2021 INSTALLATION ENERGY ASSURANCE CAMPAIGN PLAN

WHERE MISSION ASSURANCE MEETS ENERGY ASSURANCE

AIR FORCE MATERIEL COMMAND VISION

“ONE AFMC – COLLABORATIVE, INNOVATIVE, TRUSTED, AND EMPOWERED…INDISPENSABLE TO OUR NATION, DISRUPTIVE TO OUR ADVERSARIES”

OUR MISSION

“POWERING THE WORLD’S GREATEST AIR FORCE…WE DEVELOP, DELIVER, SUPPORT, AND SUSTAIN WAR-WINNING CAPABILITIES”

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COMMANDER'S MESSAGE

Energy and water are essential mission resources we depend on every day. Events of recent years demonstrate an upward trend in environmental, physical, and cyber threats to our nation's supply systems. In the past, we relied on emergency measures to sustain missions through short-term disruptions, however, with the increasing risk for a more widespread and prolonged disruption, we need to ensure our energy systems are independently capable of supporting a mission appropriate level of energy assurance.

This update to our EACP adopts the Air Force approach for defining requirements for energy assurance and improving our systems to assure mission accomplishment. The EACP establishes five pillars that lead us to a more mission secure posture. These are: Optimized Systems and Processes, Cyber-Resilient Control Systems, Mission Matched Capabilities, Reliable and Managed Infrastructure, and System Performance Assurance. As we work to execute improvements, we must remain forward thinking in positioning our installations for future AFMC and AF missions. Our messaging must be clear and far-reaching, inspiring the innovative spirit of all Airmen and capitalizing on our vast problem-solving capabilities.

I look forward to a seamless and collaborative partnership between the mission and installation support communities - unified in purpose and laser focused on assuring energy and water systems are mission ready.

ARNOLD W. BUNCH, JR.
General, USAF
Commander

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INTRODUCTION

Having energy and water readily available (energy resilience) is critical to mission success. Energy commodities like Electricity, Natural Gas, Water and Fuel and energy generated resources like Steam, Chilled Water, and Compressed Air are critical mission enablers; yet we depend upon vulnerable energy systems and supply chains. Commercial and installation infrastructure continues to age quicker than it can be replaced and is threatened by extreme weather, acts of terrorism, and cyber intrusion. The risk for disruption in our current energy supply is real and growing. We must work to better understand the limitations and vulnerabilities of energy systems and implement actions to assure we can sustain the mission.

Energy availability and resilience are often an under-valued, yet vital aspect of being mission effective. In the 2021 DAF Installation Energy Strategic Plan (IESP), leaders challenged us to rethink the critical role energy plays in meeting the mission and to better manage the impact a prolonged disruption in energy availability can have on mission accomplishment. This focus culminated in the AF vision to "*Enhance Mission Assurance through Energy Assurance*" which underpins the 2021 AFMC EACP and drives us to a more energy resilient posture.

While the IESP provided the foundation, the EACP provides an actionable framework that highlights and threads energy availability concerns and requirements into interdependent programs across the enterprise and leads to a more secure and resilient energy assurance posture. It adopts AF standards and metrics, drives unity in approach, organizes our response and heightens awareness that, without a sustained investment in energy systems and infrastructure, missions are increasingly at risk.

COMMANDER'S INTENT

By 2030, AFMC installations will have mission-enabling energy systems and infrastructure that are: 1) sustainable enough to supply known demands, 2) flexible enough to match changing priorities and missions, 3) scalable enough to meet increasing critical mission demand, and 4) secure and resilient enough to withstand cyber or operational degradation.

AFMC STRATEGIC PLAN ALIGNMENT

The "AFMC We Need" initiative drives us to identify weaknesses and to do what is necessary to assure mission readiness. The EACP implements *AFMC Strategic Plan* Line of Effort #1 to Increase Readiness and Lethality, in the context of energy systems. Specifically, we will make these systems responsive to the mission and fit for the critical role they must serve – today and tomorrow. The EACP also aligns with the DAF Strategic Plan for Control Systems LOE #3 to Implement Lifecycle Resilience of Control Systems and AF Installation and Mission Support Center (AFIMSC) Strategic LOEs to Optimize Infrastructure, Increase Installation Resilience, and Maintain Ready Airmen and Installations. AFMC will be purposeful and systematic in improving energy systems to assure ready, resilient and lethal installations.

GOVERNANCE

Vision and unity are assured through the AFMC Energy Assurance Steering Group (EASG), which is chaired by the Commander, Deputy Commander, or Executive Director. The EASG is comprised of senior leaders representing Directorates, Centers, Complexes and Wings and provides strategic direction in managing energy as a critical mission resource. The Energy Assurance Working Group (EAWG) supports the EASG and is chaired by AFIMSC Det 6. AF Installation Support Teams (ISTs) are comprised of energy experts and other key stakeholders to guide installations in operationalizing the EACP.

RESPONSIBILITIES

AFIMSC Det 6

- Champions AFMC's energy program; informs and advocates Higher Headquarters for policy; and, develops enterprise strategies and plans to improve CE-owned energy systems
- Implements and sustains the AFMC EASG (Secretary), EAWG (Lead) and ISTs (Co-Lead)
- AFMC's lead interface with the AF installation energy program and governance structure
- Liaison between Directorates, Centers, Complexes and Wings and support organizations

AFCEC/OEA
(AF Office of Energy Assurance)

- Co-Leads ISTs in defining energy resilience requirements and oversees and supports development of Installation Energy Plans (IEPs) and Phase 0 reports for installations
- Conducts technical studies and alternatives analyses and integrates expertise to determine the most economic and mission effective solution(s) to close energy system capability gaps
- Recommends energy resilience projects to the AF Facility Energy Panel for approval and transition to AFCEC for execution

AFCEC/CF/CI/CN/CO/CP

- In partnership with OEA, provides subject matter expertise, AF policy implementing guidance and business processes for the improvement, operation and control of CE owned energy systems
- Develops, implements and executes AF programs to enable installations to address energy system requirements and vulnerabilities such as improving the cyber-resiliency of CE control systems and managing aging infrastructure, as required in this EACP

