*(****Specifier Note****: The purpose of this guide specification is to assist the specifier in correctly specifying a battery monitoring system and its installation. The specifier needs to edit the guide specifications to fit the needs of specific projects. Contact a Cellwatch Product Representative to assist in appropriate product selections. Throughout the guide specification, there are Specifier Notes to assist in the editing of the file.)*

References have been made within the text of the specification to the current Master Format Section numbers and titles; specifier needs to coordinate these numbers and titles with sections included for the specific project. Brackets [ ] have been used to indicate when a selection is required. Specifier Notes should be deleted after editing has been completed.

**SECTION 26 33 46**

**BATTERY MONITORING**

NDSL, Inc. - Cellwatch

Battery Monitoring System

1. GENERAL
	* + 1. SECTION INCLUDES
				1. A daily monitoring system for lead acid and nickel cadmium batteries used as back-up power. Daily battery monitoring system consists of a means for monitoring battery voltages, Ohmic value, temperature and current. Custom wiring harnesses shall not be used and no load greater than 4 amps shall be used for measuring Ohmic values.
				2. Windows embedded software, hardware, cabling and associated accessories shall be included with the system.

*(****Specifier Note:*** *The CSI Construction Specifications Practice Guide recommends the inclusion of the date of the reference standard. In lieu of the inclusion of the date herein, the specifier may include the following statement in Division 01, Section 01 42 00 – References: “The date of the standard is that in effect as of the date of receipt of bids for the project.”)*

* + - 1. REFERENCES
				1. Reference Standards:

Conformance European (CE): EMC

Emissions: EN61326-1:2007, FCC Part 15B and ICES-00

Immunity: EN61326-1:2006

Canadian Standards Association (CSA)

Safety: CAN/CSA C22.2 NO. 61010-1-12

Safety: CAN/CSA C22.2 NO. 61010-2-030-12

Underwriters Laboratory (UL): Safety

Safety: UL 61010-1:2012

Safety: UL 61010-2-030:2012

International Organization for Standardization (ISO)

ISO 9001: Quality management systems – Requirements for quality of manufactured goods.

National Electric Code (NEC)

National Fire Protection Association (NFPA):

NFPA 70: National Electric Code.

cTUVus

* + - * 1. Definitions:

Battery: A DC electrical storage system consisting of cells or jars connected in series to achieve the required DC voltage. Strings are connected in parallel to achieve the required back up time.

String: A sub-division of a battery. A group of cells or jars connected in series.

Jar: A housing which contains multiple cells.

Cell: The basic unit of a Jar, traditionally consisting of lead acid or nickel-cadmium and delivers a nominal 1.2 to 2 VDC.

Pilot Cell: One jar of a string selected to obtain temperature readings.

* + - 1. ADMINISTRATIVE REQUIREMENTS
				1. Pre-installation meeting: Conduct a pre-installation meeting at the job site attended by Owner, [Architect] [Engineer], manufacturer’s technical representative, installer, and contractors of related trades. Coordinate installation, and other requirements specific to the project.
			2. SUBMITTALS

*(****Specifier Note****: DELETE Submittal Procedures paragraph when not required. Coordinate requirements with Division 01, Section 01 33 00 – Submittal Procedures.)*

* + - * 1. Refer to Section [01 33 00 Submittal Procedures] [insert section number and title].
				2. Product Data: Submit manufacturer current technical literature for each type of product.
				3. Shop Drawings; Submit detailed drawings showing:

Assembly details of standard components. Indicate necessary dimensions, arrangement of components, clearances and access requirements.

Include detailed wiring diagrams for power and control wiring.

* + - * 1. Delegated-Design Submittal: For battery monitoring system indicated to comply with performance criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
				2. Quality Assurance Submittals

*(****Specifier Note****: DELETE Design Data, Test Report submittal requirements when a proprietary specification is used. MAINTAIN Design Data, Test Report submittal requirement when other products may be submitted as substitutions.)*

Manufacturer Installation Instructions: Provide manufacturer’s written installation instructions including proper material storage, and maintenance instructions.

