Sustainability – Lead acid battery technology practiced at Terra Supreme Battery (TSB) is similar to conventional lead acid battery technology in two aspects: (1) active materials are lead and sulfuric acid; (2) raw materials conversion and energy storage employs reduction-oxidation electrochemistry. In virtually all other aspects of cell design, material composition and deployment TSB technology is fundamentally different.

Being different has value only if the battery provides substantially improved performance and service life. An added bonus of fundamental differences would come in the form of significantly reduced battery weight and dramatically increased production efficiency. TSB Bipolar VRLAB technology includes all these aspects while manufacturing its products well within the industry's proud tradition of 96% product recyclability and full compliance with Federal and State environmental regulations.

- **Fundamental Differences –** TSB's departures from conventional Lead Acid Battery (LAB) technology are manifest in:
    - *Current collectors (grids),*
    - *Series Cell connection*
    - *Electrode orientation and module assembly*
    - *Metal-free Oxides*

- ***Current Collectors*** – Conventional LAB grids are fabricated in a variety of casting or rolling processes using pure or multi-element lead alloys. All conventional grid production processes result in positive grids susceptible to positive grid growth and intergrannular corrosion. These conditions are major sources of failure in conventional batteries, particularly when operated under conditions simulated in SAE J2801.

  TSB current collector material is a composite wire formed by simultaneous extrusion of C-glass yarn and pure lead. C-glass exhibits zero strain up to its breaking strength of 500,000 psi. The resulting composite material—and the grid formed from this composite material--is dimensionally stable and highly corrosion resistant. Positive grid growth and associated positive material shedding are eliminated as sources of failure.

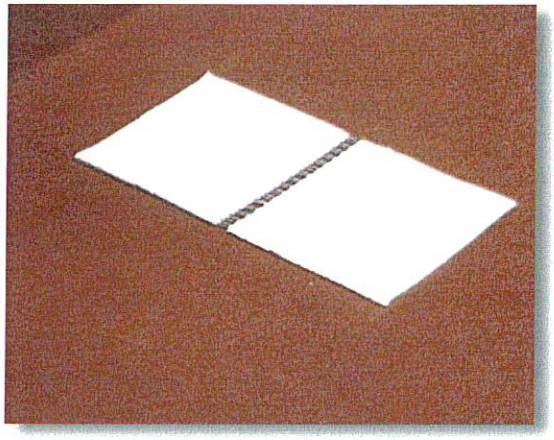
Grain structure of the pure lead in TSB's composite wire sheath is sufficiently compact to eliminate penetrating corrosion of the positive grid. Corrosion is uniformly distributed on

and restricted to the cylindrical sheath surface. Corrosion life is controlled by controlling annular thickness of the lead sheath, which can be a small as 0.0035 inches in 0.020-inch diameter composites and up to 0.0085 inches in the Group 31 0.030-inch diameter composites.

Coextruded composite wire is produced at hundreds of feet/minute in an exceptionally clean operating environment under well-controlled process temperature and pressure. The uniqueness of material produced by this process qualified it to receive a composition of matter patent--now expired--on the strength of an expert opinion provided to USPTO by Dr. David Prengaman.

The composite material produced in TSB's environmentally pristine process results in an impressively strong, lightweight, zero-strain material that is electrochemically compatible with conventional lead acid electrochemistry. It is completely recyclable with existing industry recycling technology. A particularly interesting note regarding TSB's lightweight composite wire is that its use in 100 Ahr, 12 Volt Group 31 batteries produces a battery seven pounds lighter than the current bestselling Group 31 battery. Used exclusively in production of the USA's production of Group 31 batteries, TSB grid technology would reduce annual lead consumption by ~231 million pounds.

- ***Series Cell Connection –*** Attaching the word "bipolar" to TSB's VRLAB technology refers to the use of a common current collector to connect adjacent cells in series. TSB's connection of a positive plate in one cell to a negative plate in an adjacent cell is shown in the photo below. Both plates share a common current collector.



This bipolar connection eliminates concern over non-uniform potential distribution in conventional electrodes designed with asymmetrically positioned grid tabs required to connect terminals and cells in series. TSB's unique bipolar connection provides uniform current density over both electrodes. Improved current density uniformity results in increased uniformity of active material utilization. Combined with elimination of electrolyte segregation discussed below, this bipolar cell connection ensures uniform use of active material and results in improved specific capacity, specific power and cycle life.

