



SBI ROV Interface Document

Document Number: ICD-0848-800-200-12

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	Document Title:	ROV Interface Document		
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Revision History

REV.	DATE	RESPONSIBLE	DETAILS OF CHANGE
1	Feb 17, 2012		Original Release
2	June 25, 2014		Updates to drawings. Doc text rewritten, additional detail in power and network interface for operation with the new SBI receiver interface combined SBI-1 and SBI-2 into one document
3	May 21, 2015		(1) Changed Connection Description in Table 9 for pins 5 and 6. BI-D3 is BLU/WHT and BI+D3 is BLU. (2) Changed requirement in section 3.2 from 100MB/s to 90MB/s. (3) Updated approval list with current employees
4	June 13, 2016		Sections 3.1 and 3.2 fixed references to Figure 8 and 9 and minor text changes Updated Section 2 Mechanical and Hydraulic Information Added Section 3.3 INS Requirements
5	April 20, 2017		Table 7 - Added hydraulic specification "System Working Pressure"
6	May 15, 2017		Added summary table in section 2. Added L-Class, XL-Class in section 2. Added additional information to INS section 3.3 and in Surface Setup section 4.
7	June 28, 2017		Added "Table 3 – ROV details, classification and SBI skid recommendation", text edits throughout
8	September 25, 2017		Updated Table 2, added direct ROV interface availability to each SBI system, updated the hydraulics requirements, added available interface cabling for various multiplexer ports, modified text to match the web spec sheets.
9	November 28, 2017		Added sections 5, 7 and 9.
10	December 17, 2018		Removed sections related to PHINS-II and all references. Removed references to PPS inputs to INS systems. Removed cautions for power feedback (original bottle issue). Cleaned up survey interface section.
11	October 23, 2019		Removed sections related to SB-2 and SBI Short/Extended frame along with all references. Added in SBI Millennium 3 and associated references.
12	October 26, 2020		Updated/simplified mechanical sections, simplified electrical sections

	Document Title:	ROV Interface Document		
	Document Number:	ICD-0848-800-200	Revision:	12

Table of Contents

1	introduction.....	6
2	Mechanical SBI Configurations.....	6
2.1	SBI Skid Configurable Attributes.....	8
2.1.1	Adapter Plate.....	8
2.1.2	Skid Side extensions.....	8
2.1.3	Front Frame Mounting Arms.....	8
2.1.4	ROVINS and DVL Mounting Locations.....	8
2.1.5	Front Frame Outer Hydrophone Wings.....	8
2.2	Previous ROV Installations.....	8
2.3	Certification.....	9
2.4	Hydraulic Specifications.....	9
3	SBI SYSTEM electrical requirements.....	10
3.1	Subsea Electrical Power Interface.....	10
3.2	Subsea Network Interface.....	11
3.3	INS Requirements.....	12
4	Surface system requirements.....	12
4.1	SBI Surface System Configuration.....	12
4.2	Power and Network Requirements.....	13
5	Subsea Equipment Configurations.....	13
5.1	PanGeo Subsea INS supplied and mounted on the SBI.....	13
5.2	Client supplied and mounted on the ROV.....	14
6	SBI Data Interface to Survey.....	14
7	Calibration.....	16
8	Integration with MBES.....	16
9	Scope of Supply.....	17

	Document Title:	ROV Interface Document		
	Document Number:	ICD-0848-800-200	Revision:	12

Table of Figures

Figure 1: SBI ROVSkid V3 composition in its deployed configuration with dimensional references	7
Figure 2: SBI ROVSkid V3 composition in its folded configuration with dimensional references	7
Figure 3-1: Receiver ac Power Interface Connector J3: Male (pins) Face View (P/N 5507-2008 BCR - bulkhead).....	10
Figure 3-2: Receiver Ethernet Interface Connector J4: Male (pins) face View (Burton P/N 5507-2013 BCR - bulkhead)..	11
Figure 3 - SBI bridge equipment	12
Figure 4 – SBI Geo workstation.....	13
Figure 6-1: SBI survey connection diagram.....	15
Figure 8-1: DoB definition	16

Table of Tables

Table 1 - External Document References.....	5
Table 2 - Internal Document References	5
Table 3 - Abbreviation Table	5
Table 4: SBI Work-Class ROV Skid Summary	6
Table 5: Maximum System Pressures.....	10
Table 6: SBI AC Power Connector Pin-out.....	11
Table 7: LAN Connector Pin-Out Descriptions for SBI Receiver	11

	Document Title:	ROV Interface Document		
	Document Number:	ICD-0848-800-200	Revision:	12

Document References

REF.	DOCUMENT NUMBER	DOCUMENT TITLE
(1)		
(2)		

Table 1 - External Document References

REF.	DOCUMENT NUMBER	DOCUMENT TITLE
(3)		
(4)		

Table 2 - Internal Document References

Abbreviations

ABBREVIATION	DESCRIPTION

Table 3 - Abbreviation Table

	Document Title:	ROV Interface Document		
	Document Number:	ICD-0848-800-200	Revision:	12

1 INTRODUCTION

The following document outlines the interface details between the PanGeo Subsea’s (PGSS) SBI subsea system and a ROV. It defines the mechanical interface and provides the basic SBI subsea mechanical arrangement (overall dimensions and weights) along with hydraulic interface information. The document also includes the electrical power requirement, power interface and data interface to the subsea system. A basic description and requirements are given for the shipboard SBI components.

