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Response to CFI Acquisition Quote 5536

Winch and Telemetry System

VENUS LEF
CFI Application # 1.17 – Profiler

Submitted on June 4, 2010

by:

A.G.O. Environmental Electronics Ltd
with
Microsec R&D

Electrical Subcontractor: Emery Electric

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Introduction:

A.G.O. Environmental Electronics Ltd is proposing to provide the winch and telemetry system for the VENUS profiling project. A.G.O. has been building winches for marine applications for nearly 30 years and has many winches deployed on remote buoys in profiling applications. A.G.O. is partnering with Microsec R&D for the systems integration, electronics development and software development portions of the project. Microsec R&D has been providing electronics and software development and systems integration services since 1986. Electrical power systems design, construction and installation is to be sub-contracted to Emery Electric.

The winch that A.G.O. is proposing to provide is a remote-control variant of our standard and highly popular CSW-7 large winch design. Dozens of CSW-7 winches are in daily service in locations around the world with an enviable record for durability, simplicity and reliability. The CSW-7 uses a compact footprint vertical design with marine-rated components, building on 30 years of experience with the construction of winches for the harsh service conditions found at sea.

A.G.O. Environmental intends to work closely with the University of Victoria / VENUS program to assure that the system will provide the functionality required by the project. Based in Victoria, we are available for consultation and on-site servicing of the system and for future modifications with no need to budget for long-distance travel or delays due to time zone differences.

The proposed solution to the VENUS requirements is described below, broken down by system, in the logical order from the underwater sensor termination to the VENUS plug-in. Each sub-system is designed to be independently considered, but utilize as many common components as possible.

As our experience has shown that VENUS specifications will change as the products are built, we are leaving the final specifications open to change and will request approval of each component before final construction.

Key Personnel Descriptions:

Jim Harrington (A.G.O. Environmental Electronics): Jim Harrington has been the president and owner of A.G.O. Environmental Electronics since its inception in 1982. Jim has a background in electronics and winch design, and is supported by an engineering staff and a machine shop with a variety of machines.

Ian Soutar (Microsec R&D): Ian Soutar worked for the National Research Council in Ottawa instrumenting solar energy collection systems. He founded Microsec R&D in 1986 to provide product design services for inventors and industry. Ian is responsible for microcontroller based products and signal processing / control systems. Past designs include a virtual reality fishing machine, a portable DNA analysis machine, a pocket-sized cardiogram device, spread spectrum radio tranceivers and a number of robotic industrial inspection devices. Starting in 2005 he has been doing work for the University of Victoria (UVic) in the field of robotic fish and a bionic inner ear. Currently he is providing electronic assistance in the Mechatronics Program at UVic which offers real world industrial projects to students. Ian has received 6 patents for his designs.

Ed Haslam (Microsec R&D): Ed Haslam is a Victoria designer specializing in digital/analog designs and radio communication. He has done extensive work on the Global Warming Project monitoring animal behavior. He has designed a line of ultra miniature data acquisition and radio communication products that are available for remote monitoring and animal tagging as well as developing a testing system for automotive shock absorbers. Other projects include hotel automation using data radio receivers and WIFI data links. Ed is in charge of analog and radio communication designs as well as computer programming. Current work on custom designs for internet enabled hardware has led to WIFI methods for wireless large building automation. Ed has received several patents for his designs and several more that are pending.

Stephen Akins (Microsec R&D): Stephen Akins, a professional web developer for 12 years, and a computer programmer for 25 years, has made a career specializing in user interface design, the prototyping of new online services and working with the latest standards and technologies. Stephen has worked mainly on highly interactive projects for the banking, investment, insurance, pharmaceutical and manufacturing industries, both as a project leader, and as a member of many disparate teams of various sizes.

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Instrument Interface Subsystem:

The Instrument Interface Subsystem (IIS) is the determining factor for all of the winch design calculations, which in turn determines the specifications for the buoy power supply and computer. The IIS has to be able to interface with all of the customer plug-in instruments and at the same time transmit the data back and forth to the surface while supplying sufficient power to the entire system. This requires the cable to be matched to the requirements of the IIS electronics, with the cable determining most of the remainder of the system specifications.

The IIS must be able to capture information from the following inputs:

- Eight (8) analog inputs through four (4) connectors (SUBCONN MCBH-8FAS)
- Eight (8) serial RS-232/422/485 inputs through eight (8) connectors (SUBCONN MCBH-8FAS)
- Four (4) Ethernet and power connections through four (4) connectors (SUBCONN MCBH-12FAS)

Simultaneously these connectors must supply both 24 VDC and 12 VDC power to the various instruments connected through them.

From this it is seen that the various connectors required are:

- Analog Input Connector: Two Analog Input pairs, one 12 VDC pair, one 24 VDC pair.
  SUBCONN MCBH-8FAS
- Serial Input Connector: Four-Wire Serial lines, one 12 VDC pair, one 24 VDC pair.
  SUBCONN MCBH-8FAS
- Ethernet Connector: Eight Ethernet lines, one 12 VDC pair, one 24 VDC pair.
  SUBCONN MCBH-12FAS

Data will be captured from the telemetry sensors and transmitted to the surface via three connectors on the opposite end:

- Two (2) RS-485 inputs from telemetry sensors via two (2) connectors (SUBCONN MCBH-4FAS)
- One (1) Signal Input-Output/Power Input via one (1) connector (SUBCONN MCBH-8MAS)

All of these connectors will be SUBCONN parts. SUBCONN has just released a new line of Anodized Aluminum Bodies for their MCBH series connectors which they are recommending for use with Anodized Aluminum housings over the PEEK-bodied connectors suggested in the RFQ. PEEK bodied connectors may be substituted at the request of UVIC/VENUS contracting authority if required.

The IIS also carries on board a pair of telemetry sensors for determining the IIS attitude, orientation and position in the water column. These instruments include an inertial reference sensor, a depth sensor and an altimeter.

A.G.O. is proposing that the on-board telemetry instruments be a Think Sensor Research TSR-100-D Inertial Reference Sensor with Depth and Temperature and an IMAGENEX 864 Series Programmable Digital Altimeter Sonar. Both of these instruments are manufactured by local (Greater Vancouver based) companies, assuring close and rapid sources of supply, support and servicing. Both of these instruments communicate via RS-485 serial data, which will be converted to Ethernet an multiplexed into the common Ethernet communications line. These instruments will utilize a separate Serial to Ethernet converter from the add-on instruments, to maintain data separation.

