NAVFAC
Naval Facilities Engineering Systems Command

P-602
3 Pillars of Energy Security
(Reliability, Resilience, & Efficiency)

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2.0	NAVFAC HQ	December 2020	Peter S. Lynch	Mar 2021	Triennial Update

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Foreword

Department of Navy (DON) facilities and utilities personnel at all levels require a consistent understanding of energy and water systems, standards of energy and water system operations, terminology, and methods for utility project development requisite to effective optimization of the DON program for energy security. Planning methodologies must provide holistic consideration for system reliability, resiliency, and efficiency to ensure a common operating framework and mission focused solutions. The Chief of Naval Operations (CNO) identified energy security as a strategic imperative, stating: "…shore energy security is the mitigation of vulnerabilities related to the electrical grid" (Ref. A): and the U.S. Marine Corps Assistant Deputy Commandant noted: "Success will require Energy Security solutions that mitigate the effects of supply disruptions on mission essential functions" (Ref. B).

The Three Pillars of Energy Security (3 Pillars) was developed in 2017 standardize energy security performance benchmarks across the DON. The 3 Pillars satisfies the first step in the Energy Security Framework (ESF) implementation (set performance benchmarks) by defining objective, quantitative metrics that are rooted in existing codes and industry standards and providing minimum thresholds where applicable for installations to measure system performance. This update serves to expand the scope of DON's definition of energy security to include the clear nexus between water security and installation resilience. Recognizing that installations cannot provide critical services to missions without secure energy and water, the 3-Pillars update provides new performance metrics and definitions to help form the basis of future installation resilience reporting. Additionally, this document includes best practices that can assist installations in improving system performance while acknowledging resource limitations, mission needs, and geographical diversity.

Due to ongoing changes in technology, policy, and warfighting support requirements, P-602 will be reviewed periodically and can be found in the NAVFAC Portal document library. Future versions of this document plan to include additional commodities involving energy security.

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1. Introduction

1.1 Purpose and Scope

The purpose and scope of this document is to provide guidelines for evaluating and measuring energy and water security articulated to best practices for utility system management.

These guidelines and best practices aid in the identification of energy and water security gaps, which, if resolved, will contribute to an improved mission assurance posture. Project identification is pursuant to addressing gaps based on life cycle cost effectiveness or the ability to mitigate unacceptable risks from the lack of resilience, reliability, or efficient operations. Primarily, the metrics addressed in this document consider life cycle costs, cost/benefit analyses, and risk mitigation. Future updates to this document plan to address the DON's energy security standards for additional commodities, including but not limited to natural gas, wastewater, liquid fuels, and renewable energy (RE). The purpose and scope of this document is to provide guidelines and benchmarks for evaluating and measuring energy and water security on Department of Navy installations. As energy and water security metrics continue to evolve, this document also provides best practices for enhancing installation resilience through proven utilities management procedures.

These guidelines and best practices aid in the identification of energy and water security gaps, which, if resolved, will contribute to an improved mission assurance posture. Recognizing the resource constraints that installation management commands face, the metrics addressed in this document consider life cycle costs, cost/benefit analyses, and risk mitigation. Future updates plan to address the DON's energy security standards for additional commodities, including but not limited to natural gas, wastewater, liquid fuels, and other non-electrical energy such as steam or high temperature hot water.

1.1.1 Energy Security Guidelines

Per 10 U.S.C. § 101(e) (Ref. C), energy security is defined as "…having assured access to reliable supplies of energy and the ability to protect and deliver sufficient energy to meet mission essential requirements". As shown in Figure 1.1, the 3 Pillars of Energy Security are reliability, resilience, and efficiency for the DON. This document provides implementation guidance for the DON Energy Security Framework and other relevant DOD policy in order to provide installations with a common set of standards and metrics to measure energy security.

