PRECISION POWER
INTERNATIONAL, INC.

High-Throughput Testing:
It's all about STABILITY

When considering the purchase or operation of automation equipment and instrumentation systems for High-Throughput Testing (HTT), the laboratory operating environment and most importantly your electrical power stability are the keys to successful timely and lowest cost reportable results production. With up to 80% of the power problems experienced by the laboratory operator, being generated by and within its own lab operating environment (Electrical Contractor – Nov 2006), the best way to secure your investment is to protect it at "point of use" with a certificated instrument power protection system (IPPS).

The primary reasons your institution considered the acquisition of high-throughput instrumentation and supporting automation included:

- Reduced time / cost to reportable result
- Specificity
- Precision
- Accuracy
- Continuity of testing over multiple shifts
- Long-runtime productivity
- Sample and specimen integrity
- High asset utilization and
- Operations within budget

All of the above are related to return on investment (ROI) and return on assets (ROA).

The later (ROA) is a measure of equipment utilization and overall productivity. The acquisition of HTT equipment implies you have "big plans" for your laboratory business/operation, as well as a commitment to senior management to produce results, improve the institution's image and reputation, while simultaneously maintaining a very high level of internal and external customer satisfaction.

A review of most laboratory original equipment manufacturer's (OEM) Site Preparation / Installation Guide documents identifies the requirements for a successful installation and operation of your new instrumentation system and its numerous ancillary automation and support equipment/services. The key factors for successful operation, instrumentation system availability and stability are:

1. Operating Environment (Critical Utility limits)
    - Temperature
    - Humidity
    - Vibration
    - Lighting
    - Air Quality
    - Electrostatic Discharge (ESD)
    - Water Quality
    - Shield Gas Quality
    - Instrument Cooling Systems

2. Line and Load (Instrumentation) Power
   - Power Quality - Line (input) and Load (output)
   - Power Line Monitoring (24 x 7 and/or 24 x 7 x 2)
   - Power Conditioning / Power Mitigation Devices
   - Total Harmonic Distortion (THD) management
   - Noise Suppression (EMI / RFI)
   - Transient Voltage Surge Suppression (TVSS / Lightning Arrestors)
   - Grounding (System Elements and Positive Earth Ground)
   - Local Induced (micro-environment – within lab) Disturbances

3. Data / Informatics / Control System

4. Sample / Specimen Storage Integrity

Most research and quality assurance/control laboratories have HPLC or UHPLC (LC) as a key and required instrumentation system for LC or LC/MS/MS testing. LC in all of its forms is so ubiquitous we don't generally give it a second thought. It is a fundamental workhorse of the lab. UHPLC goes by many trade names and when HTT comes into play, the stability of the instrumentation system itself and the other instruments it supports becomes more interesting and has a larger impact on the productivity of the lab. Add the MS instrumentation section of the LC/MS/MS or roll TOF/TOF MALDI or even consider next-gen sequencing into the lab's mix and you have a significant investment in instrumentation that demands environmental, power and operational stability.

Critical Utilities (CUs) are identified and well defined by the U.S. Government and the International Society for Pharmaceutical Engineering (ISPE); CUs are well known industry baseline requirements for Good Laboratory Practice (GLP) and Good Manufacturing Practice (GMP) – aka (GxP) operations. The problem with the CUs, which principally define the Operating Environment above, is that electrical power and associated power quality (PQ) are not considered in the scope of the CU Guidance documents. The standard for obtaining satisfactory CU performance is the electrical power quality (PQ) is stable and within limits of the CU specifications. Nearly everyone in the lab has at least a limited awareness of electrical PQ. If the "lights are on", the electrical system must be working and the PQ "appears" to be OK. Not a very scientific approach to power quality, but one that is the norm for most labs and commercial business. Without satisfactory electrical PQ, we cannot expect to operate within acceptable CU limits. Without control of the CUs, labs are operating on the "wild side" with respect to their budget, productivity and reputation.

Getting back to Line and Load (Instrumentation System) Power, as defined by the Site Preparation documents for your HTT system of choice, we generally find:

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1. Recommendations for operating voltages and frequency within reasonable power supply input tolerances.
2. Advice to monitor the incoming power to the instrument circuit for at least 24 x 7 to determine PQ levels.
3. Criteria for power conditioning, mitigation and/or regeneration (RPT) to provide "clean" Load power.
4. Elimination of spurious radio-frequency line noise (RMI / EMI) induced on the power lines and circuits.
5. Safeguards against transient voltage spikes - common during power switching events and storms.
6. Appropriate and mandatory instrument element grounding that eliminates erroneous data transfer.
7. Awareness that up to 80% or more of the power problems in the laboratory are induced by other local equipment on the same Line/circuit(s) as the instrumentation system you are operating.

While most labs perform a cursory review of the line voltage, they miss a fundamental and most deleterious hazard to instrumentation and its operation. By not continuously monitoring the power lines for at least one (1) or possibly two (2) week(s) before installation/operation, the lab is unaware of the "gremlins" waiting to do the lab and its HTT plan harm. By missing this key step, the lab is not aware of harmonic distortion levels on the electrical power Line and the internal damage it causes to sensitive electronics. Harmonic distortion effectively "slows roasts" and in some cases "fast broils" critical instrumentation circuits. While the "lights are on" and most equipment is humming along, your HTT equipment is subject to and experiencing asymptomatic indications of trouble ahead. If the problems your lab experiences are not reproducible, suspect your PQ is poor; this performance discrepancy must be corrected and eliminated.

Most instrumentation OEMs do specify total harmonic distortion (THD) of < 6%; MS/MS instrumentation OEMs specify < 3% THD to their products. It is doubtful the average lab can provide THD of < 9% and may typically see 30 - 50% THD as noted during Line monitoring power audits. PQ audits are simple to perform and record. Most electricians, the local Utility (Power Company) and certainly your facility engineers/technicians can provide 24 x 7 x 2 monitoring, when you first consider budgeting for the HTT system of choice. As you develop your testing plan, consider the local laboratory environment and PQ correction and regeneration that will be required to keep your instrumentation running smoothly. If your laboratory is supported by long-term emergency power generation (gen-set with an automatic transfer switch – ATS), assure your HTT system is provided with point of use "bridge power", such as an IPPS to provide flawless power delivery to your key operations asset(s).

If you find yourself in an operational mode or were only recently made aware of the OEM's Site Preparation specifications, don't despair. Certified Instrument Power Protection Systems (IPPS) are readily available and custom built/configured to meet your specific HTT system needs. IPPS units are designed with regenerated power technology (RPT) to mitigate and correct all of the power issues noted above. IPPS are equipped with "Smart Monitoring and Remote Reporting" technology as standard equipment. The best part of IPPS products is they are very affordable at < 5% of HTT equipment acquisition cost and provide 24 x 7 protection for up to five (5) years on their original internal power reserves (batteries). 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 HTT with the lowest cost per reportable result, in timely manner and within budget. After all, that is what STABILITY is all about – consistent performance and results.

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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