In order to maximize the power available within the IIS and minimize line losses through the cable, A.G.O. is recommending that the power be transmitted to the IIS from the buoy using AC power transmission. This transmission will be via GFCI-protected circuitry and will be transformed into the required 12 and 24 VDC within the IIS housing. The preferred power switching solution within the IIS for this application is a VICOR FlatPac series solution, tentatively a VI-PU13-IUU-CC or a VI-PU33-IUU-CC. The -CC version allows the unit to be cooled through conduction rather than convection, allowing for fewer heating concerns within the IIS housing.

Within the IIS housing, in addition to the power switching unit, there will be several commercial-off-the-shelf

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electronics modules combined with special wiring and mounting hardware.

Analog data will be handled by a NATIONAL INSTRUMENTS NI-ENET-9205 Ethernet 32-channel 16-bit data acquisition system, or a similar equivalent if requested by the client. This component has redundant capacity to allow for future expansion and connects directly to the IIS Ethernet Switch (see below).

Serial data acquisition will be handled via a MOXA NPort 5650-8-DT 8-port serial device server with RS-232/422/485 digitally switchable serial ports. This component connects directly to the Ethernet switch (see below). Similarly a MOXA NPort 5230 two-port RS-422/485 Serial to Ethernet device server will provide communications for the on-board telemetry instruments.

The housing will also contain an Ethernet switch (MOXA EDS-608-T with two (2) MOXA CM-600-4TX 4-port interfaces). This switch will handle the four external Ethernet connections and will have one port to handle the analog data acquisition system, one port to handle the serial data acquisition, one port for the telemetry instruments and one port as a spare or for possible connection to a power-handling and/or internal control solution.

Transmission to the surface will be handled by an EIS Extend-C Ethernet Extender over Coaxial Cable from B&B Electronics. This extender is rated to provide between 64 and 74 Mbps over distances up to 600 meters, or between 75 to 85 Mbps over distances up to 200 meters. In all likelihood, speeds should be approximately 75 Mbps over the 275 meters of cable we are recommending for this system. A matching unit will be installed at the topside junction of the cable to the computer control system to return the signal to standard Ethernet CAT-5e cable.

All of these electronics will be housed in a Class II anodized aluminum pressure housing. The housing will be manufactured with double-x-ring seals for seal redundancy (four sealing surfaces per potential leak path) and nylon line closure systems for ease of maintenance and reduction in dissimilar metals. One end cap will mount the main cable plug-in and for plugging the telemetry instruments in, while the other will hold the connectors for the inputs to the system. Preliminary estimates are that this housing will be 10.75” in diameter and approximately 30” long. The designed depth rating of the housing will be a minimum of three and typically five times the maximum expected depth of the housing; in this case the pressure housing will given a depth rating of at least 300 meters and be designed for a collapse depth of at least 900 meters (and typically 1500 meters).

The main housing will be surrounded by and connected to a frame which will include a cable support through which load lifting capacity will be transferred from the cable to the payload and clamping/connecting points for add-on instruments. As indicated in the attached drawings, this frame will include a variety of machined slots and holes to allow the attachment of add-on instruments via bolts, straps and clamps, as required. If requested this frame can be minimized to simple support rings and rods which will hold the main housings and the auxiliary instruments and transfer the load to the cable, allowing UVIC to design their own instrument mounting frame. Depending on final consultation with the client and strength calculations on the final design, this frame could be constructed either from anodized aluminum or from high-strength thermoplastics. This frame will carry of the load applied to the IIS, with the IIS subsea housing supported inside the frame with no load-bearing duties required of it. The frame will also form a protective cage around the telemetry instruments without restricting the mounting area available for add-on instruments.

With the use of SUBCONN anodized aluminum connectors, anodized aluminum screw connections to the lifting frame and the anodized aluminum housing, it is anticipated that there will be no dissimilar metals in contact with the seawater, resulting in a significant reduction in the possibility of anodic/cathodic corrosion due to the components supplied under this contract. Note that attached zinc anodes will help should instruments attached to this housing utilize stainless steel or titanium components that could cause corrosion.

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Winch Subsystem:

The winch and cable subsystem are the core of this proposal. Examining the signal and power requirements for this proposal leads us to require the following cable specifications for the subsea cable:

- One (1) coaxial cable for Ethernet data transmission
- Three (3) conductors for single-phase 220 VAC power transmission (Hot, Neutral and Ground)

To this end we have had a custom cable designed by Teledyne Storm Cable. This cable has the following characteristics:

Conductors:	1 x 75Ω Coaxial Conductor, 3 x 16 AWG Power Conductors
Strength member:	1 x Molded Kevlar Overbraid, rated strength 1500 lbs
Waterblocking:	Waterblocking is included to prevent ingress of water through minor damage
Outer Jacket:	Polyurethane outer jacket, colour and markings TBD
Outer Diameter:	0.375 inches
Cable Weight in Water:	70.4 lbs/1000 feet
Cable Weight in Air:	21.35 lbs/1000 feet
Cable Bend Diameter:	7.5” minimum

Combined with the payload and operational requirements of the application, our calculations have determined that the winch required will be an AGO model CSW-7-D20-C22x12-L. This winch will allow, at a minimum, for the Det Norske Veritas (DNV) standard free flange of at least 2.5 cable diameters on the drum flange. The 250 meter basic minimum cable length combined with this drum has an allowance for eight dead wraps, two more than the minimum standard of three required by ANSI/ASME B30.7 (Base Mounted Drum Hoists) to allow for the 210 meter operational cable length and the cable length required to reach from the winch to the sheave and then to the sea surface.

The CSW-7 in this and similar configurations has been in service worldwide since 2001, with almost 100 in service. This is our most commonly manufactured and most popular winch,with many components available off-the-shelf for construction and repair. A.G.O. has several smaller winches in extended buoy deployments and the lessons learned from these deployments will be applied to the winch included in this quotation. These can be described as our buoy deployment package:

- stainless steel bearings versus our standard steel bearings
- overall winch enclosure (with sloped top surfaces to prevent water pooling) to prevent bird nesting and protect from wave-borne debris strikes and vandalism
- severe-duty greases to minimize maintenance requirements and prevent grease loss due to sea-water and rain exposure
- guard grills over required cooling penetrations to prevent bird and small animal entrance
- brush weatherstripping over cable entrance area to prevent bird and small animal entry
- remote buoy control system

The winch is constructed with 6061-T6 marine-grade aluminum and stainless steel, with powder-coating and anodizing being used to prevent corrosion as much as possible.

