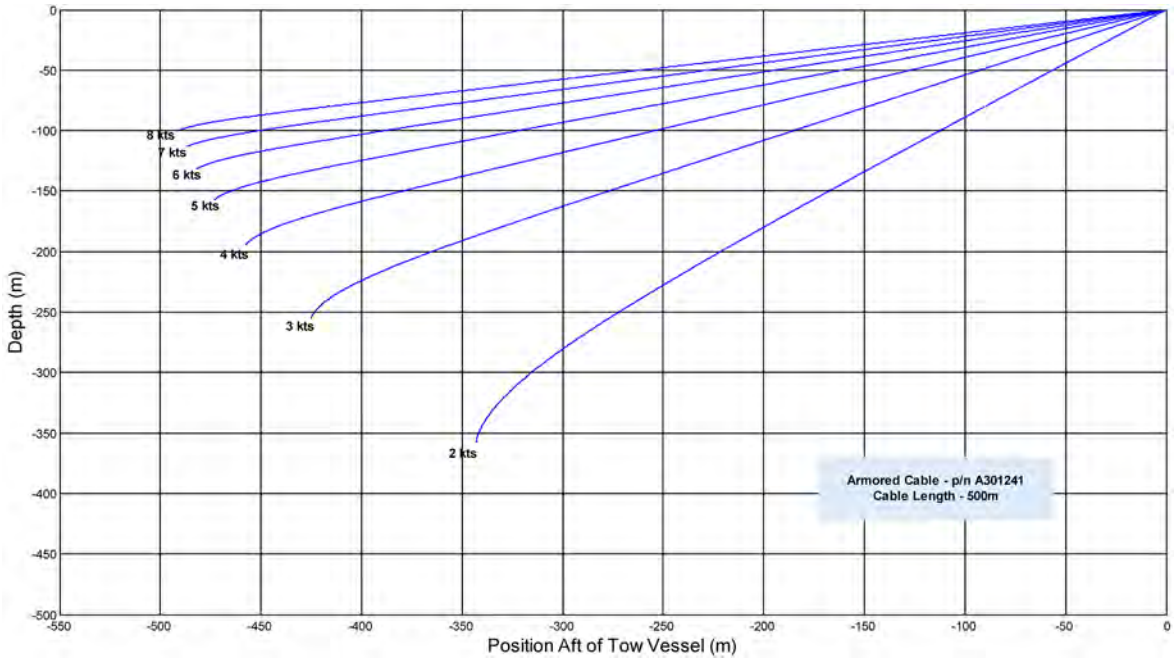

Figure C-19: Tow Cable Shape and Tow Vehicle Position—Cable A301241, 500 Meters

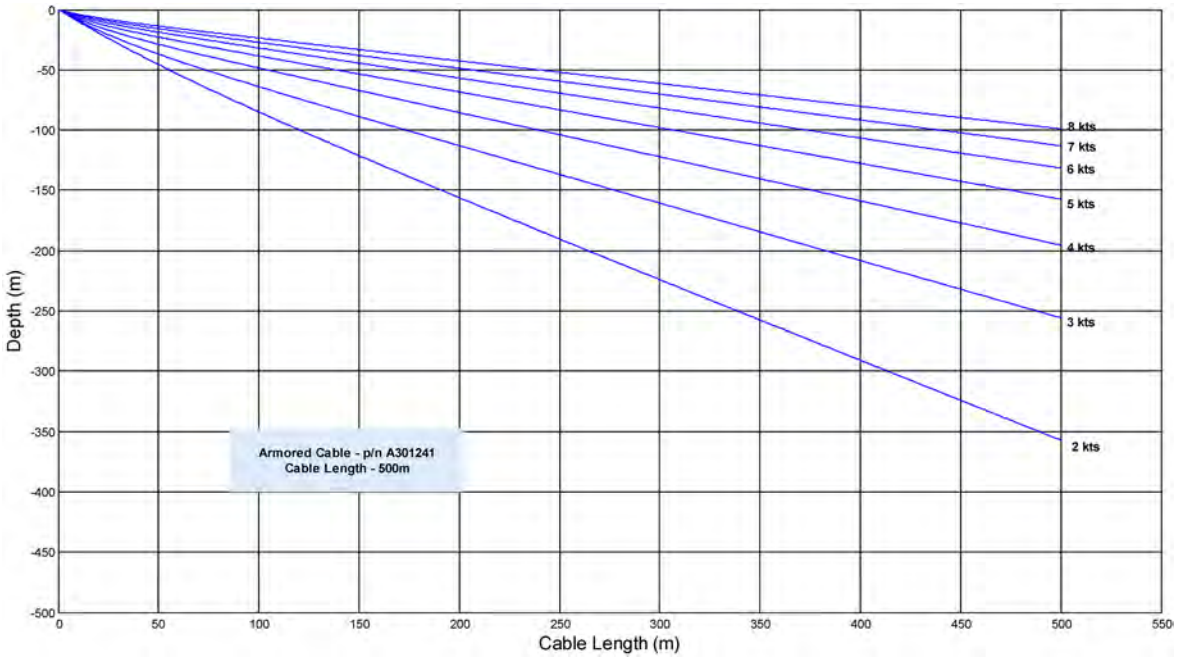

Figure C-20: Tow Cable Length Versus Depth—Cable A301241, 500 Meters

C.13 Configuration 13

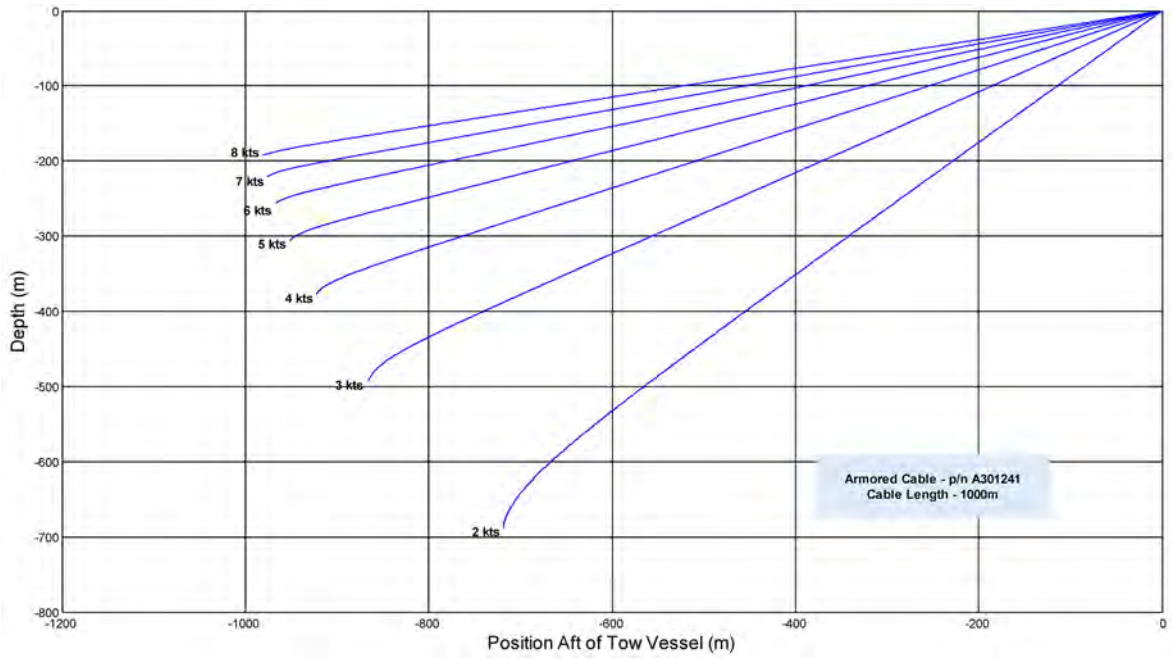

Figure C-21: Tow Cable Shape and Tow Vehicle Position—Cable A301241, 1000 Meters

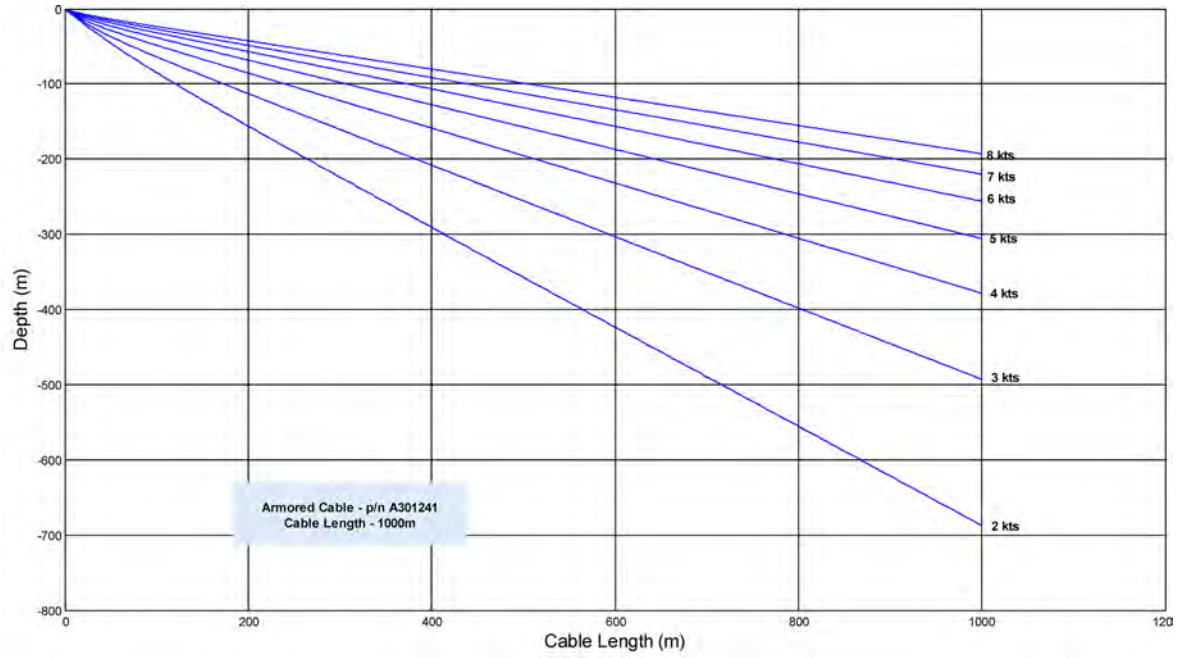

Figure C-22: Tow Cable Length Versus Depth—Cable A301241, 1000 Meters

C.14 Configuration 14

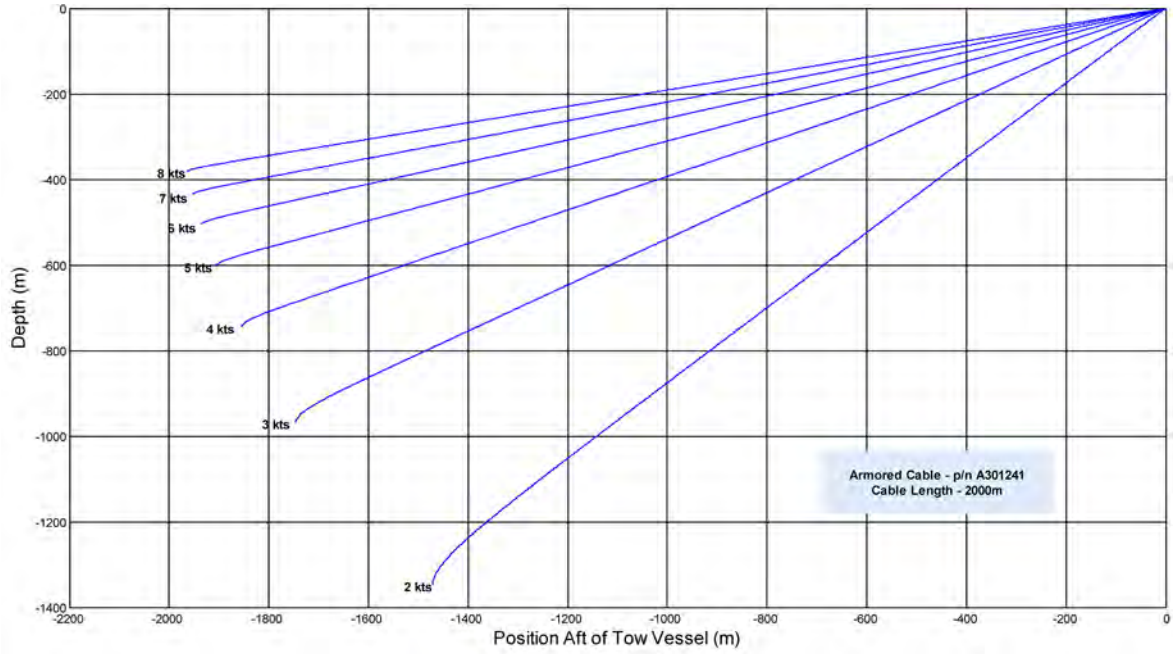

Figure C-23: Tow Cable Shape and Tow Vehicle Position—Cable A301241, 2000 Meters