2 MECHANICAL SBI CONFIGURATIONS

This section outlines the mechanical details of the multiple SBI Work-Class ROV Skids available, including system general dimensions, weights in air and in water, and the hydraulic requirements. The information provided will give the reader an understanding of the various SBI systems available to facilitate the mechanical interfacing between the SBI and ROV. Table 4 provides basic dimensional information for the four types of work-class ROV skids PanGeo currently has in its fleet. Please note that there is a range in some of the values provided as these skids are adjustable in length and width to account for INS mounting locations and the size of ROV the skid is being coupled with. Refer to the images below the table for the dimension key shown in the table headings.

Typically, the SBI ROV Skids listed below are interchangeable with one another, i.e. either skid can be chosen to interface with the same ROV.

Due to the differences in ROV mechanical interfacing requirements, further analysis and discussions must be completed to ensure all mechanical interfacing aspects are considered. Additional detailed drawings, or 3D format files (STEP format), for all SBI configurations are available on request from PanGeo Subsea.

SBI ROV Skid Systems	Fleet Quantity	Front Array Folded Width (m) (a)	Front Array Deployed Width (m) (b)	ROV Skid Width (m) (c)	ROV Skid Length (m) (d)	Total Length Folded (m) (e)	Total Length Deployed (m) (f)	Height (m) (g)	Weight in air (kg)	Weight in water (kg)	Depth Rating (m)
ROVSkid V1	1	2.1	3.5	1.5 – 1.8	2.5	3.9 – 4.4	3.3 – 3.8	0.55 – 0.58	815 – 952	53 – 156	500
ROVSkid V2	1	2.1	3.5	1.5 – 1.8	2.5 – 2.7	3.9 – 4.6	3.3 – 4.0	0.55	790 – 996	-24 – 58	500
ROVSkid V3	3	1.9	3.1	1.5 – 1.8	2.5 – 2.7	3.5 – 3.9	3.3 – 3.7	0.55	790 – 941	-22 – 76	500
L-Class	1	1.9	3.1	1.5 – 1.8	2.4 – 3.1	3.1 – 3.8	3.1 – 3.8	0.41	551 – 625	28 – 31	*130

*Limited by buoyancy foam depth rating

Table 4: SBI Work-Class ROV Skid Summary

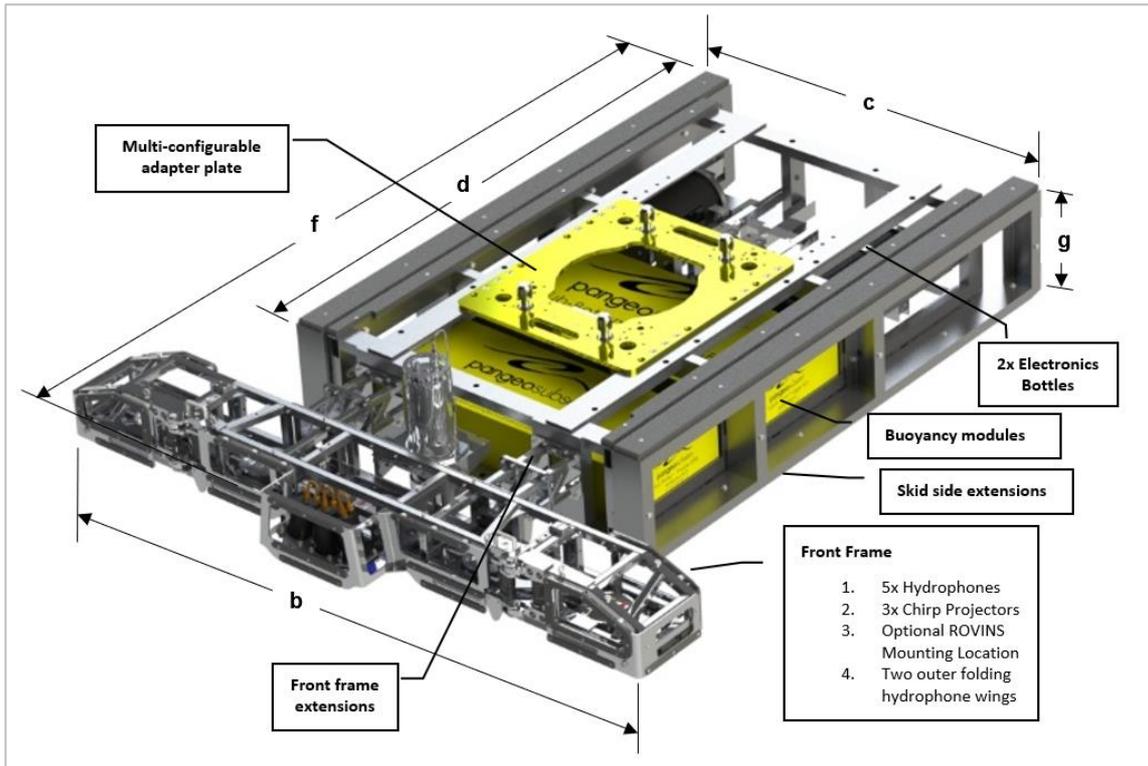


Figure 1: SBI ROVskid V3 composition in its deployed configuration with dimensional references