*(****Specifier Note****: DELETE warranty submittal if proprietary specification is written using only Cellwatch System.)*

Submit copy of manufacturer’s warranty.

* + - 1. QUALITY ASSURANCE
				1. Manufacturer Qualifications:

Manufacturer shall have comparable Battery Management Systems (BMS) in operational service a minimum of ten (10) years.

Manufacturer shall be registered and certified by ISO 9001.

Manufacturer shall have a minimum of 2 sources for all major manufactured components, both shall be ISO 9001 registered and certified.

Upgrades to the system shall have backward compatibility so that major components are not required to be replaced.

Repair process is facilitated by component replacement and should not require returning the system to the manufacturer.

* + - * 1. Installer Qualifications:

Installer shall be authorized, trained, and certified to install BMS by the manufacturer.

* + - 1. DELIVERY, STORAGE AND HANDLING

*(****Specifier Note****: DELETE Product Requirement paragraph when not required. Coordinate requirements with Division 01, Section 01 60 00 – Product Requirements.)*

* + - * 1. Refer to Section [01 60 00 Product Requirements] [insert section number and title].
				2. Deliver materials and components in manufacturer’s original, unopened, undamaged packaging with identification labels intact.
				3. Store materials on dry, level, firm, and clean surface.
			1. WARRANTY
				1. Refer to Section [01 78 00 Closeout Submittals] [insert section number and title].
				2. Warranty:

Standard form in which manufacturer agrees to repair or replace products that are defective in materials or workmanship within the specified warranty period.

Warranty Period: One (1) year from date product is placed in service, or 15 months for date of shipment from manufacturer, whichever occurs first.

* + - * 1. Endemic Warranty:

Endemic Warranty shall be defined as follows:

Greater than 4 failures or 10 percent failure rate, whichever is greater, of any piece of warranted equipment on any one location in any one 12 month period.

10 percent failure rate of any single piece of warranted equipment in the field population.

When an endemic warranty condition occurs the installer will provide assistance to the end-user in one of the following forms:

Pay the end-user reasonable labor costs to remedy or attempt to remedy the endemic warranty condition.

Provide staff, travel and accommodation to remedy the endemic warranty condition.

During the endemic warranty condition remedy if it is discovered that the cause was not attributable to defective manufacturer’s materials or workmanship the end-user shall reimburse manufacturer for costs incurred.

1. PRODUCTS

*(****Specifier Note:*** *Product Information is proprietary to NDSL’s “Cellwatch Battery Monitoring System”. If additional products are required for competitive procurement, contact NDSL, Inc. for assistance.)*

* + - 1. MANUFACTURER
				1. NDSL Inc.; Raleigh, NC 27612 919-790-7877 (www.cellwatch.com)
				2. Basis of Design:

“Cellwatch Battery Monitoring System”.

*(****Specifier Note****: DELETE or COORDINATE Substitution Limitations paragraph if substitutions are addressed in Division 01, Section 01 21 00 – Substitution Procedures.)*

* + - * 1. Substitution Limitations:

Submit written request for approval of substitutions to the [Architect] [Engineer] [a minimum of [14] days prior to the date for receipt of bids] [Insert bid date]. Include the following information:

Name of the materials and description of the proposed substitute.

Drawings, cut sheets, performance.

List of projects of similar scope.

Other information necessary for evaluation.

List of all exceptions and Deviations to this Specification

After evaluation by [Architect] [Engineer], if approved, approval will be issued via addendum. No verbal approval will be given.

Substitutions following award of contract are not allowed except as stipulated in Division 01 – General Requirements.

* + - 1. PERFORMANCE CRITERIA
				1. Delegated Design: Design battery monitoring system by a qualified professional engineer, using performance criteria indicated.
				2. Battery Monitoring System (BMS):

Provide transient voltage surge suppression for system components.

Battery types monitored by semi-permanent connection to battery system:

Valve regulated lead acid (VRLA) Sealed batteries: Ohmic value range 50 µΩ to 65 mΩ.

