REQUEST FOR INFORMATION – SHORESIDE ELECTRICAL SYSTEM

GUEMES ISLAND FERRY REPLACEMENT

000 GENERAL REQUIREMENTS

000.1 Objective

This Request for Information describes the requirements for the shoreside electrical system required to support the Guemes Island Ferry Replacement (GIFR) vessel, a 160-ft. battery electric passenger and vehicle ferry, at the ferry terminal in Anacortes, Washington. Skagit County owns and operates the Guemes Island ferry and ferry terminal. Glosten has been selected by Skagit County to design the replacement vessel and the associated charging system. We are requesting detailed technical information including a basic one-line diagram, equipment drawings, specifications, and rough order of magnitude (ROM) pricing for this equipment to progress the design of the terminal modifications.

The GIFR vessel is expected to be the first purpose-built electric vehicle ferry in the United States and implementation of the automated shore charging system for the vessel is expected to be the first of its kind in the United States. The shore charging system selected for this project could serve as a model for future ferry projects in Washington State and the surrounding region.

The information provided in response to this RFI will not be used as a basis for selection of vendor or equipment.

Responses are requested by 30 June. Please note all information does not need to be provided at one time and early information submittal is encouraged.

000.2 Reference Documents

The following are documents referenced within this RFI:

1. *GIFR Transportation System Assessment (PDF)*. Glosten, Inc., Document No. 17097-000-02, Rev. -, 14 December 2018.

2. *Schedule 26 Large Demand Service* (PDF). Puget Sound Energy. Issued March 30, 2018.

The above documents are for informational purposes only and should not be used for design and engineering beyond the purposes of this inquiry.

To request these documents, please email Jeff Rider at jmrider@glosten.com.

000.3 Acronyms

Acronyms used throughout this document are as follows:

ASCS	Automatic Shore Connection System
CFR	Code of Federal Regulations
GIFR	Guemes Island Ferry Replacement
LMFB	Last make/First break
NEC	National Electrical Code, NFPA 70
NESC	National Electrical Safety Code, IEEE C2
NRTL	Nationally Recognized Testing Laboratory

PMS	Power Management System
PSE	Puget Sound Energy (electrical utility)
RFI	Request for Information
ROM	Rough Order of Magnitude
SES	Shoreside Electrical System
VES	Vessel Electrical System
WAC	Washington Administrative Code

000.4 Requested Data

The following drawings and data are requested:

- Dimensional drawings of all components.
  - Switchboards.
  - Electric house.
  - Battery bank.
  - Transformers.
  - Control equipment.
- Weight estimate of all components.
- Electrical equipment description and ratings.
- Outline of proposed standards and listings (NRTL) to be used for compliance with NEC and NESC for system design and major equipment including batteries, battery management system, and power conversion equipment.
- One-line electrical diagram indicating scope of supply and significant features.
- Auxiliary system requirements (cooling, ventilation, etc.).
- Technical description of equipment and its operation. The description should list all components that are in the scope of supply and proposed step by step instructions for system operation. If drawings of minor components cannot be provided at this time, a clear description with overall dimensions and weights should be provided.
- Electrical efficiency of all major distribution and conversion components.
- ROM cost estimate for equipment, with itemized commissioning services. Cost estimates should not include costs for shipping equipment.
- Information outlining vendor support and warrantee of equipment throughout vessel's operational life.

All documents do not need to be delivered at one time.

000.5 Project Information

The GIFR project electrical system (see Figure 1 for overview) has been divided into three portions: the Shoreside Electrical System (SES), the Automatic Shore Connection System (ASCS), and Vessel Electrical System (VES). Figure 1 is an outline of how the systems are expected to interface with each other; details of system architecture within each system may vary by vendor and technical solution.

