PRECISION POWER
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How Do You Choose the Right Laboratory Instrument Power Protection System Option?

Making the Right Choice Will Save Money and Time

You recently acquired or are considering a new and very expensive piece of instrumentation for your laboratory. The instrument manufacturer (OEM) recommends, in the site installation requirements document, that you evaluate your power and assure that your new instrument is properly protected. What are your options? What does each choice deliver? What does each choice fail to address? What are the consequences of making the wrong choice?

Basically, there are four (4) possible options associated with protection or lack of protection for any instrument. There are pros and cons to each option.

1. **Operate the instrument without any form of power protection.**

In this case, the only benefit is cost saving up front. The downside risks substantially outweigh this dubious benefit. Your instrument will be subject to all the hazards commonly associated with dependency on the local utility (mains) power: electrical distribution, utilization and circuit reliability/failure. On average, at typical 99.99% power delivery reliability, local utilities suffer 53 minutes of power outages a year. Typically, these outages do not conveniently occur on Sunday at midnight, or during low productivity time. The number of minutes of total outages does not include the unmitigated power fluctuations (transients) from the wall outlet, or power panel, delivered directly to the instrument. Transients occur at inconvenient times such as during peak demand, when you need clean power the most.

The consequences of exposing today's highly sensitive scientific instruments to "dirty" or unmitigated power range widely. Poor power quality may be the ultimate culprit in an ongoing series of annoying instrument behaviors that no one can trace even after hours, days or weeks of OEM maintenance visits to troubleshoot the problems. Power fluctuations and random outages may cause test data/informatics to become corrupted or lost. If a prolonged outage with the ubiquitous power surge(s) at restart occurs, the instrument may suffer costly damage in terms of repairs and extended loss of operational and billable or research time.

An unprotected instrument system is not a viable option because the long-term consequences greatly outweigh the short-term gains. What are your other options?

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2. **Install a central UPS to protect the facility**.

Once the central (typically three-phase/3-Ø) UPS (uninterruptible power source) and associated infrastructure is installed, mains power enters the UPS where it is conditioned and corrected, then voltage reduced and distributed to the laboratory and other departments within the enterprise. The laboratory, however, does not have just one instrument plugged into that nicely conditioned central power source from the Power Distribution Unit (PDU) and sub-panels. Common line noise and harmonic distortion is introduced into the pooled power source by all of the other instruments, automation, sample preparation, centrifuges, vacuum pumps, refrigerators/freezers, fume hoods, computers, printers and other ancillary equipment and what have you connected to it.

The laboratory must address the issue of local 3-Ø load balancing to prevent overloading the individual circuits and the central UPS. The lack of remedial isolation transformers and point-of-use harmonic distortion correction means that instrument circuit isolation; even from "dedicated circuits" is forfeit.

Further, without intelligent communication, command, and control of the central UPS to the instrument system controller, there is no soft shutdown capability to safely manage a critical laboratory asset should the central UPS fail to provide battery backup reserve power.

A central UPS does a great job for most other power consumers in your laboratory, however, for your highly sensitive analytical instruments, it is not enough. Point-of-use power mitigation should be considered, especially if the central UPS is load limited.

3. **Install a local UPS to mitigate power issues for the instrument**.

Having read thus far, most seasoned laboratory managers agree that a local point-of-use UPS should be placed between any building power (mains) source and your high-throughput and sensitive workhorse instrumentation. How do you determine which type of UPS will do the job that your specific instrument needs done?

Let's eliminate two (2) types of UPS immediately. "Off-line" and "line-interactive" (Automatic Voltage Regulator- aka limited "online") UPS are not recommended for instrumentation as they do not continually mitigate the power to produce required power quality for instrumentation. To provide "green operational benefits" these low-cost UPS products provide minimal waveform correction and are principally designed for voltage regulation. These UPS designs (low cost "off-line"/"line-interactive" topology) are in many cases sophisticated extension cords. What may be good for a computer system is not necessarily the right choice to protect instrumentation.

Power correction/regeneration technology recommended for such instruments must, ***at a minimum*****,** meet the following criteria:

- Double conversion technology/topology (AC > DC || DC > AC) is mandatory.
  - The double conversion design must have fidelity to a true sine-wave to reduce harmonic distortion to < 3% and preferably ≤ 2% Total Harmonic Distortion (THD).
- Voltage regulation ± 1%
- Frequency regulation ± 0.5% with Phase Lock Loop (PLL) to the mains frequency.
- In the case of any instrument (load), any scheme (hardware and software) other than what has been tested by the OEM must be qualified (certified) on-site to communicate with the power protection/regeneration system and the "load".
- Ideally, intelligent communication, command and control of this design should be present to enable soft shutdown.