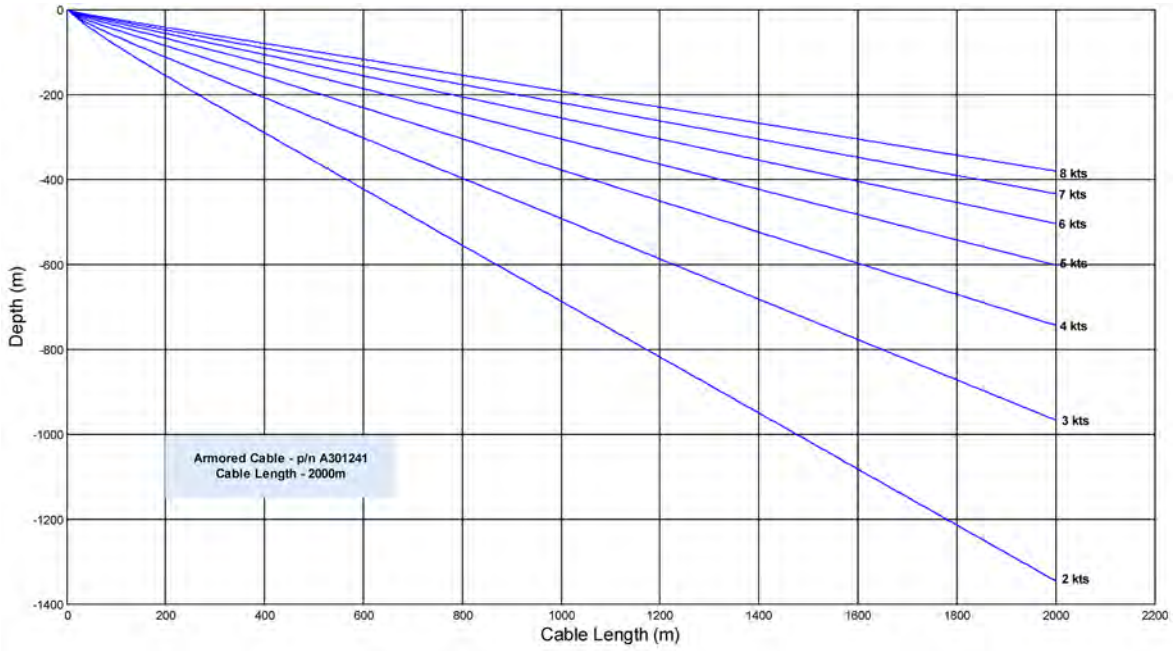

Figure C-24: Tow Cable Length Versus Depth—Cable A301241, 2000 Meters

C.15 Configuration 15

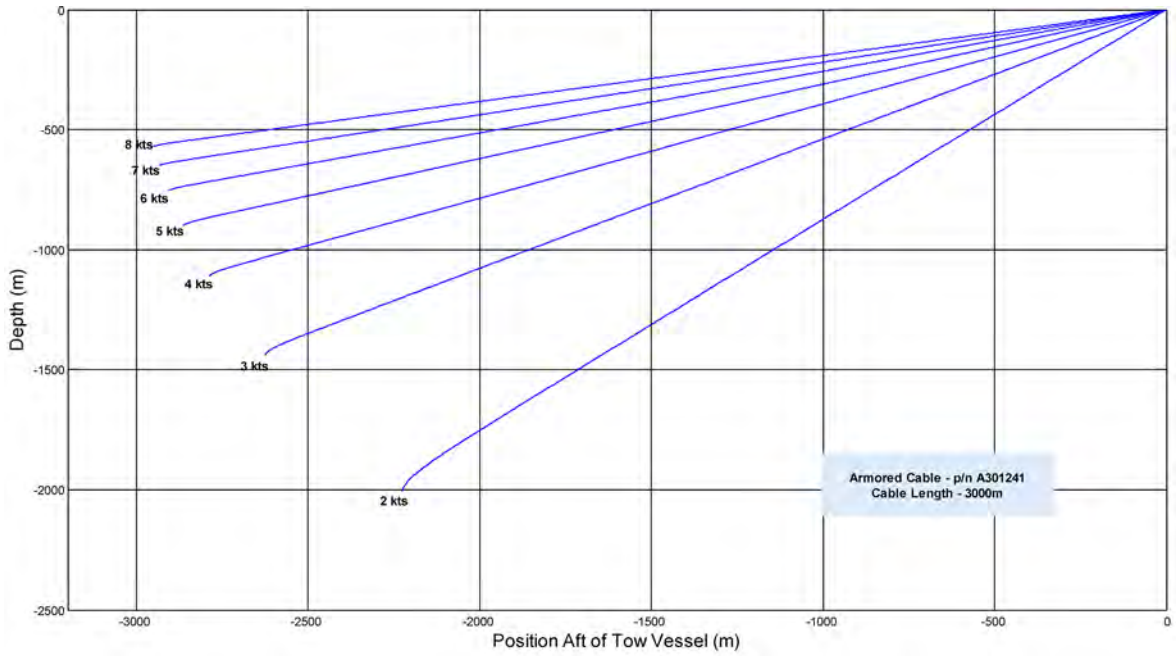

Figure C-25: Tow Cable Shape and Tow Vehicle Position—Cable A301241, 3000 Meters

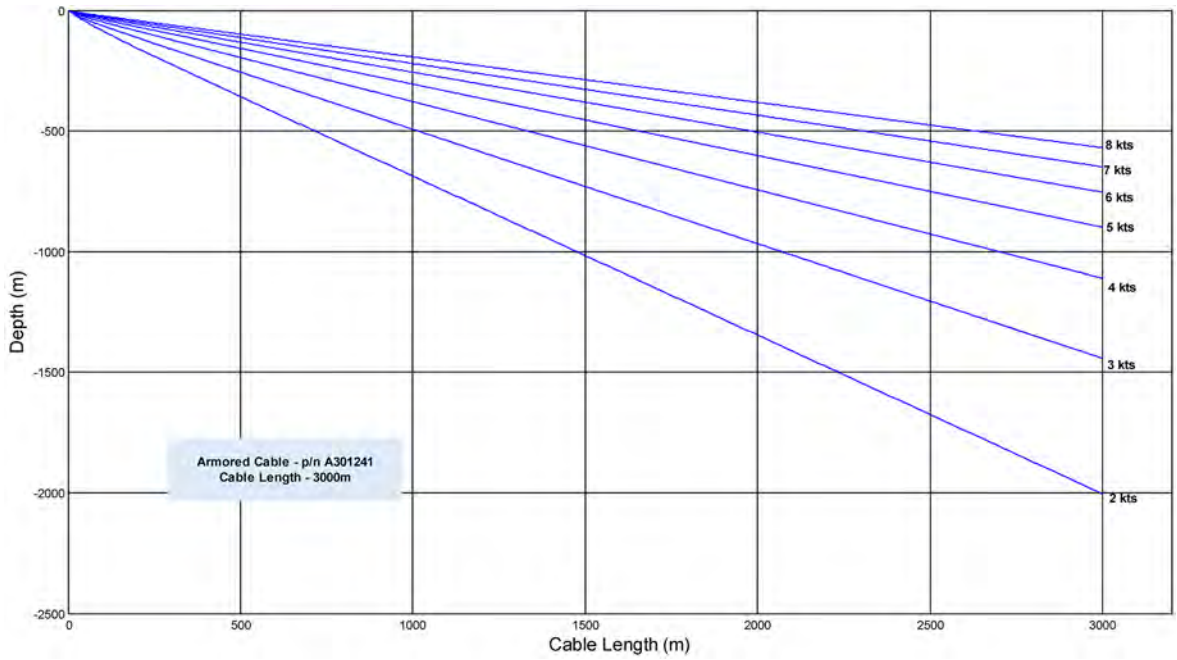

Figure C-26: Tow Cable Length Versus Depth—Cable A301241, 3000 Meters

C.16 Configuration 16

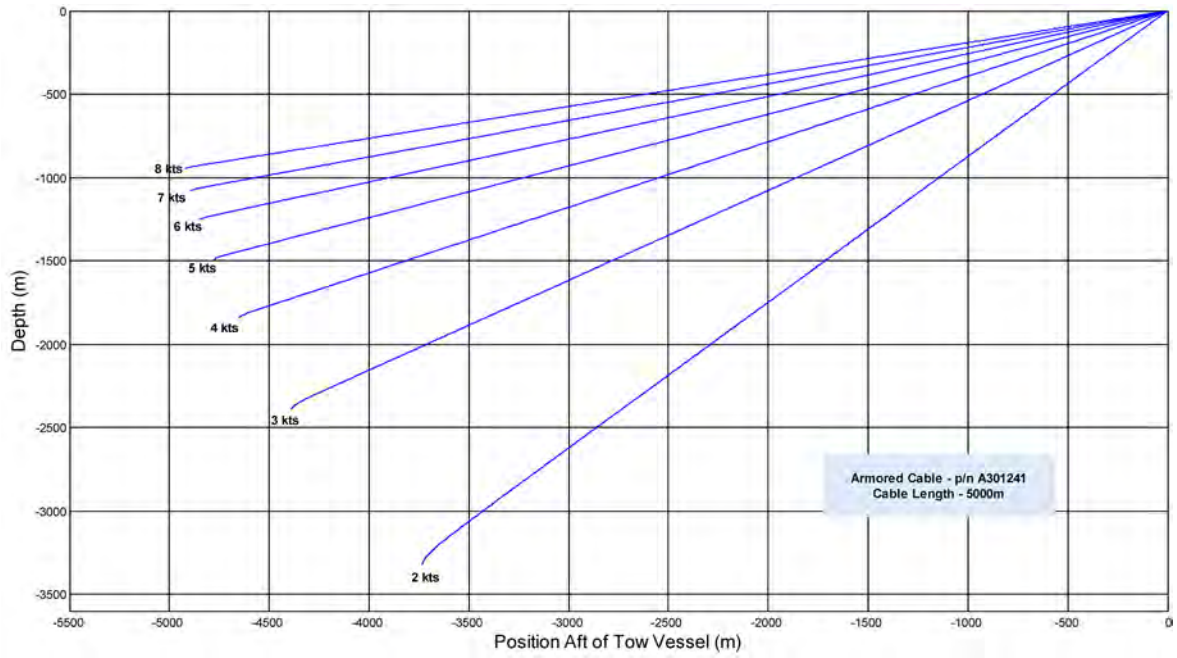

Figure C-27: Tow Cable Shape and Tow Vehicle Position—Cable A301241, 5000 Meters

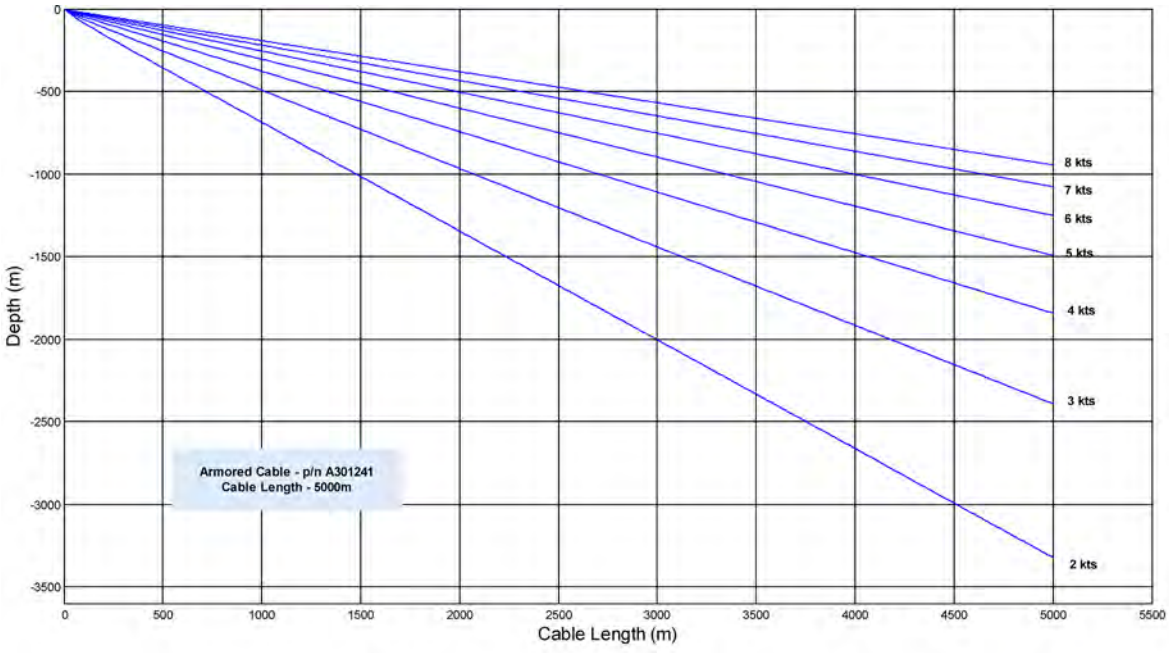

Figure C-28: Tow Cable Length Versus Depth—Cable A301241, 5000 Meters

C.17 Configuration 17