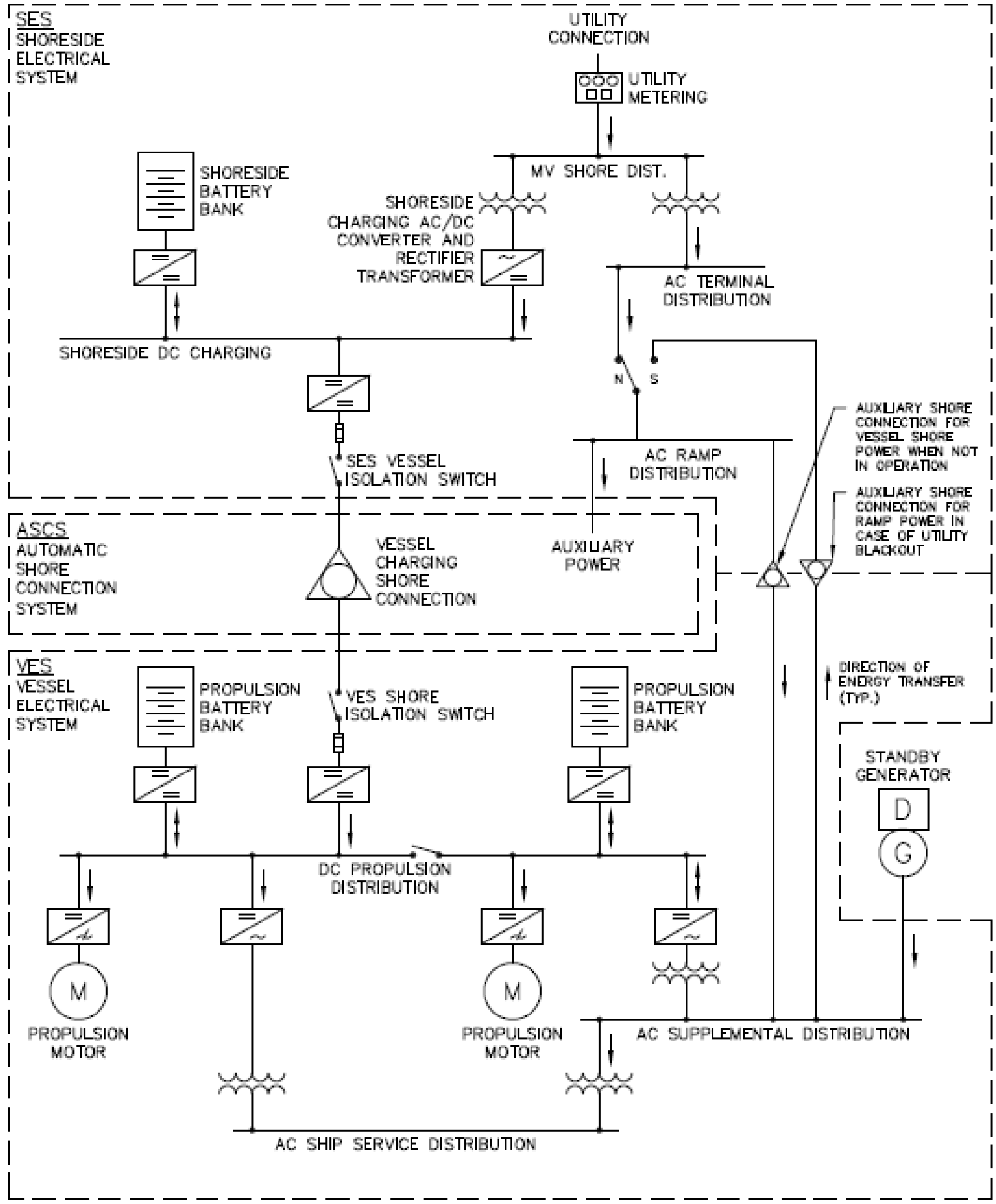

Figure 1 GIFR project electrical overview

000.5.1 Procurement and Support

Table 1 Estimated project timeline

Preliminary design complete	September 2020
Contract design complete	March 2021
Shipyard period	November 2021 to July 2023
Terminal modification period	November 2022 to April 2023
Vessel in service	September 2023

Table 1 provides an estimated timeline for major milestones for the GIFR project. Preliminary SES information from vendors is expected ahead of the completion of the preliminary design.