AFRL/RXSC-APTO & AFRL/EO

- Recommends insertion of readily available and cost effective advanced technologies, where practicable, to promote energy system modernization
- Demonstrates and validates innovative energy system technologies in an operational environment (Technology Readiness Level 6 or higher)
- Serves as the technology integration advisor for the ISTs

INSTALLATIONS

- Through the IST, supports development and/or update of the IEP, Phase 0 reports and IEAP
- Establishes an EASG chaired by an installation senior leader or the BCE and attended by mission leadership to operationalize this EACP
- Plans, programs, budgets and executes energy resilience projects and initiatives
- Identifies shortfalls in energy posture using mission commander readiness reporting, inspections and new mission bed down and mission basing analysis tools.
- Ensures new energy technology concepts are integrated with future installation planning, base of the future concepts thru HAF/A4C and AFIMSC Chief Innovation Officers

POSITIONING INSTALLATION ENERGY SYSTEMS

Installations share commonality with war fighting machines as a system-of-systems platform and provide the foundation mission requires. Energy and water systems, including subsystems that supply energy generated resources are critical mission enablers. To assure freedom to operate, these system(s) must be mission-aligned and sustained in a state of readiness – robust enough to respond to dynamic mission needs, agile enough to assure continuity in times of system stress, and resilient enough to rapidly recover from adverse events.

The *AF Future Operating Concept - A View of the AF in 2035*, highlights the central idea of leveraging operational agility as a way to adapt swiftly to any situation or adversarial action. Operational agility is the ability to rapidly generate - and shift among - multiple solutions for any given war time scenario. In the context of energy systems, agility refers to the ability to rapidly deliver energy and water resources when and where they are needed. There are several methods to enhance agility, such as; diversifying the sources of energy supply, improving infrastructure to provide alternative paths of delivery for the energy available from these sources, and modernizing control systems to better secure and control the flow of energy across the installation.

While these attributes frame what we need energy systems to do, the technologies we exploit to do it must be visionary, yet grounded, in principles of economy and sustainability. Strong winds, sunny skies, and heat from the earth can provide sustainable, resilient and affordable energy and contribute to a more secure (modular and diversified) supply. Over recent years, we have begun to capitalize on sustainable technologies like solar and capitalized on more efficient energy technologies like combined heat and power plants. We must continue to build on these efforts in improving mission resilience and readiness.

Securing unimpeded access to the energy needed to sustain critical missions by improving energy systems is only one aspect of a mission-assured posture. We must remain committed to eliminating waste by optimizing energy use - as part of being mission effective. We must assure energy control systems are fit and cyber-resilient such that we can control the flow of energy across the installation grid and can rapidly shift between alternative sources and paths of delivery. We must understand the increasing challenges in managing aging infrastructure and the consequences of faults and failures arising within energy systems. These and other mission enabling aspects must be integrated into our approach.

Mission accomplishment is rooted in collaboration and teamwork between the mission and installation support communities. Working in partnership with installation support, mission owners identify mission requirements for energy assurance. Mission support is then charged with finding the best practical solution to meet those requirements in alignment with installation wide energy assurance priorities and needs. Energy systems support both non-mission critical and mission critical requirements. This distinction is important because not all installation functions are mission critical. For missions determined to be mission critical, supporting energy systems must be independently capable of providing an uninterruptable supply of energy at the quality and quantity required for the period of time needed to relocate the mission or at least seven days, whichever is longer. In deciding how best to support critical missions, we must not underestimate dependencies on other direct and ancillary installation support functions.

The amount of energy needed to sustain critical mission(s) will increase as the duration of a disruption increases and additional mission support capabilities are needed. This planning value is influenced by the amount of energy that can be readily and enduringly produced and supplied by the energy system(s) and, the expected recovery rate of the energy commodity supplier in returning to normal capacity. As much as practical, installations will evolve systems to enable energy and energy generated resources to be shared across all critical missions and to generate or store independent of commercial sources the minimum amount of energy needed to sustain critical missions. Commercial energy sources may only be used as the primary resilient source of energy if it is determined by OEA to be sufficiently resilient for the critical mission and the commercial source grants the installation the first right to the minimum amount of energy needed during a utility disruption or declared emergency.

INSTALLATION ENERGY PLANS

To assist Commanders in better understanding the mission readiness of their energy systems through the development of the IEP, OEA in partnership with AFIMSC Det 6 and Installations will develop ISTs. As results oriented teams, ISTs provide an installation level cross-functional support forum for development and sustainment of the IEP. The IEP integrates applicable guidance and policies into an installation appropriate roadmap toward strengthened resilience and improved mission readiness.

The IEP framework captures mission specific requirements and evaluates current energy system capabilities against standard readiness strategies across five AF components of resilience –

Robustness, Redundancy, Resourcefulness, Response and Recovery. Collectively, these components or 5Rs and their associated sub-categories describe what energy systems need to do, as noted in Table 1. Differences between the AF standards and current conditions identifies capability gaps within energy systems for further decomposition in a follow-on Phase 0 Report.