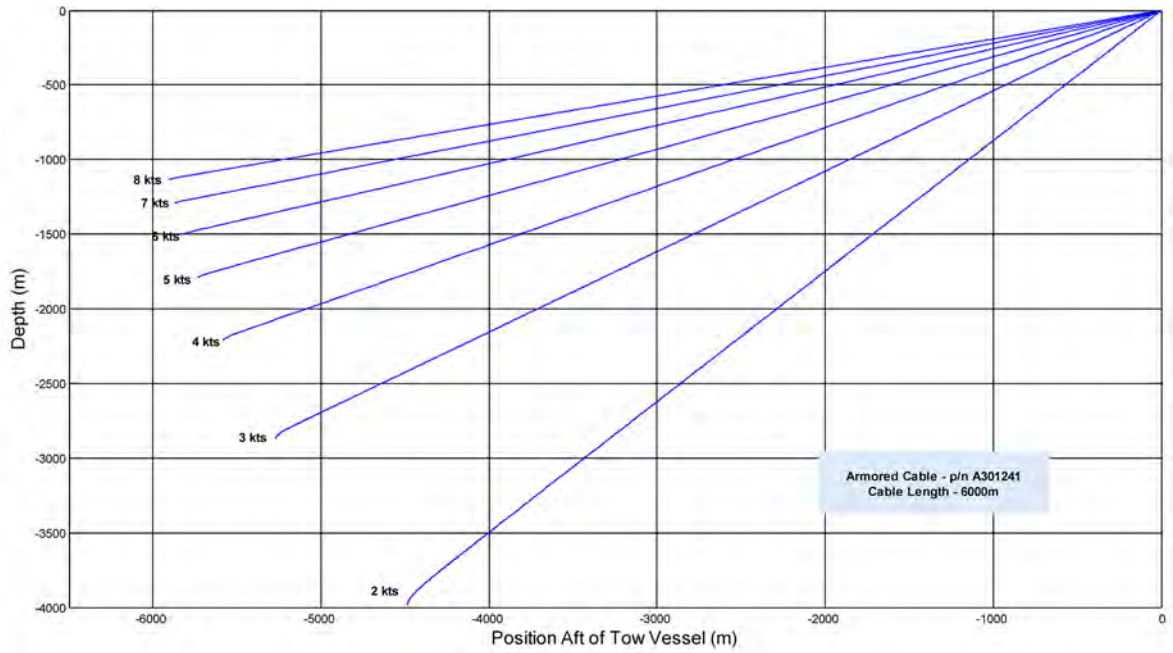

Figure C-29: Tow Cable Shape and Tow Vehicle Position—Cable A301241, 6000 Meters

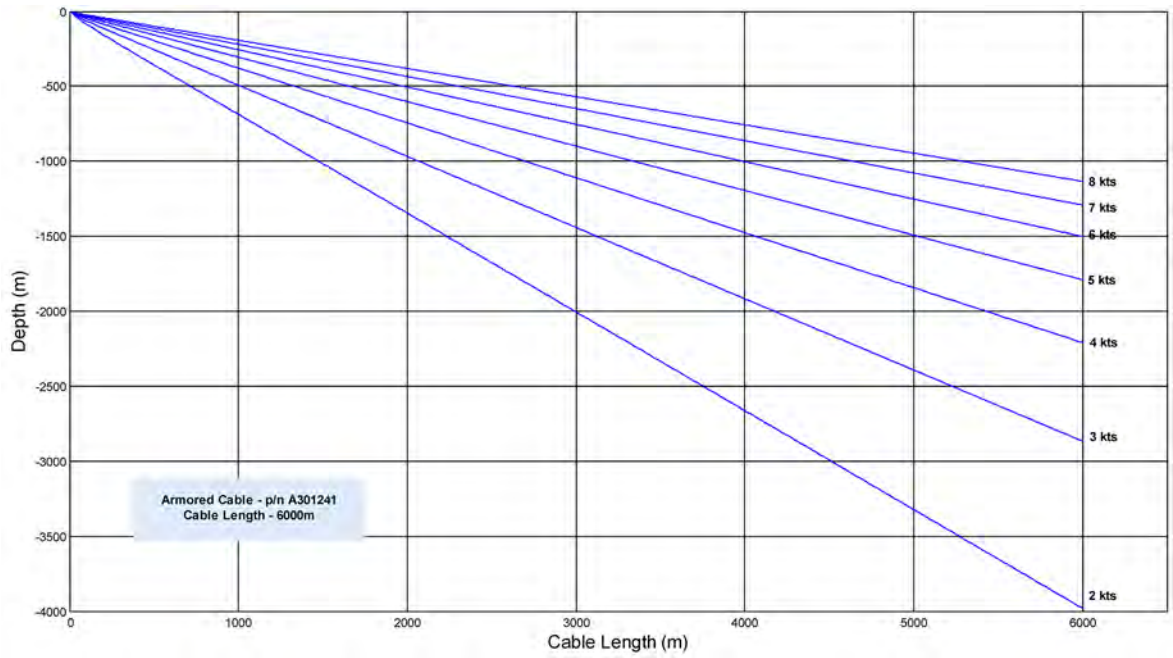

Figure C-30: Tow Cable Length Versus Depth—Cable A301241, 6000 Meters

C.18 Configuration 19

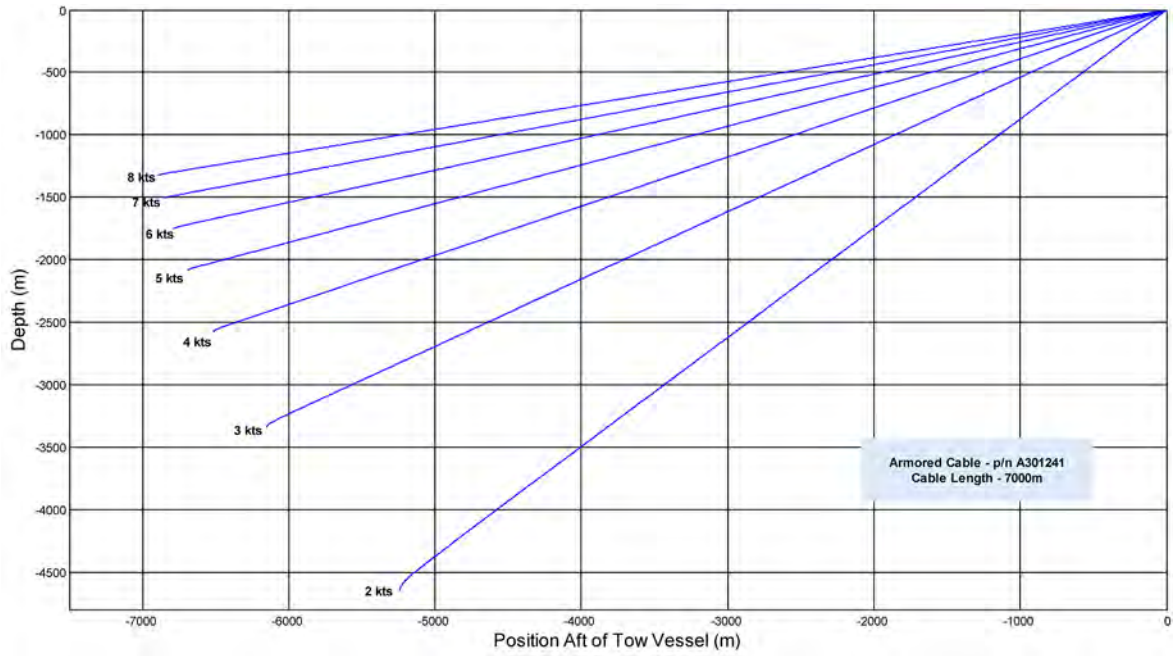

Figure C-31: Tow Cable Shape and Tow Vehicle Position—Cable A301241, 7000 Meters

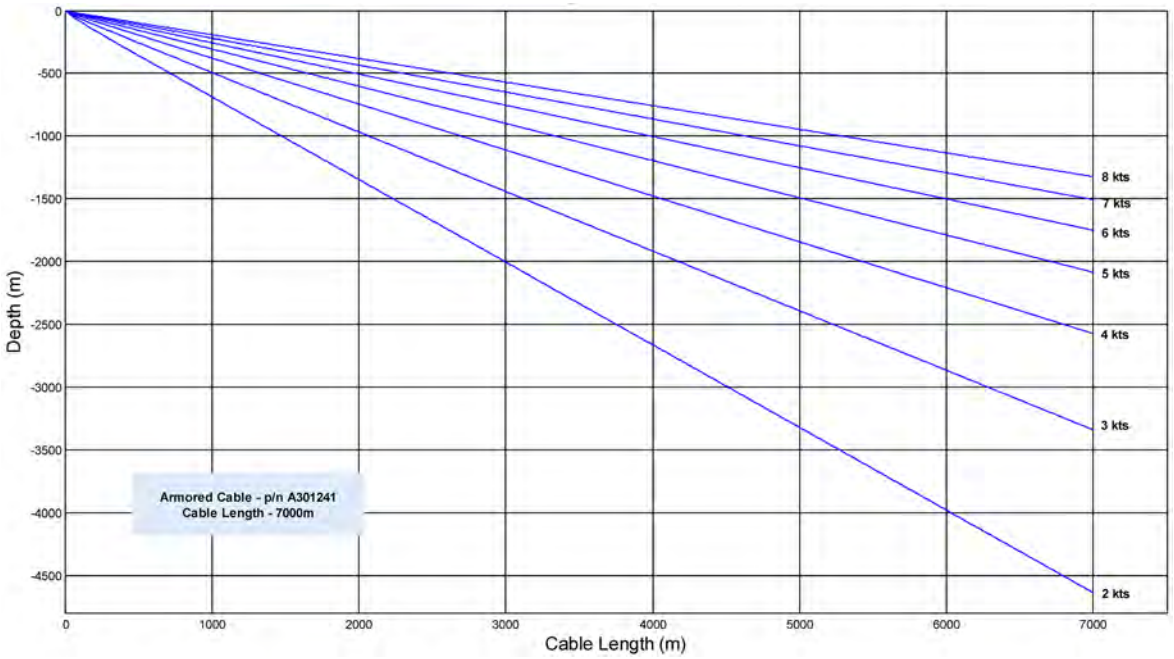

Figure C-32: Tow Cable Length Versus Depth—Cable A301241, 7000 Meters

C.19 Configuration 20

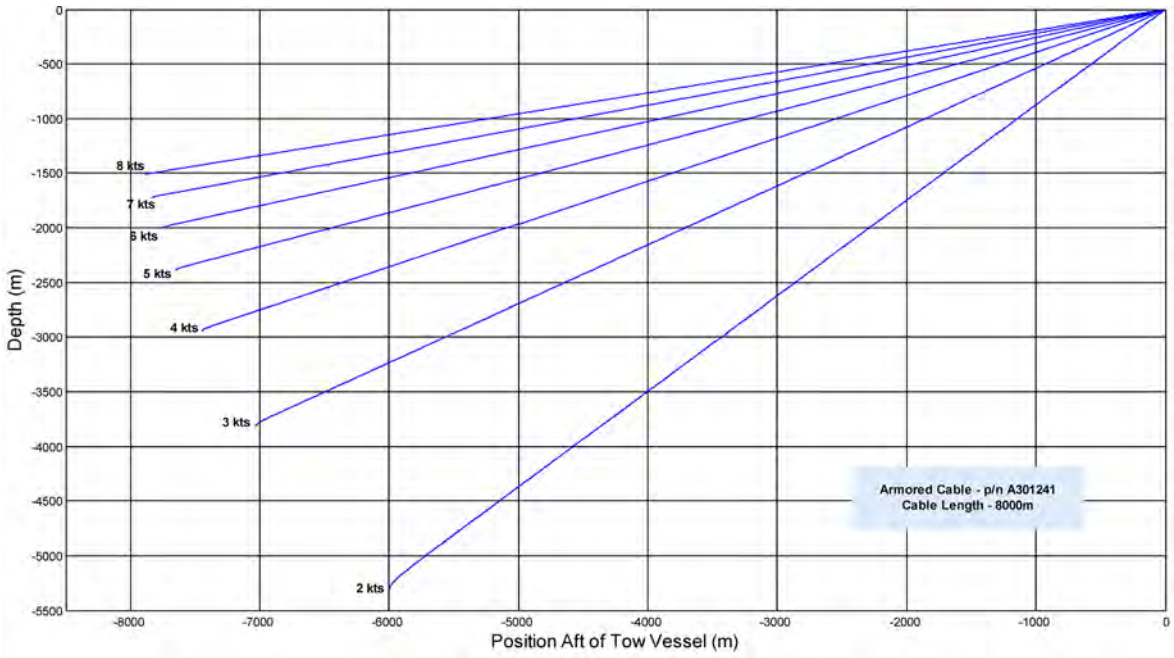

Figure C-33: Tow Cable Shape and Tow Vehicle Position—Cable A301241, 8000 Meters