000.5.2 Multiple GIFR RFIs

Glosten will issue separate RFIs for the automatic shore connection system (ASCS), vessel electrical system (VES), and propulsor units. Vendors may elect to respond to any of the RFIs on an individual basis. In cases where a cost savings may be obtained by selection of a single vendor for multiple scope items, this should be explicitly stated and costs savings broken out.

000.5.3 Vessel

Table 2 Vessel particulars

Length, Overall	160'-0"
Beam	53'-0"
Draft	7'-6"
Car Capacity	28
Full Load Displacement	530 LT
Propulsors	(2) 700 kW L-Drive Azimuthing Propulsors
Speed, Cruise at Full Load	11.5 kts

It is estimated that the vessel will operate 365 days per year, with an average of 24 round-trip crossings per operating day. Figure 2 depicts the timeline of a typical round-trip crossing, which takes 30 minutes. Note the battery sizing calculations assume some maintenance downtime resulting in 8400 round trips per year.

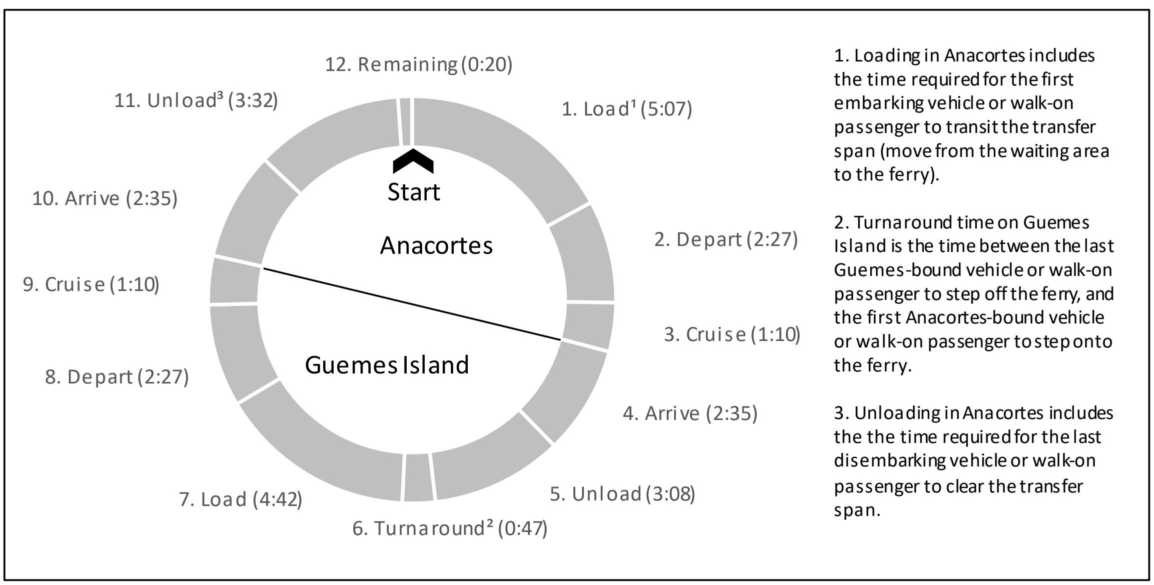

Figure 2 Typical round-trip transit

The vessel electrical system (VES) will consist of a common DC bus with two independent propulsion battery banks, which serve as the primary sources of power. Power for the propulsion motors will be taken directly from the DC bus and converted to 600-690VAC, 3-phase. Other consumers can be powered by 480VAC or 208Y-120VAC, 3 phase, 60 Hz. A 550 ekW onboard standby diesel generator will provide supplementary power for propulsion, ship loads, and battery charging during abnormal operations (e.g. bad weather, transit offsite).

The VES outlined above is outside the scope of this RFI, see Section 000.5.2.

000.5.4 Terminal

The SES will be installed at the Anacortes terminal to serve the GIFR vessel. No significant modifications will be made to the existing Guemes Island terminal electrical system.