The winch controller is a standard commercial-off-the-shelf regenerative drive motor controller from KB Electronics (locally represented by Canadian Electro Drives of Vancouver). This KBRC-240D controller has proven to be a durable, reliable and versatile system in our winch designs of the last ten years. The controller will have an off-the-shelf option added, namely the KB Electronics SIRC Bipolar Signal Isolator with Auto/Manual switch, allowing the winch to be run locally in manual mode or remotely (i.e.: by a computer over the VENUS network) using a virtual potentiometer for speed control. Interface of the SIRC board with the Buoy control computer will be accomplished with off-the-shelf components such as, for example only, an OMEGA OMEGABUS Computer to Analog Output Module.

The winch specification sheet is presented on the following page:

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WINCH Specification Sheet	June 4, 2010
Customer Information: **UVIC VENUS Buoy Winch**	

Item	Quantity	Description
1	1	**CSW-7 PORTABLE ELECTRIC WINCH** **Model Description:** CSW-7-D20-C22x12-L **Drum Size:** 22” diameter flanges, 12.75” diameter core, 12” face width **Drum Capacity:** 290 meters of 0.375” Storm subsea cable 1.5” free flange (DNV minimum: 0.9375”) **Motor:** LEESON TEFC 180 VDC motor, 2.0 HP 2500 RPM, WASHGUARD upgrade **Power Source:** 208-240 VAC, 50/60 Hz (220 VAC, 60 Hz nominal) **Controller:** KB Electronics KBRC-240D-SIRC regenerative motor controller with variable speed, reverse and power controls, IP65 and SIRC bi-polar signal isolator. **Gear-train:** Leeson 626 series sealed aluminum gearbox 30:1 HKK Aqua Corrosion-proof #60 chain with sprocket ratio 60:16 Total gear reduction of 112.5:1 **Operational Characteristics:** Line speed at core: 0 to ~23 m/min Line speed at maximum drum: 0 to ~33 m/min Rated lifting capacity at core: 433 lbs (196 kg) Rated lifting capacity at maximum drum: 310 lbs (140 kg) Maximum rated payload capacity: 430 lbs (195 kg) **Features:** Manually-operated disc brake for maintenance Drum anti-rotation pin lock for transport and maintenance Manual dog clutch with locking pin for maintenance and emergency power-out manual recovery Removable manual 1:1 backup handle for maintenance and emergency power-out manual recovery **Factory-Installed Option: Automatic Mechanical Level Wind** Direct-drive diamond-pattern automatic reversing screw level winding system. Includes gearbox, chains, uprights, follower, fair-lead, chain guard and spare pall. **NOTE: Minimum fair lead distance 3 ft (0.91 m)** **Factory-Installed Option: AGO-SR06 Slip ring with Subconn MCBH Connectors with Slip ring Guard** **Rating:** 6 Conductors rated to 5A @ 380 VAC/240 VDC **Factory-Installed Option: Buoy Winch Package** Includes: stainless steel bearings versus our standard steel bearings, overall winch enclosure (with sloped top surfaces to prevent water pooling) to prevent bird nesting and protect from wave-borne debris strikes and vandalism, severe-duty greases to minimize maintenance requirements and prevent grease loss due to sea-water and rain exposure, guard grills over required cooling penetrations to prevent bird and small animal entrance, brush weatherstripping over cable entrance area to prevent bird and small animal entry, remote buoy control system **Materials:** Powder-coated or anodized marine-grade 6061-T6 or 5052 aluminum 304 or 316 stainless steel UV-rated engineering thermoplastics

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Buoy and Winch Surface Telemetry Subsystem:

To accommodate the requirement of buoy monitoring for weather conditions and monitoring of the winch for operational data, we are proposing a combination of several sensors for this purpose.

The sensors will include:

- A sheave block mounted electronic wire counter with line speed and line payout distance measurements and an attached overboard line angle sensor. This system is a modification of a standard system manufactured by A.G.O. Environmental Electronics Ltd
- A crane scale with NEMA 4X rated housing, NIST-traceable certification and digital RS-232/485 output on the overboard sheave to monitor cable tension and loading. This system will be a Cooper Instruments RON 2150 (2 Ton) Portable Tension Crane Scale / Dynamometer with the RS-232 and IP68 options, or equivalent if requested by the customer or otherwise determined by operational requirements.
- An inertial measurement unit located on the buoy with measurements of compass heading, pitch, roll, yaw and heave, using an off-the-shelf system from Think Sensor Research. The same electronics, in an underwater housing, will be used for inertial measurement on the Instrument Interface System.
- A rotation sensor on the winch drum to monitor drum RPM, doubling as both a feedback loop input for winch speed control and as a failure checkpoint. This system will be a Reinshaw LM13 or equivalent.
- A rotation sensor on the level wind screw as a failure checkpoint. This sensor will be a simple contact closure measurement system.

From all of these buoy telemetry systems, the user will be able to accomplish the following:

- Monitor sea conditions as they are effecting the buoy.
- Monitor winch loading conditions to prevent cable over-strain and excessive cable angles.
- Monitor line speed, allowing a feedback loop to control profiling speed.
- Redundant measurement of cable length versus deployed depth (from the on-board depth sensor) allowing confirmation of the IIS dropping consistently through the water column.
- Monitor winch operation for fault detection

We are recommending, as an optional fitting, an Ethernet-enabled Pan-Tilt-Zoom security camera mounted on a high point on the buoy both as a visual reference to watch the winch in action and check the buoy for damage, and also for security reasons, to prevent (or at least deter) theft and vandalism. This item will be listed as an optional accessory as it is not specified on the RFQ, but it could provide an exceptional method of determining weather conditions and monitoring buoy conditions and potential faults.

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Computer Control and VENUS Interface Subsystem:

Using the same series of enclosures as the battery and power-conditioning modules, the computer control and VENUS interface system will include a commercial-off-the-shelf rugged portable PC (for example one of the systems available from Stealth Computer Corporation or TRI-M Systems). This system will be installed with a commercial LINUX distribution and will use solid-state memory to prevent damage to the drives from buoy motion. The use of LINUX is preferred due to the configurable nature of the operating system and the long-duration stability of the operating system without need to reset, reboot or otherwise perform remote shutdown and down-time procedures.

To simplify operation of the system, it is proposed that the computer be configured as a remote terminal system, such that a user may log on to the buoy control computer from any shore-based VENUS-connected computer via a buoy-served interactive web site, with remote software on the buoy computer written and responsible for recording data to on-board solid-state memory and uploading it to the central data repository upon request or programmed schedule.