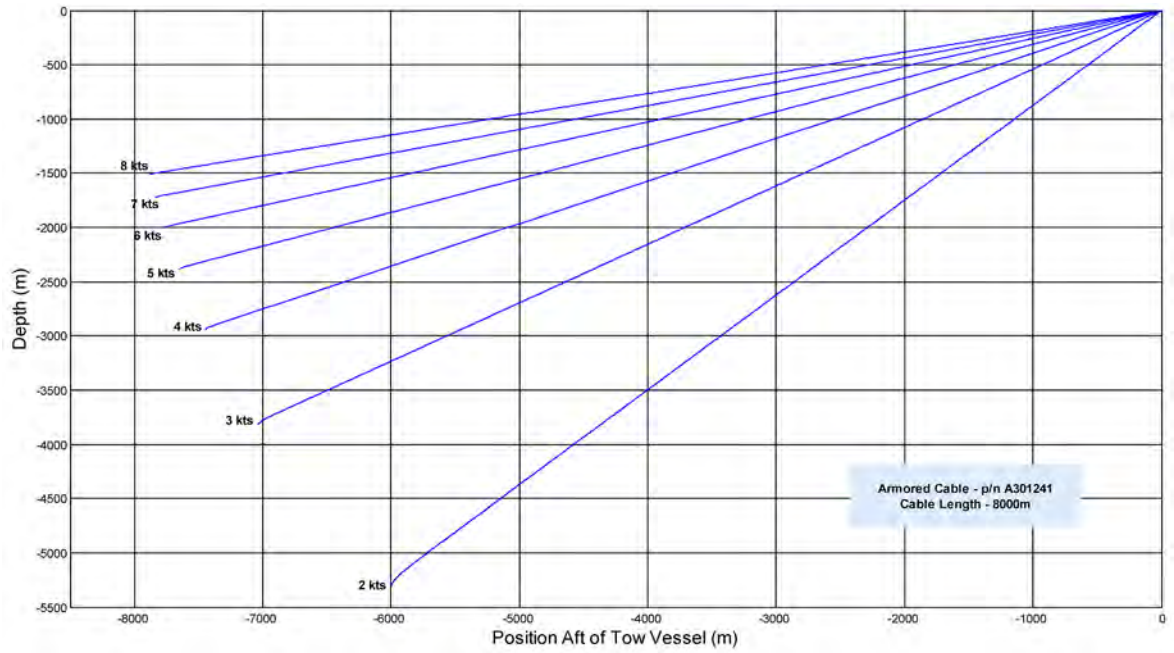

Figure C-34: Tow Cable Length Versus Depth—Cable A301241, 8000 Meters

C.20 Configuration 21

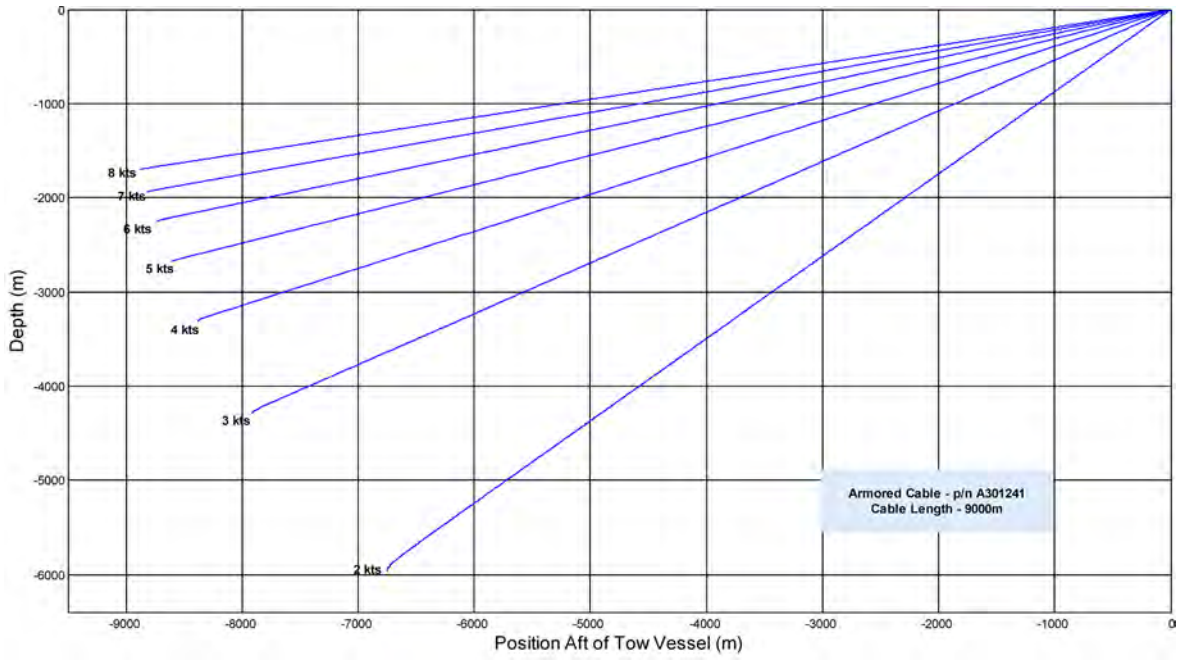

Figure C-35: Tow Cable Shape and Tow Vehicle Position—Cable A301241, 9000 Meters

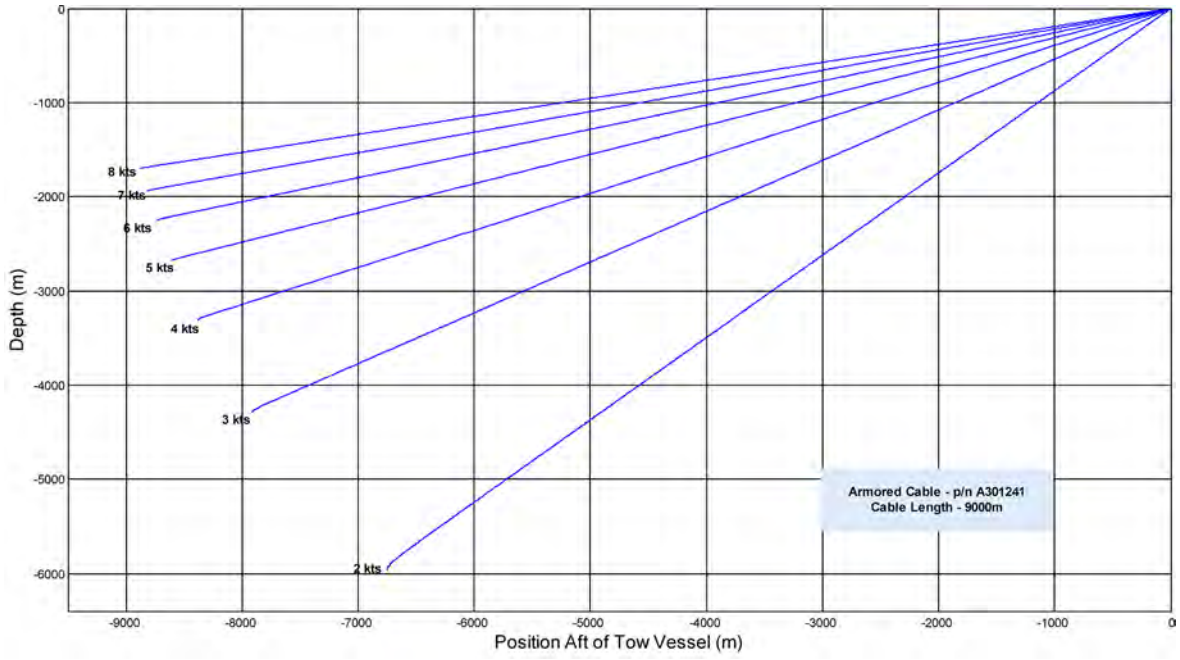

Figure C-36: Tow Cable Length Versus Depth—Cable A301241, 9000 Meters

C.21 Configuration 22

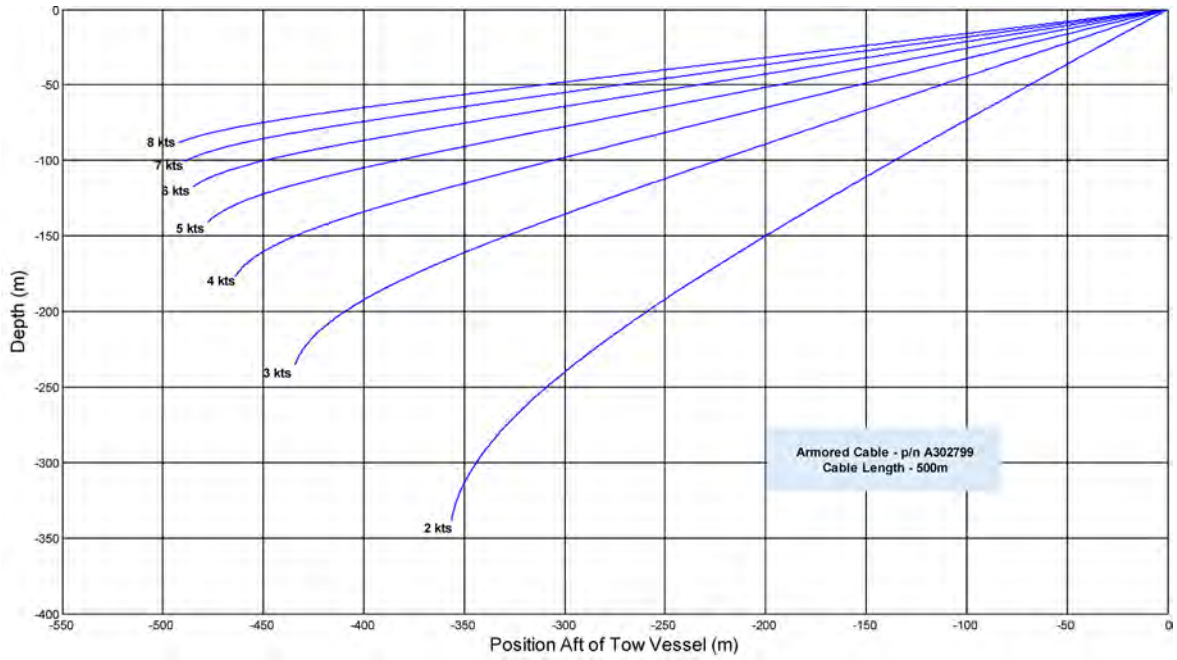

Figure C-37: Tow Cable Shape and Tow Vehicle Position—Cable A302799, 500 Meters

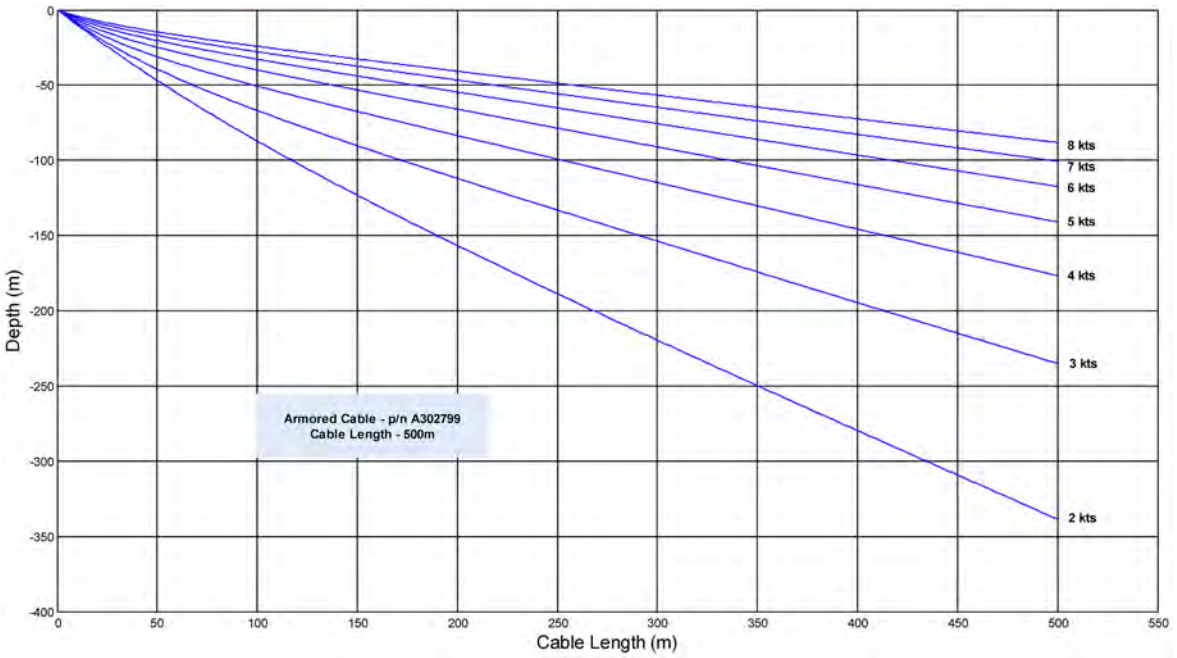

Figure C-38: Tow Cable Length Versus Depth—Cable A302799, 500 Meters

C.22 Configuration 23