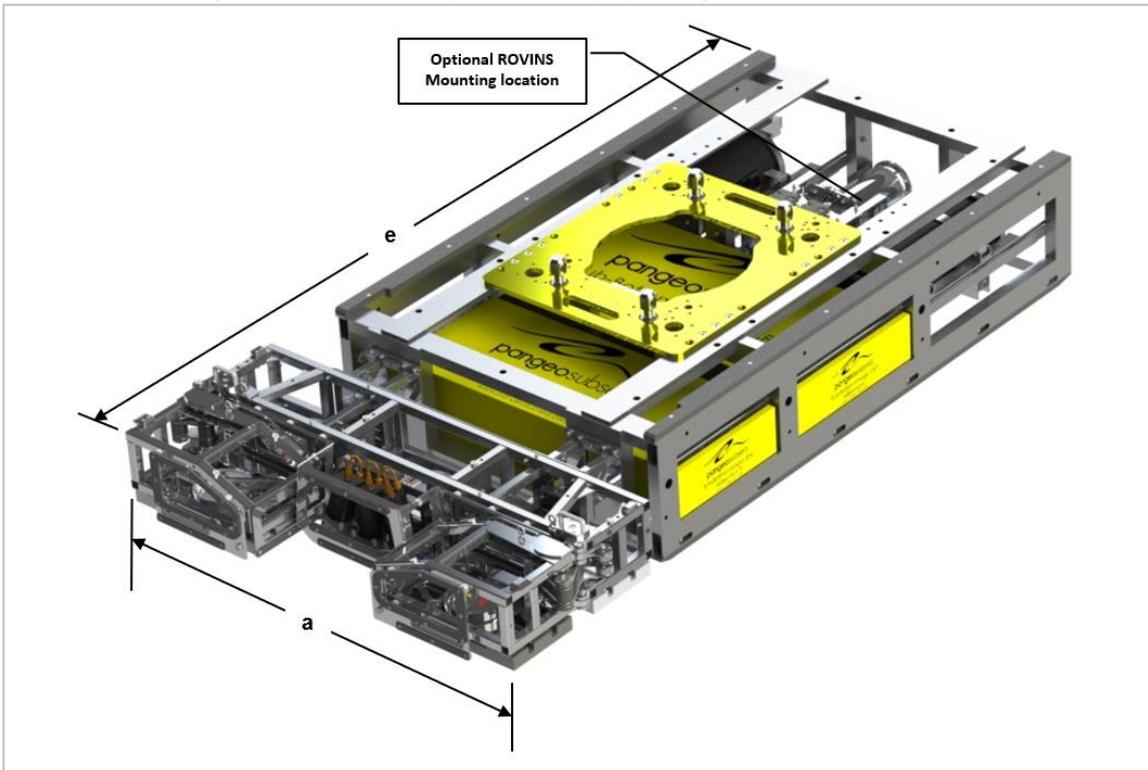


Figure 2: SBI ROVskid V3 composition in its folded configuration with dimensional references

	Document Title:	ROV Interface Document		
	Document Number:	ICD-0848-800-200	Revision:	12

2.1 SBI Skid Configurable Attributes

The following sections describe the components of the SBI Skids that account for its adjustability and size.

2.1.1 Adapter Plate

The adapter plates supplied for each skid are highly configurable and can be set up to allow docking of most ROVs. The docking posts supplied are ROV specific and some are adjustable in height to account for varying locking pin height (from bottom of ROV). Additional spacers can be installed between the adapter plate to increase the locking pin height if required.

The adapter plate can be attached in multiple locations in the fore aft direction along the top of the skid, to aid in weight distribution or other requirements such as adding an external ROVINS on the rear of the ROV.

Additionally, for the Oceaneering Millennium ROV, an interface frame can be supplied which must be bolted to the underside of the ROV to allow docking of the ROV onto the PanGeo skid using the general 4-post docking arrangement.

2.1.2 Skid Side extensions

The bolt-on skid side extensions are installed to increase the width of the ROV skid from 1.5 m to 1.8 m. For example, these are installed when integrating with larger ROVs such as the Schilling UHD or Triton XLX.

2.1.3 Front Frame Mounting Arms

The front frame mounting arms are supplied in a short or long configuration. When it is necessary to install a coupled ROVINS/DVL in the skid it is generally located in the front frame and therefore it is necessary to use the long mounting arms configuration. The long arm configuration is also used when installed the skid on a Millennium ROV to push the front frame forward and outside the ROV cage when the ROV resides there.

If the PanGeo supplied split ROVINS/DVL unit is supplied and installed in the rear of the skid the short mounting configuration is preferred as it allows for improved vehicle trim. Likewise, if the client supplies the ROVINS and it is located at the rear of the ROV or inside the ROV body the short arm configuration will be used.