Flooded cells or Value Regulated lead acid 2v VRLA: 1 µΩ to 15 mΩ.

Ni-CAD batteries: Ohmic value range of 50 µΩ to 25 mΩ.

Inter-tier and Inter-Cell straps from 1 µΩ to 65 mΩ

Components shall have the following regulatory approvals:

CE listings for electrical noise emissions and susceptibility.

Emissions: EN61326-1:2007, FCC Part 15B and ICES-00

Immunity: EN61326-1:2006

The following listings are for electrical safety:

CAN/CSA C22.2 No. 61010-1-12

CAN/CSA C22.2 No. 61010-2-030-12

UL 61010-12:2012

UL 61010-2-030:2012

System Capacity:

Potential Voltage value measurement points: 1 to 30,000.

Potential Ohmic value measurement points: 1 to 30,000.

AC Ripple Voltage measurement: 1 to 124.

Float Voltage measurement 1 to 124.

Supports different voltage cells from 1.2vdc to 16vdc on the same system using the same components.

Current Sensors: 1 to 124.

Temperature Sensors: 1 to 124.

Integrated Battery Monitoring Unit (iBMU) – Component capacity: 31 Control Units (CU).

Control Unit (CU) – Component capacity:

254 Data Collection Modules (DCMs)

4 current measurement inputs.

4 temperature measurement inputs.

4 volt free relay contact for external alarms.

Visual indicator for Powered On / Communications Active Thermal Runaway Controller

The system meets IFC 608.3

Four relays will be incorporated to disconnect each string. Relays will be rated up to 30vdc or 250vac at 5amps.

Visual indicators will be used on each Control Unit to indicate when a string is in Thermal Runaway.

Measurement ranges:

Point Voltages: 1.2v DC to 16v DC nominal.

Temperature measurement: plus 36 to 176 degrees F.

Ohmic value range: 1 to 65,000 µΩ.

Current measurement: Scalable 10– 5000 amps depending on number of conductors used

The system shall not require any calibration at installation, yearly intervals or when jars are replaced.

The BMS shall be modular. Components of the BMS shall be reconfigurable to allow for changes in battery layouts and have the ability to add or remove BMS components without changing the entire system. New components or revisions shall be backward compatible.

* + - * 1. Software:

System shall operate using Windows 7 embedded operating system and shall be capable of loading operating system and initialize scanning without user intervention.

Monitoring capabilities:

Monitored Data: Provide for each [Cell] [Jar] [or] [String where indicated], in the BMS. Each operation listed shall be capable of being programmed with upper and lower alarm operating limits.

Voltage. (The BMS shall be able to support different voltage cells on the same system)

Ohmic value (including inter-cell link resistance). (System should not damage the battery or have a measurable impact on the battery due to ohmic value measurement.

Charge/Discharge current.

Pilot cell temperature.

Ambient temperature.

Individual jar temperatures

Ripple Voltage

Thermal Runaway conditions

Alarm conditions; program shall be capable of indicating the following either by [visual alarm indicator] [or] [audible alarm]:

Specifier Note: Ripple Voltage measurement can be selected as an option or removed if not required)The system shall be configurable for monitored data that exceeds predetermined or programmed limits set for the entire system, or by battery, string or individual cells or jars.

Cell or Jar Voltage

String Voltage

Ripple Voltage

Ohmic Value

Current

Temperature

Current Discharge Event: Occurs when the current outflow exceeds the predetermined and programmed limits set.

Current Recharge Event: Occurs when the current inflow exceeds the predetermined and programmed limits set.

The system shall provide four volts free alarm relays to permit interface to third party devices.

Ohmic value should be automatically and uniquely programmable for each jar/cell for the entire system or per string. The system should also automatically revise the base line ohmic value alarms after 35 days.