ASCS

The ASCS will be installed at the Anacortes terminal docking facility to serve the GIFR vessel. The ASCS will transfer the required electrical energy from the SES to the VES to charge the propulsion batteries and power the vessel during connection. No shore charging connection is required on the Guemes Island side.

The ASCS outlined above is outside the scope of this RFI, see Section 000.5.2.

Existing Terminal Electrical Distribution

The existing electrical infrastructure at the Anacortes terminal consists of the following:

a. 480VAC, 3 phase, 60 Hz power supplied to machinery at the ramp apron and lifting tower and shore connection for the existing vessel.

b. Additional 120VAC, 1-phase, 60 Hz supplied to the terminal building for various small loads.

These existing loads at the terminal will be modified and integrated with the new SES, but are not a major focus of this RFI.

000.5.5 Regulatory

The modifications to the existing ferry terminal in Anacortes will be required to satisfy the requirements of WAC-246B Electrical Safety Standards, Administration and Installation, the NEC, and NESC. See the requested information regarding proposed standards and listings in Section 000.4.

The vessel will be required to satisfy the rules for a USCG Inspected Small Passenger Vessel under US CFR Title 46, Subchapter T. This includes all aspects of the shore connection system which are installed on the vessel, and may also include review of the shoreside system for information.

The integration of an ASCS of this nature on the vessel is unique in the United States and we expect both the USCG and the Washington State electrical inspectors to review this aspect of the project. Glosten is working with the regulatory bodies to define particular requirements and will provide details to vendors when available.

001 SHORESIDE ELECTRICAL SYSTEM (SES)

The SES includes the infrastructure required to bring utility power to the VES, through the ASCS. This includes a shoreside battery bank to provide energy storage to accommodate high charging power without incurring high utility demand (peak) costs. Figure 1 shows the scope of supply for the SES. The SES shall be installed at the Anacortes ferry terminal.

The SES will regulate the source voltage to maintain the nominal voltage at the vessel. Cables and wireways are to be provided by the vendor from the utility connection to the ASCS. Additional details and requirements will be developed as the design progresses.

Table 3 provides a summary of the major electrical power sources and loads on the vessel.

This RFI is written with the assumption that an SES configured in a manner similar to that shown in Figure 1 will be best suited for this project. Figure 1 is primarily intended as an outline of the scope of each electrical system; the details of the configuration may be modified to fit the capabilities of the systems offered by vendors. Vendors may propose alternate configurations to the SES. If proposing an alternate configuration, vendors should interpret the requirements of this RFI accordingly, and are encouraged to provide support in the proposal to justify the deviation from the described configuration.

Table 3 Summary of major electrical power source and loads

Equipment	Qty.	Rating (each)	Notes
ASCS Interface	1	2.0 MW 1000V DC (nom.)	See Section 001.2
Shore Battery Banks	1	600 ekW (charge) 1300 ekW (discharge)	Energy storage capacity to be based on operating profile, see Section 001.2.2
Rectifier Transformer and AC/DC Converter	1	600 ekW	See Section 001.2
AC Ramp Distribution	1	~30 ekW 480V, 3Ø, 3W, 60 Hz	See Section 001.4
AC Terminal Distribution	1	Loads to be determined Various voltages, 60 Hz	For use when moored and not in operation, see Section 001.4

001.1 Electrical House

The SES must be installed in an electrical house or other purpose-built structure located as shown in Figure 3. The electrical house and related infrastructure should be included in the scope of the SES vendor. The electrical house should include the utility metering, medium-voltage distribution switchgear, the shoreside DC charging system, shoreside battery bank, low-voltage AC terminal distribution, and the related transformers and converters.

The electrical house should be complete with all necessary safety and monitoring equipment for the electrical distribution system and battery installation.

Building foundation and other civil and structural modifications required to facilitate the electrical house are expected to be provided by others, through a separate contract with Skagit County.

The estimated area for the electrical house including all access, inspection areas, and clearances is 20' x 40'.

