# Battery Energy Storage Systems

## CASE STUDY | SOLON MANUFACTURING CO.




Large-scale BESS installations supporting grid stability and power demand

**9%**
Projected AI share of U.S. power demand by 2030

**5×**
Preload loss reduction with Belleville washers

**24/7**
Mission-critical uptime required in BESS facilities

## INDUSTRY CHALLENGE

As AI workloads and high-density data centers drive unprecedented growth in power demand, utilities and infrastructure providers are rapidly deploying Battery Energy Storage Systems (BESS) to stabilize the grid and ensure continuous power availability.



BESS installation

These systems play a critical role in balancing load, supporting peak demand, and enabling more resilient energy distribution. But as BESS installations scale in size and frequency of use, they face increasingly extreme operating conditions:

- Dissimilar materials in joint components result in differential thermal expansion (DTE)
- High current flow causes joint materials to heat up more than the bolts themselves, increasing DTE
- Rapid charge and discharge cycles reduce bolt load with every thermal cycle
- Vibration and embedment relaxation cause connections to loosen over time

As bolt load is reduced, electrical joint resistance increases, causing heat or hot spots that can result in even higher resistance and, ultimately, catastrophic failure. In mission-critical BESS infrastructure, even a single compromised connection can threaten the reliability of the entire system.

**Reliability is no longer determined solely by system capacity; it is determined by the integrity of the connections within it.**

## SOLUTION

Solon Belleville spring washers provide a proven, engineered solution, actively compensating for thermal cycling, material creep, and vibration to maintain consistent preload in bolted electrical connections throughout the service life of the installation.

Unlike traditional flat washers, Belleville washers apply a continuous, flexible load that adapts dynamically to changes in joint conditions. As components expand and contract through repeated thermal cycles, the washer deflects to maintain clamping force, preserving consistent contact pressure across the connection without the need for re-torquing.

By stabilizing preload, Solon Belleville washers minimize resistance changes, reduce heat buildup, and prevent loosening over time. Electrical connections remain secure and conductive even under the demanding conditions typical of modern BESS applications, including switchgear, busbars, battery terminal blocks, and inverter connections.

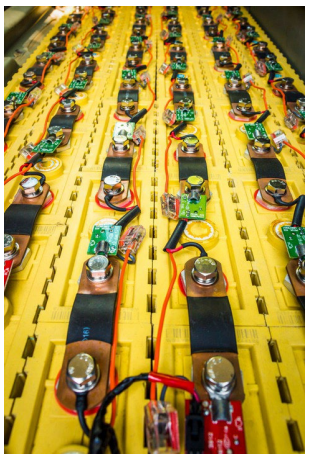
Their live-load capability ensures continuous performance under rapid load fluctuations and aligns with IEEE, IEC, and NEMA standards for high-reliability connections in mission-critical power infrastructure.

## WHERE BELLEVILLE WASHERS ARE APPLIED IN BATTERY ENERGY STORAGE SYSTEMS

| | |
|---|---|
| Busbar Connections | Busbar joints connecting dissimilar materials experience differential thermal expansion (DTE) with every charge cycle, reducing bolt load each time. Belleville Washers counteract DTE to prevent hot spots and reduce preload loss. |
| Battery Terminal Blocks | Terminal connections accumulate embedment relaxation over thousands of cycles. As bolt load drops, joint resistance increases. This leads to hot spots and potential catastrophic failure. Belleville Washers reduce preload loss to less than 1%. |
| Switchgears & Disconnects | Connections loosened by vibration and embedment relaxation can cause arc flash, a type of electrical explosion. Solon Belleville Washers maintain sufficient bolt preload to prevent the resistance increases and hot spots that trigger arc flash. |
| Grounding & Bonding Points | Thermal cycling degrades ground path integrity over time. Belleville Washers maintain reliable ground continuity through repeated thermal cycles, supporting compliance with grounding and bonding standards. |



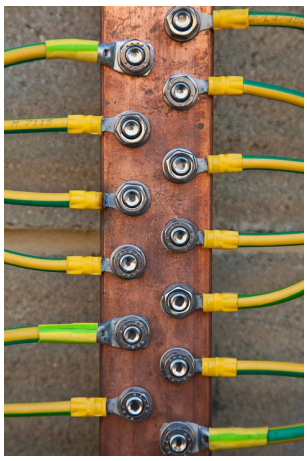
*Busbar Connection*



*Battery Terminal Block*



*Switchgears & Disconnects*



*Grounding & Bonding Point*

## KEY BENEFITS

| | |
|---|---|
| Connection Integrity | Maintains consistent clamping force under high-cycle thermal conditions, preventing resistance buildup and joint degradation. |
| System Uptime | Enhanced operational reliability reduces the risk of connection-level failures that cause unplanned outages in mission-critical installations. |
| Reduced Maintenance | Live-load compensation eliminates the need for periodic re-torquing, lowering total cost of ownership and maintenance burden. |
| Standards Compliance | Engineered to align with IEEE, IEC, and NEMA requirements for bolted electrical connections in high-reliability power systems. |

## ADDITIONAL RESOURCES

| | |
|---|---|
| Case Study | Improving Electrical Reliability to Meet AI Power Demand |
| Case Study | Belleville Washers Supercharge Grid Reliability |
| Case Study | Solon Belleville Springs Maintain Bolt Preload on Electrical Connections |
| White Paper | Bellevilles Strengthen Grounding & Bonding Reliability in Data Centers |
| White Paper | Maintain Bolt Preload on Electrical Connections Using Belleville Springs |
| White Paper | Bellevilles Distribute Load to Improve Performance and Reliability |
| Application | Belleville Washers Keep Bolted Joints Tight |
| Calculator | Bolted Electrical Connections Calculator |
| Industry Served | Data Centers |

# ABOUT THE AUTHOR



***George P. Davet, BSME, MBA is President, Chief Engineer and Owner at Solon Manufacturing Company and has written and published numerous articles on the use and application of Belleville spring washers. To learn more about Bellevilles and Solon Manufacturing, visit www.solonmfg.com, for technical resources such as case studies, white papers, product selection tools and videos.***

Copyright © 2026. All Rights Reserved.

For additional information, please contact Solon Manufacturing Co.
800.323.9717 | sales@solonmfg.com | www.solonmfg.com