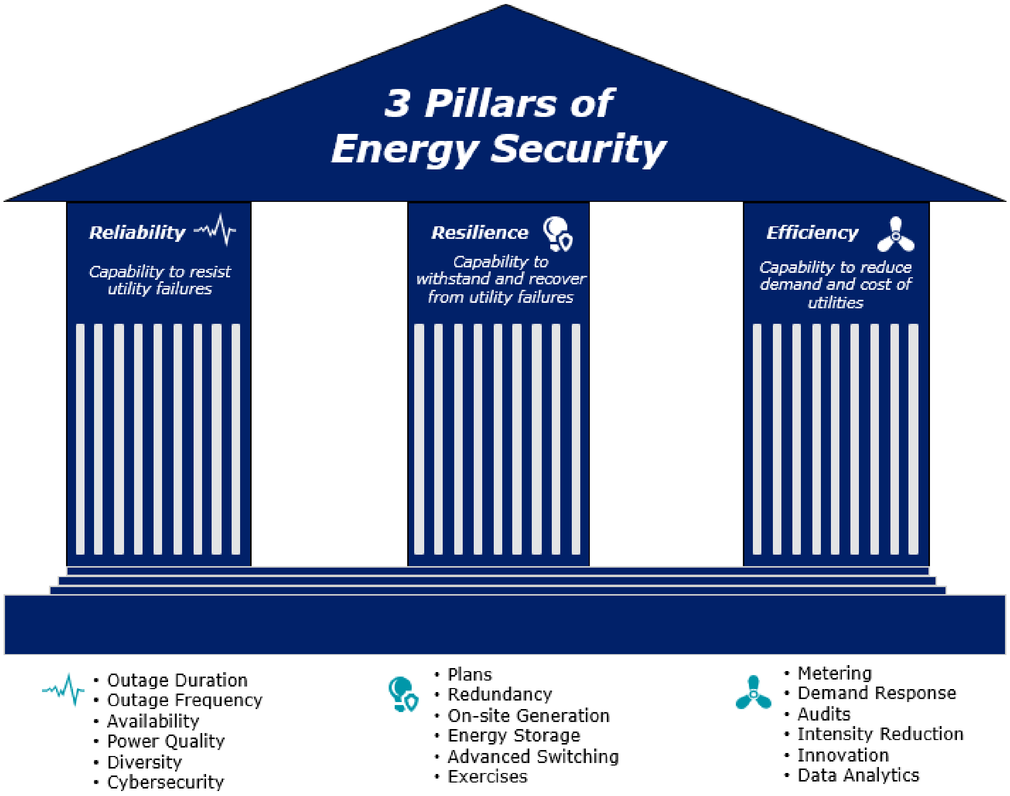


Figure 1.1 - 3 Pillars of Energy Security

1.1.2 Priorities and Funding

Although energy reliability and resilience are desirable on an enterprise-wide scale, not all facilities require high levels of reliability and resilience. That means energy security vulnerabilities become reliability, resilience, and efficiency priorities when identified by Navy and Marine Corps during assessments. Appropriated funding or third-party finance mechanisms are used to close energy security gaps. Appropriated funding options include Sustainment, Restoration, and Modernization (SRM) funds, Energy Resilience and Conservation Investment Program (ERCIP) funds, Military Construction (MILCON) funds, Environmental Security Technology Certification Program funds, or other funds, such as Local/Mission/Regional funds, or SYSCOM funds. Alternatively, third-party financing opportunities can be used, such as Energy Savings Performance Contracts (ESPCs), Utility Energy Service Contracts (UESCs), Power Purchase Agreements (PPAs), Enhanced Use Leases (EULs), Utility Privatizations (UPs), and Intergovernmental Service Agreements (IGSAs), where applicable.

1.1.3 Naval Facilities Engineering Systems Command

Naval Facilities Engineering Systems Command (NAVFAC) is the Naval Shore and Expeditionary Systems Command that plans, builds, and maintains sustainable facilities, manages real estate and real property from cradle to grave, delivers environmental, utilities and other base services, and acquires and manages expeditionary combat force systems and equipment. NAVFAC's vision is to be the facilities technical and business experts with the total trust and confidence of the Navy and Marine Corps. NAVFAC provides shore facility management to worldwide clientele including, the Commander, Navy Installations Command (CNIC), Naval Sea Systems Command (NAVSEA) ship commands, Naval Air Systems Command (NAVAIR) aircraft squadron commands, Bureau of Medicine and Surgery (BUMED) hospital facilities, and the Marine Corps. Through the Public Works Business Line (PWBL), NAVFAC supports the Navy warfighters with shore capabilities, including utility commodities optimization. NAVFAC provides essential shore capabilities to the mission of naval operations, as well as support for the quality of life for the U.S. Military, their families, and civilian employees.

1.1.4 Public Works

Public Works (PW) is responsible for providing both technical and business expertise for facilities, utilities, energy, transportation, and infrastructure support services. PW provides process, procedures, and community management through four product lines. The four product lines include Facilities Support Contracts (FSCs), Facilities Management and Sustainment (FM&S), Utilities Management (UM) and Transportation (TR). NAVFAC HQ has an additional branch for Utilities Rates and Assessments that are part of the UM product line and can provide assistance to installations facing rate changes. The Energy Branch provides direct execution of innovative energy solutions.