4. Install an IPPS, the ideal power regeneration and mitigation solution for laboratories.

An IPPS (Instrument-specific Power Protection System) has the advantage of being purpose-built and certified to the unique instrument application (with ancillary support equipment and control) and is supported by "**Smart Monitoring and Reporting**" communication capability.

An IPPS meets or exceeds all of the mandatory OEM criteria and delivers the highest asset protection, smoothed digital signal processed-synthesized sine-wave power with virtually harmonic-free power delivery, soft-shutdown, and battery backup, for total system reliability.

An IPPS with an internal isolation transformer continually regenerates, conditions and cleans the irregular harmonics to prevent inconsistent the power flowing to your instrument. An IPPS offers all the capabilities of a fail-safe battery backup system for extended runtime, and is emergency generator compatible.

An IPPS is configured to require intervention on restart (no automatic restart) via manual or software control to eliminate the possibility of secondary mains failure as the utility comes back online. Without this feature and other configurations/operational procedures, any instrument is subject to power surge/transient "whiplash" as the utility comes back online and is eventually stabilized. <u>These types of transient incidents cause the most damage to instrumentation and loss or corruption of informatics. The damage is post-power failure and occurs upon utility/mains power return to service.</u>

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An IPPS delivers "Smart Monitoring and Reporting" communication via the SNMP (standard network management protocol) - a global industry standard.

IPPS units designed for high-end instrumentation are equipped with special hardware and software configuration and SNMP protocol cards and software. This allows:

- Intelligent communication, command and control of the IPPS by the laboratory globally.
- Real-time information on incoming power quality and delivery (output) to the instrument.
- Battery condition and autonomy (backup) time to allow a soft shutdown to prevent damage to the instrument and avoid damaging the batteries of the IPPS.
- Troubleshooting via internal data logging associated with catastrophic power incidents/events directed at the IPPS and the instrument.

An IPPS provides autonomy (battery backup) for extended operation

The IPPS is specifically designed to be compatible with an emergency generator (gen-set) system with an Automatic Transfer Switch (ATS); accepts a wide range of input voltage with frequency independence (VFI). An IPPS connected to an emergency generator circuit provides **near unlimited** backup time and completely regenerates the electrical power. When the generator runs out of its fuel (energy) source, the batteries of the IPPS continue operation until the user selected autonomy limit time is reached.

The next step to achieve consistent laboratory and equipment performance

If key laboratory equipment is not protected by a combination of an IPPS/UPS and an emergency generator, consider adding "point-of-use" IPPS units to protect those "mission critical" laboratory assets. IPPS provide regenerated power technology (RPT) with "Smart Monitoring and Reporting" communication and control capability. Most power events last between 20 msec. and 5 minutes, which is well within the capability of these power quality mitigation products, their technology and autonomy (backup) time. If longer backup time is required, auxiliary battery extension cabinets are available to extend run times up to two (2) hours. A soft equipment shutdown is much preferred to a hard crash, due to a collapse of the utility/mains power system.

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IPPS units include surge protection (SPD/TVSS), true sine wave digital signal processing (DSP) and noise filtering circuits in their design. The best part of IPPS products is they are very affordable, at < 5% of equipment acquisition cost, and provide 24 x 7 protection for up to five (5) years on their original internal power reserves (batteries). If your laboratory has limited access to long-term emergency generator power, "point-of-use" IPPS products become a viable solution to your laboratory power management and contingency planning strategy.

Precision Power International, Inc. (PPI) understands the laboratory market and has over 35 years of engineering expertise to assist in providing a certified IPPS in a timely manner that meets your needs and provides complete instrumentation system protection. The bottom line is your lab can now ***produce consistent results with the lowest cost per reportable result, in timely manner and within budget***. After all, that is what business performance and continuity is all about – consistent performance and results, with high customer satisfaction. Your colleagues will be impressed how your lab operates at near perfection and how you made the right choice in picking the best laboratory and instrument power protection option.

If you still have questions regarding the right choice to protect your mission critical laboratory operation or a sensitive instrument, Contact a PPI applications engineer to discuss your application and operational goals. A few minutes spent with a PPI engineering consultant will allow you to learn how you can protect your valuable laboratory instruments with the right instrument power protection systems with appropriate battery back-up system and runtime.

Precision Power International (PPI) is a developer and supplier of energy and power products to protect sensitive and costly laboratory instrumentation. The company also provides engineering services to assist laboratory managers in achieving the right power solutions for their unique applications. PPI specializes in value added systems engineering (VASE), software monitoring services (SMS), and consulting engineering services (CES) for the global energy, power technology, and large end-user technology markets. PPI offers "true" turnkey systems integration with "plug and play" designs for the scientific, technology specifier, and end user applications. Precision Power International's engineers design, integrate and certify product applications utilizing the best and most robust "world-class" technology available.

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