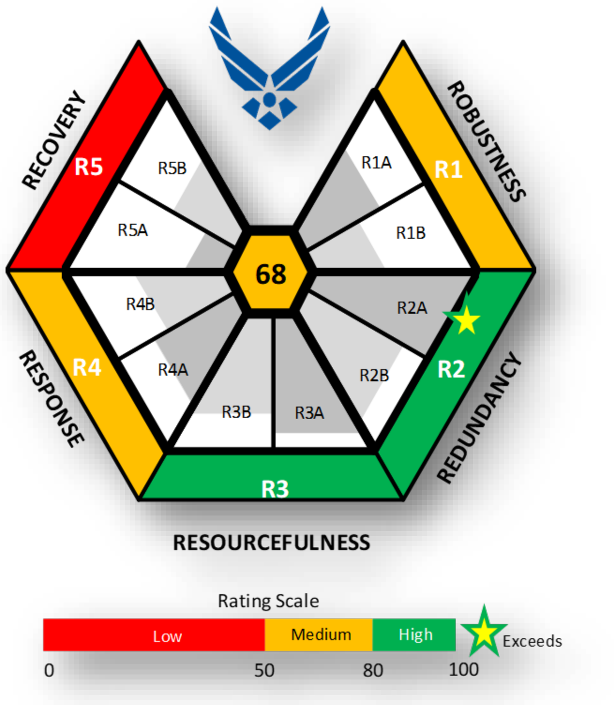
TABLE 1 – COMPONENTS OF RESILIENCE

COMPONENT OF RESILIENCE	R	RESILIENCE SUB-CATEGORY	DESCRIPTION
R1 ROBUSTNESS	R1A	Cybersecurity of Energy Systems	Level of compliance with cybersecurity protocols
	R1B	Physical Hardening	Protection of physical infrastructure
R2 REDUNDANCY	R2A	Supply Path Alternatives in Energy & Water Systems	Alternative resource supply routes
	R2B	Energy and WaterSource Diversity	Alternative resource supply sources
R3 RESOURCEFULNESS	R3A	Energy and Water Demand Reduction	Reduction of resource use
	R3B	Loads Sustainment Capacity	Ability to store, maintain and manage resource supply on site
R4 RESPONSE	R4A	Emergency Management Protocols	Level of emergency response plan and trained personnel
	R4B	Analytics, Smart Controls and Islanding Capabilities	Access to information and infrastructure to enable island (off-grid) operations
R5 RECOVERY	R5A	Availability of Personnel for Assessment and Repair	Ability to access staff of appropriate expertise for recovery and repair
	R5B	Equipment, Parts and Procurement	Ease of access to replacement equipment

INSTALLATION RESILIENCE SCORECARD

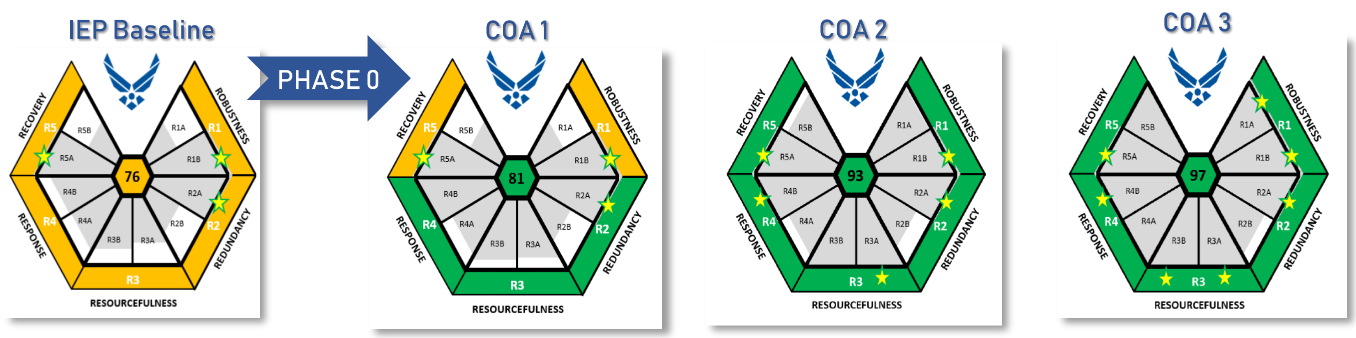
The IEP Energy Resilience Profile or commonly referred to as the Installation Resilience Scorecard provides a visual representation of an installation's existing energy resilience posture as well as the future state or the readiness improvement made by implementing alternative courses of action. The Scorecard provides an overall energy resilience score at the installation (and also available at a mission level), which is illustrated in the center of the chart, as noted in the sample model displayed in Table 2. Results of the baseline assessment are colored as Red, Yellow or Green, which indicates how well the energy system compared against the pre-defined resilience strategies underpinning each of the 5Rs.

TABLE 2 – INSTALLATION RESILIENCE SCORECARD EXAMPLE



Upon completion of the IEP, energy system capability gaps and alternatives to solve them are assessed in a Phase 0 report developed by OEA and the IST. As capability gaps within each of the sub-categories are addressed through implementing identified Courses of Action (COA), the shaded area moves outward and the color of the affected component advances toward Green, as illustrated in Table 3. Installations will use and update this illustrative framework to identify baseline conditions and report progress in addressing capability gaps.

TABLE 3 – INSTALLATION RESILIENCE CURRENT VS FUTURE STATE EXAMPLE



OPERATIONALIZING IEPs

While energy systems' functions are defined in the IEP, closing capability gaps and assuring mission readiness requires an integrated approach that bridges often independent communities. To assure connectedness, we will execute improvements in the Installation Resilience Scorecard through five LOEs, as illustrated in Table 4. These LOEs align with the 5Rs of resilience, as illustrated in Table 5.