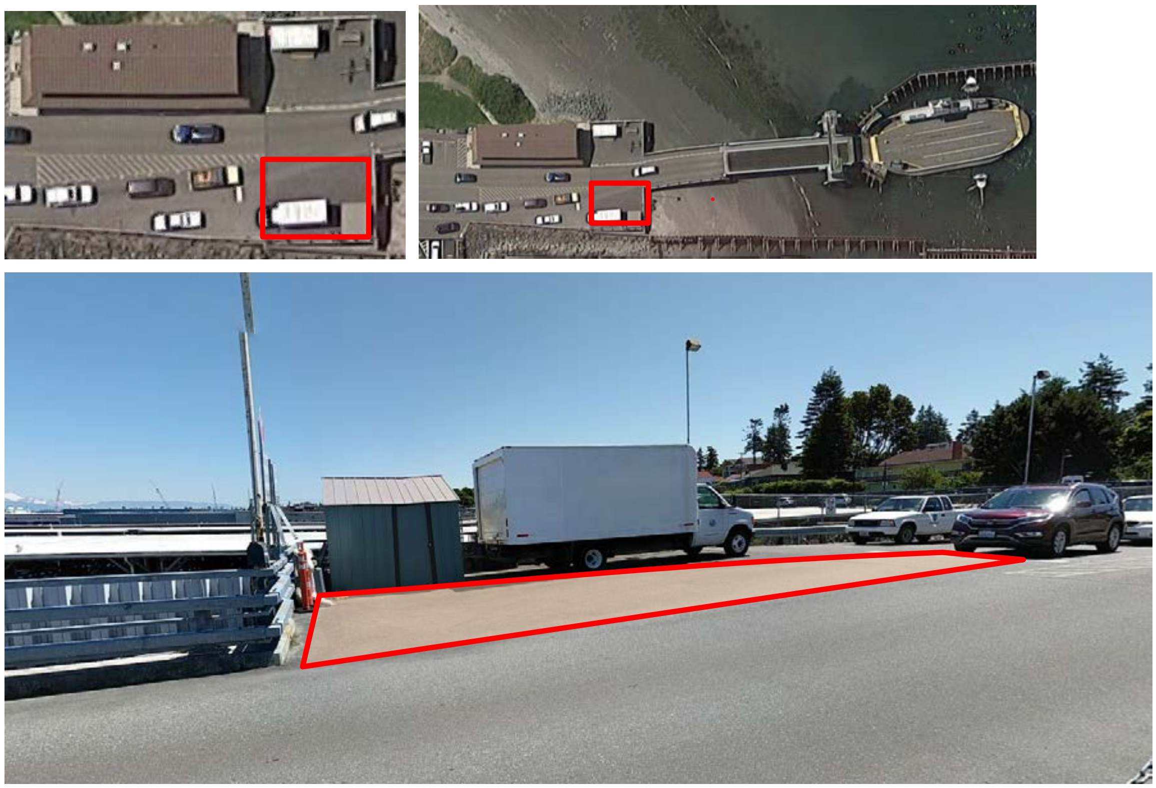

Figure 3 Proposed location for SES electrical house and utility connection infrastructure

001.2 Shoreside DC Charging

Shoreside DC charging is provided to reduce power demand charges from the utility. DC charging will be provided through an AC/DC converter and rectifier transformer. Connection to the ASCS will be through a DC/DC converter and SES isolation switch.

The AC/DC converter and rectifier should be designed to provide the required power quality at the point of common coupling, to be developed later. Redundant AC/DC converter and rectifier transformers shall be provided.

The interface between the SES and the ASCS and VES is discussed in Section 001.5.

001.2.1 Power Management System

A power management system (PMS) must be provided as part of the shoreside DC charging system. The purpose of the PMS is to coordinate vessel charging and charge/discharge of the shoreside batteries with power demand from the utility, to optimize the operating cost of the new GIFR. The primary function will be to reduce the peak monthly power demand from the utility, with a secondary function to optimize the cycling of the shoreside batteries to maximize battery life.