***Specifier Note****: If Thermal Runaway protection is not required this section can be deleted)*

Thermal Runaway (optional) shall be able to meet the requirements of IFC 608.3 and shall include an audible and visual alarm capabilities including LEDs on the Thermal Runaway Controller, a warning state with programmable delay to isolate the string from the UPS. The Thermal Runaway condition shall be dependent upon current, temperature of string or jar and jar voltage. The BMS shall provide advanced notification so issues can be addressed without putting mission critical loads at risk.

E-mail Alert Alarm Notification. The BMS shall have the ability to send an e-mail when an alarm occurs. Each e-mail send will include details about the site location, battery, string, date, time and type of alarm event: voltage, ohmic value, current, temperature, thermal runaway or discharge.

Monitoring frequency: The customer shall have the ability to set the frequency of data collection for voltage and ohmic value. Voltage data shall be able to be logged constantly, every hour or every 6 hours. Ohmic value shall be logged every 12 or 24 hours.

Continuously measure the following at an interval of more than once per minute:

Charge current.

Discharge current.

Pilot jar temperature.

Ambient temperature.

Individual jar temperature

Individual Jar voltage during discharge.

String voltage during a discharge

Ripple voltage

*(****Specifier Note****: Float voltage measurement shall be set between 4 and 24 times each day.)*

Float voltage measurement: Measurement set between [4] [24] times each day.

Ohmic measurement: Measurement set to [1] or [2] time[s] each day.

Monitored Data and Analysis: All retrieved data shall be stored and may be displayed as a spreadsheet in most formats (e.g. Microsoft Excel). The system shall have the ability to store at least 10 years of historical data on the iBMU. All measurement records can be extracted to a CSV file for easy viewing.

Daily Archival:

Monitored data shall be captured on a daily basis.

A trend analysis of monitored data shall be provided.

Ability to display archived data and trend analysis.

Analysis Graphs: Displayed as line or bar charts, except trend analysis and discharge graphs which shall be displayed as line graphs.

Each cell or jar monitored data for the current day.

Each cell or jar monitored data for the complete history stored.

Most recent voltage and ohmic reading for each string.

A trend analysis of monitored data for each year of operation.

An analysis of the best and worst performing Cells, Jars or Strings in a system discharge. Provide the capability of adding all Cells, Jars in the system

Alarm condition – Current outflow event: Discharge analysis showing all battery voltage curves for performance analysis. Graph shall be able to show one to all cells or jars in the system. Analysis graphs shall be capable of allowing user defined colors.

Analysis graphs shall be printable, each graph individually or all graphs.

Graphs of historic data should provide support for panning and zooming.

Graphing tool should support overlay of alarm setting for each cell or jar as an overlay to the actual measurement.

Graphs should provide support for dual axis plotting of measured parameters in a single graphic view.

The system shall support Modbus TCP/IP and SNMP interfaces.

The system shall incorporate a separate program to manage alarm data. It shall include the ability to sort events by type, alarm value, time and start or end date. All reports can be generated and exported to a CSV file. All active alarms shall be shown in red, acknowledged alarms shall be denoted with a check mark. Users must be able to filter alarm events by using the battery, string or cell/probe selections. As an option the user can select only batteries, strings and cells/probes that have alarmed will be available for filtering.

The system shall be able to provide reports for:

Total String/Battery Float Voltage

Individual Jar/Cell Float Voltage

Discharge Voltage per Jar/Cell

String Current

Ambient Temperature

Pilot Temperature

***(Specifier Note****: Per Cell Temperature, Ripple Voltage and Thermal Runaway are options and may be deleted if not required)*

Per Cell Temperature

Ripple Voltage

Thermal Runaway Conditions

Dependent upon Current, String Temperature and Jar Voltage

The system shall be able to physically identify cells or jars under investigation via a ping feature which will cause an audible alarm and flash an LED at the DCM(s) indicating which jar(s) under investigation.