Using TSB bipolar technology to assemble multi-cell modules, no secondary connections are required to connect multiple cells in series. This connection schema not only

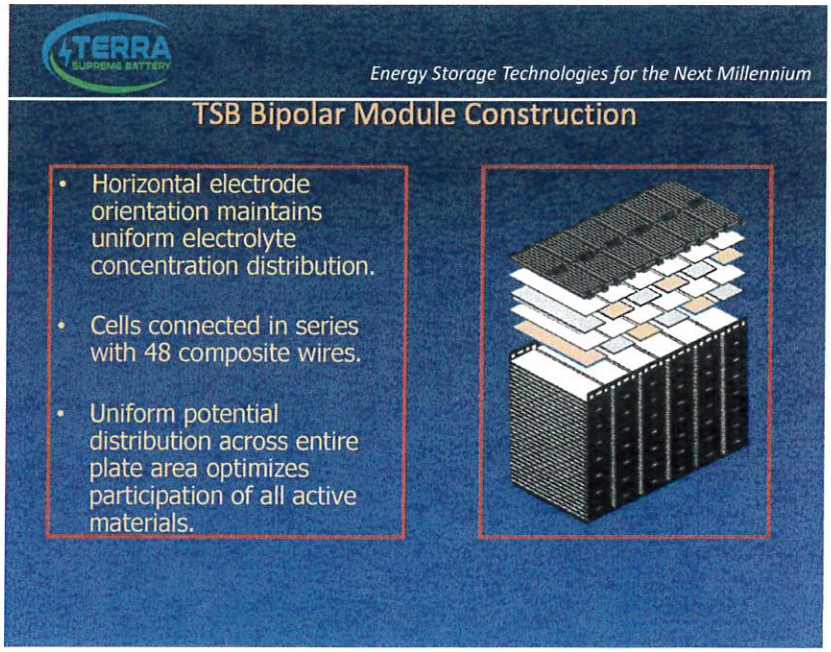
eliminates concerns over issues arising from joining dissimilar alloys to effect series connections, it also eliminates completely the need for secondary series connections. Both positive and negative plates use identical pure lead current collectors. Composite wire spanning the open space between plates is coated with hydrophobic material which isolates cells as effectively as a solid partition.

- ***Electrode orientation and module assembly*** – A major source of failure in conventional lead acid battery technology is electrolyte stratification. Effects of stratification on premature capacity and power loss are well understood by the industry. While particularly problematic in flooded cells stratification is also a source of premature failure in AGM VRLAB.

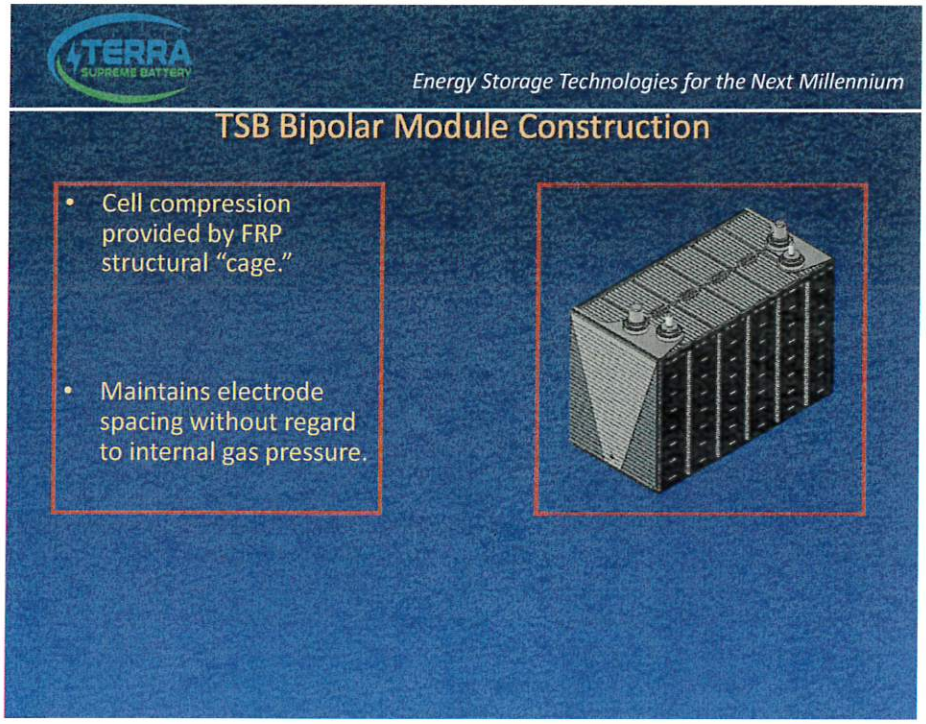
  Gravity induced concentration gradients in the electrolyte begin forming almost immediately after acid is introduced to conventional cells containing vertically oriented plates. Concentration gradients result in conductivity gradients which degrade full participation of active materials in every plate. Several schemes have been devised to maintain uniform concentration over the full surface of every electrode. None has achieved the goal of maintaining uniform concentration over the entire electrode surface. Nonuniformity increases with use and contributes substantially to premature capacity loss.