2.1.4 ROVINS and DVL Mounting Locations

Two locations are available on the ROV skid for installation of the ROVINS/DVL combination. If a rental or client supplied ROVINS is required for the campaign, then it may be located in the front frame. If PanGeo are to supply the split ROVINS/DVL unit it will be located in the rear of the skid between the two electronics bottles. If the client supplied ROVINS is located in the body of the ROV it may be required to re-locate the DVL to the skid: In this case, the DVL can be situated either in the front frame or in the rear of the skid.

2.1.5 Front Frame Outer Hydrophone Wings

All front frame hydrophone arrays fold to make the skid width smaller for launch and recovery through the launch and recovery system. This is accomplished using hinges and hydraulic cylinders.

2.2 Previous ROV Installations

PanGeo have interfaced the SBI with a variety of ROV's. The list below highlights the ROV's that the SBI Skid has been integrated with, to date. Exclusion from the list does not mean the SBI Skid cannot be integrated with a particular ROV.

1. **Kystdesign Supporter** – Skid equipped with an adapter plate with four height adjustable posts. The locking pins for coupling the skid to the ROV are not supplied.
2. **Schilling HD** – Skid equipped with an adapter plate with four height adjustable posts. The locking pins for coupling the skid to the ROV are not supplied.
3. **Schilling UHD** - Skid equipped with an adapter plate with four height adjustable posts. The locking pins for coupling the skid to the ROV are not supplied.

	Document Title:	ROV Interface Document		
	Document Number:	ICD-0848-800-200	Revision:	12

4. **Triton XLX** - Skid equipped with an adapter plate with four height adjustable posts. The locking pins for coupling the skid to the ROV are not supplied.
5. **Triton XLS** - Skid equipped with an adapter plate with four height adjustable posts. The locking pins for coupling the skid to the ROV are not supplied.
6. **Fugro FCV 600** – Skid equipped with an adapter plate with four square fixed height posts. The locking pins for coupling the skid to the ROV are not supplied.
7. **Fugro FCV 3000** - Skid equipped with an adapter plate with four square fixed height posts. The locking pins for coupling the skid to the ROV are not supplied.
8. **SMD Quasar** – Skid equipped with an adapter plate with either the four larger outer diameter height adjustable posts or the four smaller outer diameter fixed height posts. The locking pins for coupling the skid to the ROV are not supplied.
9. **SMD Quantum** - Skid equipped with an adapter plate with either the four larger outer diameter height adjustable posts or the four smaller outer diameter fixed height posts. The locking pins for coupling the skid to the ROV are not supplied.
10. **Oceaneering Millennium** – Skid equipped with the Millennium adapter frame that is required so the skid coupled to the ROV can fit into the ROV cage. The ROV frame is bolted to the ROV then the ROV/adapter frame assembly is dropped onto the SBI Skid using a four post and pin arrangement which is supplied by PanGeo.

2.3 Certification

All ROV skids have annual load testing certification for the following values:

1. Load Test 1 (Load test without skid side extensions) – 10,000 kg
2. Load Test 2 (Load test with skid side extensions) – 12,000 kg
3. Pull Test (pull test on adapter plate with secured skid) – 2,000 kg

2.4 Hydraulic Specifications

All SBI systems specified above incorporate two outer hydrophone folding wings. Regardless of the hinge mechanism they all utilize the same hydraulic fittings and generally have the same cylinder specifications. The hydraulic rams have stainless steel fittings to provide #4 JIC ports as the standard connection.

All Ports are SAE-ORB #6 (9/16"-18 with BS906 O-Ring) adapted to #4 JIC.

Hoses and tee-pieces are supplied. These require to be connected to a single control valve. The cylinders need to be pressurized in the open position during operation to maintain proper alignment of the hydrophones. During fitment to the ROV it is recommended to test the hydraulic system to ensure the outer hydrophone wings open and close sufficiently and at a reasonable rate. Pay attention to the maximum pressure stated in Table 5.

Dead recovery of the sub can be accomplished by recovering the system through the LARS in a backward orientation, as the outer wings of the SBI front frame fold forward. As the system is being recovered the wings will bump up against the LARS A-frame and begin to fold.

Note: ROV Skid V3 and L-Class Skids have pressure relief valves built into the system to prevent over pressurizing of the SBI hydraulic circuit.

	Document Title:	ROV Interface Document		
	Document Number:	ICD-0848-800-200	Revision:	12

Maximum System Pressures	
WARNING: System Maximum Pressure: Do not exceed the maximum working pressure as it puts unwanted stress on hinge components	
System	Maximum Hydraulic Pressure (psi)
ROVskid V1	1000
ROVskid V2	1000
ROVskid V3	1200
L-Class	1200

Table 5: Maximum System Pressures

3 SBI SYSTEM ELECTRICAL REQUIREMENTS

The SBI system consists of two electronics units (the SBI receiver and transmitter), three acoustic projectors, five acoustic hydrophones, an iXBlue ROVINS/ DVL, a velocimeter, depth sensor and the associated cabling.