TABLE 4 – AFMC LINES OF EFFORT

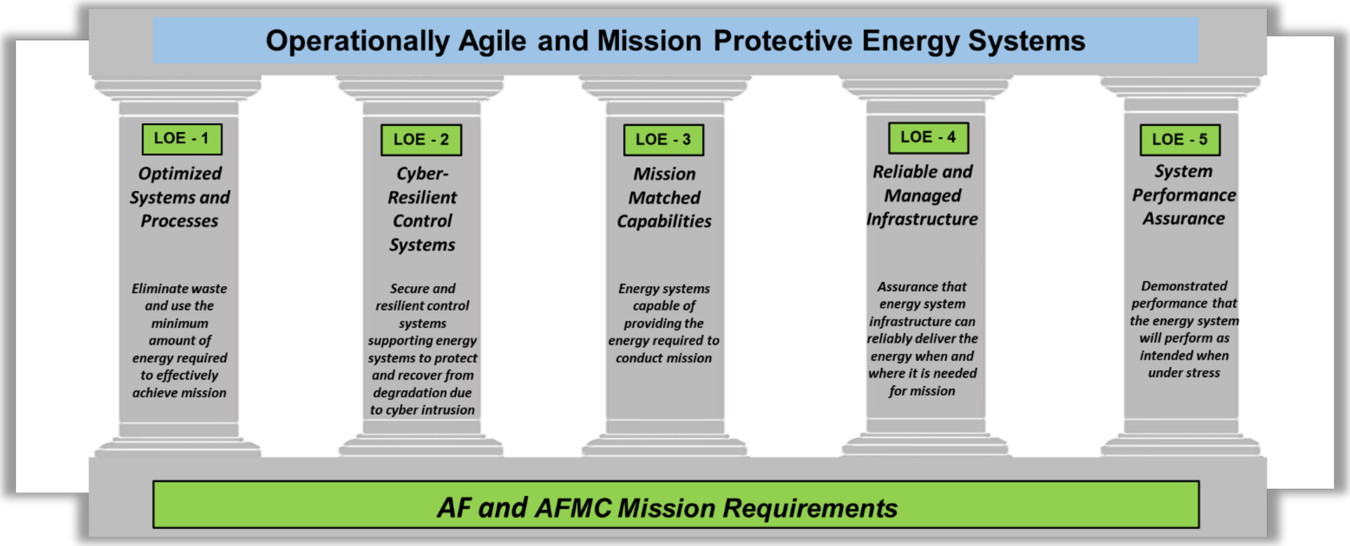


TABLE 5 – LOE ALIGNMENT WITH THE ENERGY RESILIENCE DASHBOARD

Lines Of Effort (LOE)	5Rs of Resilient Energy Systems									
	Robustness		Redundancy		Resourcefulness		Response		Recovery	
	R1A	R1B	R2A	R2B	R3A	R3B	R4A	R4B	R5A	R5B
1: Optimized Systems and Processes					✖					
2: Cyber-Resilient Control Systems	✖	✖	✖				✖	✖	✖	✖
3: Mission Matched Capabilities			✖	✖		✖		✖		
4: Reliable and Managed Infrastructure							✖			✖
5: System Performance Assurance	✖	✖					✖		✖	✖

Performance objectives and indicators to assure progress in each of the interdependent LOE's are defined in Appendix A. AFCEC/OEA and AFIMSC Det 6 will review for continued relevancy and update, where needed, on an annual basis.

LOE – 1. OPTIMIZED SYSTEMS AND PROCESSES

Optimizing demand often reduces the amount of energy needed in times of stress and is vital to realizing energy security. The greater the energy demand, the more extensive the infrastructure required to support it. We will pursue improvements in efficiency and conservation, as part of being mission effective, and use realized budget savings to subsidize the cost of making improvements to energy systems.

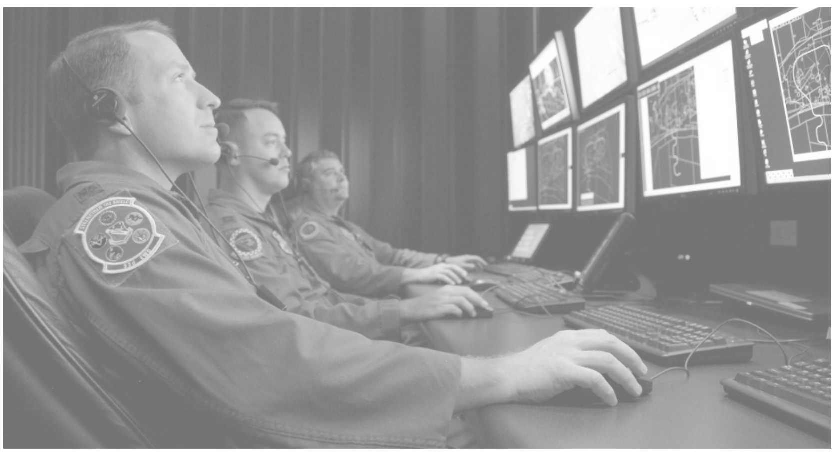
Improving energy efficiency in the design of buildings, support systems and infrastructure is a key component to reducing energy demand. As assets age, they can become unreliable. By upgrading to newer, more efficient equipment, these reliability concerns can be mitigated. Facilitating and enabling system optimization requires a comprehensive understanding of energy usage; both quantitative and the processes and missions it serves. To do this, AF requires the use of the enterprise standardized Advanced Meter Reading System (AMRS).

Operational efficiency occurs when the production of an output is maximized while the amount of waste is minimized. We will improve energy efficiency and conserve energy through actions such as:

- Identify and assess energy intensive uses for opportunities to optimize. (Action 1.1a)
- Implement AMRS to provide near real time consumption reporting and visibility of use. (Action 1.1b)
- Upgrade to more efficient real property and equipment during replacement cycles.
- Obtain International Standards Organization (ISO) certification for energy management weapon system sustainment industrial processes.
- Continuously strengthen an energy aware culture across the enterprise.
- Expand and/or modernize control systems to optimize consumption.
- Capitalize on technologies to improve energy efficiency and increase capability.

LOE – 2. CYBER-RESILIENT CONTROL SYSTEMS

Control systems (a subset of Operational Technology) provide the backbone for a modern, operationally-agile, mission-supportive and resilient energy system. They perform functions such as monitoring and directing the flow of energy, governing the storage and/or production of energy and/or energy-generated resources and regulating facility mechanical systems (e.g. power generation and distribution, air conditioning, water and wastewater, natural gas distribution). Additionally, they monitor, operate, and/or control processes such as industrial production and equipment used in applications such as weapon system sustainment and test programs. Although control systems across the enterprise reside under multiple functional communities (such as Civil Engineers, Security Forces, Logistics, Medical, etc.), the control systems supporting energy systems primarily fall within the Civil Engineers' responsibility to assure and secure through their life cycle. Control systems can take various forms according to size, complexity, function, or configuration. Some types of control systems may exist as building automation systems, fire suppression systems, industrial control systems, airfield lighting systems, etc.



A further example includes energy supply side control systems such as Supervisory Control and Data Acquisition (SCADA), which overlay energy system infrastructure regulating the flow of energy and responding to changes within it. As part of a micro-grid, they provide real time agility in responding to stresses and faults within the energy system. On the demand side, control systems such as Energy Management Control Systems (EMCS), Programmable Logic Controllers (PLCs) and Direct Digital Control (DDC) manage mission support functions like airfield lighting.