The inputs into this computer system will include Ethernet in/out (via dual Ethernet ports, one each for down-stream and up-stream communications), RS-232/485 communications (for communications with the telemetry systems on the buoy and the Instrument Interface system) and the capability to add auxiliary communications systems for future expansion (i.e.: GPS, radio telemetry, beacon systems, cellular, satellite, additional sensors on the buoy).

The computer system will have various data interface modules, for the most part duplicating those found in the IIS, such as MOXA Serial to Ethernet servers and MOXA Ethernet Switches.

The computer will be housed in a stainless steel enclosure with venting, from the same series as those proposed for the Power systems, described in the next section.

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Power Conditioning and Battery Storage Subsystem:

This portion of the project is the power conditioning and battery storage subsystems, with feed power input from the VENUS network. A.G.O. will be providing electronics enclosures as follows.

The battery housing and power conditioning enclosures will be industry-standard wash-down outdoor electronics enclosures. The enclosure will be certified to NSF criterion C-2 and UL listed for use as an electronics enclosure; if at all possible a CSA, cUL or ULC approved enclosure will be used. The enclosures proposed are manufactured from stainless steel with a gasket sealed entry door, sloped top to prevent standing water pooling and include multiple latches and a security lock to prevent tampering in the field. Metal UL and CSA rated penetrations designed to prevent water ingress are to be used at all points where the electronics will need to be connected to the exterior. The enclosures will include a continuous pressure/vacuum relief vent to prevent the buildup of gas from potential battery off-gassing and allow hot air to vent.

A.G.O. intends to sub-contract the design of electronics of this subsystem to Emery Electric who have provided a quotation for the work, as follows.

Emery Electric Deliverables regarding Labour:

1. Installation of main 330VDC Power Switch and fuses, 330VDC to 48VDC Converter/Charger, Battery Bank, Battery Charge Monitor, Power Inverter, AC Panelboard, AC output control contactors (2), and AC Ground fault relays (2) and 50Watt AC/DC converter in waterproof enclosures supplied by others. Installation work and commissioning to be performed at A.G.O. shop or Emery Electric shop in Esquimalt.

2. Installation of power wiring and status wiring as applicable to interconnect the equipment supplied by Emery Electric to the equipment supplied by others. Wiring is limited to power distribution wiring and status wiring from Emery supplied equipment to input terminals of ancillary equipment.

3. Commissioning of Emery Electric-supplied equipment at A.G.O. shop prior to equipment shipment to site. Commissioning to include working with A.G.O. to ensure equipment supplied by others is functioning correctly on the power output supplied by Emery Electric.

4. Four 8-hour days of site time at Venus Buoy for final battery installation, undersea cable termination, and additional in-situ commissioning.

5. Permit fees and equipment approvals. Our labour price includes an allowance for the electrical permit to perform the site wiring and an ETL special inspection of the final build.

Emery Electric Deliverables regarding Materials:

1. DC Power Switch / Over current protection
Supply 330VAC safety disconnect switch and associated fuses

2. DC Converter / Battery Charger Unit
Supply Heavy Duty 330V DC to 48VDC converter with battery charger capability. System limited to 750Watts of power consumption to match limitations of VENUS node.

3. Battery Bank
Supply 390aH / 48VDC AGM Battery Bank (8 cells that are 14”T x 12”D x 7”W). Battery bank designed for four one-hour “profiles” at 40 amps full-load before requiring 15-20 hours of charging utilizing the full 750W of the VENUS node. Actual performance will vary with ambient temperature, VENUS supply voltage regulation, total parasitic load on batteries, and other current draws on VENUS node. Operational profile may vary from the given example.

4. Battery Charge Monitor c/w Ethernet Interface
Supply of 48V battery charge monitor complete with Ethernet interface and remote computer software for

monitoring. Battery charge monitor will allow remote display of voltage, current, watts, battery percent, temperature and aH consumption.

5. Power Inverter
Supply of Military Grade 2000W 48VDC to 220VAC inverter “pure sine wave”.

6. AC Output Distribution
Supply 220AC panelboard complete with breakers to supply four 2-pole circuits.

7. AC Output Control
Supply two sets of GFI relays, current sensors, and shutdown contactors to allow protection and remote control of one Winch Motor Controller (supplied by A.G.O.) feeder and one Slip Ring Feeder (supplied by A.G.O.). All control functions to be via contact closure supplied by others.

8. AC/DC Converter
Supply one 50W 220VAC to 24VDC Converter

9. Wiring and misc terminations
Our material price includes supply of the interconnection power wiring between the equipment supplied by Emery Electric and AGO, including the 220VAC feeder to the Main Computer System. Miscellaneous fasteners, terminals, and cable glands required by code will be provided.

10. Engineering Review
Our materials price includes a $2000 allowance for an engineering review of any Emery Electric or A.G.O. supplied materials that cannot be sourced with a CSA, CUL, ULC, or ETL approval as required by the code. Review would be conducted by a P.Eng Electrical Engineer.

Break-out price – Battery installation

Our “total price” listed above includes **$8364** labour and materials to supply the 390aH 48V battery bank (batteries only – no enclosure or enclosure fittings) and interconnecting battery jumper wire and install the system on the buoy during one day. This break-out price could be used to add an additional battery bank like-in-kind. The cost of the enclosure and enclosure fittings for this system can be provided should UVIC/VENUS choose to install more than one battery bank. Note that there is a limit to the number of battery banks that can be installed, to be determined once practical field testing of the charging capacity of the VENUS node is determined.

Exclusions, Limitations and Notes:

1. Power Budget
Emery Electric has observed that the requirements for power consumption on the buoy when operating the winch, compared to the available shore power charging current, creates a distinct net energy loss that will prevent the system from being used continuously or constantly without allowing significant time for the batteries to recover. The need to have approx. 2000W of output, with only 750W of input creates a situation where adding extra battery capacity only delays the inevitable run-down of the system. Also, the ability of the system to charge a very large battery bank is questionable due to the limited power input. Emery Electric has suggested a value of 390Ah as a practical compromise between charging time, the ability of the battery charger to operate, and total battery capacity. Emery Electric makes no claim that 390aH will be suitable for the types of operations expected, and suggests an engineered review of the power budget be undertaken. Battery Amp-hour capacity should be specified by an Electrical Engineer based on the system’s proposed usage and the known available power of the Venus Node.