For the SBI system to operate it requires two electrical interfaces: (1) ac power and (2) a wired Ethernet connection. The required interfaces are:

- a) Power interface (115 V ac 50/60 Hz)
- b) Ethernet interface (8-wire GB/sec preferred, 4-wire 100MB/sec usable in most cases)

These interfaces can be made through connections in two ways. They can be made through either a single cable, having both power and Ethernet, or through two individual cables. To date, PGSS has interface cabling available for many common ROV and subsea MUXs (RTS, Innova, MacArtney). Whips are also available from PGSS, to support the two types of interfaces, for on-vessel termination.

3.1 Subsea Electrical Power Interface

The SBI system requires a nominal power supply of 115 V ac ($\pm 13\%$), 50/60 Hz. The system will not start up if the supply voltage is outside of this range (approximately 100 V to 130 V).

The normal power consumption during operation is ≤ 300 Watt (3 Amp) although a maximum inrush current of 6 Amps is possible.

The ac supply interface can be configured differently depending on the ROV. The ac power can either be interfaced to a separate power connector or it can be interfaced to the combined ac power and Ethernet connector. The combined interface is described in Section 3.2.

The separate ac power interface to the receiver is made via an 8-position male Burton bulk-head connector (P/N 5507-2008 BCR). The description of this interface connector is defined in Figure 3-1 and Table 6.

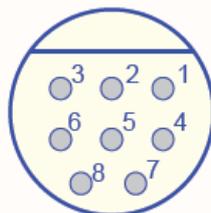


Figure 3-1: Receiver ac Power Interface Connector J3: Male (pins) Face View (P/N 5507-2008 BCR - bulkhead)

	Document Title:	ROV Interface Document		
	Document Number:	ICD-0848-800-200	Revision:	12

Connector Pin Position	Connection Description
1	Cable shield connection
2,3,7,8	No Connection
4	AC Ground connection to chassis
5	115 Vac Line (6 Amp maximum)
6	115 Vac Neutral (6 Amp maximum)

Table 6: SBI AC Power Connector Pin-out

3.2 Subsea Network Interface

The ROV Ethernet interface is made via a 1000 Base-T compatible (GB/sec) wired underwater connection to a standard LAN. The interface is made through a 13-pin male Burton bulk-head connector (Burton P/N 5507-2013 BCR). The description of the interface is shown in Figure 3-2 and Table 7. Table 7 also shows the wire color code for PGSS underwater interface cable P/N 0811-200 and the connection required to a standard RG-45 Ethernet connector.

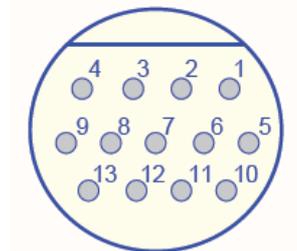


Figure 3-2: Receiver Ethernet Interface Connector J4: Male (pins) face View (Burton P/N 5507-2013 BCR - bulkhead)

Connector Pin Position	Connection Description	Function	Wire Color for PGSS Cable P/N 0811-200	RJ-45 Connections
1	TX+_D1	Ethernet	ORG/WHT	1
2	TX-_D1	Ethernet	ORG	2
3	RX+_D2	Ethernet	GRN/WHT	3
4	RX-_D2	Ethernet	GRN	6
5	BI-_D3	Ethernet	BLU/WHT	5
6	BI+_D3	Ethernet	BLU	4
7	SHIELD	Ethernet shield	SHIELD	Back shell
8	BI+_D4	Ethernet	BRN/WHT	7
9	BI-_D4	Ethernet	BRN	8
10	Spare	Not used	RED	-
11	AC Neutral	120V ac power 50/60 Hz	WHT	-
12	AC Line	120V ac power 50/60 Hz	BLK	-
13	AC Ground	120V ac power Ground	GRN	-

Table 7: LAN Connector Pin-Out Descriptions for SBI Receiver

	Document Title:	ROV Interface Document		
	Document Number:	ICD-0848-800-200	Revision:	12

3.3 INS Requirements

The SBI system is normally provided with an INS system that can be either the iXBlue PHINS 6000 Gen-III or the iXBlue ROVINS.

Each INS is mated with a DVL, a velocimeter and depth sensor for position aiding. The INS can be provided by PGSS and in this case it is mounted as part of the SBI system. However, if the client ROV has an INS included, this can be accepted if the data streams are available to the SBI surface computers. Physical offsets between the client INS and the SBI must also be determined by survey for entry into the SBI processing software. See section 5 for additional details on the INS interface requirements.

4 SURFACE SYSTEM REQUIREMENTS

This section defines the configuration and requirements for the surface components of the SBI system.

4.1 SBI Surface System Configuration

The topside SBI equipment on the vessel will be servers and workstations used to acquire and process the SBI data. The arrangement of the equipment is shown in Figure 3 and Figure 4.