These and other uses of control systems are foundational to the effective and efficient supply and use of energy. Historically, manual control systems have been increasingly automated and interconnected for greater efficiency and cost savings, without much consideration for the increased cyber vulnerabilities. Legacy control systems were not specifically designed to operate in a contested environment and are increasingly vulnerable to cyber intrusion and attack: (1) potentially leading to mission failure, extended operational impacts, and physical damage to critical infrastructure or (2) providing an attack vector into the broader AF Network (AFNET).

To better secure them, AFCEC developed the Community of Interest Network Enclave (COINE) as an interim network to logically-segment control system traffic from AFNET. Before control systems (as part of projects or initiatives to improve energy system resilience) are installed, we will ensure CE control systems are assessed for cyber risks by AFCEC, approved to be installed, and migrated into the COINE environment at the base.

We will mitigate the cyber risk by modernizing legacy control systems to make them more capable and cyber-resilient, by following the contract requirements outlined in DAFGM2021-32-01 and UFC 4-010-06 to "bake-in" cybersecurity standards into these systems' life cycle. We will also ensure to incorporate cybersecurity standards into applicable energy assurance and resilience efforts including IEP, Utilities Privatization (UP), micro-grids, energy storage, etc.

- HAF/A4 publish the DAF Strategic Plan for Control Systems to guide and direct cyber resilient improvements. (Action 2.1a)
- Implement COINE as a cyber-resilient network for hosting CE control systems. (Action 2.1b)
- Establish guidance for the selection of CE control systems when acquiring or upgrading control systems. Develop requirements for system sustainment and tech refresh. (Actions 2.1b and 2.1c)
- Modernize legacy SCADA systems to make them mission appropriate, improve mission readiness and strengthen mission capability. (Action 2.1c)
- Actively monitor systems and networks to manage the risk of cyber-intrusion. (Action 2.1c)
- Establish criteria for and incorporate control systems and their cyberspace implications into AF Asset Management and Asset Management Plan (AMP) principles, structure, roles, processes and maintenance activities of control systems. (Action 2.1d)
- Ensure that critical control systems and their components have operational redundancy, backup/restoration protocols, and manual control procedures that are properly and routinely configured, maintained, and exercised.

LOE – 3. MISSION MATCHED CAPABILITIES

What it takes to make energy systems mission ready will vary across installations. System requirements depend on the specific mission being supported, capabilities and limitations of the existing energy system(s), expected recovery rate of the commodities provider(s) and suitability of the system(s) for the role we need them to play. The AF IEP provides a baseline determination of mission requirements, an assessment of current system capabilities and a decision framework from which to decide what additional actions should be taken to fill capability and/or capacity gaps in the energy system. The IEP is followed by one or more Phase 0 reports, which provide an in-depth assessment of energy system requirements and capabilities and recommends projects to improve energy system resilience.

The IEP captures mission tolerance for an energy related disruption and determines the level of mission dependence on real property assets. There are two foundational determinations OEA documents in the IEP. The first is capturing the critical energy and water requirements of key missions on the installations, the level of energy availability appropriate to sustain those mission(s). Critical energy demand is the energy required to operate critical real property assets, which house and/or support key missions. Energy availability is the collective amount of this demand that must be readily available to support critical mission(s). The second is identifying the ability of existing facilities and utility infrastructure to meet the pre-identified energy and water requirements. The IST and OEA will use the IEP-defined energy requirements and existing infrastructure capabilities to determine practical strategies that should be pursued to ensure all energy availability requirements are met.

To achieve energy security, we need to improve the readiness and resilience of energy systems. Generally speaking, energy systems were designed to meet reliability and efficiency standards in place at a particular point in time. Systems and systems components are becoming increasingly technology dated and often lack important physical and cyber resilience attributes required to achieve diversity in supply and redundancy in distribution (Refer to LOE-2). Energy diversity means the energy we need is assured and available through a variety of reliable commercial and/or installation sources like solar arrays, wind turbines or energy storage systems such that if one source is compromised we can readily shift to another. Energy redundancy infers that the energy system is able to route energy needed to mission through a variety of distribution paths.

Although temporary back-up systems, e.g. 7-day AF standard facility emergency generators, will remain an important capability in sustaining mission, the risk of failure in these systems increases as the duration of a disruption increases. As such, OEA will guide installations through the development of Phase 0 reports in the evaluation and determination of what improvements need to be made to energy systems to assure an enduring source of energy (assured supply) is available across the installation's critical energy load.

Improvements required to energy systems will be captured in an IST developed IEAP, which summarizes the projects and initiatives planned and underway to remedy capability gaps. We will diversify supply and improve agility through modernization of energy system infrastructure and related control systems by taking the following actions:

- Develop ISTs to support installations in developing, updating the IEP, Phase 0 report and IEAP. (Action 3.1a)
- Complete IEPs to define mission requirements, determine limitations of energy systems, and define capability gaps. (Action 3.1b)
- Complete Phase 0 reports to decompose IEP defined capability gaps, evaluate alternative solutions and determine the most practical and economic solution. (Action 3.1c)
- Develop a strategy and process for updating IEPs to capture mission changes. (Action 3.1d)
- ISTs develop an IEAP to organize and sequence improvement projects both planned and underway to resolve energy system gaps, as defined in the IEP. (Action 3.1e)

LOE – 4. RELIABLE AND MANAGED INFRASTRUCTURE

Aging and obsolete infrastructure presents a mission risk as significant as a disruption in the commercial supply chain. In an energy system, reliability is a measure of how well the system provides availability. Resilience refers to the ability of the system to adapt to changing conditions and withstand, respond to, and recover from energy system failures both within and beyond the fence line. Both are key attributes of an operationally agile and secure system, but assuring reliability and resilience isn't only about having diversity in supply and redundancy in distribution. Managing the risk for failures arising from within the energy system is as important as owning an assured supply of energy.

