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FEA has been publishing the designPLUS Newsletter every quarter for the past five years and during that time we have witnessed many changes to the data processing environment. What has been the most disconcerting is that most of the changes we see today, including dual power cord technology and high density data processing equipment, were not even envisioned three or four years ago. It is very difficult to accommodate these new requirements so it is necessary to ensure that data centers are designed and built with the flexibility to meet almost any need. The designPLUS newsletter addresses mission critical design issues with the hope that it assists in providing some insight into these changing environments.

GLOBAL WARMING

by Leo P. Soucy, Jr., P.E.

Whether you agree with the reasons for global warming - excess carbon dioxide emissions or a natural re-occurrence of long-term weather changes - we have to admit that this past summer showed the consequences with long, record breaking heat waves.

This past summer's hot weather resulted in many localized power problems. Power problems in the past tended to be very extensive, affecting large geographic areas and many businesses; and were relatively short-lived with power restoration within hours to a few days. These outages were the result of a portion of the electrical power system being overloaded, usually a large transmission line, resulting in the system shutting itself down as a safety measure to minimize damage. After the initial shutdown, the problem section was isolated and the network re-establish. Often times the section that caused the problem could either be brought back on-line or bypassed, allowing for full service restoration while this section was being repaired.

The power problems this past summer were more localized and resulted in extensive damage to a portion of the power system at the distribution level and not the transmission level. At this level there is less opportunity to by-pass a problem to re-feed the loads, so any equipment damage must be repaired prior to power restoration. Some areas were without power for over a week.

This summer's power outages resulted in a number of power companies' maintenance and operating practices being scrutinized due to the time required for them to react and adequately determine the extent of the problem and necessary time to repair. One area that exacerbated the problem is that deregulation, where the generation, transmission and distribution systems are operated by separate entities, divides the overall responsibility for power delivery to the end user. We only see this problem getting worse over time.

Mission critical facilities need to be aware of these problems and prepare for these long outages. It is important that standby power systems be operated at least 24 hours under full load annually during hot weather to adequately test the system's ability to operate under the most severe conditions. If there is a system problem it is best to identify it when utility power is available to fall back on and not when there is a total utility outage.

ARC FLASH HAZARD PART I OF II: WHAT IS ARC FLASH HAZARD?

By Rafiq Bulsara, P.E.

The arc flash hazard in electrical installations has now become a huge liability for owners and employers. For starters, arc flash hazard analysis is required by Code, NEC article 110.16. Also, OSHA inspectors are currently enforcing NFPA 70E that outlines how to perform an arc flash hazard analysis. The responsibility of meeting Code and OSHA requirements ultimately lies with the Owner. This responsibility involves performing an arc flash analysis and providing training and protective equipment to the electrical staff. We plan to provide some insight into this issue in two parts. Part I will review what arc flash hazard is and Part II will review how to perform an arc flash hazard analysis.

In an arcing electrical fault there is a visible arc established between the electrical points involved in the fault. The arc is established when the insulating medium, typically air, breaks down and starts conducting electricity. An unabated arc will result in ionizing, heating and rapid expansion of the air, resulting in a flash or blast or both. Since the arc fault current is not completely contained within the electrical conductors, it releases a dangerous amount of heat and energy into the surroundings. Extreme heat causes metal to melt and even vaporize. Intense light is emitted; the blast causes the propagation of pressure and sound waves, as well as shrapnel. This makes an arcing fault very dangerous to a person and the equipment in the vicinity, even though an arcing fault usually involves lower levels of current and energy compared to a bolted, solidly connected fault. However, in a bolted, solidly connected fault the fault current and energy remains more or less contained within the conductors and is not emitted into the surroundings. The high current of a bolted, solidly connected fault also causes the protective overcurrent devices to open quickly limiting the damage, while the lower arcing fault current may delay the clearing of the protective devices or they may not even clear, causing considerable damage.

The best way to avoid injuries and damage related to an arc flash event is not to work on or within close proximity to live electrical components. If this is unavoidable, proper Personnel Protective Equipment (PPE) needs to be worn by the person performing the live electrical work. Simple acts such as opening and closing of a switch or a breaker, even with covers on, or measuring voltage with a multi-meter are considered live work. Measuring the voltage to verify that the bus is dead is also considered live work. All such work requires proper PPE to minimize arc flash and shock related injury. PPE is designed to limit the burn injuries to second-degree burns, which are extremely painful but curable.