The power management system should be a non-proprietary system that allows adjustment over the life of the vessel to meet a changing energy market. A qualified person shall be capable of future modifications to the system.

A desired function, though not required, is the ability for the PMS to respond to intermittent AC terminal loads with the goal to reduce peak power draw from the utility. These terminal loads include the ramp machinery and possibly future electric car chargers.

001.2.2 Shoreside Batteries

The batteries should be sized to provide a 10-year operational life based on the probabilistic load profiles listed in Table 4 and 8400 round trips per year (24 runs per day, 350 operating days per year). The times listed in Table 4 for vessel charging are based on the expected time available for charging during unloading and loading of passengers and vehicles at the Anacortes terminal. The time listed for the operating duration of the shoreside AC/DC converter is typically the total round-trip time for the vessel, which is scheduled for 30 minutes.

The shoreside battery installation should be complete with a battery management system, and other required safety equipment.

Table 4 Cumulative probability load profiles for shoreside batteries based on weather and tidal predictions

Operation	50% Probability[1]		80% Probability[1]		95% Probability[1]				99.7% Probability[1]	
	Average Run		*Above Average*		Without Generator		With Generator		Schedule Slip	
	Time [minute]	Power [kW]	Time [minute]	Power [kW]	Time [minute]	Power [kW]	Time [minute]	Power [kW]	Time [minute]	Power [kW]
Vessel Charging [2]	10.72	863.2	10.0	1214.0	9.07	1850.0	9.07	131.0	9.75	945.1
Shoreside AC/DC Converter [3]	30.0	318.6	30.0	418.6	30.0	579.3	30.0	41.0	31.4	303.8

1. Probabilities listed indicate the annual cumulative probability that the required load profile power will not be exceeded.
2. Required vessel charging power reflects the estimated quantity that would be measured in the feed to the ASCS at the exit from the electrical house (i.e. downstream of any switching, protection, or converters related to the shoreside DC charging system).
3. Estimated DC power required from the shoreside AC/DC converter assuming a constant charge/discharge cycle efficiency of 95%. These values should be adjusted based on specific system capabilities. Note that resulting utility power demand will be higher due to efficiency losses through the rectifier transformer or AC/DC converter, which are not included in the above numbers.

001.3 Utility Connection

Puget Sound Energy is the electrical power utility which serves the Anacortes ferry terminal. Existing utility primary distribution to the terminal is through four-wire, medium voltage (12.47kV), effectively grounded, overhead lines.

Based on initial discussions, the existing utility distribution system is expected to be suitable for expansion to support power demand of the SES, but Glosten will be working with PSE to assess the scope of any needed upgrades.

The new utility connection service is expected to be under PSE Schedule 26 (see reference 2) for large demand general service (>350kW) at primary voltage. The SES must include all equipment required by PSE beyond the Point of Delivery, including provisions for metering installation, switches, cut-outs, and other items related utility service at the primary voltage. These items should be installed as part of the electrical house and provisions should be made for access as required by PSE.

The rates for 2019 are summarized in Table 5. Due to the variability in vessel energy consumption, the peak total demand charge is anticipated to make up 40-50% of the monthly cost for electrical utility service.

Under Schedule 26, Skagit County will reduce the monthly cost for electrical utility service by 3.8% with service at the primary voltage. Due to this factor, a proposed SES intended for connection at secondary voltage (600V and below) will not be considered unless the vendor can provide strong justification otherwise.

Table 5 Summary of PSE Schedule 26 for primary service (May 2019)

Basic Charge	$343.66	per month
Total Demand Charge		
October-March	$11.89	per kW
April-September	$7.92	per kW
Total Energy Charge	$0.05669	per kWh
Total Reactive Power Charge	$0.00126	per kVARh

001.4 AC Terminal Distribution

Low voltage 480 V, 3-phase terminal distribution shall be provided for the vehicle loading ramp, miscellaneous terminal loads, and possibly electric car charging. Variable loads include ramp operation and potential car charging.