Visibility of the age and condition of infrastructure components and how the system deteriorates over time is critical to managing the risk for internal system failure. Energy systems are comprised of thousands of components such as feeders, switches, transformers, and substations, which all play an interdependent role. All of these components are susceptible to failure and many take days, weeks or even months to acquire, if they can be found at all. Maintenance of spares and other temporary solutions can help mitigate mission impact, but these approaches are not always practical or even viable. The AF requires installations to report and track causes of disruptions in energy supply through the enterprise standard Utility System Operational Report Tracker (USORT). This data will help in assessing system performance, predicting system deterioration and mitigating emerging risks attributed to internal system faults and failures.

The AF Asset Management Program provides a structured process to capture aging infrastructure related system risks, lend visibility to the potential mission impact of a specific asset failure and enable proactive investments to mitigate. As part of the AF Asset Management Program process, utility systems are being segmented, components captured and conditions assessed in preparation for the DoD Enterprise Sustainment Management System Utility Domain (ESMS Utilities); which is currently under development. We will mitigate the aging infrastructure risk by capitalizing on ESMS Utilities, implementing asset management principles in managing infrastructure risks and by working with privatized utility system owners to assure these types of risks are managed through actions such as:

- Complete linear segmentation of AF owned energy systems to capture infrastructure condition and identify mission critical segments. (Action 4.1a).
- Develop a framework to improve the use and usefulness of utilities system condition data. (Action 4.1b)
- Operationalize ESMS Utilities to actively manage aging energy infrastructure risk (record, analyze and respond to problematic infrastructure). (Action 4.1c)
- Develop strategies and standards for analyzing and interpreting condition data.
- Build plans and requirements that manage infrastructure related risk to mission.

LOE – 5. SYSTEM PERFORMANCE ASSURANCE

How well an energy system performs speaks to its reliability, which provides insight into the system's health based on past performance. In the context of assuring system reliability, redundancy signifies that the system has been designed to continue to function in spite of a failure of some of the system components. This resistance to failure is gained by providing alternative paths for energy supply and/or distribution by arranging selected elements of the energy system in parallel.

From an energy system perspective, resilience can be thought of as the systems' ability to recover and continue to function to the level required under a variety of stresses. As such, a system's resilience is an outcome of a purposeful design that mitigates the assessed likelihood and consequences of a failure arising with the energy supply chain or the system itself. How resilient a system is can only be validated by its performance simulated stresses. The AF Energy Resilience Readiness Exercise (ERRE) program provides a framework to demonstrate system resilience. As part of the exercise planning process, subject matter experts will assess the risk to installation infrastructure and mission systems and recommend mitigation measures that can be taken. Based on the assessment, mission and mission support commanders will determine how best to demonstrate energy system resilience.

To assure energy systems (includes systems providing energy generated resources) are properly designed to mitigate or eliminate mission disruption risks, we will demonstrate the systems designed resilience through actions such as:

- Thread demonstration of energy resilience in Continuity of Operations (COOP) exercises. (Action 5.1a)
- Conduct "Pull-the-Plug" exercises under the AF ERRE program. (Action 5.1b)
- Implement energy availability table top and/or simulated exercises.
- Include failure in the system(s) or disruption in availability in readiness exercises.
- Participate in large scale, regional table top exercises such as GridEx.
- Include disruption in installation energy availability as part of war-gaming exercises.

APPENDIX A – FY21/22 PERFORMANCE OBJECTIVES & MEASURES

LOE-1: OPTIMIZED SYSTEMS AND PROCESSES

Objective 1.1: Optimize energy demand by identifying and acting on opportunities to mission effectively reduce the amount of energy required to meet mission

a) Action 1.1a: Base Civil Engineers (BCEs) identify the organizations and processes that consume the top 75% of the energy consumed on the installation and determine what can be done to optimize demand
   i. EASG Reporting: Consumption trend FY15-25 with highlighted projects planned and underway reported by installations during their annual briefing
   ii. Performance Measure: BCEs identify and program at least two Facility Sustainment Restoration and Modernization (FSRM) eligible improvement projects for each year

- OPR: BCEs
- OCR: Mission Owners

b) Action 1.1b: AFCEC in partnership with ISTs develop and implement a plan to assist installations in reaching Full Operating Capability (FOC) build-out of a fully-functional AMRS
   i. EASG Reporting: Status Update – FY21/3rd QTR (short-term). Annual Update (long-term)
   ii. Performance Measure: Number of utility meters required by law vs the number of AMRS compliant meters installed, connected and automatically read

- OPR: AFCEC
- OCR: BCE

LOE-2: CYBER-RESILIENT CONTROL SYSTEMS

Objective 2.1: Manage the risk for mission impact attributed to cyber intrusion into energy control systems by developing policy, guidance, processes and standards to enable installations to better manage the risk for cyber intrusion

a) Action 2.1a: HAF publish the DAF Strategic Plan for Control Systems and enabling policy directives
   i. EASG Reporting: Status Update – FY21/3rd QTR
   ii. Performance Measure: None

- OPR: AF/A4CS
- OCR: AFCEC

b) Action 2.1b: AFCEC/COO develop guidance aligned with DAFGM2021-32-01 that enables installations to better select, field and/or secure control systems, and to assess control systems for cyber vulnerabilities in order to be installed and hosted in COINE
   i. EASG Reporting: Status Update – FY22/3rd QTR
   ii. Performance Measure: Supplemental "how to" guidance to DAFGM2021-32-01 provided to bases (short-term). Number of installations with COINE functioning at FOC and number of CE owned control systems hosted on COINE (long-term)

- OPR: AFCEC/COO
- OCR: BCEs

c) Action 2.1c: AF/A4CS and AFCEC/COO co-develop standards for life cycle resilience and contract requirements for new CE control systems. In accordance with these standards and DAFGM2021-32-01, BCEs identify system modernization requirements for CE control systems and program an FSRM requirement, as required
   i. EASG Reporting: Status Update – FY22/3rd QTR
   ii. Performance Measure: Additional guidance provided by AF/A4C for life cycle resilience standards for CE control systems (short-term). Number of CE control systems modernized vs number required (long-term)