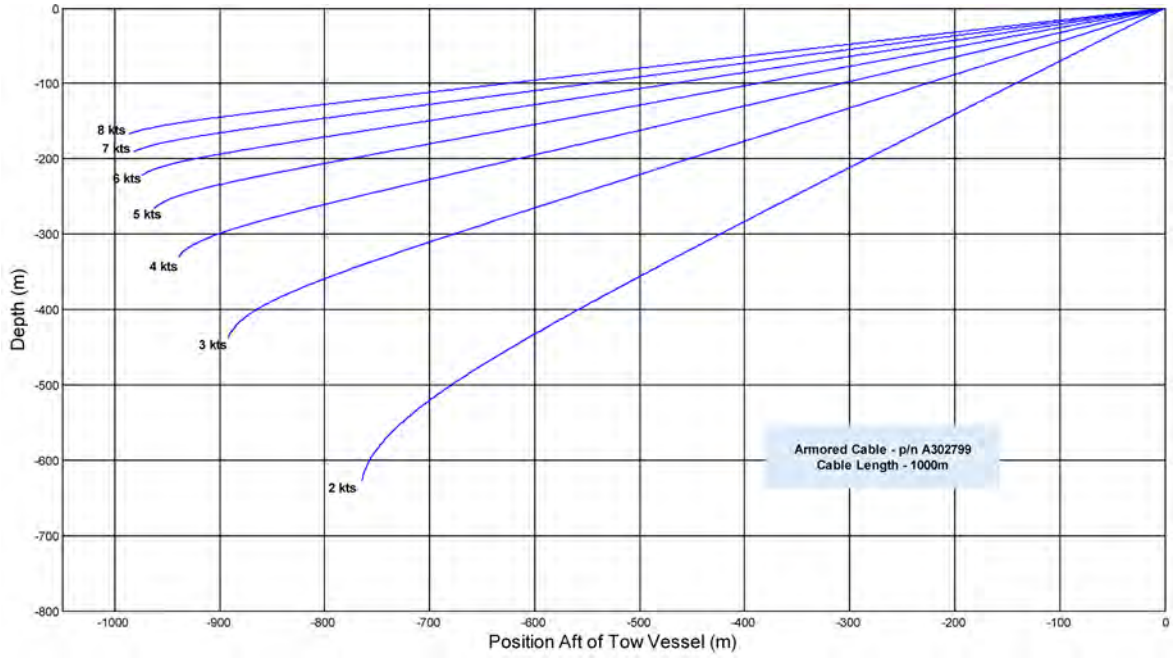

Figure C-39: Tow Cable Shape and Tow Vehicle Position—Cable A302799, 1000 Meters

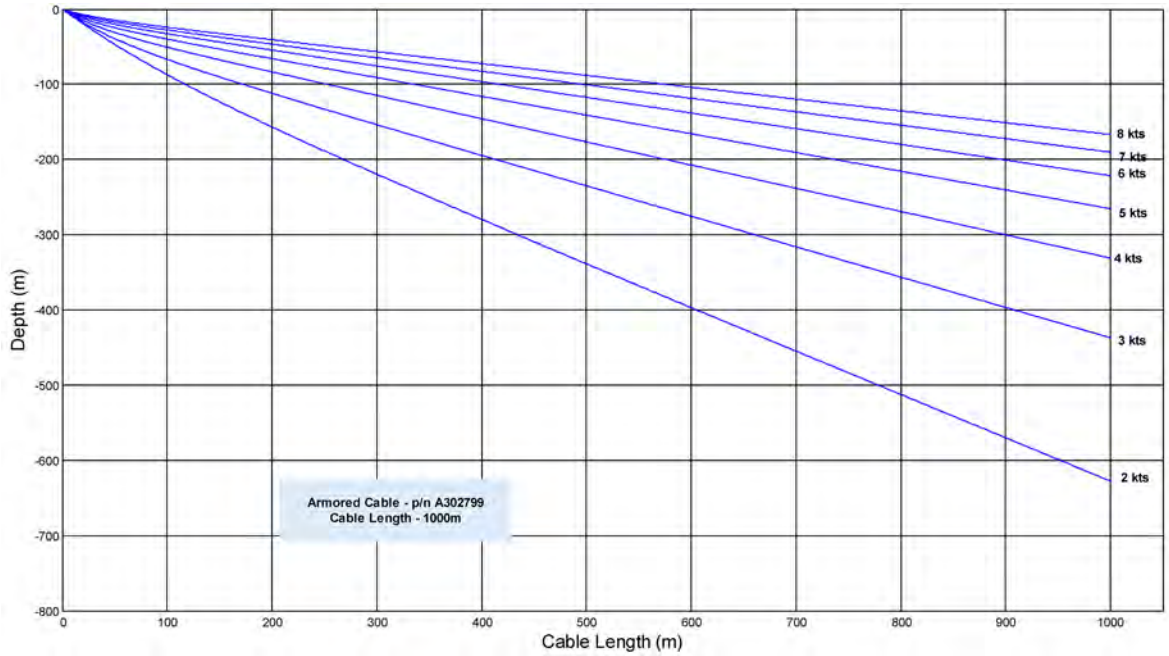

Figure C-40: Tow Cable Length Versus Depth—Cable A302799, 1000 Meters

C.23 Configuration 24

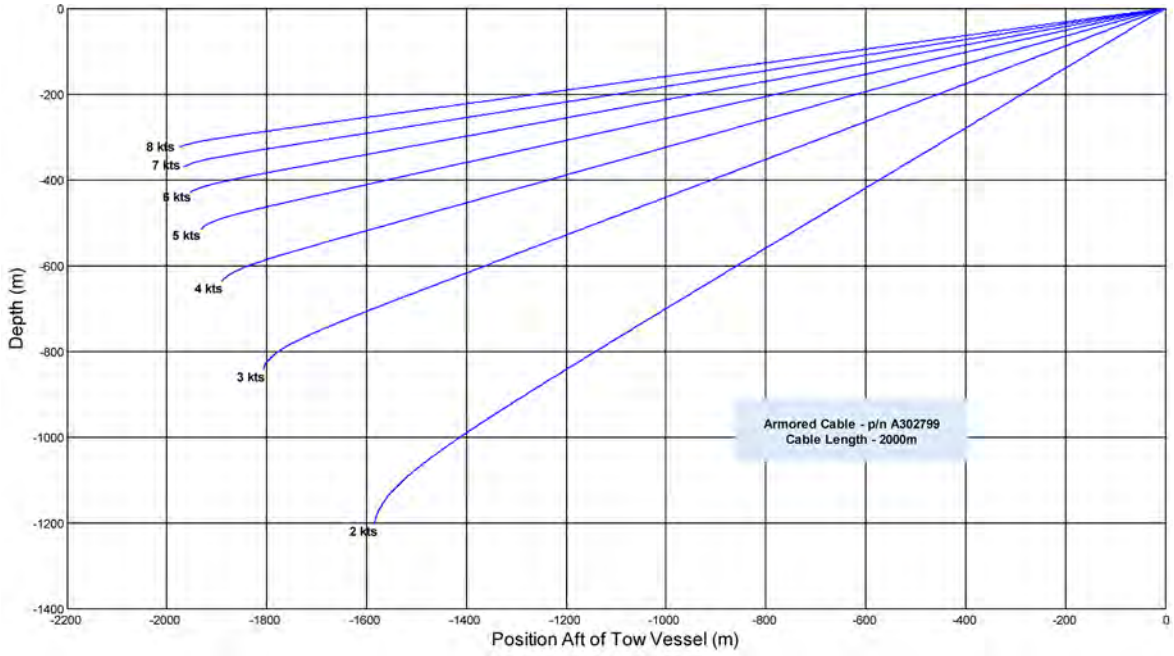

Figure C-41: Tow Cable Shape and Tow Vehicle Position—Cable A302799, 2000 Meters

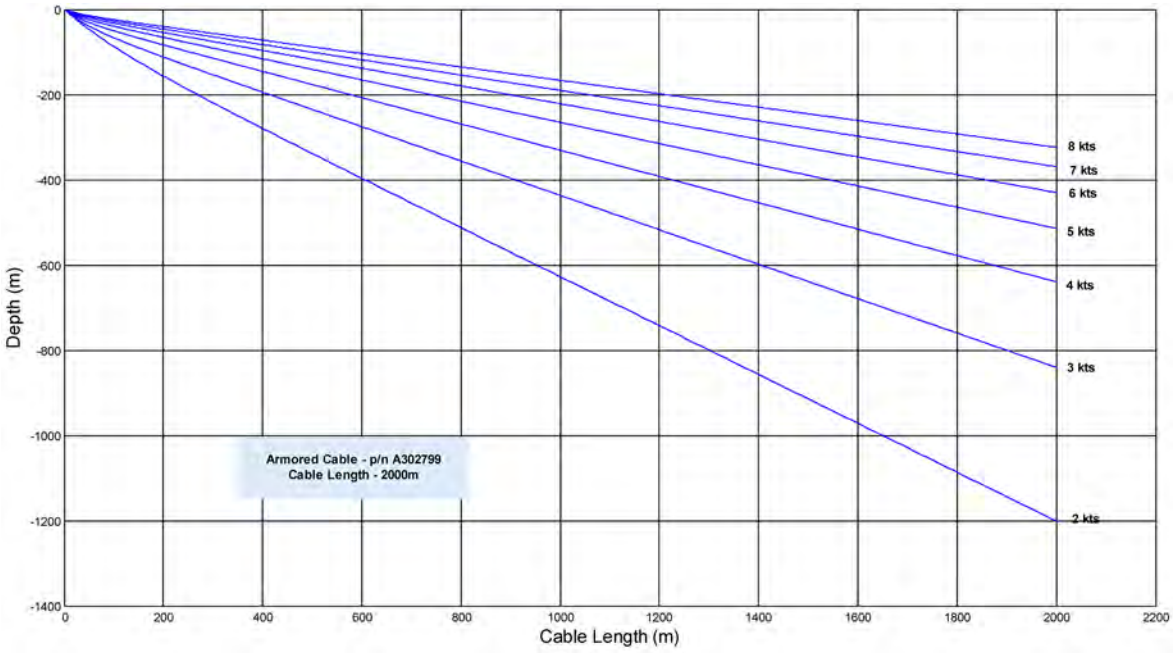

Figure C-42: Tow Cable Length Versus Depth—Cable A302799, 2000 Meters

C.24 Configuration 25

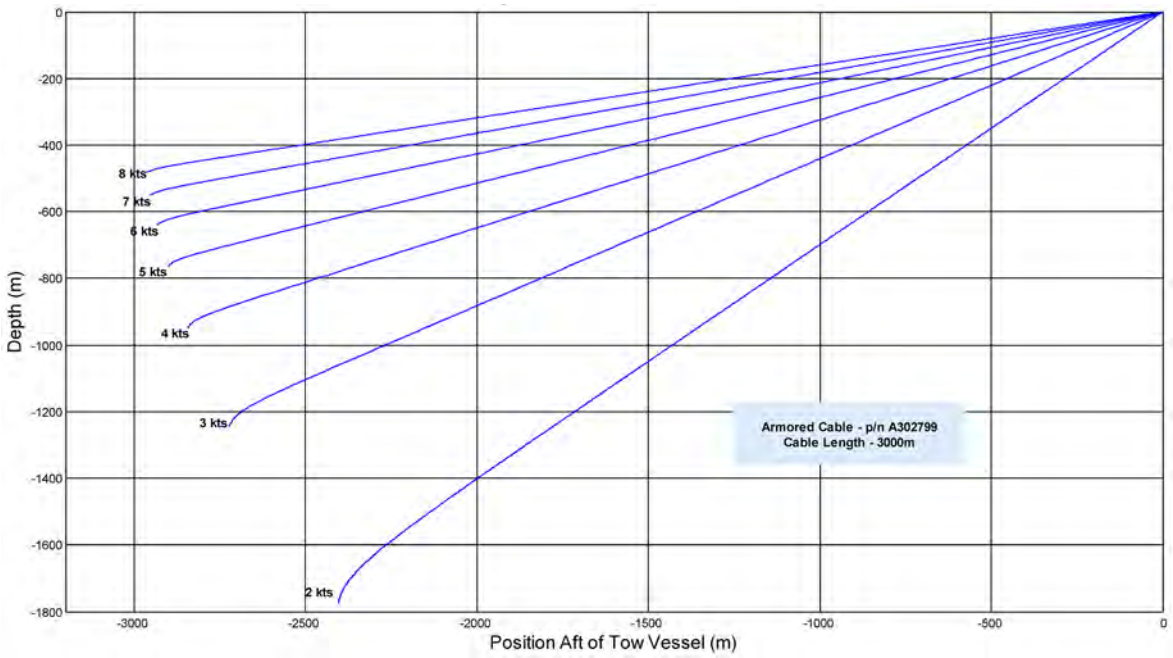

Figure C-43: Tow Cable Shape and Tow Vehicle Position—Cable A302799, 3000 Meters

