

Integrated Sequence of Operations: Coordinating ATS and UPS Set Points Can Avoid a Hidden Cause of Downtime

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A relatively unknown cause of downtime that can easily and inexpensively be prevented is often detected (regrettably) when it occurs—sometimes after catastrophic events leading to downtime. Yet, this cause can be avoided altogether by:

- Maintaining proper documentation
- Regularly checking set points
- Conducting routine transfer tests
- Conducting routine outage simulations
- Commissioning and re-commissioning properly

The trigger is having uncoordinated set points for your automatic transfer switch (ATS) and uninterruptible power supply (UPS), which can produce conditions where the ATS is unresponsive to threatening power fluctuations, which can damage equipment and/or cause downtime.

The following three conditions can lead to problematic situations:

Under-voltage (brown-out) The utility voltage decreases below the nominal voltage, typically 208V, 240V, or 480V (depending on the site). If the UPS system's voltage tolerance is set to transfer to battery backup at a higher voltage value than the ATS tolerance, the generator will not start, the UPS will run on its batteries until depleted, and the site could suffer a power outage.

Over-voltage An incident in which the utility voltage exceeds the nominal voltage. Depending on the age of the ATS, or the options package purchased with the ATS, over-voltage sensing may not be present. Over-voltage conditions can cause end user equipment damage or cause the UPS system to transfer to batteries. The generator will not start, the UPS will run on its batteries until depleted, and the site could experience a power outage.

Out-of-phase transfer When transferring the load from the generator source to the utility source, a transfer out-of-phase can cause some UPS and inverter systems to reject the source voltage based on their set points. This can be a concern for an older ATS and those without an in-phase transfer option.

Incorrect set points, and set points that are not coordinated between ATS and UPS or inverter systems, can lead to damaged equipment and/or site downtime. The frequency or likelihood of occurrences are site-dependent, and can increase if the electric utility is conducting tests or the utility transmission system is under construction.

The following three instances actually occurred at EEC customer sites. Affected customers have now taken corrective actions to document, assess, and check set points to avert similar crises in the future.

Field Example #1

The UPS under-voltage threshold was set at 85% of nominal voltage and the ATS shipped with a standard under-voltage threshold set at 70% of nominal voltage. However, no one calibrated the transfer switch to its new environment. When the utility introduced a low-voltage condition with a value that fell between 70% and 85% of nominal voltage, the UPS transferred to its batteries, but the ATS did not start the generator. Once the UPS batteries were depleted, the site went dark.

Field Example #2

The utility substation lost voltage regulation, causing an over-voltage condition in excess of 110% of the nominal value. The grid lost remote control of voltage regulation at the substation and the ASCO 300-series transfer switch has only under-voltage protection, not over-voltage. As a result, end-user equipment was damaged.

Field Example #3

The electrical contractor and operator were either unaware of the equipment type they bought, or never took the time to correctly set up the protection relays. The site lost one phase of utility, which the main breaker micro-logic control identified. However, the OEM of the generator controls regarded the alarm as a hard fault in the switch gear and would not allow the generator main breaker to close to support the customer site.

Uncoordinated set points between systems is typically discovered and corrected during site commissioning. But if the site was never properly commissioned, or if equipment has been replaced or adjusted over time, the problem may expose itself only during an electric utility event.

Technicians who specialize in UPS, switch gear, or generators often focus solely on their equipment and area of expertise while overlooking calibration with related equipment. In addition, specialists may be apprehensive about making equipment adjustments beyond their assigned responsibilities. Sometimes they're not authorized to make adjustments.

In contrast, customers utilizing the EEC integrated approach to mission-critical facility services benefit from a more “holistic perspective” to the data center. For these customers, all the required technicians are dispatched so they can properly calibrate set points across diverse equipment types to ensure optimal site uptime.

These recommendations and best practices for proper sequencing of switchgear, UPS, and generator help ensure optimal uptime:

- Utility fluctuations vary by location and upper / lower thresholds are site-specific, so customize these to the utility. First, consider how tight you want the thresholds to be since you don’t want the generator coming online several times a day.
- Perform initial calibration when commissioning a new site. This is largely an engineered solution in which technicians program all equipment set points in a “staggered approach” to ensure the equipment responds appropriately and in the right sequence.
- Perform a re-commissioning and assessment whenever adding new equipment (UPS, generator, ATS). Consider it re-commissioning a subset of your data center around new equipment. For older equipment, you would be adjusting an inaccurate mechanical potentiometer. Now with most of the new units, you can calibrate the component voltage within a single volt or tenth of a hertz. Newer technologies use smaller circuit boards, and unlike older equipment, solid-state electronics are fine-tuned and very sensitive to voltage fluctuations.
- Immediately calibrate new equipment to the site and other equipment, since it often ships with factory settings and is not calibrated to existing equipment or the local utility supply. In addition, factory settings may be out of sync with existing equipment.
- Testing and calibrating is recommended at least every five years if no new equipment has been added.
- Testing outage simulations is also recommended, though you may fear a failure and jeopardizing the infrastructure when transferring the data center to generator. To ensure no downtime, EEC coordinates transfer tests during maintenance windows with multiple trades and blackout plans.

Verifying and adjusting set points properly could cost as little as \$2,000, depending on the site and amount of equipment to be calibrated. This represents as little as \$400 per year over a five-year period. A complete sequence-of-operations review may cost up to \$10,000.

A quick calibration represents only 1% to 4% of equipment cost, relative to the cost of a new UPS, ATS, or generator that could range from \$50,000 to \$200,000.

Furthermore, when you consider downtime cost, the time and expense to properly sequence equipment becomes insignificant. In a study by the Ponemon Institute and Emerson, downtime cost was estimated at \$7,900 per minute.¹

Do you have proper documentation that has been updated after moves, changes, adds? If not, you are at risk; sequencing should have been done. Conduct sequencing when adding new equipment, or at least every five years. You don't want to discover you don't have sequencing plans in place when you're in the midst of an incident.

So, help evade data center downtime by easily and inexpensively coordinating set points between your ATS and UPS. Don't forget to:

- **Maintain proper documentation**
- **Regularly check set points**
- **Conduct routine transfer tests**
- **Conduct routine outage simulations**
- **Commission and re-commission properly**

These recommendations apply to single UPS/ATS pairings. Sites with additional layers of redundancy or higher Tier ratings could likely have the same coordination issues, but the process required to calibrate the set points could be more complex. EEC recommends that a thorough study be performed on a per-site basis to determine the appropriate solution.

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¹ <http://www.datacenterknowledge.com/archives/2013/12/03/study-cost-data-center-downtime-rising/>