TO: LFEV Team

FROM: Drew Jeffrey

DATE: 9 May 2014

SUBJECT: GLV/HV Isolation FEV Compliance Memo

ABSTRACT:

This memo details how the analysis requirements relating to GLV/HV isolation have been met in our system's final design. This document outlines how requirements EV 3.6.5, EV 4.1.3, EV 4.1.4, EV 4.1.5, and EV 4.5.5 have or have not been met by the current design.

REQUIREMENTS:

EV 3.6.5 - Any GLV connection to the AMS must be galvanically isolated from the TSV, including any connections to external devices such as laptops. This isolation must be documented in the ESF.

This requirement is met through the use of isolation on each signal coming out of the accumulator container. The safety loop connectors on the pack are completely GLV. The Ethernet port which leads to the TS-8160-4200 is magnetically isolated by definition of the Ethernet protocol, so even though the TS-8160-4200 SBC is powered by TSV, the Ethernet port and output is isolated on the outside of the pack. Under normal operation, the TSV terminal connections to the charging port are isolated from the outside of the pack via normally open relays. In addition, the charging detect signal coming from the charging port is isolated via an optoisolator before running to the TS-8160-4200 SBC, separating the GLV and TSV connections galvanically. The last external port, the RS-485 communication port, is isolated from the TSV through the use of an RS-485 isolator chip on the Pack Manager Breakout Board.

EV 4.1.3 - Traction system and GLV circuits must be physically segregated. I.e. they may not run through the same conduit or connector, except for interlock circuit connections.

On the outside of the battery pack, each connector only contains either TSV or GLV signals. The powerlock connectors contain the TSV provided by the battery cells. Both of the 4-pin safety loop connectors, the 6-pin RS-485 connector, and the Ethernet jack are isolated from the TSV and contain GLV alone. The charging port will typically isolate

the outside of the pack from the TSV path, so it is usually GLV. The only time the TSV will be running through the charging port is when the battery pack is charging.

EV 4.1.4 - GLV circuits must not be present in the accumulator container except for required purposes, for example the AMS and AIR. This must be demonstrated in the ESF submission.

The only two sets of GLV circuits present in the accumulator container are the isolator chips being used to interface the AMS systems inside the accumulator container with external systems such as the SCADA. In addition to isolators, the safety loop and AIR voltage runs within the accumulator container, but this is allowed by EV 4.1.4.

EV 4.1.5 - Where both tractive system circuits and GLV circuits are present within an enclosure, they must be (a) separated by electrical insulating barriers rated for 150 C or higher (e.g. Nomex based electrical insulation), or (b) separated by the spacings shown in Table 13 through air, or over a surface (similar to those defined in UL1741):

The GLV and TSV circuits on the pack manager breakout board are separated by a 0.23 inch barrier meeting the spacing requirement for 0-50VDC circuits over the surface of the PCB in Table 14 of the FEV rules. The charging relays within the pack are separated by 1 inch minimum from the TSV path.

EV 4.5.5 - All electrical insulating material must be appropriate for the application in which it is used.

There are no improper uses of insulating material in this project. Any PVC heat shrink tubing used for insulation is rated for around 600V at 105°C, which is much higher than the temperature max of 65°C and voltage maximum of 30V in normal operating conditions in which this project was designed for.