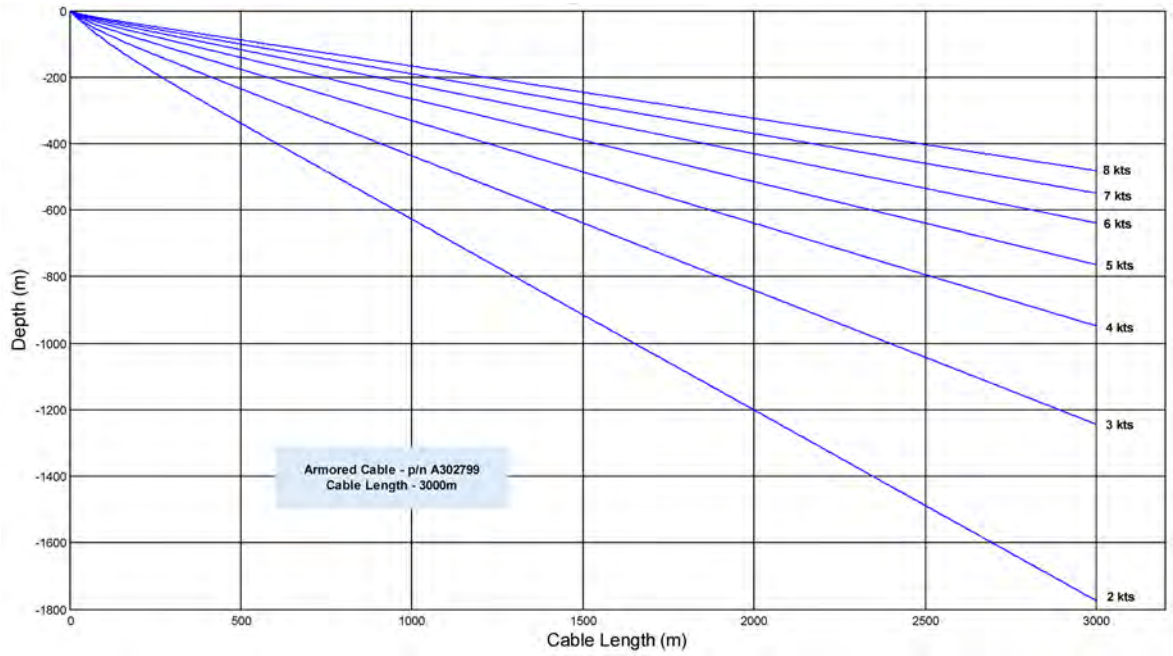

Figure C-44: Tow Cable Length Versus Depth—Cable A302799, 3000 Meters

C.25 Configuration 26

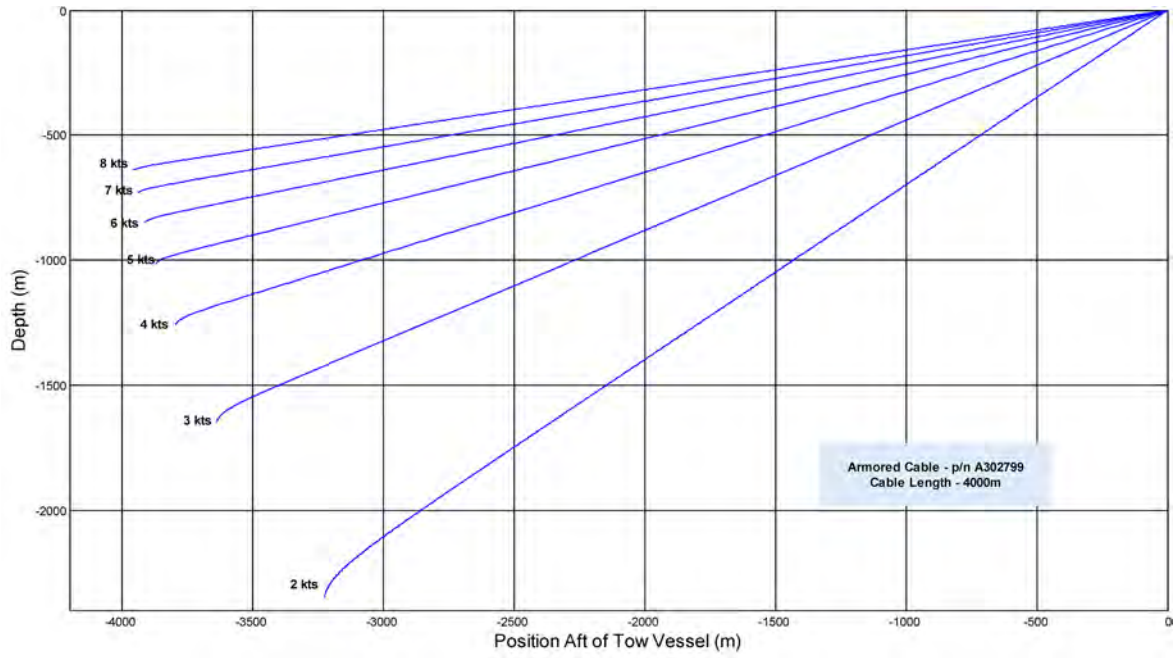

Figure C-45: Tow Cable Shape and Tow Vehicle Position—Cable A302799, 4000 Meters

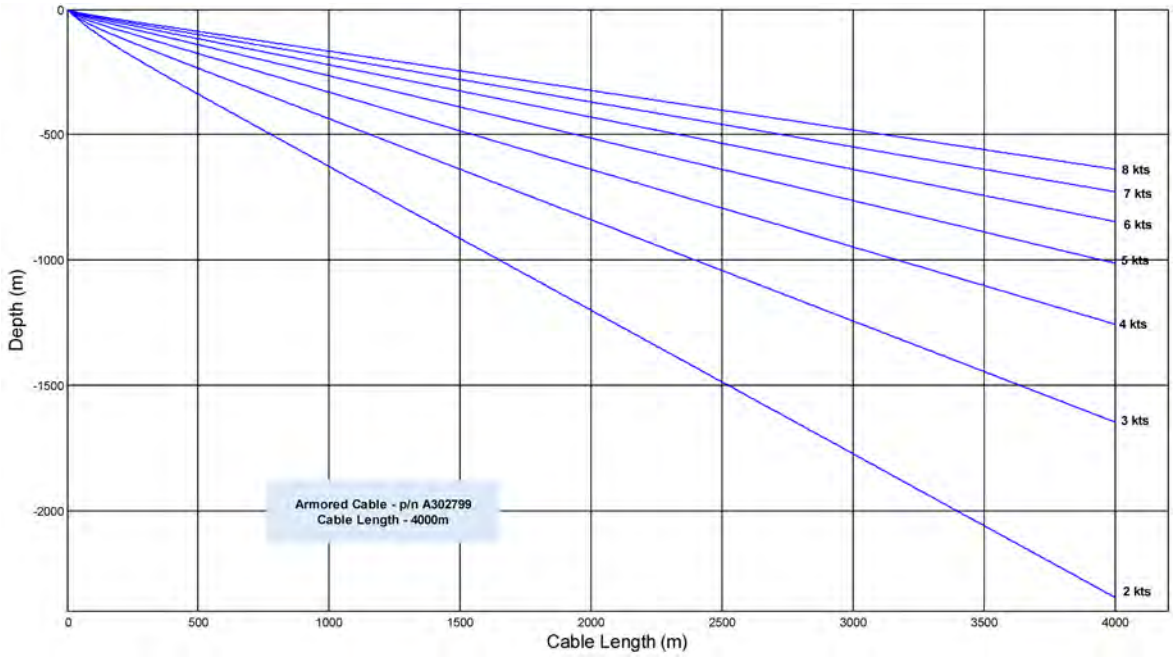

Figure C-46: Tow Cable Length Versus Depth—Cable A302799, 4000 Meters

C.26 Configuration 27

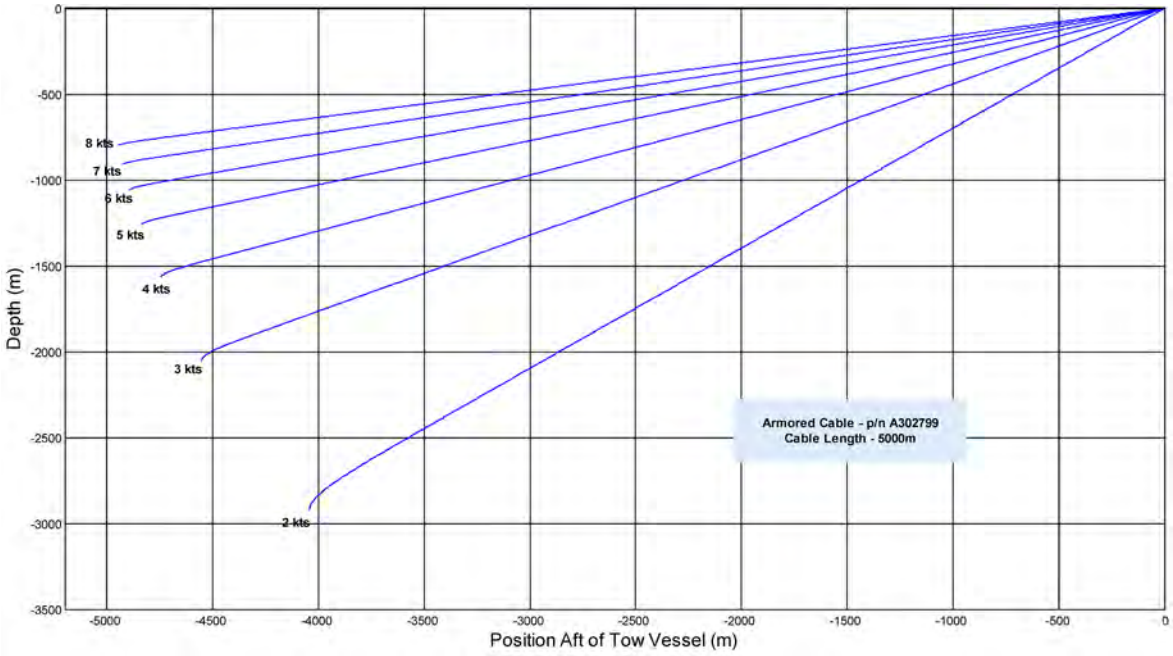

Figure C-47: Tow Cable Shape and Tow Vehicle Position—Cable A302799, 5000 Meters

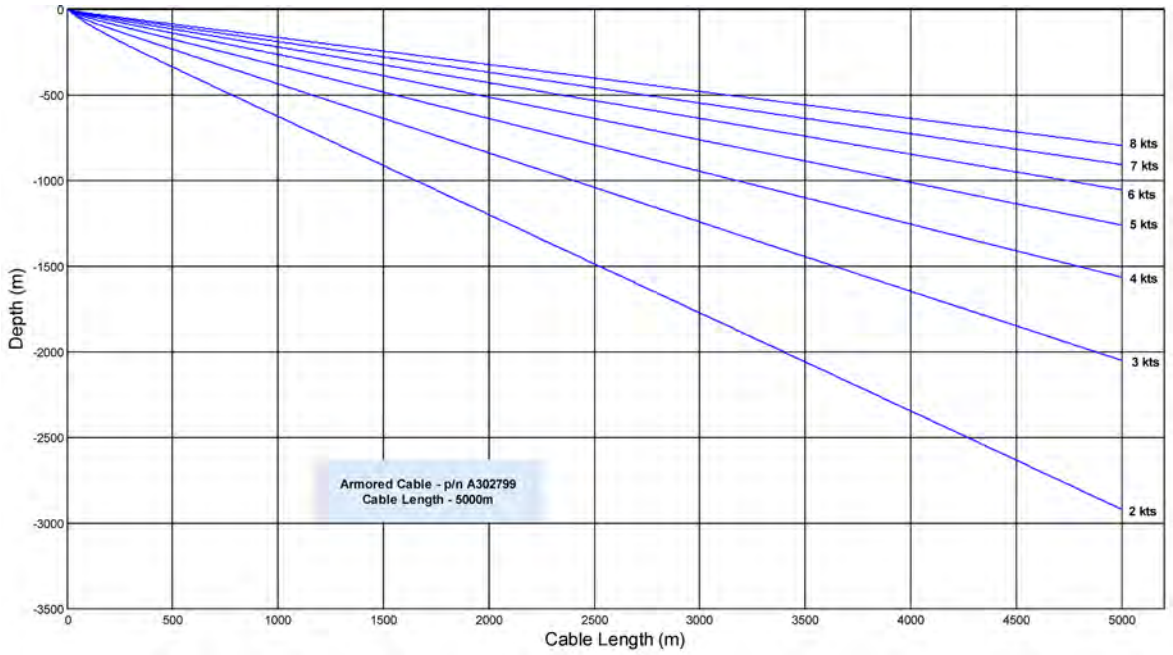

Figure C-48: Tow Cable Length Versus Depth—Cable A302799, 5000 Meters