* + - 1. COMPONENTS
				1. Battery Monitoring Unit (iBMU): The iBMU will control all aspects of the monitoring process including: retrieving, displaying and saving data; indicating alarm activation; processing data for historical trending; real time calculations; and control outputs to trigger external functions. The data will be presented on a customer supplied and connected color screen or over an Ethernet network connection via MODBUS over TCP/IP, SNMP, via an integrated webpage, using Remote Desktop, or a customer supplied and connected KVM over IP. A KVM over IP option allows the iBMU to be accessible via the network but isolated from the network as the KVM connects directly to the Video, Monitor, and Mouse ports on the iBMU.

Mounting: [Wall] [Rack] mounted.

iBMU hardware – minimum requirements:

1.6Ghz processor

1GB RAM.

16 GB Solid State Hard drive+

Windows 7 embedded operating system.

Fanless Mother Board

2 Network Interface Connector (NIC) 10/100/1000 MHz Ethernet Connections

One static service port (192.168.0.128/255.255.255.0)

One dynamic (DHCP enabled)

1 VGA Video Port

1 RS 485 Port for connections to the Control Unit(s)

6 USB Ports

Communicates with up to 31 Control Units

Power: [110] [240] VAC, 300 Watts, must be powered from a UPS backed supply

Component connections: RS485 cable, Belden 8102 or 88102.

Language: [English] [French]

Standard connections for external components:

Ports: Printer, [1 USB port].

Modem: via external USB Modem device

2 USB ports

2 Network Interface Connector: 10/100Mhz Ethernet connection

* + - * 1. Control Unit (CU): The Control Unit shall communicate to the DCMs via a fiber optic loop. The functions of the Controller include; conversion between digital RS485 and optical signals, up to four independent current readings per Control Unit, up to four independent temperature reading per Control Unit for ambient and/or pilot cell temperatures and the facility for four volt free contacts to be used as alarm and control outputs. A total of 31 RS-485 Addresses can be connected to a single IBMU. The Control Unit must support a network up to 2000’ from the iBMU.

Mounting: Wall mounted.

Power: [110] [240] VAC, 20 Watts, must be powered from a UPS backed supply

CU hardware – minimum requirements:

Controls 254 Data Collection Modules (DCMs)

Includes 4 current inputs.

4 temperature probe inputs.

4 alarm triggered volt free relay contacts.

10 alarm triggered volt free relays for Thermal Runaway Controller

Interface for generator extension via RJ45 connector

Sensing inputs:

Temperature- Solid state probe

Resolution- 0.05 degrees C

Accuracy- +/- 1 degree C

Range- 2 to 80 degrees C

Current- Solid state magnetic core sprung clamp 2” (50mm) capacity 1,000 amps or 4.5” (112mm) 2,500 amps

Resolution- 1.0 amps

Useful Range- +/- 10 to maximum amps of clamp

Component connection: RS485 cable, Belden 8102 or 88102.

* + - * 1. Generator Kit : The system shall be capable of monitoring small remote batteries typically used for generators up to 4000ft from the BMU
				2. Data Collection Module (DCM): Data collection modules shall measure voltage and Ohmic Value for of up to four measurement points to which they are connected. All electrical wiring shall be affixed to the DCM prior to shipment and no cable crimps shall be required during installation. DCMs shall have an option for measuring the temperature on the negative post of each jar. DCM shall utilize fiber optic cable for communications to ensure reliability, noise elimination and safety. Electrical wiring between DCMs is NOT acceptable. Each DCM shall support a transmitter (white or blue connector) and a receiver (black connector) that is fiber cabled to provide a fiber connection between each DCM and continues until a loop is formed returning to the Control Unit. Maximum distance between DCMs will be up to 150’. The maximum rating of any DCM is 80VDC standard.

***Specifier Note****: DCM VDC measurement rating set to [60] or [80]*

Mounting: Dual Lock.

Conductors shall be minimum 22 and maximum 14 AWG, 300 v rated, 15 amp maximum, insulated wire meeting the requirements of UL 1015

Conductors shall be color coded.

All wiring that connects to the battery should be acid resistant.

Each DCM can measure up to 4 jars or cells data. Data collection includes:

Voltage

Ohmic Value

DCM shall have a sleep mode that after 25 hours of no communication with the Control Unit it shall reduce the power requirement to less than 2ma to conserve battery life.

