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Cutting-edge Research Facility Uses Harmonic Suppression Technology to Ensure Integrity and Reliability of the Electrical Distribution System

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The National Space Science and Technology Center is a research facility which is a partnership between NASA's Marshall Space Flight Center, Alabama universities, federal agencies and industry. The facility is designed to support cutting-edge research in selected scientific and engineering disciplines. The facility is staffed by University of Alabama faculty and outside scientists from around the world. It also serves as a training facility for both graduate and undergraduate students. Students work with the professional staff to develop research skills while contributing to the many projects that are ongoing.

At the NSSTC research performed ranges from theoretical concepts to product development. Research fields include spacecraft, sounding rockets, balloons, aircraft and alternative energy.

Principals involved in the successful completion of this project are, from left to right: Hanaback, Brown, Robinson, Grega, and Hughes.

The building is owned by the University of Alabama in Huntsville and is located at 320 Sparkman Drive. The facility electrical distribution system was designed by Jerry Robinson, electrical engineer, *O&S Enterprises, Inc*. Building design was under the direction of Larrel Hughes, architect, *L. Hughes Associates*, The electrical contractor and electrical supplier were Johnny Hanback, *Allied Electric, Inc*. and Drew Grega, *Mayer Electric Supply*. The overall project was under the direction of Dave Brown, Associate Vice President for Facilities and Operations at the University.

In designing this system it was clear that the primary requirement was for reliable power. Much of the building load would consist of computers and sensitive laboratory equipment, all of which would be susceptible to voltage surges and circulating ground currents. It was also clear that the loads would all be non-linear and would therefore draw significant amounts of harmonic current through the electrical system. The design of the electrical system was optimized to avoid electrical problems.

The following significant design features were implemented to ensure the reliability of equipment operation.

1. Numerous small transformers were used to provide power, rather than a single large transformer. This ensured that an electrical failure, if one occurred, would be localized.

2. A harmonic suppression system was installed with each transformer to ensure that harmonic currents were minimized on both phase wires and ground wires throughout the system. This type of harmonic mitigation reduces harmonic currents from the transformer out to the furthest outlet.

3. A dedicated ground wire was run from each transformer back to the main service ground to reduce the possibility of circulating ground currents.

Multiple harmonic-suppressed transformers were used to power the building reliably without permitting harmonic current flow.

4. Transient voltage surge suppression (TVSS) was added at the panel level throughout the building. This would best protect the equipment from surges and high-voltage transients.

5. Each laboratory was powered from its own dedicated panel, rather than sharing panels between multiple labs. This was done to minimize the possibility that electrical disturbances generated in one area could affect another area.

Incorporating harmonic suppression technology into the original electrical system design resulted in an additional benefit – cost savings. Since harmonic currents were eliminated from all the system wiring, transformers, and switchgear, oversizing of the system to handle extra current was unnecessary. There was no need for double neutral wires, special panels, or oversized or k-rated transformers. Eliminating these features resulted in lower building costs. Operating costs were also reduced. Lower harmonic currents reduced I^2R heat losses throughout the system, resulting in direct energy savings. Additional energy was saved because the air-conditioning was not required to remove harmonic-generated heat. Based on results from other installations of this type, the entire cost of the harmonic suppression technology is expected to be offset by energy savings in less than two years.

The building has been in operation for one year with completely satisfactory operation of the electrical system. All the sensitive test equipment and computers have operated reliably. Those doing research in the facility have remarked on the lack of trouble with their equipment. It appears that designing this facility from the start to be electrically reliable and, particularly, to be free of harmonic currents, has paid off. The National Space Science and Technology center has proved to be an outstanding facility for research into cutting-edge technology.