   - OPR: AF/A4CS, AFCEC/COO
   - OCR: BCEs

d) Action 2.1d: Establish criteria for and incorporate control systems and their cyberspace implications into Air Force Asset Management and Asset Management Plans (AMP) principals, structure, roles, processes and maintenance activities of CE control systems
   i. EASG Reporting: Status Update – FY22/3rd QTR
   ii. Performance Measure: An outline of how risk determinations of CE control systems accomplished through the Risk Management Framework (RMF) was incorporated into AMP "rack-n-stack" decision-making

   - OPR: AFIMSC
   - OCR: AFCEC/CF, AFCEC/CP

e) Action 2.1e: AFMC A3/6, develop a plan to actively monitor, detect and respond to cyber intrusions to defend CE control systems and associated devices
   i. EASG Reporting: Status Update – FY22/3rd QTR
   ii. Performance Measure: Plan and program for an Integration Cell for Control Systems as outlined in the DAF Strategic Plan for Control Systems (short-term). Number of attempted and successful cyber intrusions (long term)

   - OPR: AFMC A3/6
   - OCR: BCEs

LOE-3: MISSION MATCHED CAPABILITIES

Objective 3.1: Assure critical missions have unimpeded access to energy when and where needed in the right amount and of the right quality

a) Action 3.1a: AFCEC/OEA in partnership with AFIMSC Det 6 develop ISTs to support and guide installations in defining and making energy system improvements
   i. EASG Reporting: Installation Resilience Scorecard
   ii. Performance Measure: Reduction in number of IEP defined Red and Yellow categorized mission critical capability gaps identified in the energy system(s)

   - OPR: AFCEC/OEA
   - OCRs: AFCEC, AFRL, BCEs

b) Action 3.1b: AFCEC/OEA in partnership with ISTs complete IEPs to define energy resilience requirements for missions, establish mission specific energy availability standards and identify capability gaps in supporting critical missions
   i. EASG Reporting: IEP development update – FY21/3rd QTR
   ii. Performance Measure: Number of IEPs complete vs number in progress or pending

   - OPR: AFCEC/OEA
   - OCR: BCEs

c) Action 3.1c: AFCEC/OEA in partnership with ISTs complete Phase 0 reports to decompose capability gaps identified in the IEP and develop proposed projects to solve them for approval by the AF Facility Energy Panel (FEP)
   i. EASG Reporting: AFCEC Phase 0 Report development update – FY21/3rd QTR
   ii. Performance Measure: Number of Phase 0 reports complete, number in progress or pending and number required

▪ OPR: AFCEC/OEA ▪ OCR: BCEs

d) Action 3.1d: AFCEC/OEA in partnership with ISTs complete updates to baseline IEPs to capture mission changes within 18 months of last publication
   i. EASG Reporting: Plan/Update - FY22/3rd QTR
   ii. Performance Measure: None

▪ OPR: AFCEC/OEA ▪ OCR: BCEs

e) Action 3.1e: ISTs develop an IEAP summarizing the projects and initiatives planned and underway to resolve capability gaps identified in energy systems
   i. EASG Reporting: Investment summary reported by installations during their annual briefing
   ii. Performance Measure: Reduction in number of IEP defined Red and Yellow categorized mission critical capability gaps identified in the energy system(s)

▪ OPR: AFCEC/OEA ▪ OCR: BCEs

LOE-4: RELIABLE AND MANAGED INFRASTRUCTURE

Objective 4.1: Manage the risk for faults and failures arising within energy systems and attributed to aging infrastructure by improving visibility of the condition of assets and the usefulness of infrastructure data.

a) Action 4.1a: AFCEC in partnership with affected installations, complete utility condition assessments through the AF Linear Segmentation Support Services Contract to close data gaps in AF Owned energy systems at Arnold, Edwards, Eglin, Hanscom, Robins and Wright Patterson AFBs.
   i. EASG Reporting: AFCEC Plan/Update – FY21/3rd QTR
   ii. Performance Measure: Number of installations and systems where linear segmentation of AF owned utility systems is complete vs number in progress or pending update

▪ OPR: AFCEC ▪ OCR: BCEs

b) Action 4.1b: AFCEC develop and execute a pilot project at Robins AFB to establish a benchmark-able framework to improve the use and usefulness of utilities system condition data in proactively identifying and responding to system vulnerabilities
   i. Performance Measure: None
   ii. EASG Reporting: AFCEC Plan/Update – FY21/3rd QTR

▪ OPR: AFCEC ▪ OCR: Robins BCE

c) Action 4.1c: AFCEC develop a plan to assist installations in the stand-up of the DoD ESMS Utilities to provide enduring visibility of utility system assets and associated vulnerabilities.
   i. EASG Reporting: AFCEC Plan/Update – FY21/3rd QTR
   ii. Performance Measure: Number of installations FOC with ESMS – Utilities vs number in progress or pending

- OPR: AFCEC
- OCR: BCEs

d) Action 4.1d: Installations continually analyze energy system outage data (frequency, duration and scope) as reported in USORT to identify and mitigate risks that may lead to future outages.
   i. EASG Reporting: Service interruption trends (FY18-most recent fiscal year) as reported in USORT to include outage data analysis results, System Average Interruption Duration Index (SAIDI) data, and actions or plans to mitigate energy assurance risks.
   ii. Performance Measure: Locally established SAIDI Target for energy systems

- OPR: BCEs
- OCR: Mission Owners

LOE-5: SYSTEM PERFORMANCE ASSURANCE

Objective 5.1: Assure installation energy systems enable non-relocatable critical missions to continue to function during a prolonged disruption in commercial energy supplies

a) Action 5.1a: AFMC incorporate demonstration of the mission resilience provided by the installation energy system(s) as part of assessments and exercises conducted to meet mission Continuity of Operations (COOP) requirements
   i. EASG Reporting: AFMC A3/6 Plan/Update - FY22/3rd QTR
   ii. Performance Measure: Annual number of IEP identified critical missions and supporting energy systems at installations exercised, as part of COOP, vs number of IEP identified critical missions.

