The Mission Criticality of Energy Resilience

Enhancing survivability and recovery for installations

by Randy J. Monohan

Secure and resilient supplies of energy are critical to an installation's mission, yet many Marines take energy security for granted. Our installations are vital to the defense of our Nation but are also vulnerable to various threats and resource limitations that put our energy security at risk. Extreme weather events, accidental and deliberate disruptions, reliance on a fragile and complex commercial grid, and deliberate cyberattacks can cause missions or essential services to be interrupted with little to no warning. As the 2018 National Defense Strategy makes clear, the homeland is no longer a sanctuary. In response to these threats and the growing need to increase Marine Corps energy resilience, Marine Corps Installations Command recently set a goal of energy independent operations for priority base services and mission-critical operations. By establishing a fourteen-day supply of energy for critical functions and securing energy-related control systems, installations will be able to support the Marine Corps mission of generating combat power through any foreseeable disruption to energy supply.

The Marine Corps recognizes that innovation is the road to resilience and is focusing on energy resiliency projects and technologies to help installations harden energy distribution systems, survive in the event of a prolonged loss of electrical service, and to enhance recovery from disruptions. By recognizing and investing in innovative energy security projects and new technologies capable of responding to disruptions in the energy supply chain, the Marine Corps will improve its ability to sustain critical missions, better equip Marines for forward operations, and heighten overall readiness of our operational forces.

>Mr. Monohan is the Energy Projects Officer (GF-1), Marine Corps Installations Command.

Resilience is an Attitude

The concept of resilience is intrinsic to the Marine Corps. Marines are trained to be resilient and self-sufficient in diverse combat situations, responding swiftly to risks and adapting to various environments. The readiness and resilience of Marines sets them apart and allows them to complete the mission despite any adversities. It is necessary to bring this same culture of readiness and resilience to installation energy operations.

The Marine Corps is instilling energy security awareness in its Marines, civilians, and organizations, with a focus on personal energy behavior. The Marine Corps' energy ethos is the shared vision that the efficient use of energy resources

APS reviews the controls in the MCAS Yuma microgrid which eliminates energy interuptions to allow Marines to focus on their aviation mission. *(Photo by author.)*

is a critical component of mission readiness. A successful Marine Corps energy ethos will ensure a secure and resilient supply of energy and water to support the operating forces, their mission, and their families. Energy ethos is the foundation for installation energy culture, emphasizing the value of our energy supplies and the connection between energy performance, warfighting capability, and battlefield survivability.

While the energy ethos focuses on reducing the demand for energy, it is part of the larger program to achieve energy security. The installation and facility systems that provide and use energy resources need to be reliable, resilient and efficient in order to provide the mission support that the Marine Corps requires. Accomplishing this feat goes beyond merely investing in reliable power sources. Achieving resilience includes assessing and prioritizing the energy security needs of installation operations, developing contingency plans, and training essential personnel to ensure operations continue through disruptions. Now more than ever, stakeholders from across the installation including public works departments, mission assurance teams, facility managers, tenant commands, information assurance, and cybersecurity managers need to work together. Finding the optimal energy security solutions to ensure mission success requires careful collaboration and leadership engagement at every level. Several installations are already implementing these concepts. Now, all commands need to recognize the importance of resilience to Marine Corps readiness and work together to create greater energy security on our installations.

Marine Corps Installations Seeing Benefits of Resilience Projects

The commercial electric grid, which the Marine Corps does not operate or control, typically supplies installation energy. Using commercial grids as the primary—and sometimes, only—energy supplier for Marine Corps installations comes with several risks, including unanticipated power outages, inclement weather, operational errors or accidents, and potential physical or cyberattacks. Sometimes, the solutions and risk mitigations are simple. For example, the Marine Corps recently conducted an energy resilience exercise at an administrative building. The exercise found that a portion of mission-critical computer equipment was connected to outlets that were not powered by the emergency generator. During a power outage, the generator kicked in; however, the equipment that the unit needed to continue operations still did not have power. Many lessons were learned and the unit relocated the equipment to an outlet that is served by the backup generator. This easy, low-tech exercise increased resilience and illustrates the importance of Marines coming together to prepare for any situation.

The new cogeneration (CHP) plant at MCRD Parris Island under construction in July 2018. ***(Photo by author.)***

Energy supply and distribution often create a single point of failure.

In other situations, solutions are more complicated. Energy supply and distribution often create a single point of failure (SPOF) in terms of continuity of mission. To address a SPOF, Marine Corps bases are beginning to use a mix of micro-grids, renewable energy, and backup generators to combat the threat of a prolonged grid outage. In a few locations, the bases are already seeing the benefits.

