Large-Capacity DC Battery System for Nuclear Power Plant

Features
Backup DC power system utilizing Toshiba Lithium-ion Secondary Batteries, SCiB.

(1) High-Energy Density Batteries
(2) Highly-Efficient Battery Cells

The SCiB batteries can enable configuration of more compact DC power systems than conventional lead acid batteries.

The product lineup of the backup DC power systems contains floor-standing type and portable type.

(1) Large-Capacity Integrated Battery Panels
(2) Portable Uninterruptible Power Unit

Application
The backup DC battery system can enable to implement an extended loss of all AC coping time of 72 hours for core and spent fuel pool cooling and for reactor coolant system and containment integrity as needed.

In addition, the backup DC battery system can be the alternate DC power source when a loss of DC power event occurs.

The backup DC power system classified as Non-Class 1E for Nuclear Power Plant.

Portable Uninterruptible Power Unit can be flexibly applicable to Instrumentation and Control systems of Nuclear Power Plant.

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SCiB Integrated Battery Panels contains their Battery Capacity about 3 times the capacity of lead-acid storage batteries per unit area.

Portable SCiB Uninterruptible Power Unit is available as Backup DC Power for Instrumentation and Control systems. The feature of Portable enables flexible connection to any I&C Panels at any time or place.

Backup DC Battery System comprised of the SCiB batteries, classified as Non-Class 1E, can assist station DC power when loss of DC power occurs.

**Background**

Necessity of measures for Loss of DC Power situation is one of lessons learned from the Fukushima accident precipitated by an earthquake and tsunami, the direct caused that both AC and DC power were unavailable. As a result, plant monitoring systems and controls of Motor Operated Valves were unavailable. Therefore operators in the control room could not open the valves to the containment vents, owing to the station blackout and the loss of DC power. Toshiba provides the backup DC battery system which supplies DC power to the auxiliaries during the station blackout.

**Benefits**

This system is connected to existing DC Power System only when needed. This design provides:

1. **Large-Capacity and Space-Saving**
   Battery Capacity has more than tripled as SCiB Integrated Battery Panels contains their Battery Capacity about 3 times the capacity of lead-acid storage batteries per unit area.

2. **Easy Installing into Existing DC Power System**
   Installing the Backup Batteries for existing DC power system of Operating Plant will not require any difficult task. Connection into the existing Bus of the DC system is required.

3. **Easy Operation**
   Changing the decayed batteries to the SCiB will be configured by the operations of breaker control on the power distribution panel. The control system for operation from Control Room optionally will be relievable task of operators during the station blackout.
Experience
SCiB has been released in 2007 and has been adopted to EV (Electric Vehicle) and HEV (Hybrid Electric Vehicle), industrial batteries, and Portable UPS for office and home use. Toshiba develops Seismic Qualified, fault tolerant, and online maintenance featured Battery System, for Backup use of the existing DC Power System of Nuclear Power Plant, based on the technology of SCiB.

The SCiB has a special anode chemistry and separator construction that make it much safer than conventional lithium ion batteries; it is very resistant to thermal runaway phenomenon common to other batteries, as demonstrated by testing.

Description
During normal plant operation, station AC power supplies the Backup Lithium-ion Secondary Batteries. When a station blackout event occurs, the station DC batteries supply DC power to the auxiliaries. After the station DC batteries are decayed, circuit breakers shall operate to disconnect the station batteries and connect the Backup DC Battery System comprised of the SCiB batteries.

The Backup DC Battery System with Large-Capacity Integrated Battery Panels is composed of the followings:

- Battery Panel
- Battery Modules with Battery Cells and CMU (Cell Management Unit)
- BMU (Battery Management Unit) and Main Switches and Contactors
- Battery Control Unit
- Battery Charger (for SCiB)
- Load Center (Air Circuit Breakers)
- Power Distribution Panel

The Portable Uninterruptible Power Unit with SCiB is supplied as a packaged unit (battery charger included). Equipment supply is include all required instrumentation and control systems.

Technical Data
The specification of the backup DC power system is shown as below.

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of cells per string</td>
<td>51</td>
</tr>
<tr>
<td>Nominal Battery voltage</td>
<td>125 V</td>
</tr>
<tr>
<td>Maximum Floating Voltage</td>
<td>129 V</td>
</tr>
<tr>
<td>Minimum Discharge Voltage</td>
<td>105 V</td>
</tr>
</tbody>
</table>

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