- OPR: AFMC A3/6
- OCRs: Mission Owners

b) Action 5.1b: Demonstrate the resiliency of the installation energy systems at Wright Patterson AFB through the AF Energy Resilience Readiness Exercise (ERRE) program
   i. EASG Reporting: ERRE findings brief during FY21/22 Installation Briefing Cycle.
   ii. Performance Measures: Number of ERRE complete vs number required. Number of ERRE findings outstanding vs number of findings fixed.

- OPR: WPAFB BCEs
- OCR: AFIMSC Det 6

c) Action 5.1c: Ensure that degradation of control systems (e.g. from a physical or cyber incident) are incorporated into Installation Emergency Management Plan(s), processes, and capabilities, as well as inclusion of local Cyber Squadrons
   i. EASG Reporting: Status Update during FY21/22 Installation Briefing Cycle.
   ii. Performance Measures: Update of Installation Emergency Management Plan.

- OPR: BCEs
- OCR: AFIMSC Det 6

DEFINITIONS

CONTROL SYSTEM: A system in which deliberate guidance or manipulation is used to achieve a prescribed value for a variable. Control systems include SCADA, DDC, PLC and other types of industrial measurement and control systems (ref. NIST SP 800-82r2).

CRITICAL ENERGY REQUIREMENT: The minimum amount of energy that must be always available to support critical missions, as determined through the IEP development process.

CRITICAL MISSION: Those aspects of the installation's missions that are critical to the successful performance of AF and AFMC missions, as determined through the IEP development process.

ENERGY: Any usable power, including purchased energy commodities such as electricity, natural gas, propane, and fuels; energy produced onsite including sustainable sources such as solar, wind, geothermal, and nuclear; and, energy generated resources such as back-up power, steam, chilled water, hot water and compressed air.

ENERGY AVAILABILITY: The minimum amount of energy and energy generated resources such as steam, chilled water, hot water purchased or produced that is required for a mission to perform its required function at a stated instant of time or over a stated period of time.

ENERGY COMMODITY: A commercially available energy product purchased from a commercial supplier, such as electricity, natural gas, propane, coal, water, propellants, chemicals, fuel, pure gases, and cryogenic fluids.

ENERGY GENERATED RESOURCE: An energy product typically installation produced and derived from the conversion of an energy commodity or commodities into a useful product such as steam, chilled water, hot water and compressed air.

ENERGY DIVERSITY: The capability in an energy system to assure the supply of the energy required by a mission component or system to perform required functions under stated conditions for a stated period of time.

ENERGY RELIABILITY: The ability of an energy system to supply energy to a mission component or system to perform required functions under stated conditions for a stated period of time.

ENERGY RESILIENCE: The ability of the installation and the energy system(s) to readily adapt to changing conditions and withstand, respond to, and recover from internal system failures and/or externally imposed disruptions in the availability of energy.

ENERGY SECURITY: Having assured access to reliable supplies of energy and the ability to protect and deliver sufficient energy to meet mission essential requirements.

ENERGY SYSTEM: The interconnected infrastructure and control system that produces and/or supplies energy to a mission component or system to perform required functions under stated conditions for a stated period of time.

INSTALLATION ENERGY: The energy used to power all facilities, systems and processes on military installations.

INSTALLATION SUPPORT INFRASTRUCTURE: The physical systems and assets of an energy system that are not immediately vital to the performance of installation's critical mission(s).

MISSION ASSURANCE: A process to protect or ensure the continued function and resilience of capabilities and assets – including personnel, equipment, facilities, networks, information and information systems, infrastructure, and supply chains – critical to the performance of DoD Mission Essential Functions (MEF) in any operating environment or condition.

MISSION CRITICAL INFRASTRUCTURE: The physical systems and assets of an energy system so vital that the incapacity or destruction of such systems and assets would have a debilitating impact on the installation's ability to execute critical missions.

PULL-THE-PLUG EXERCISE: Exercise to simulate the impact of an event that cuts power to an installation, such as a natural disaster, to better prepare for and recover from an energy disruption.

GLOSSARY

AF - Air Force
AFCEC - Air Force Civil Engineer Center
AFIMSC - Air Force Installation and Mission Support Center
AFMC - Air Force Materiel Command
AFNET - Air Force Network
AMP - Asset Management Plan
AMRS - Advanced Meter Reading System
ATSO - Ability to Survive and Operate
BCE - Base Civil Engineer
CAT - Crisis Action Team
COA - Course of Action
COINE - Community of Interest Network Enclave
COOP - Continuity of Operations
DAF - Department of the Air Force
DDC - Direct Digital Control
EACP - Energy Assurance Campaign Plan
EASG - Energy Assurance Steering Group
EAWG - Energy Assurance Working Group
EMCS - Energy Management Control Systems
ERRE - Energy Resilience Readiness Exercise
ESMS - Enterprise Sustainment Management System
FEP - Facility Energy Panel
FOC - Full Operating Capability
FSRM - Facility Sustainment Restoration and Modernization
GIS - Geographic Information System
HAF - Headquarters Air Force
IEAP - Installation Energy Action Plan
IEP - Installation Energy Plan
IESP - Installation Energy Strategic Plan
ISO - International Standards Organization
IST - Installation Support Team
LOE- Line of Effort
MEF - Mission Essential Function
OEA - Office of Energy Assurance
PLCs - Programmable Logic Controllers
QTR - Quarter
RMF - Risk Management Framework
SAIDI - System Average Interruption Duration Index
SCADA - Supervisory Control and Data Acquisition
UP - Utilities Privatization
USORT - Utility System Operational Report Tracker

REFERENCES

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DoD Directive 4180.01, DoD Energy Policy
DoD Instruction 4170.11 Chapter 2, Installation Energy Management, 31 August 18
AFPD 10-24, Mission Assurance, 5 November 19
AFPD 90-17, Energy and Water Management, 20 May 20
DAFI 90-1701, Installation Energy and Water Management, 16 December 20
DAF Installation Energy Strategic Plan, 15 January 21
AFMC Strategic Plan, July 2020
National Defense Authorization Action of 2020