2. Site Time
Emery Electric’s price includes for four 8-hour days at the buoy for final site installation and commissioning. Any site time in excess of that, including any time waiting for travel to or from the Dockface at Patricia Bay will be charged at $86.00 straight time, and $150 for time in excess of 8 hours, including waiting and travel.

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3. Subject to Approval By Electrical Inspector

All work described in this quotation will be reviewed in conjunction with the electrical inspector prior to proceeding and is contingent on his/her approval. At this point it is unclear whether the existing VENUS system was built under appropriate permits, and the BC Safety Authority does not seem to be appraised of its existence. A site inspection of the shore-based power supply in coordination with the inspection authority will be undertaken as a first step to ensuring a successful and code compliant job.

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Pricing Structure:

The following table indicates the price for each subsystem required for this proposal. A.G.O. Environmental is proposing to offer a 10% educational discount and a 5% additional CFI discount over and above our normal educational discount on manufactured components, as indicated by the RED and BLUE numbers at each appropriate location within the tables. A summary of the total educational and additional discounts offered are provided with the summary table at the end of this section.

All prices shown are in Canadian Dollars. Taxes are shown in the summary table; note that the delivery will occur after July 1, 2010 so HST is being assessed rather than PST/GST.. Please note that the RFQ states to include taxes in one section, and to not include taxes in another.

A.G.O. Environmental will donate as an in-kind contribution:

- Delivery within the Greater Victoria Region
- Support during installation, to the extent of providing staff who will be available to make final hookups of the system on the buoy and testing of the system during deployment. These staff will be available for a maximum of twenty (20) person days, calculated as eight (8) hours per person-day. Please note that Emery Electric Staff are not included in this provision, and are billed as per the specifications and limitations described in the relevant sections above.

The numerical value of the in kind contribution may vary according to the number of days of actual time spent on the installation and testing, but could reach a maximum of $17,000.00, based on 160 man-hours at a basic charge-out rate of $100/hour and $1,000.00 for local delivery charges.

Payment Schedule:

The following payment schedule is required to take on this project:

- 50% payment upon awarding of the contract. This payment is required to purchase the Commercial-Off-The-Shelf components not normally stocked by A.G.O. Environmental Electronics, Microsec or Emery Electric.
- 25% payment before delivery.
- 25% payment within 30 days of delivery.

Delivery Schedule:

This project is estimated to require a minimum of sixteen (16) weeks and a maximum of thirty-two (32) weeks between date of order and date of delivery. Extensions beyond this time period may be negotiated if additional work is entailed to meet specific customer requests not detailed in this proposal, or if custom-built components are not available due to outside causes and notice of said delays are communicated to UVIC and agreed upon.

The time proposed above is required due to the long delivery dates of some of the Commercial-Off-The-Shelf components, which in some cases are manufactured to order rather than stocked, especially due to the recent economic downturn.

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Pricing Summary				
Item	**Quantity**	**Description**	**Unit Price**	**Total Price**
1	1	**Instrument Interface System (IIS) Subsystem** **Includes:** - anodized aluminum pressure housing - SUBCONN anodized aluminum subsea connectors - external support framework - National instruments DAQ system - MOXA Serial to Ethernet Servers - MOXA Ethernet Switches - VICOR Power Converter - B&B Electronics EIS-EXTEND-C Ethernet Extender - internal electronics support structure and heat sinks - internal wiring - IMAGENEX 864 Digital Programmable Altimeter - Think Sensor Research TSR-100-D Inertial Measurement Unit - required external connectors and molding	$50,000.00	$50,000.00 $5,000.00 $2,500.00
1.1	1	**IIS Integration Charges** **Includes:** - connection, testing and wiring of electronics modules - connection and testing of functionality of Ethernet communications interface - basic setup and testing of all interfaces for functionality	$5,000.00	$5,000.00
2	1	**Winch Subsystem** **Includes:** - CSW-7 Winch with slip ring - Remote Buoy Deployment Modifications Package - 250 meters of subsea cable	$65,000.00	$65,000.00 $6,500.00 $3,250.00
2.1	1	**Winch Integration Charges** **Includes:** - installation, wiring and testing of the digital winch control subsystems	$3,000.00	$3,000.00
3	1	**Buoy and Winch Surface Telemetry Subsystem** **Includes:** - electronic wire counter system with line out angle indicator - crane scale to measure line tension and loading - winch rotation sensors - Think Sensor Research TSR-100-S surface mounted Inertial Measurement Unit	$25,000.00	$25,000.00 $2,500.00 $1,250.00
3.1	1	**Telemetry Subsystem Integration Charges** **Includes:** - installation, wiring and testing of the telemetry subsystems	$5,000.00	$5,000.00
4	1	**Computer Control and VENUS Interface Subsystem** **Includes:** - rugged computer designed for outdoor installations - MOXA Serial to Ethernet Server - B&B Electronics EIS-EXTEND-C Ethernet Extender - additional telemetry interfaces as necessary - UL-rated outdoor electronics enclosure - connection hardware as required	$30,000.00	$30,000.00 $3,000.00 $1,500.00
4.1	1	**Computer Subsystem Integration Charges** **Includes:** - installation, wiring and testing of the telemetry subsystems - development and testing of the web-based interface and control system	$15,000.00	$15,000.00

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Pricing Summary				
Item	**Quantity**	**Description**	**Unit Price**	**Total Price**
5	1	**Power Conditioning and Battery Storage Subsystem** **Includes:** - Outdoor electronics enclosures as required - Internal enclosure brackets, insualtion as required - Enclosure fittings as required - AGM deep-cycle batteries or equivalent (390 Ahr as discussed above) - Inverter - Charge Controller - Power Converter - wiring and additional components as required - installation (subject to Emery Electric limitations as described above) - Electrical Engineering certification and Electrical Inspector certification as required - electrical wiring diagrams as required	$75,000.00	$75,000.00 $7,500.00 $3,750.00
6	1	**Non-Refundable Engineering Charges**	$10,000.00	$10,000.00 $1,000.00 $500.00
			Subtotal:	**$319,750.00**
			Total Educational Discounts:	**$25,500.00**
			Total Additional CFI Discounts:	**$12,750.00**
			Total:	**$281,500.00**
			HST# R100083377 – HST @ 12%:	**$33,780.00**
			GRAND TOTAL:	**$315,280.00**

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OPTIONAL SUGGESTED BUOY ADDITIONS				
1	1	**Optional Ethernet Buoy Video Monitoring System** **Includes:** - Ethernet-enabled camera in outdoor enclosure with pan-tilt-zoom - installation, wiring and testing of the telemetry subsystems	$5,000.00	$5,000.00
2	1	**Optional Photovoltaic Charging System** **Includes:** - photovoltaic solar cells (~ 1000 Watts) - support framework and mounts for marine duty **Note:** installation, wiring and testing of the photovoltaic cells is not included. This will require an electrical permit and a professional electrician to perform. Emery Electric may be available to provide this service. **** Price is per Kilowatt ****	$10,000.00	$10,000.00

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Example Drawings:

The following pages illustrate proposed design elements of the solution presented in this proposal. These drawings are not final revisions and are provided for illustration purposes only.