Average current draw during ohmic testing shall be less than or equal to 2 amps.

Voltage range shall be 0 to 80vdc with 2mv resolution with accuracy of 0.1%, +/-5mv.

Ohmic value range 1 to 65 milliohms with accuracy of 2%, +/- 8 micro ohms below 1m ohm and 1.5% above 1m ohm

Ripple voltage (across 4 jars, 40 Hz to 1K Hz) range 0 to 4 v rms with resolution of 2mv rms and an accuracy of 2%, +/-5mv rms.

Component connection:

Factory installed terminators on 36 inch wire harness to Jars.

Fiber optic cable for data communication between DCMs and the CU.

* + - 1. ACCESSORIES
				1. DCM Cables Specifications:

Fiber optic cable shall be acrylic, 1.0mm core diameter and 2.2mm outside diameter with a 400-700 nm wavelength. The supplied cable must be acid resistant, highly isolated, and immune to electrical noise.

* + - * 1. Current Transducers (CT):

Mounting: Battery lead, clamped around bus line

Component connections: Standard 35’ cable provided by manufacturer. Maximum distance is 150’.

Solid state, magnetic core sprung clamp. 2” (50mm) capacity, 1,000 amp or 4.5’ (112mm) 2,500 amp.

* + - * 1. Temperature Probe (TP):

Mounting: bolted via 8mm (5/16”) lug fitted or with removable adhesive pad

Component connections: Standard 35’ cable provided by manufacturer. Maximum distance is 150’.

Solid state probe

 *(****Specifier Note****: If external annunciators, such as buzzers, light fixtures, etc., are provided under another section indicate section number and name. Delete if no annunciators are required.)*

* + - * 1. [External Annunciators: Refer to Section [Insert section number and name]]
1. EXECUTION
	* + 1. EXAMINATION
				1. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of electrical equipment. Connect in such a way as to facilitate future disconnecting with minimum interference with other components.
				2. Verify that power source for all equipment has surge protection as required by manufacturer.
			2. PREPARATION
				1. Coordinate external enunciator’s location and connection to BMS.
				2. Conduit installation:

Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

Electrical Contractor to install conduit and provide 120VAC circuit with duplex outlet from the UPS output to provide power to the iBMU.

Electrical Contractor to install conduit and provide 120VAC circuit with simplex outlet from the UPS output to provide power to the Control Units and Thermal Runaway Controllers.

Electrical Contractor to add a network drop and coordinate with end user for provisioning an IP address.

* + - 1. INSTALLATION
				1. General:

Installation shall maintain System UL listing.

Mount components plumb and rigid without distortion of component chassis.

Ground equipment in accordance with manufacturer’s requirements.

Install and wire components in accordance with the NEC.

No custom wiring harnesses shall be required.

The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Chapter 3.

* + - * 1. Install components in locations within the manufacturer’s installation guidelines.
			1. CONFIGURATION and START UP
				1. Factory Authorized service representative must program the system utilizing the end user’s designations for the system components.
			2. FIELD QUALITY CONTROL
				1. Testing Agency: Engage a qualified testing agency to evaluate BMS and perform tests and inspections.
				2. Perform the following tests and inspections with factory authorized service representative:

Operational Test: After installing components, and after electrical circuitry has been energized, start system to confirm proper operation.

Test and adjust controls and alarms limits in accordance with manufacturer’s recommendations.

* + - 1. DEMONSTRATION AND TRAINING
				1. Refer to Section [01 79 00 – Demonstration and Training] [Insert Section number].
				2. A minimum of 2 hours on site customer training shall be completed by the installer before the system is turned over to the customer. This training will be performed within 48 hours of the completion of the installation.
				3. Engage a factory authorized service representative to train Owner's personnel to adjust, operate, and maintain components.
				4. Completion of manufacturer provided Commissioning report and submission of completed report to the manufacturer for validation.

END OF SECTION