1.1.5 Utilities Management (UM)

The UM Product Line provides the engineering and technical program management responsible for all Navy Shore Utilities systems and infrastructure and is relied upon for Utilities services. The UM mission is to produce and/or procure commodities (i.e. water, wastewater, electricity, steam, gas, etc.) and provide services to support mission ready utilities, all while minimizing downtime in a sustainable manner aligned with the 3 pillars of energy security.

UM also includes the efficient operation and maintenance (O&M) of Navy shore infrastructure. In addition, the basis of fiducial maintenance strategies rests upon a Utilities Infrastructure and Condition Assessment Program (UICAP). UM Managers are responsible for maintaining their respective utilities data accurately in NAVFAC business systems such as the Geographic Information Systems (GIS), the Internet Navy Facility Assets Data Store (iNFADS) and Maximo™. Proper identification and prioritization of utilities projects to improve system efficiency and maintain optimal mission readiness aligned to supporting mission assurance are additional responsibilities of the UM Manager.

1.2 Overall Intent

In compliance with requirements from the 2017 through 2021 National Defense Authorization Act (NDAA), Department of Defense (DoD) Instruction 4170.11 Installation Energy Management Energy Resilience Title 10, Section 2925(a), and Unified Facilities Criterion.

2. Energy Security

The following subsections define each of the 3 Pillars. See Appendix E for a more comprehensive list of energy security definitions.

2.1 Energy Reliability

Energy reliability serves to improve mission readiness and is considered the percentage of time energy delivery systems (utilities) can serve mission functions at acceptable levels including meeting regulatory standards. Reliability metrics are measured by the frequency and duration of service disruptions to customers, and the value of reliability depends on the magnitude of adverse effects an electrical outage has on customers. Reliability is determined by the adequacy, security, and quality of two primary elements: supply (i.e. generation availability) and delivery (i.e. electricity or power to an Installation). Outages occur when critical control parameters for electricity fall outside allowable ranges for voltage, current, and frequency. Key attributes of a reliable electrical transmission and distribution systems include:

- System monitoring and control by keeping parameters within acceptable limits during normal operating conditions
- System controls limiting the impact and scope of instability and cascading faults when outages occur
- System receives regular maintenance and testing per current industry standards
- System has current cybersecurity protections in place to prevent or minimize unplanned outages due to cyber threats and communication system outages

2.2 Energy Resilience

Per 10 U.S.C. § 101(e), energy resilience is defined as "…the ability to avoid, prepare for, minimize, adapt to, and recover from anticipated and unanticipated energy disruptions in order to ensure energy availability and reliability sufficient to provide for mission assurance and readiness, including mission essential operations related to readiness, and to execute or rapidly reestablish mission essential requirements" (Ref. C). Threats that may cause a disruption include weather events, accidents, animals, vegetation, geo-magnetic storms, terrorism, fire, cyber-attack, and the effects of climate change e.g. sea level rise (Ref. D and E). All in all, considering energy resilience enhances warfighting capabilities and ensures the DON's Installations will have the ability to prepare for and recover from utility interruptions impacting mission assurance. Key attributes of a resilient energy system include:

- System relies on or can operate from more than one fuel source (resource diversity)
- System has redundancy built in to minimize the effects of outages on supported missions
- Emergency operating procedures are well documented and exercised regularly
- System has on-site generation capability to sustain operations during a commercial grid outage

2.3 Energy Efficiency

Energy efficiency is the use of minimal energy required to achieve the desired level of service to meet mission essential requirements. Aging infrastructure, outdated equipment, poor maintenance, and lack of cultural awareness contribute to inefficiencies at Installations. Key attributes of an efficient energy system include:

- System relies on the minimal amount of energy to operate

- System can measure facility level consumption and demand to optimize resources across the entire system
- System can respond to demand response events to reduce loads and keep critical and essential functions operational during commercial supply shortages
- System is regularly evaluated (audited) to identify inefficient equipment, configurations, or end uses.
- Advanced data analytics are in place to identify trends, spikes, or other anomalies that affect efficiency

2.4 Energy Performance Criteria

The DON has established the following performance criteria for reliability, resilience, and efficiency criteria.