PPE is categorized by the incident energy that it can withstand. There are 5 levels of PPE, from 0 (none) to 4. If the incident energy exceeds category 4 levels, the equipment cannot be worked on while energized. To perform any work on the equipment, a shut down must be taken. Only a properly designed, dual path redundant or N+N electrical system will permit shutting down part of a system for maintenance without affecting the critical loads.

It is difficult to perform work with a PPE rated category 3 and above because of the restricted movement and vision. The PPE itself could be the cause of an accident. Also a person cannot stay, for any reasonable length of time, in PPE category 3 or 4 as the flow of fresh air is blocked by the PPE.

There are two guidelines available today to perform an arc flash hazard analysis. One is described in NFPA 70E and the other is in the IEEE standard 1584. These will be reviewed in the next newsletter.

<u>*NOTE:*</u>

- ⇨ *The heat of an arc flash can reach 35,000 degrees F, four times the temperature of the surface of the sun.*
- ⇨ *The sound magnitude of an arc blast can reach 140dB at a distance of 2 feet. This is comparable to a jet engine at take-off or a gun muzzle blast.*
- ⇨ *If arc flash results are accurate and the proper PPE is used, it will only limit injuries of affected persons to second-degree burns.*
- ⇨ *A properly designed, redundant dual path or N+N electrical system would permit shutting down part of a system for maintenance without affecting the critical loads. This is the best insurance against Arc Flash Hazard liabilities.*

DATA CENTER LIFE SPAN

by William H. Flaherty, Jr., P.E.

In the early 1980s data center hardening began in earnest. Early systems consisted of uninterruptible power supplies installed along with standby generator plants. Although the terminology did not exist at the time, the systems were typically N+0 or N+1 redundant. As time progressed, Fortune 500 companies realized that further hardening of the their infrastructure was required if reliability was to be maintained at the increasing levels demanded by the business. Some of the improvements made include:

- ➪ Hardening of the chiller plant and chilled water distribution system (early 1990s)
- ➪ Implement static switch technology (mid - 1990s).
- ➪ Upgrade of UPS systems to IGBT
- ➪ Upgrade system from N+0 or N+1 to 2N redundancy and implement "A/B" power distribution to dual power cord equipment
- ➪ Upgrade data center cooling to accommodate high-density equipment technologies (early 2000 to present).

These improvements span over 20 years and have resulted in some of the originally installed equipment being replaced with newer more current equipment. Some of these improvements require the complete re-design of the data center infrastructure.

One of the questions that has been raised is when is the existing data center electrical infrastructure equipment obsolete? ***FEA*** has been involved in many data center upgrade projects and we have found that most equipment has a life of no more than 15 to 20 years. The main reason for this is the fact that this specialized equipment uses commercially available electrical and electronic components that become obsolete in that time frame and are no longer commercially available. We have replaced numerous UPS systems that were just under 20 years old due to the fact that the manufacturer no longer supported the equipment. During the last years that this equipment was on-line, it was necessary to scavenge parts from units removed from service to keep the on-line equipment operating. In some cases this resulted in the Owner purchasing decommissioned equipment to insure that these parts were available. Equipment is also re-designed to take advantage of newer technology that renders the original equipment obsolete. The application of IGBT technology in UPS systems is an example. This design change resulted in having to pay a premium to purchase the older SCR technology, as the new IGBT based equipment could not parallel with the older design.

Infrastructure obsolescence is another concern. The implementation of 2N redundancy, UPS power distribution supporting dual power cord equipment (A/B bus), and high density cooling are now the driving factors in upgrading data centers and are driven by computer equipment technological changes. These infrastructure upgrades require major re-configuration of the utility infrastructure and also revisions to the facility including added space, increased raised floor heights and/or complete revision of the air conditioning system.

FOOD FOR THOUGHT - Generator Wet Stacking

Operating generators at less than 35% of their rated capacity results in wet stacking, which is a condition where fuel is not completely burned and migrates into the valve housing resulting in the valves sticking. This condition results in the generator not being capable of operating at higher loads. The excess fuel in the exhaust stream also deteriorates gaskets. If you have to operate a generator at low load, make sure you run it near fully loaded for 45 minutes to burn off any excess fuel.

Policy
designPLUS Newsletter is published to keep the readers current with the latest trends in mission critical systems.

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