C.27 Configuration 28

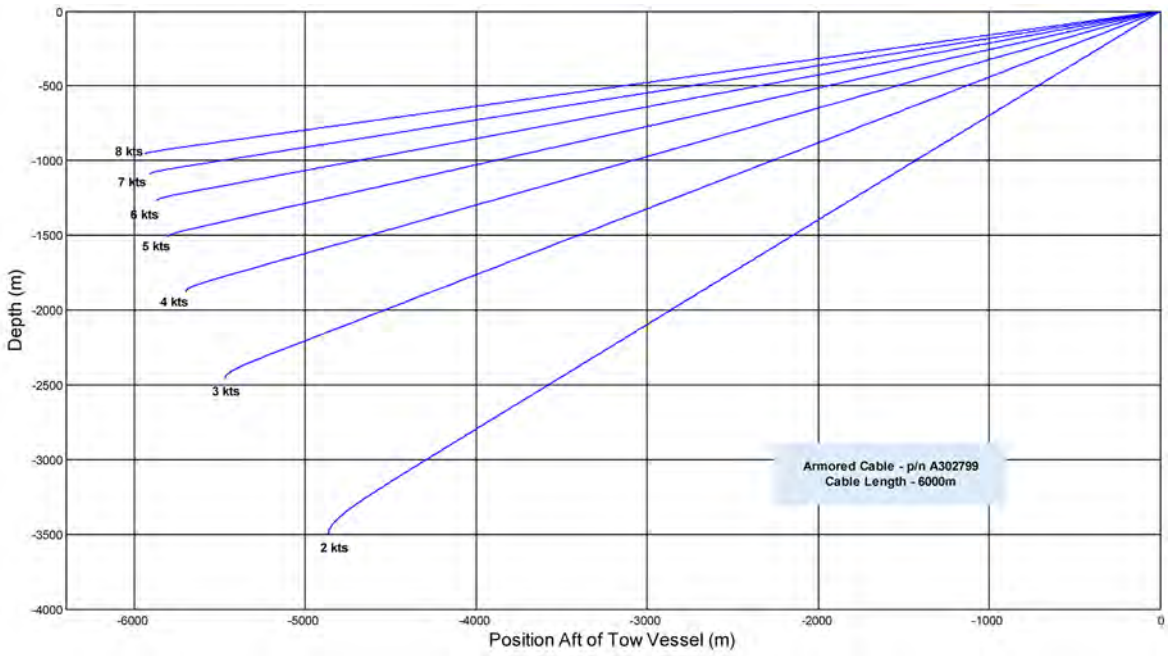

Figure C-49: Tow Cable Shape and Tow Vehicle Position—Cable A302799, 6000 Meters

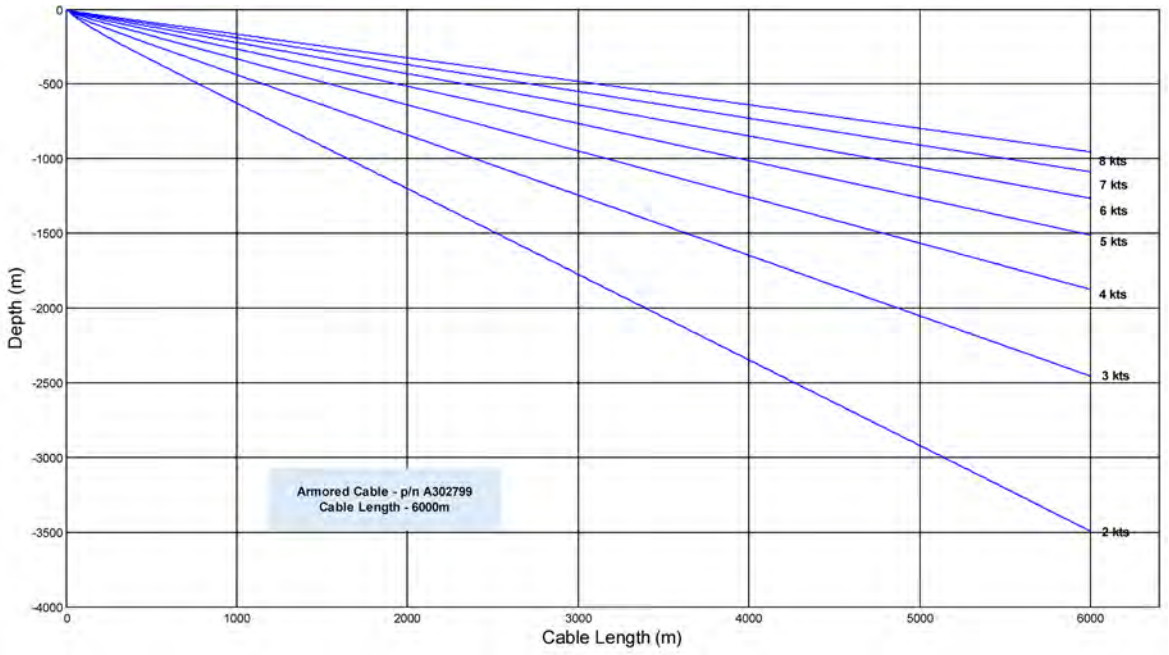

Figure C-50: Tow Cable Length Versus Depth—Cable A302799, 6000 Meters

C.28 Configuration 29

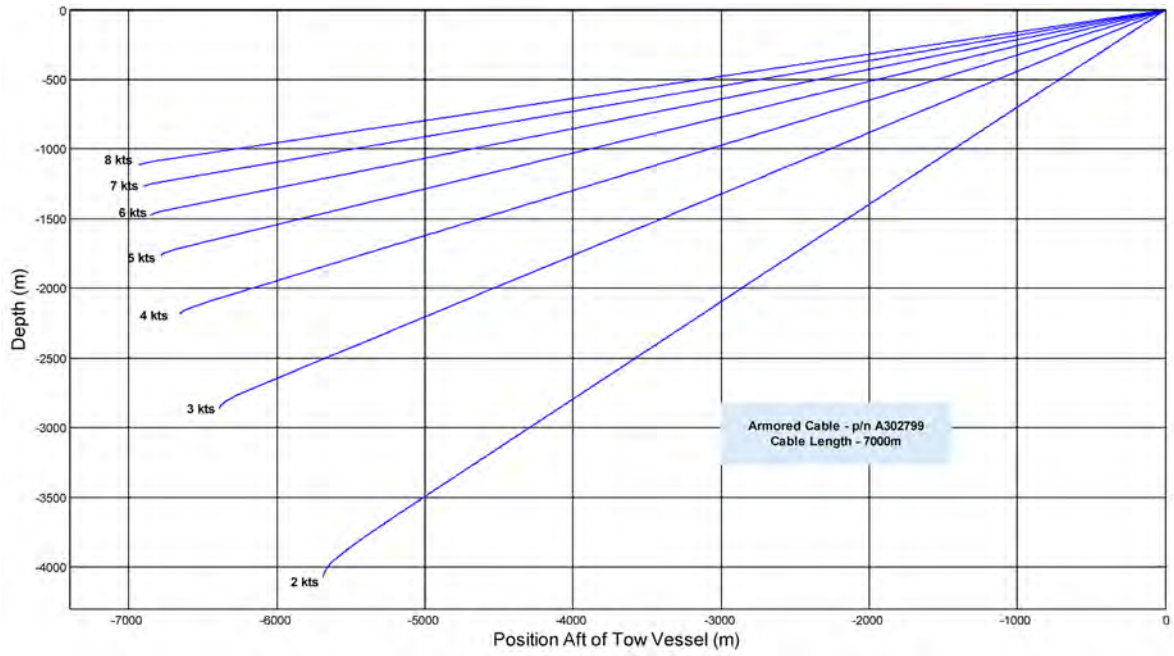

Figure C-51: Tow Cable Shape and Tow Vehicle Position—Cable A302799, 7000 Meters

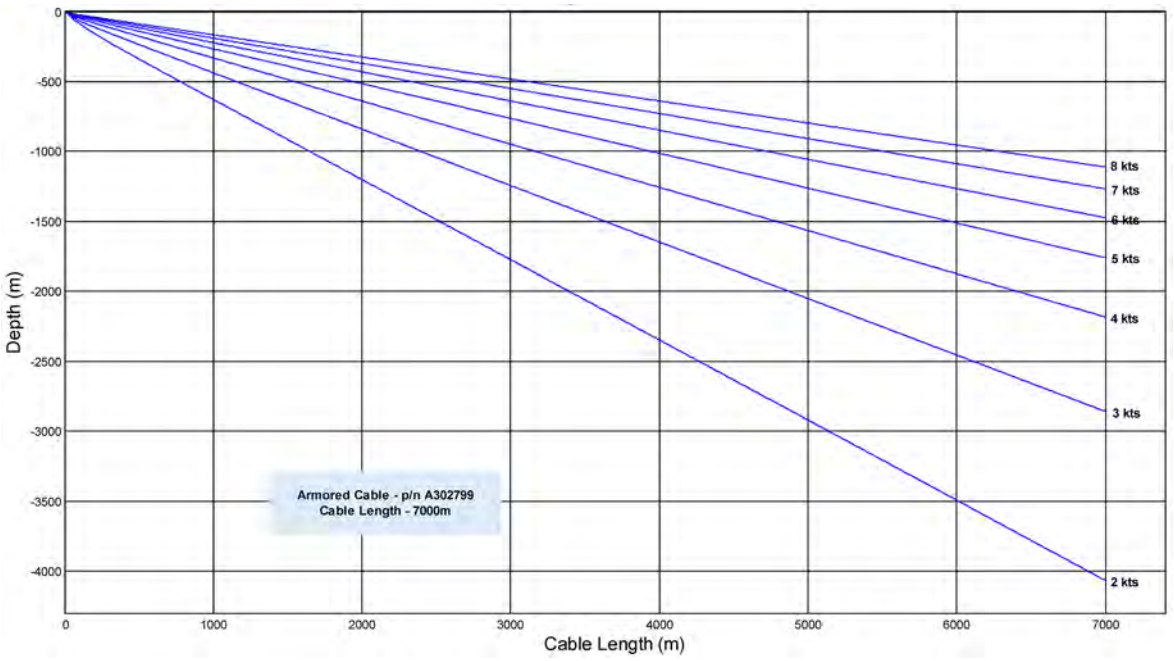

Figure C-52: Tow Cable Length Versus Depth—Cable A302799, 7000 Meters

C.29 Configuration 30

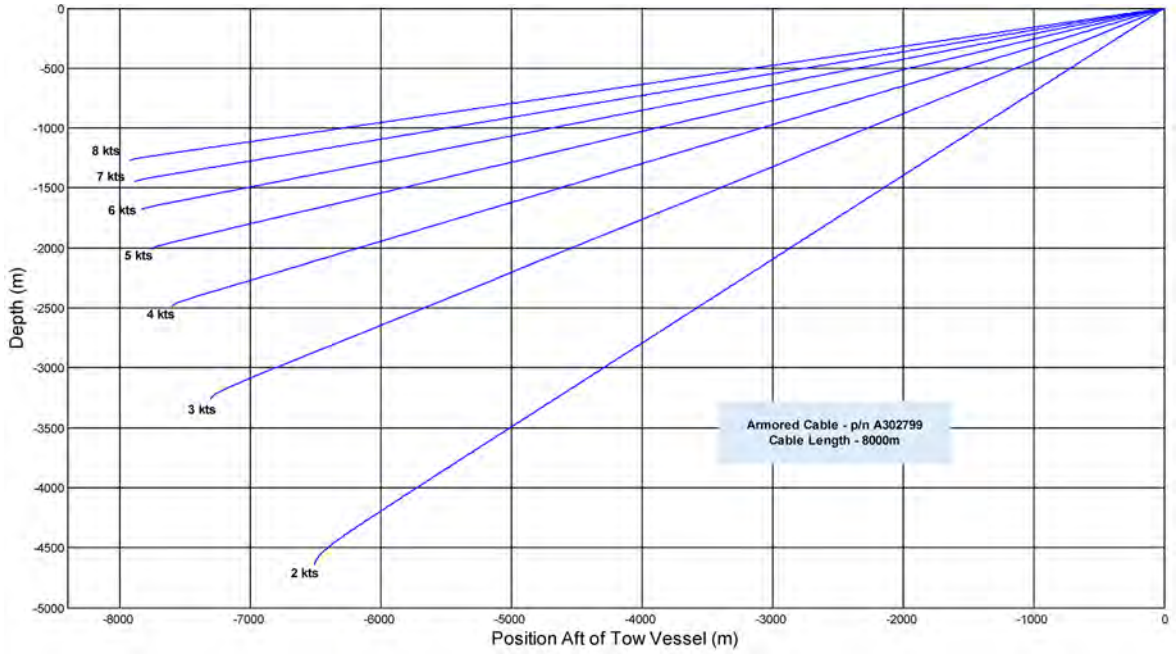

Figure C-53: Tow Cable Shape and Tow Vehicle Position—Cable A302799, 8000 Meters