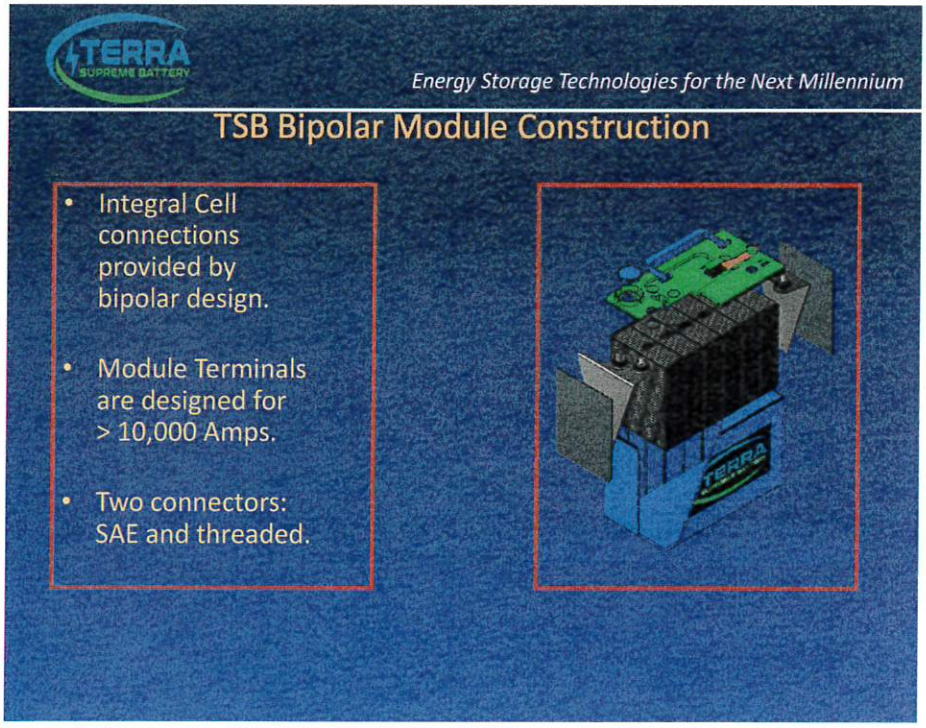
  TSB's approach to mitigating this failure mode is horizontal orientation of bipolar plates as shown below. Horizontal plate orientation provides and maintains uniform electrolyte concentration over the entire plate surface for the design corrosion life of the positive grid, corrosion of which is the primary failure mode in TSB's technology.

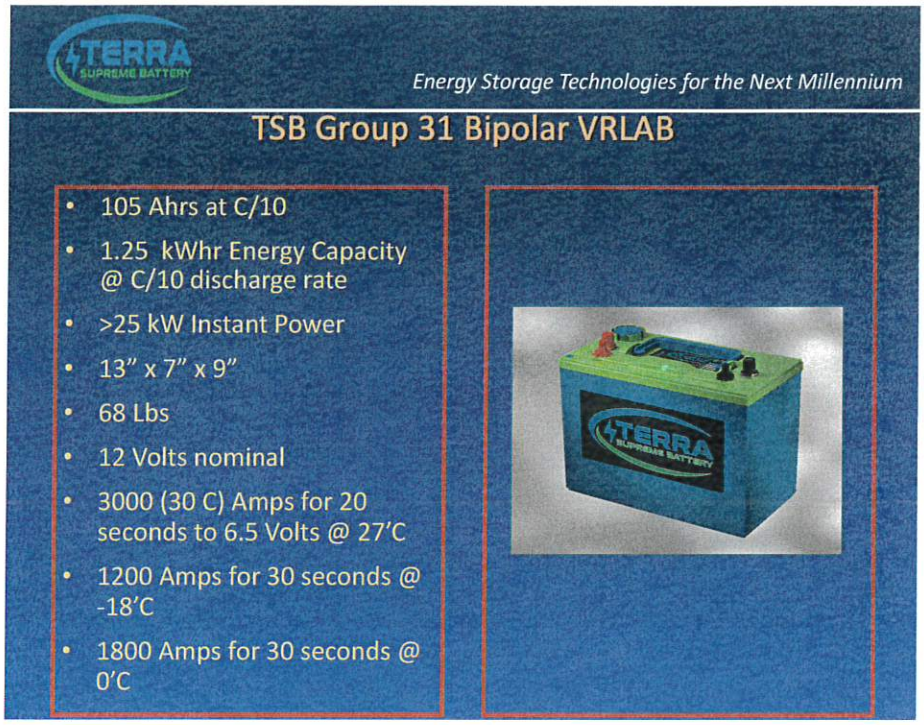
  As seen in the image below, cell connections are provided by bipolar plates during the core stacking process. The sole secondary connection required to complete assembly of TSB's Group 31 core is attaching terminals at both ends of the core.