SBI DATA ACQUISITION AND PILOT'S CONSOLE

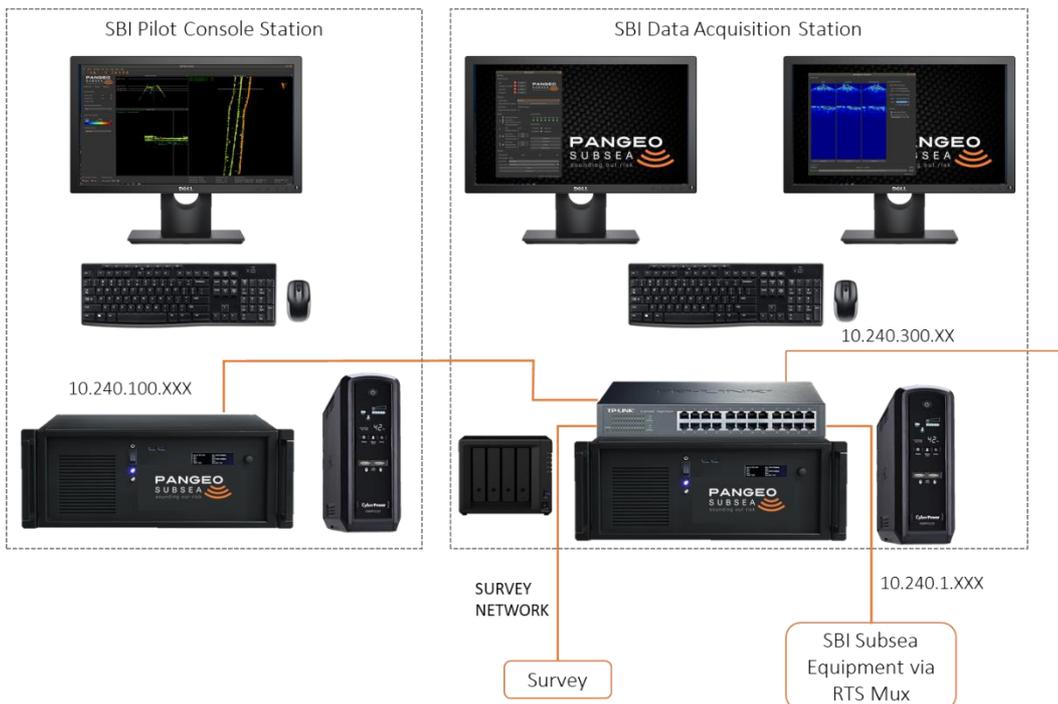


Figure 3 - SBI bridge equipment

	Document Title:	ROV Interface Document		
	Document Number:	ICD-0848-800-200	Revision:	12

SBI GEO PROCESSING WORKSTATION



Figure 4 – SBI Geo workstation

4.2 Power and Network Requirements

All the surface equipment operates from an electrical supply of 100V - 240 ac 50/60 Hz with a maximum power requirement of 3000 Watts. All surface equipment LAN cables should be of the type CAT5e or better. The network connection to the SBI Subsea system should be verified to have a throughput of better than 100 MB/s.

5 SUBSEA EQUIPMENT CONFIGURATIONS

The SBI subsea equipment arrives at a vessel in a predetermined physical configuration as outlined in section 2, Mechanical SBI Configurations. Depending on the scope of supply or equipment availability, the INS may require further configuring. The following section illustrates the options available for INS type and mounting locations and the implications of each.

The iXblue ROVINS or the PHINS 6000 Gen-III are currently the only INS units supported by the SBI software. These have identical interfaces and software and therefore are considered together. These units can be supplied as part of the SBI system but are often part of the survey equipment installed on ROVs. For these units we have two cases to consider as below.

5.1 PanGeo Subsea INS supplied and mounted on the SBI

1. A “PHINS Standard” string is recorded top-side and is available to survey via serial port (155200,8, N, 1) or Ethernet. The “PHINS Standard” string is output at a rate of 10 Hz.
2. A calibrated depth sensor is attached to the INS, but it is possible to use survey depth data if required. This can be input to the system topside via serial port or Ethernet.
3. A calibrated velocimeter is attached to the INS.
4. The INS is time synchronized through a survey supplied ZDA string. This can be input to the system topside via serial port or Ethernet.
5. A survey position string from GPS or USBL is required. This can be GGA or any USBL string the INS can decode (PUSBA, APOS PSIMLBP, APOS PSIMSSB). This can be input to the system topside via serial port or Ethernet.

	Document Title:	ROV Interface Document		
	Document Number:	ICD-0848-800-200	Revision:	12

5.2 Client supplied and mounted on the ROV

PanGeo Subsea will require the following:

1. Access to the “PHINS Standard” string topside, at a rate of 10 Hz, via serial port or Ethernet.
2. The INS must have a calibrated depth sensor attached.
3. A calibrated velocimeter must be attached to the INS.
4. A calibrated DVL must be attached to the INS
5. The INS must be time synchronized through a survey supplied ZDA string.
6. The INS must be given a survey position string from GPS or USBL. This can be GGA or any USBL string the iXBlue INS can decode (PUSBA, APOS PSIMLBP, APOS PSIMSSB).
7. The offset between the SBI frame origin and the INS output position will be entered in SBI software.
8. The offset between the SBI frame origin and the DVL will be entered in the SBI software

6 SBI DATA INTERFACE TO SURVEY

For the SBI system to function properly, data connections are required to and from the vessel / survey. These signals are described below and are shown in Figure 6-1.