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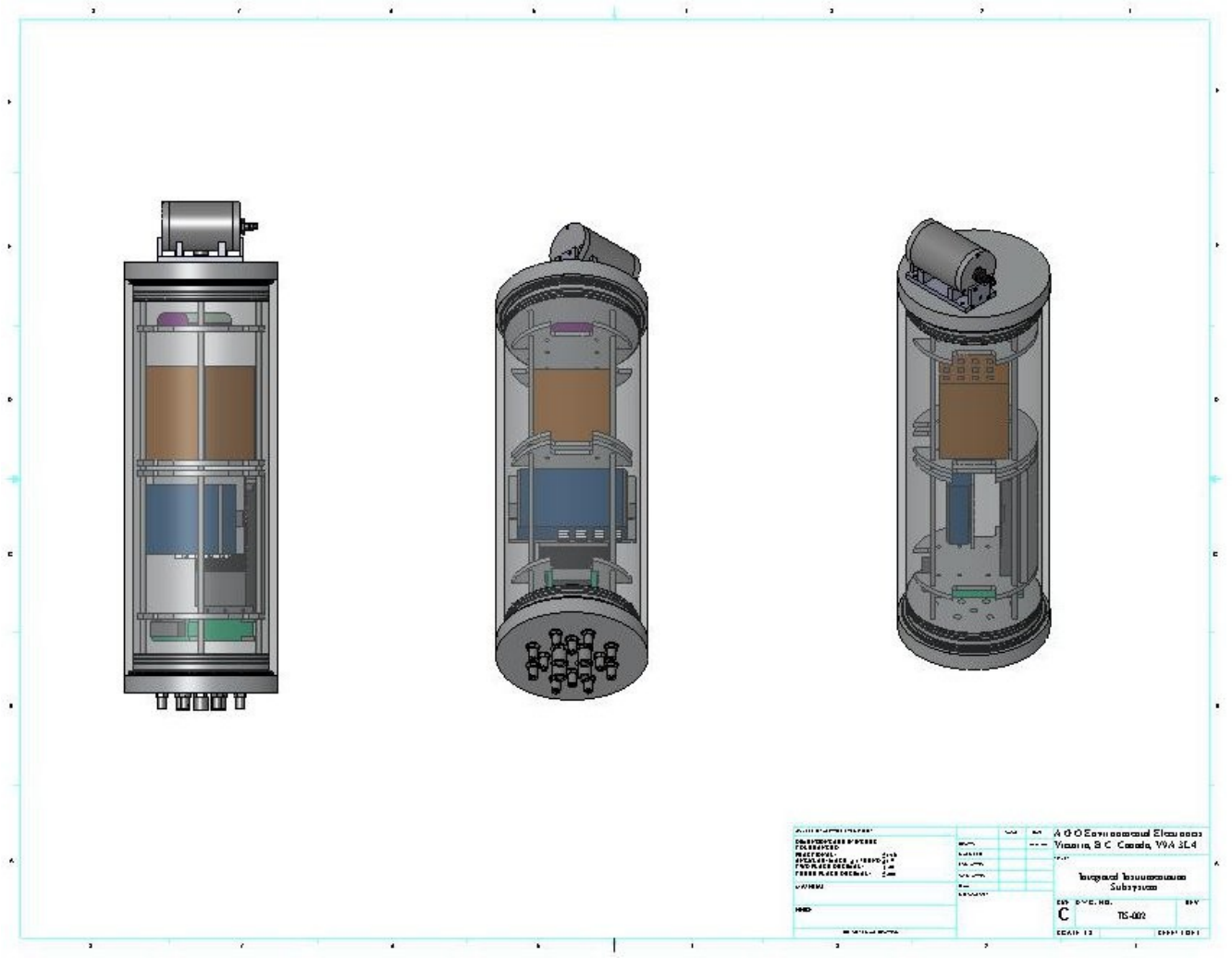

Integrated Instrumentation Subsystem
Proposed System Geometry

Outer housing is shown transparent for illustration purposes only
Construction in anodized 6061-T6 aluminum

Exterior cylinder: TSR-100-D
Imagenex Altimeter not shown(mounted to external framework in this revision)
Purple Component: EIS-EXTEND-C and Telemetry Serial Server
Beige Component: Ethernet Switch
Blue Component: Serial Server and Power Converter
Green Component: DAQ System