Marine Corps Air Station (MCAS) Yuma. At MCAS Yuma, home to the F-35B Joint Strike Fighter, a 25-megawatt (MW) backup power plant connected to a micro-grid went online in February 2017. During times of high operational tempo training and preparing F-35B pilots and crews for deployment, losing power to the airfield is not an acceptable outcome. Without reliable and resilient power, computer equipment cannot function, which could cause support system malfunctions or grounded aircraft. The new power plant produces enough electricity to power the entire base in the event of a commercial grid outage. MajGen John J. Broadmeadow, former Commander of Marine Corps Installations Command, said at the groundbreaking:

> This project will make MCAS Yuma 100% resilient to external grid failures, and is an example of an effort that will ensure our bases remain at the forefront of the defense of the country.

Arizona Public Service (APS) constructed the micro-grid through an enhanced use lease where the utility constructed, owns, and manages the micro-grid that was built within MCAS Yuma's fence line. The micro-grid is connected to the utility's substation and can protect both MCAS Yuma and

other local APS customers on the Yuma grid. Since going live, the micro-grid has started up nearly 60 times, preventing and mitigating impacts that could have degraded both the mission and the surrounding community. "The system constantly monitors the power grid in real time and can see fluctuations in frequency," explained David Morton of APS, "When it notices something that could cause harm to the base, it automatically starts 25 MW of power from a dead stop, to a full load powering into the grid, in just 15 seconds." MCAS Yuma will remain mission ready because of this newly patented technology that provides all systems on base uninterrupted power in times of energy disruption.

While MCAS Yuma's micro-grid arose out of a need to support mission readiness, it has also provided other substantial benefits. The structure of the enhanced use lease means that the DOD did not need to fund the project and was able to lease the underutilized land to the utility where the micro-grid is installed. APS continues to maintain the land, saving DOD maintenance dollars and personnel that will instead be devoted to mission critical work.

Marine Corps Recruit Depot (MCRD) Parris Island. MCRD Parris Island has plans to install a variety of new energy security systems to help reduce the installation's dependence on the commercial grid and diversify its energy sources, increasing the base's energy reliability and resilience. MCRD Parris Island entered into a $91.1 million, 22½-year term energy savings performance contract with an energy service company that bundles long-term payback resilience measures with shorter-term payback standard efficiency upgrades (e.g., LED lighting and HVAC upgrades). This project is scheduled for completion in spring of 2019 and will include the installation of a 3.5 MW cogeneration plant, 3.5 MW of backup steam generators, and 5.6 MW of solar energy. The new on-site solar generation assets are installed in two locations at MCRD Parris Island: a solar carport on a large parking lot used for boot camp graduation and an array on an old airstrip. The energy produced by these new resources will be stored in an 8-megawatt hour battery connected to the installation's micro-grid control system. This state-of-the-art control system will monitor use, optimize energy performance as well as provide "islanding" capability, which means powering the micro-grid in stand-alone mode in the event of a prolonged commercial grid outage. The combination of these distributed energy resources and secure control systems will enable the Parris Island training mission to continue critical operations through future disruptions.

Marine Corps Air Station (MCAS) Miramar. As part of its mission to provide combat ready expeditionary aviation forces, MCAS Miramar has become a leader in energy security innovation. In June 2016, the installation established islanding capability for its public works building using a 250-kilowatt (kW) flow battery, a rechargeable battery that stores energy in two tanks of liquid that flow past each other to generate electricity. The flow battery stores power from a 230kW solar-powered micro-grid system. This micro-grid system uses 100 percent solar power and advanced energy storage technology to provide complete independence from the grid while supplying enough power to cover all of the energy the building consumes.

This building-level micro-grid is just the beginning. MCAS Miramar is currently constructing an installation-wide micro-grid, which will supply on-site resilient power to over 100 mission-critical and essential facilities. This project will leverage the existing landfill gas power plant and on-site solar generation combined with new diesel and natural gas generators. All of these distributed resources will be controlled and managed at two separate locations to provide the energy security needed for mission assurance and this important installation.

Creating resilience for energy security requires many stakeholders working together across the installation.

The Future of Resilience

Creating resilience for energy security requires many stakeholders working together across the installation. Mission owners, facilities, energy, utility, and control systems communities must collaborate to identify critical, priority, and essential requirements to achieve mission assurance. Collaborating and sharing information will enable the development of effective technical solutions for each of our unique installations. Completed projects show that the Marine Corps can—and should—be prepared to provide uninterrupted power in support of the mission. An energy-resilient Marine Corps is a stronger Marine Corps, capable of training, power projection, operational support, and sustainment of forward deployed forces.

In the future, the Marine Corps plans to support and protect all critical installation missions from energy supply disruptions by providing energy security and the technology to be self-sufficient. Just as Marines are resilient in the face of threats in the field, our bases must also be resilient to recover from energy security risks at home. The Marine Corps is proud to be at the forefront of energy resilience innovation within the DOD.