1. Network link to the SBI system

The network connection between the SBI Subsea and Topside systems must have a verified throughout rate of 100 MB/s or better.

2. PHINS Standard string input

The iXBlue “PHINS standard” string with 10 Hz update rate contains all positional information required by the SBI system.

If the INS is administered by PanGeo, this will be received via the same network link to the SBI system. This can be forwarded to survey via ethernet or serial, along with any additional INS outputs required by survey.

3. Subsea Position Aiding to the INS

The INS must receive positioning aiding via GPS, USBL, or LBL, in addition to ZDA GPS time sync, DVL, depth, and sound velocity. The INS must receive this aiding directly, so that the “PHINS standard” string is populated with the appropriate data. GPS, Time, USBL, and optionally Depth can be received Topside via serial link or ethernet link as TCP/UDP.

If the INS is administered to PanGeo, the GPS, USBL and other positioning aiding strings must be made available for use with the INS if supplied by Survey

4. NTP Synchronization to GPS time

This will be received via a network link through which PanGeo has access to an NTP server administered by Survey.

5. OPTIONAL: Live Tide Correction

There is an option to apply live tide correction to the SBI SAS data, using either a streaming tide string forwarded by Survey or using a pre-loaded predicted tide file.

6. OPTIONAL: Auto-Archive by KP

There is an option to allow auto-archival of SBI data by KP. This is desirable when collecting long, continuous lines of data. This can be achieved either by a streaming KP string forwarded by Survey or by using a pre-loaded RPL file.

Additional Requirements

Survey INS Offsets

If the INS is part of the PGSS system a surveyed offset from the ROV USBL transponder or GPS antenna to the INS position is required. If the INS is part of the customer equipment and is not mounted in the normal INS location on the PGSS system, then the INS offsets to the SBI must be provided by survey.

	Document Title:	ROV Interface Document		
	Document Number:	ICD-0848-800-200	Revision:	12