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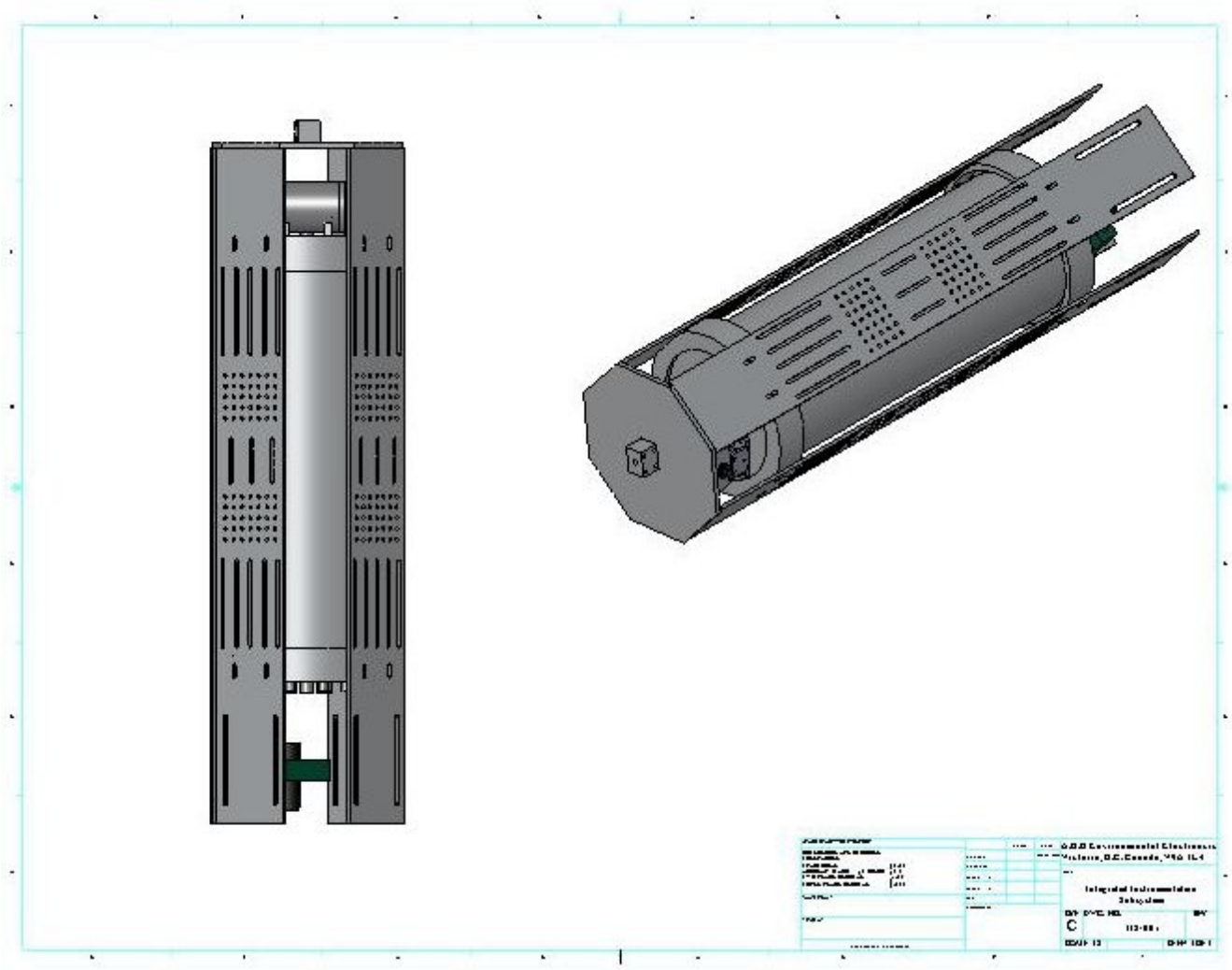

Fully Assembled Pressure Housing
with Exterior “Add-On” Instrument Mounting Rails / Structural Reinforcement Frame

Exterior rails are proposed design and may be changed or simplified as requested by the customer
Note Imagenex altimeter installed below primary pressure housing

External Structural Frame may be constructed from anodized 6061-T6 aluminum or thermoplastic, as required by final calculations

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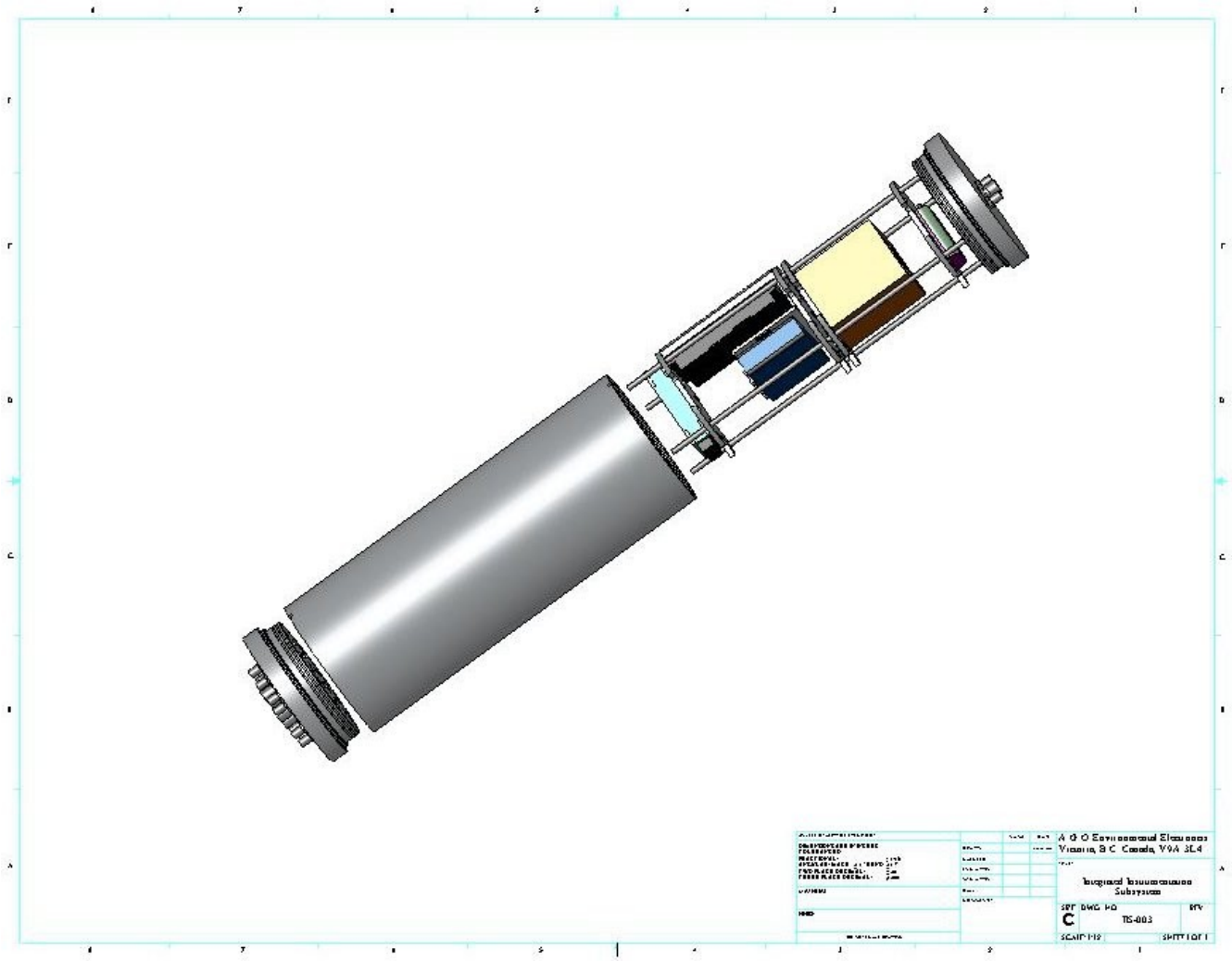