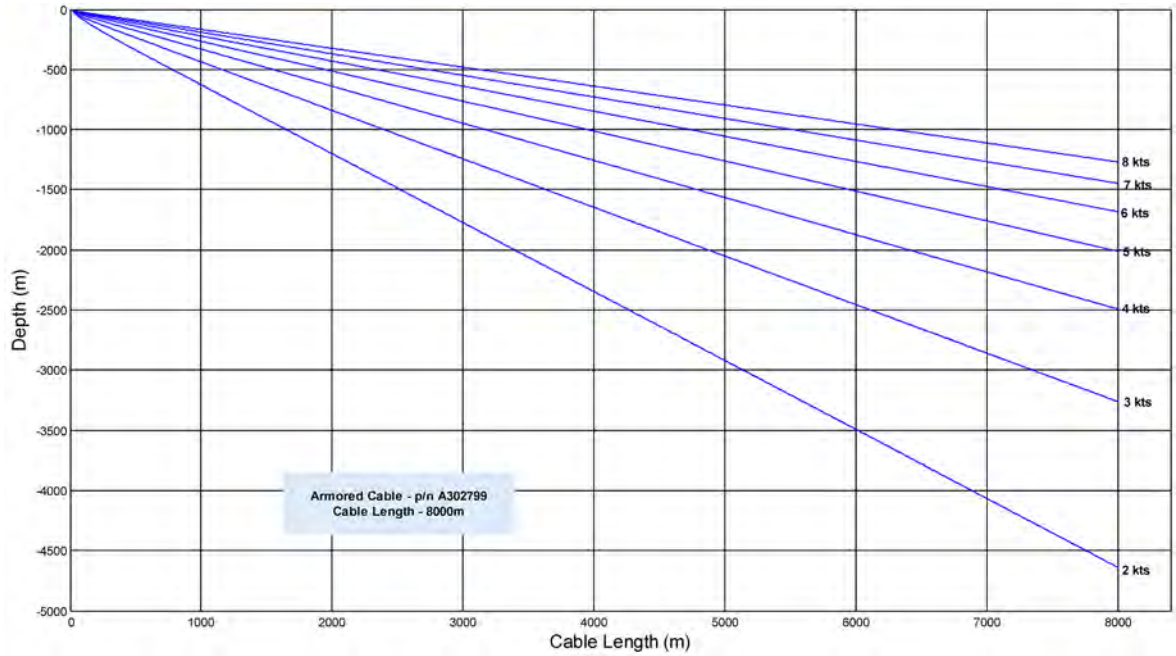

Figure C-54: Tow Cable Length Versus Depth—Cable A302799, 8000 Meters

C.30 Configuration 31

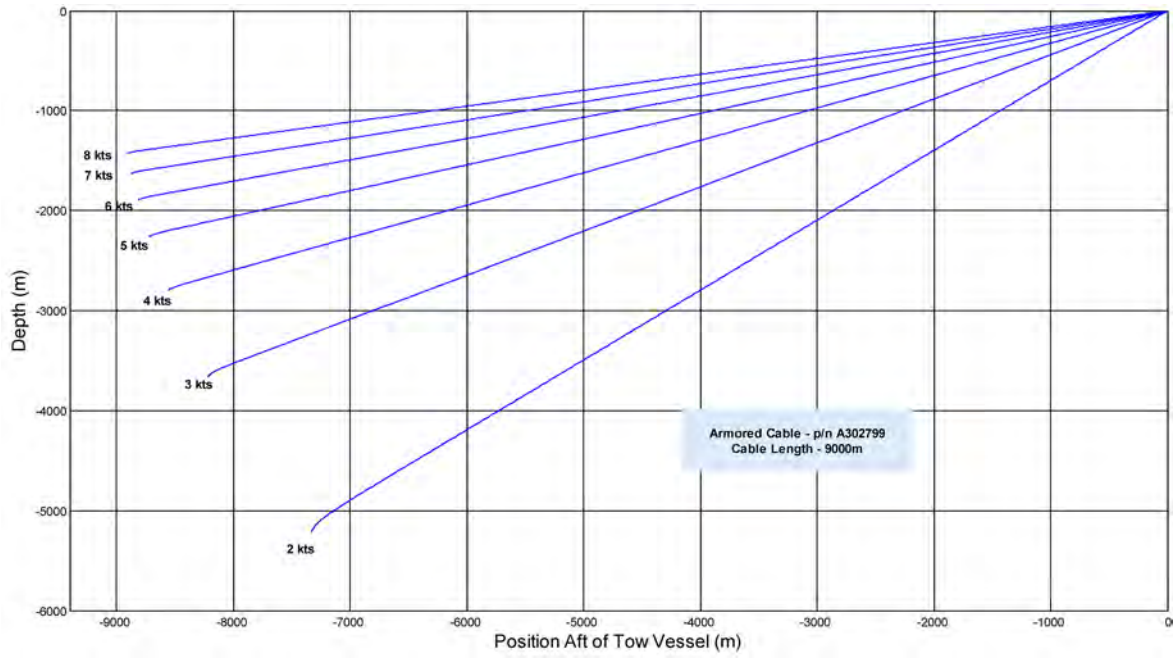

Figure C-55: Tow Cable Shape and Tow Vehicle Position—Cable A302799, 9000 Meters

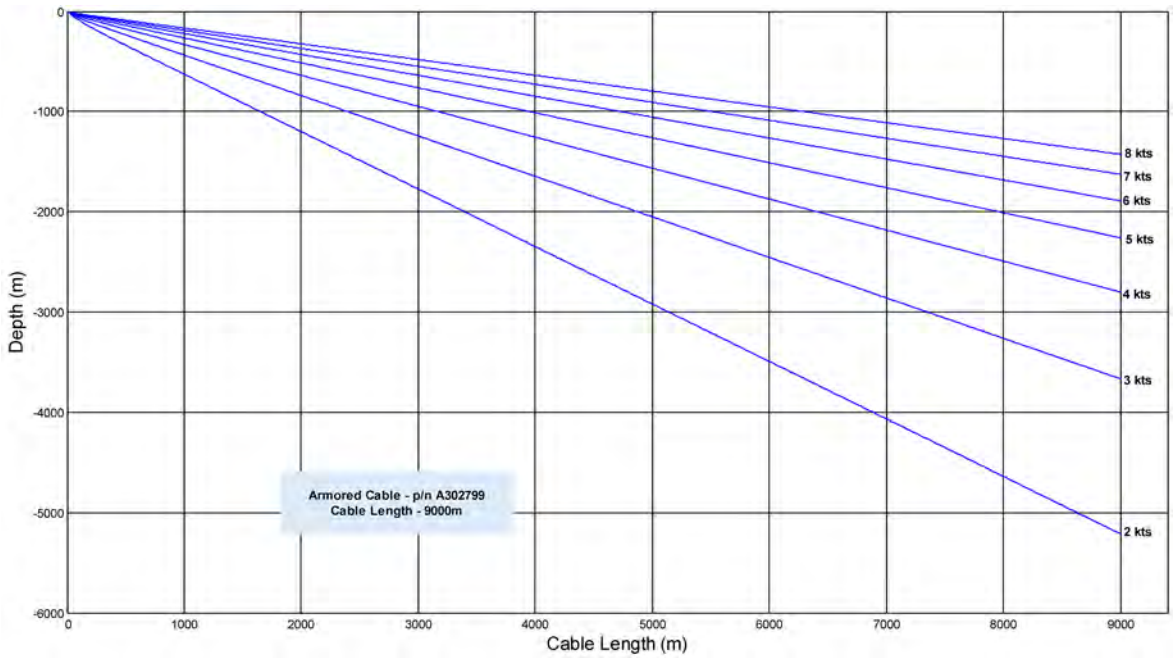

Figure C-56: Tow Cable Length Versus Depth—Cable A302799, 9000 Meters

C.31 Configuration 32

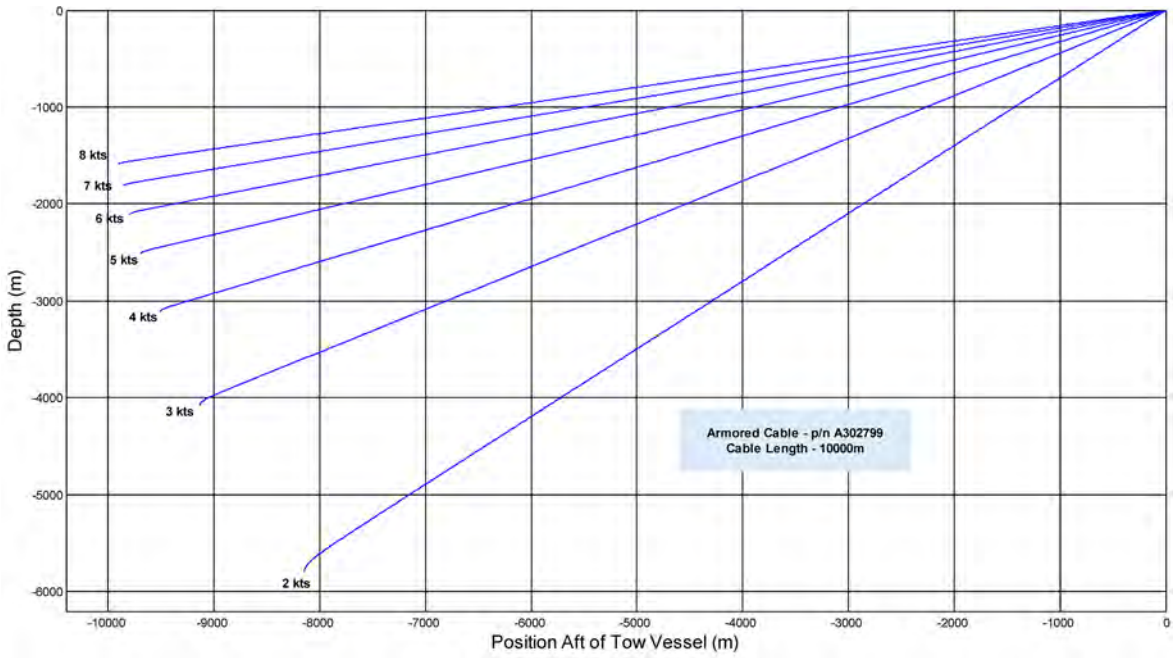

Figure C-57: Tow Cable Shape and Tow Vehicle Position—Cable A302799, 10000 Meters

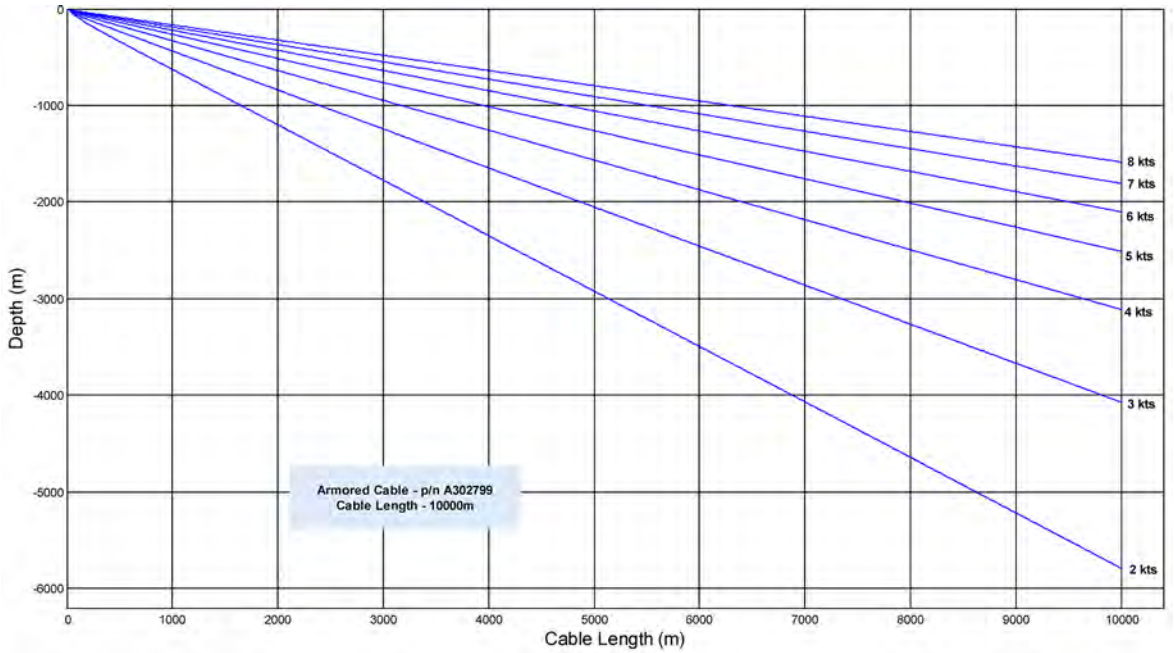

Figure C-58: Tow Cable Length Versus Depth—Cable A302799, 10000 Meters