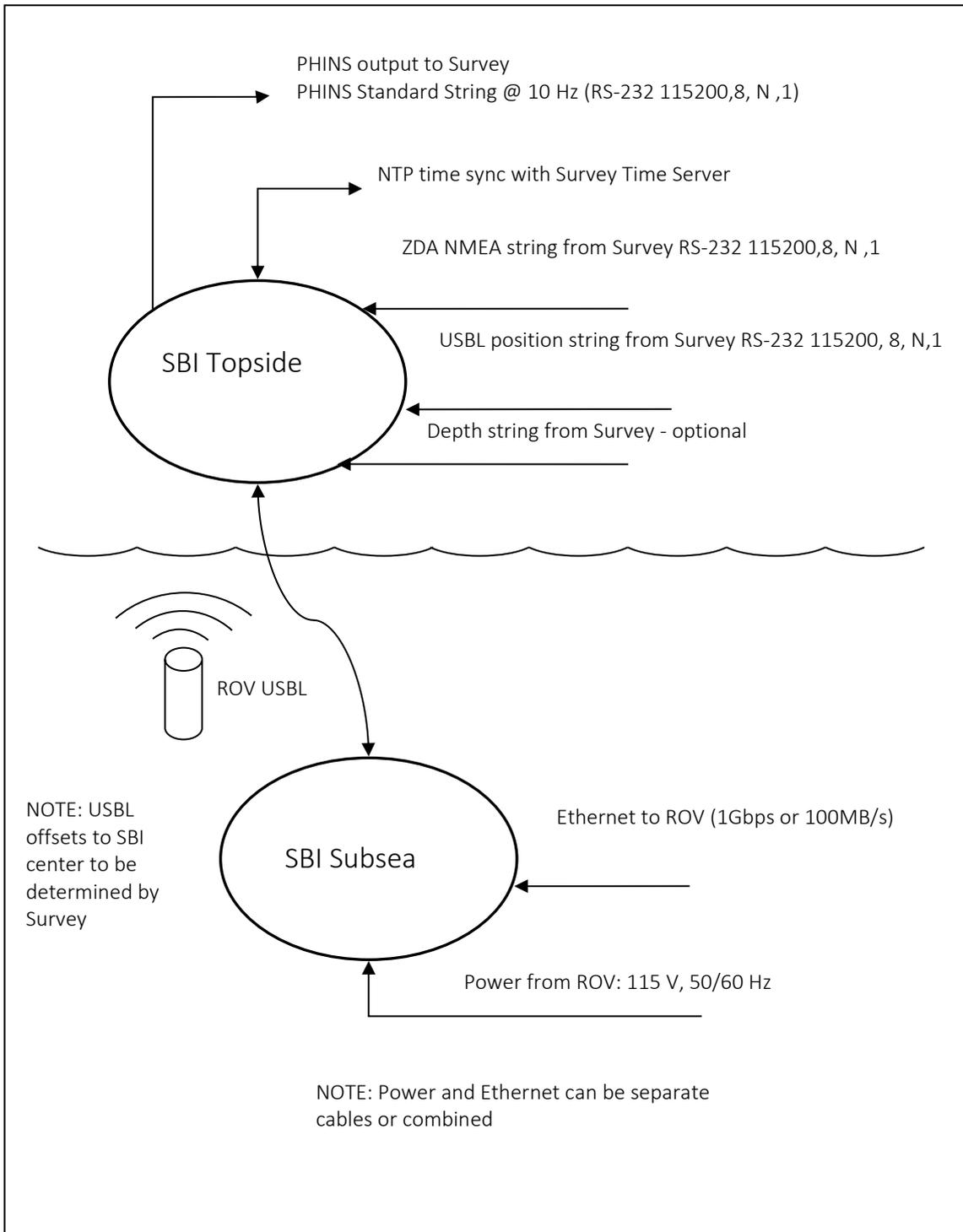


Figure 6-1: SBI survey connection diagram

	Document Title:	ROV Interface Document		
	Document Number:	ICD-0848-800-200	Revision:	12

7 CALIBRATION

PanGeo Subsea will ensure that all equipment supplied for a survey will arrive with a valid calibration. Also, the mobilization process involves the completion of a Mobilization checklist. This is a procedure where the following tasks are performed:

1. Inspection of equipment,
2. Confirmation of the mechanical interface including the hydraulics,
3. Verification of the electrical interfaces (client side),
4. Full self-test of all SBI components including survey interfaces (deck test),
5. Wet test over target of opportunity to verify correct input of lever arms, ROV trim, navigation, and data collection/processing. No patch test calibration is required for SBI acoustic equipment.
6. In addition, a pre-dive checklist is followed prior to each dive.

The SBI Mob Qualification checklist and the Acceptance report can be made available upon request.

8 INTEGRATION WITH MBES

A high percentage of SBI surveys are performed to provide “depth of burial” (DoB) measurements. The DoB is usually measured with respect to the mean seabed (see Figure 8-1). Since the SBI has a narrow swath it can calculate the “depth of cover”, but in order to determine the DoB a mean seabed must be determined. An additional survey using a multi-beam echo sounder (MBES), with its wide viewing angle, is used to determine the mean seabed. While the SBI has been used to calculate DoB using previously collected MBES data, the highest data quality is achieved when both surveys are done simultaneously. Since the operating frequencies for the SBI and a typical MBES are far apart simultaneous data collection is possible.

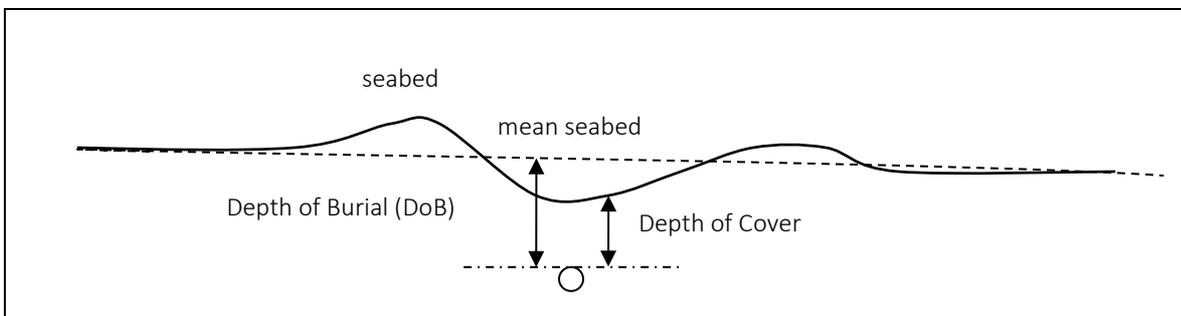


Figure 8-1: DoB definition

	Document Title:	ROV Interface Document		
	Document Number:	ICD-0848-800-200	Revision:	12

9 SCOPE OF SUPPLY

Since the SBI is a tool which requires a suitable vessel and platform as well as support from survey, each SBI survey project is a collaborative effort between PanGeo Subsea and the client. The following section defines the scope of supply for a typical SBI survey.

Supplied by PanGeo Subsea

1. SBI unit complete including skid,
2. Mechanical interface (adaptor plate and posts),
3. Topside servers and topside laptop computers,
4. Trained offshore team (based on data point picking every 5 meters)
 - a. 12-hour two-person team (1 x offshore manager plus 1 x technician/data processor)
 - b. 24-hour three-person team (1 x offshore manager plus 1 x technician/data processor plus 1 dedicated data processor)

Note that as options PanGeo Subsea can supply the following:

1. INS/DVL unit including depth sensor and velocimeter,
2. Full one stop survey solution (Full detail available upon request).

Supplied by the Client

1. Suitable vessel,
2. Survey spread (including USBL, GPS and MBES if required),
3. WROV, ROV or any agreed suitable platform,
4. ROV docking receptacle locking pins,
5. INS / DVL (iXBlue PHINS Gen-III or ROVINS with DVL),
6. Subsea 115 v ac power source,
7. Mux interface for subsea Ethernet,
8. Crane / FLT at quayside for offload from flatbed truck (maximum single piece weight of one tonne)