The slide below shows TSB Group 31 Core with terminals cast onto monopolar plates at each end of the core. Total number of composite conductors attached to terminals is ~1500. Ampacity of each composite conductor is ~5 Amps, limiting total current to ~7,500 Amps. The second slide below illustrates how core, terminal and container are assembled to maintain horizontal orientation of electrodes in final assembly







Metal-free Oxides -TSB Positive and Negative active materials are prepared with oxides containing less than 1% metallic lead. This low-lead content in TSB oxides enables significantly reduced pasted plate curing time and supports continuous flow of material from pasting curing, assembly, acid filling, formation and finishing processes.

Bi-directional power supplies are used in formation and cycle testing to invert discharged power and return it to the 3-phase plant power distribution bus for use by other plant equipment. TSB production proceeds efficiently at an industry-leading pace in its highly automated, exceptionally clean, state of the art Indiana facility.

Safety – TSB bipolar VRLAB technology has been used to produce safe, commercially competitive energy-storage products deployed in a wide variety of challenging land-based, marine and airborne applications for over thirty years. The unique characteristics of TSB's technology provide superior performance in both short duration, high current and long duration low current applications.

A unique and highly valuable feature of TSB's bipolar module construction derives from its use of a proprietary phase-change material to fill all spaces inside the container unoccupied by active materials. Adding this material to the container contents after formation encapsulates each cell with non-conductive phase change material, forms discrete cell headspace for Oxygen recombination and essentially converts container contents into a rigid block endowed with robust shock, vibration and temperature tolerance properties. Batteries constructed with this technology are perfectly suited to operate safely in the most severe environments.

TSB's Indiana production facility successfully demonstrates scalability of its process and product technology to multi-GigaWhr annual capacity while retaining the environmentally responsible

standards embedded in the Indiana facility and processes.

Cost – TSB's Indiana plant has invested heavily in robotics and automation to provide a solid basis for commercial scaling to meet market demands. This strategy has significantly reduced "touch labor" to both improve quality and reduce manufacturing labor cost.

TSB's composite bi polar Group 31 product provides a significant reduction in Levelized Cost of Storage (LCOS) due to its long service life. TSB's VRLAB is designed to deliver 4,000 charge discharge cycles at 50% Depth of Discharge (DoD) and 2,000 charge discharge cycles at 80% DoD. This service offers energy delivery performance consistent with lithium products at a reduced cost while avoiding lithium's intrinsic safety issues, transportation issues, environmental issues and human rights issues associated with mining / drilling and recycling to support lithium products.

Performance – Many practitioners of lead acid battery production have long considered Bi Polar battery technology to be the holy grail for producing high-Voltage modules and delivering peerless specific power. Conceptually such performance derives from incredibly low internal resistance provided by contiguous cells sharing common current collectors. TSB's product offers best in class high current, short duration applications (CA, MCA, CCA and PHCA) and the longest deep cycle service life for marine, recreational vehicle and renewable energy storage applications.

Uniqueness – TSB is unaware of any Bi Polar AGM VRLAB being manufactured at scale today in the USA. TSB's path to creating its efficient high-volume, continuous material flow production system includes creation of over 300 trade secrets.

Value – TSB's Group 31 VRLAB provides industry leading performance and service life in both high power and deep-cycle applications at competitive pricing. The product achieves this performance duality with an almost indestructible Group 31 package weighing 7 lbs less than the current high-performance Group 31 product. TSB's Group 31 VRLAB carries a 5-year warranty.

Target applications include trucking, railroad, heavy construction, mining, agricultural, marine, recreational vehicles, data center power back up, residential renewable storage and grid scale storage solutions.