Increasing Operational Integrity in Military Electrical and Electronics Systems

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American military superiority has been achieved through a variety of means... much of it rooted in advanced "smart" weapons and sophisticated C3 systems that allow our forces to enjoy supremacy in the air and on the ground.

All of these systems are, however, dependent upon uninterrupted electrical power... literally, the "central nervous system" of all advanced military systems. Without electrical power, personnel and infrastructure are not only left non-operational... they are effectively left defenseless and blind-folded.

Although any electrical power outage can have catastrophic consequences for our men and women in uniform, there are particular military environment in which power must be maintained at all costs to preserve life and facilities:

- **Unfriendly Territory:** Environments in which U.S. military facilities are located in geographic areas in which they must remain completely self-sustaining, e.g. the local government cannot always guarantee failsafe electrical power in the event of an emergency.

- **State of High Alert:** Situations in which U.S. military facilities – such as the DMZ between North and South Korea – remain on high alert for hostile actions by opposing forces. An interruption of C3 capabilities could invite enemy incursions, and irreparably jeopardize the safety of U.S. forces.

- **Adverse Climate**: Situations in which flight conditions are already imperiled due to ice, snow, rain, high winds, sandstorms, etc. In such adverse conditions – found literally everywhere in the world – on-the-ground electrical systems are essential to maintaining ground readiness and air traffic control, e.g. ensuring safe take-offs and landings.

- **24x7 Operational Readiness**: Some facilities – such as NORAD – must maintain uninterrupted surveillance over large sections of North American airspace as part of military and Department of Homeland Security defense measures… despite adverse weather conditions or regional power problems. Since September 11, 2001 NORAD fighter jets have responded to more than 2000 air threats here in North America a mission that would be compromised if advanced electronics systems were even temporarily non-operational.

A vital partner in ensuring the security and safety of U.S. airspace is the Federal Aviation Administration, whose 14,000 tower employees ensure the safety of nearly one billion passengers and 100 million arrivals/departures annually.

Because FAA air and ground control operations – like those used by the military – are wholly dependent on electrical systems, the Administration is constantly researching the most advanced electrical power maintenance technologies as they approach the commercialization stage.

Since October 2004, the FAA has been evaluating "Power Analytics" technologies developed by a San Diego-based company called EDSA Micro Corporation. In its simplest terms, "Power Analytics" describes a class of software tools (marketed under the commercial name Paladin™) that possess the ability to predict – and thus, prevent – electrical power irregularities that could jeopardize operational readiness.

In April 2005, the FAA deployed Paladin™ in its New York TRACON for systems level monitoring and maintenance operations; based upon the success of that deployment, a second deployment, in the Denver ARTCC, was subsequently undertaken.

Over months of "on the job" FAA use, Paladin™ correctly predicted and preempted 99.95% of potential electrical faults. Or, put another way, the system correctly diagnosed pending electrical problems *at their formative stages* – while there was still time to effect repairs and avoid a power outage – 99.95% of the time.

As a result of these trials, the FAA concluded that Paladin™ is a very effective platform for ensuring electrical system integrity, for four primary reasons:

- Potential electrical infrastructure problems can be "designed out" of a facility before it is constructed or modernized. The Paladin™ system creates more than a typical CAD blueprint of a facility: it creates a dynamic, "virtual model" of all internal systems and components. This model is used to simulate and validate the operational parameters of the overall electrical distribution system, to ensure system-wide integrity even before it is physically constructed... even potential "what if" problems that are beyond the scope of operational probability.

- Once the facility is constructed, the software can be switched from "design mode" to "surveillance mode." In this mode, Paladin™ compares the "virtual model" – armed with all expert knowledge about the facility's target operating specifications – to actual, online data from the facility's physical equipment to check for deviations.

- In comparing the "actual" and "virtual" performances of the electrical infrastructure, the software is able to detect the most negligible variations... even those involving seemingly unrelated components.

This actual-to-virtual methodology accurately predicts yet-to-fail component that, left undetected, could result in a power outage.

- Paladin™ has advanced, customizable data reporting tools that can generate individualized real-time status reports – tailored for the informational needs and the technological knowledge of each individual.

  So, if an administrator needs an overall, general understanding of a facility's electrical "health," he or she can receive high-level reports, as simple as "green/yellow/red light" readouts. But if an electrical engineer needs very detailed, component-by-component readings on voltage, frequency, and power factor, those reports can be easily customized as well.

  This flexible reporting capability prevents one of the most frequently-cited problems resulting in electrical power outages: information overload. In case after case, human error – specifically, incorrect human action caused by misinterpretation of systems readings – has been shown to worsen, if not directly cause, the severity of power outages.

In conclusion, the FAA's trials have yielded a wealth of valuable civilian intelligence that the military aviation community can learn from and leverage with regard to electrical power problems.

Since both share the common goal of ensuring maximum systems safety and integrity, it is logical to conclude that the same operational benefits already achieved by the FAA's use of the Paladin platform – maximized operational readiness, electric/electronic vigilance, and situational awareness of infrastructure health – could be extended to our military aviation capabilities, as well.

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