Exploded View of IIS Housing

This view illustrates the completely removable interior mounting rail system
Final design may have the rails mounted to the opposite end cap to simplify wiring

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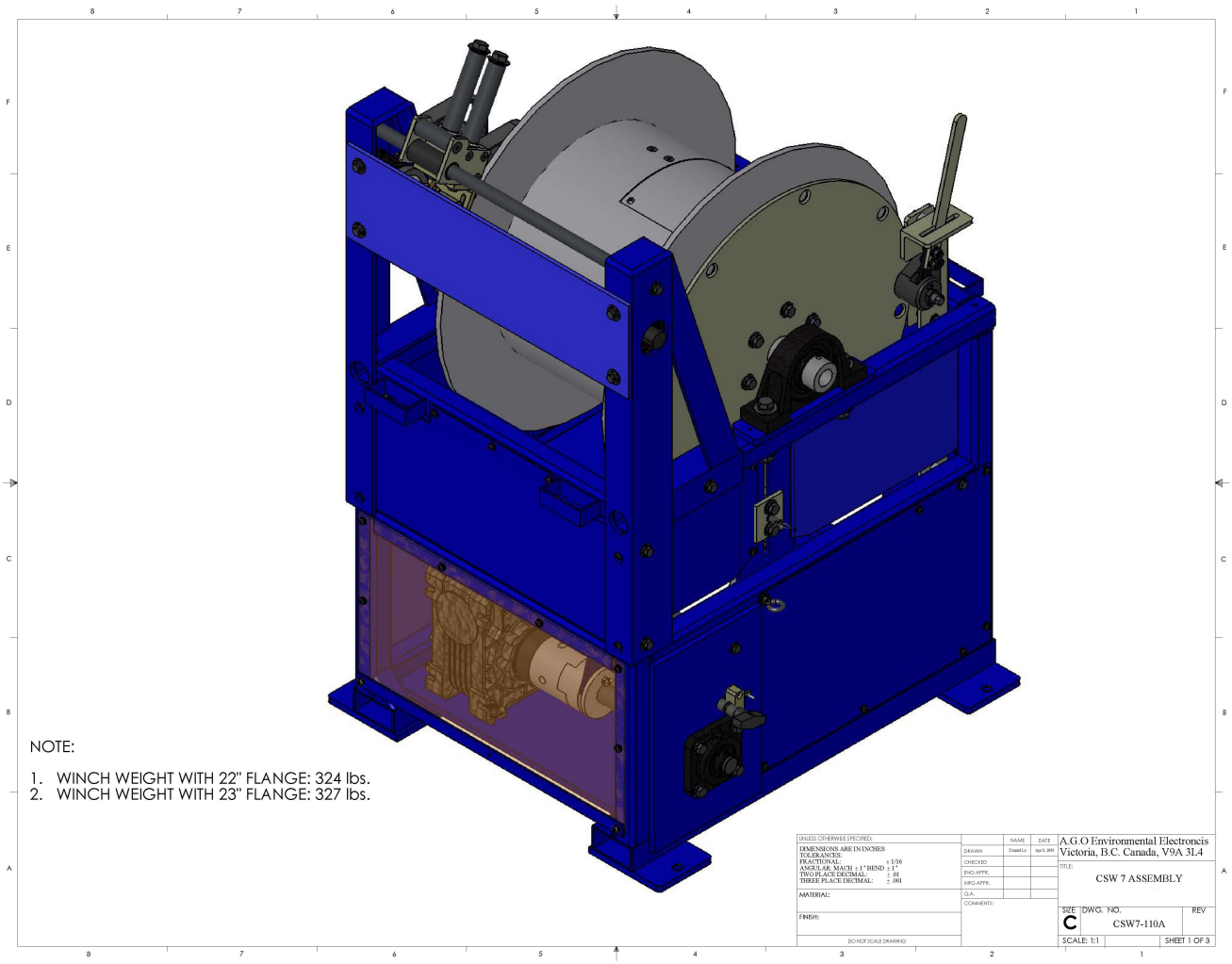

Example Drawing of CSW-7 Winch

Enclosures and Components Of Remote Buoy Accessory Package are not shown

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Please complete the following tables where appropriate:

Items Required

ITEM	QTY.	DESCRIPTION	List Price	Education Discount %	In – Kind Contrib. discount (%)	Discounted CFI Price
1	1 Only	Profiler Winch & Telemetry System	$319,750.00 + $17,000.00 Add'l In-Kind not accounted for in price	10% Some Portions Equivalent to ~7.77% Overall	5% CFI to some portions Equivalent to ~3.87% overall $17,000.00 Add'l In-Kind	$281,500.00

Table 3 – Offers Other Than Discount or Equipment

Item(s) Offered	Item 1
Offer retail value	$319,750.00 + $17,000.00 Installation Services/Delivery In-Kind contribution not accounted for in total price
Normal Educational Discount (%)	10.00% Some Portions ~7.77% Overall Discount
Education Unit Price	$294,250.00
CFI Discount (Greater than Educational discount in %)	5.00% Some Portions ~3.87% Overall Discount
Dollar Value of CFI discount (In-Kind Contribution)	$11,500.00 Direct 5% Discount $17,000.00 Installation Services/Delivery In-Kind Contribution
Total Value of Proposal Including CFI discount	$281,500.00

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SUPPLIERS MUST COMPLETE/CONFIRM THE FOLLOWING INFORMATION

F.O.B. University of Victoria: Delivered within Greater Victoria Region	
Shipping Charges:: INCLUDED__YES_____EXTRA_____ COST_____	
Method of Shipping: Local Truck Delivery	
Name of Firm: **A.G.O. Environmental Electronics Ltd**	**Quote submitted by:** **James R Harrington**
Signature: (signed copy to follow by regular post)	
Vendor Quote Reference: UVIC030110	**e-Mail Address: jim@agoenvironmental.com**
Telephone Number: 250-386-4015	**Fax Number: 250-386-4016**
Terms: As specified above **50% down payment, 25% on delivery, balance Net 30**	**Do not include GST/PST in the quote.**
Suppliers may offer alternatives that in their opinion equal or exceed the technical or performance standards of the quoted reference. UVic, at its sole discretion, determines "equal or exceed" specifications.	
Electrical Unit must be CSA approved or have Acceptable Electrical Certification Marks in British Columbia as Listed at http://www.safetyauthority.ca/files/Approved_Certification_Marks_for_Electrical_Products.pdf	