Power consumption of the various AC terminal distribution loads should be coordinated with the charging system through the PMS. This information should be included in optimization of the SES charging cycle. See Section 001.2.1.

001.5 System Integration

The SES should provide a high level of automation and integration to simplify the operation for the two-person crew on the ferry to allow them to focus attention on maneuvering and vessel operation.

001.5.1 Automatic Shore Connection System (ASCS)

The following outlines the interfaces and connections expected to be required between the SES and ASCS to facilitate the necessary operations.

a. A wired communication shall be provided between ASCS and SES. The details and level of ASCS/SES integration will depend on the systems used. See Section 001.5.2 for communication details.

b. SES to provide ground continuity relay with the ASCS disconnection switch opened on a continuity fail. VES to facilitate installation of ground continuity relay end device, but the ground continuity check system to be provided as part of SES.

c. The following hard-wired control circuits are envisioned but may be modified as the design progresses:

    1. The primary control and data transfer interface between the SES and VES (see below).

    2. ASCS emergency disconnect circuit. The circuit will be energized by the ASCS control power, and the ASCS will immediately disconnect if the circuit is opened. The ASCS vendor shall provide emergency pushbuttons to open the circuit at the pilothouse control stations and adjacent to the ASCS socket.

    3. SES pilot circuit, circuit made by LMFB contacts in ASCS. The circuit will be energized by the SES control power, and the SES isolation switch will not be able to close unless the circuit is closed and will open if the circuit is broken. The VES shall provide a contact in series with the circuit to coordinate operation of the isolation switches.

    4. VES pilot circuit, circuit made by LMFB contacts in the ASCS. The circuit shall be energized by the VES, and the VES shore isolation switch shall not be able to close unless the circuit is closed and shall open if the circuit is broken. The SES and ASCS will provide contacts in series with the circuit to coordinate operation of the isolation switches.

Items (b) and (c) above are based on what is expected to be required for a galvanically connected ASCS. Induction or other galvanically isolated types of connection systems will have different interfaces, but the functions for item (c) will still be required in some manner.

001.5.2 Vessel Electrical System (VES)

Electrical Power

The SES will provide electrical power on demand to the VES through the ASCS to charge the vessel batteries and power vessel loads while the ASCS is connected. The SES will regulate the source voltage to maintain the nominal voltage at the vessel.

The SES must maintain a relatively constant power transfer to the VES based on input requirements from the VES.

Control and Data Transfer

The SES and VES must have a set of control and data transfer interfaces which allow communication between the two systems. These interfaces are expected to be driven primarily by the requirements of the SES, but will include:

a. Basic connection and monitoring feedback from the VES to coordinate operation of isolation switches and charging.
b. Basic energy required and charging duration feedback in real-time from the VES during the vessel charging cycle. This is intended to allow the SES to coordinate the power flow from the shoreside batteries and the utility in an effort to allow the SES to optimize utility power demand (i.e. reduce monthly peak power demand) and the shoreside battery cycle.
c. Additional feedback from the VES including required energy and duration predictions for upcoming charge cycles, time remaining before next charge cycle, and other relevant data. This is intended to inform the shoreside battery charging rates while the ASCS is not connected as a means to further optimize each SES cycle.
d. Basic monitoring information to the VES to alert vessel operators of utility blackouts and other shoreside electrical conditions which will impact vessel operations or require attention from maintenance personnel.

The primary interface between the two systems will be over a wired or fiber-optic connection provided through the ASCS, intended to facilitate items (a) and (b) above. The details of the signal protocol used for (b) will be developed. Either analog current/voltage signals or an industrial ethernet communication over fiber-optic is expected to be used. Note that if the ASCS is of the non-conductive type (e.g. inductive charging) the primary interface will need to be over a robust and secure wireless connection.

A secondary interface between the two systems should be able facilitate basic data transfer between the VES and SES when the ASCS is not connected (i.e. wireless) to facilitate items (c) and (d) above. The secondary interface is not intended to be used for primary control of charging equipment.