2.4.1 Reliability

For electrical reliability, DON shall employ the Institute of Electrical and Electronic Engineers (IEEE) Standard IEEE 1366 Guide for Electric Power Distribution Reliability Indices (Ref. F). Metrics for reliability of electrical systems are measured by tracking the duration and frequency of electrical outages. The indices include IEEE 1366 System Average Interruption Duration Index (SAIDI), System Average Interruption Frequency Index (SAIFI), and Availability. SAIDI, SAIFI, and Availability are universally accepted throughout industry as reliability indicators for electric power utilities. In addition, the Customer Average Interruption Duration Index (CAIDI), Electrical Preventative Maintenance (PM) Execution Rate, and Power Quality (PQ) are other metrics used to track electrical reliability.

Table 2.1 below displays electrical reliability benchmarks that for Navy and Marine Corps installations. These benchmarks allow for assessment of current system performance and the identification of potential requirements to improve reliability. Installation Commanders and Mission Owners should prioritize all performance metrics in section 2.4.1, including power quality (PQ) that fall below threshold values for two consecutive years. Subsections 2.4.1.1-2.4.1.5 define the benchmarks displayed in Table 2.1, and subsection 2.4.1.6 describes how PQ goes hand in hand with electrical reliability.

Recommended Levels of Service					
Installation Type	**SAIDI (Average outage duration in minutes per year)**	**SAIFI (Average interruption frequency of occurrence per year)**	**Availability (% of time utility is operable)**	**CAIDI (Customer Average Interruption duration in minutes per year)**	**Electrical Preventive Maintenance (PM) Execution Rate**
Naval Shipyards, Air Station, Aviation Depots	60	1	99.9886%	60	95.0%
Other Installations	120	2	99.9772%	60	90.0%

Table 2.1 - Electrical Reliability Benchmarks

2.4.1.1 SAIDI

SAIDI is an Installation level metric that is the yearly average outage duration for the average customer served at a particular Installation. Customers are the total number of facilities/buildings/ships on an Installation or PWD that receive electricity (i.e. metered and billed for electric usage). Note that PWDs can have special areas that add to the total customer count. SAIDI calculations take the total number of customer outage minutes per year divided by the total number of customers served in a defined area. Units of measure are minutes/year. The reportable utility outage duration is greater than five (5) minutes and must cause a disruption of services, according to the BMS B-5.2.14, Utility Outage Reporting and Data Collection, and all utility outages must be recorded in Maximo™ (Ref. G). The following is an example of how to calculate SAIDI from PWD Norfolk Fiscal Year FY20 using notional data:

- SAIDI = Sum of customer outage durations (min) / Sum of Customers
- SAIDI = 377,987 customer minutes / 920 customers
- SAIDI = 410.86 [System Average Outage Duration (minutes/year)]

2.4.1.2 SAIFI

SAIFI is an Installation level metric that is the yearly average number of interruption occurrences experienced by a customer served at a particular Installation or PWD. Similar to SAIDI metrics, PWDs can also have special areas that add to the total customer count. SAIFI calculations take the total number of customer interruptions divided by the total number of customers served in a defined area. Units of measure are outage occurrences/year, and just as SAIDI metrics, the reportable utility outage duration is greater than five (5) minutes and must cause a disruption of services (Ref. G). The following is an example of how to calculate SAIFI from PWD Norfolk FY20 using notional data:

- SAIFI = Sum of customer outages / Sum of Customers
- SAIFI = 829 customer outages / 920 customers
- SAIFI = 0.90 [System Average Outage Frequency (outage occurrences/year)]

2.4.1.3 Availability

Availability is the total percentage of time that customers (Buildings, Ships, Installations, or Facilities) had electricity, and is calculated by taking the SAIDI divided by total minutes per year, then subtracting by one. The following is an example of how to calculate Availability from PWD Norfolk FY20 using notional data:

$$\text{SAIDI} = \frac{\sum(min)(Cust)}{(Cust)}$$

$$\text{SAIFI} = \frac{\sum(Out)(Cust)}{(Cust)}$$

$$\text{AVAIL} = 1 - \frac{SAIDI}{525{,}600}$$

- Availability = 1 – (SAIDI / total minutes per year)
- Availability = 1 – (410.8 minutes / 525,600 minutes)
- Availability = 0.999218 = 99.9218%

2.4.1.4 CAIDI

CAIDI is another Installation level metric for the average customer at a certain Installation. CAIDI is the reliability index commonly used by electric power utilities and gives the average outage duration that any given customer would experience. Essentially the average restoration time for a customer, CAIDI is calculated by dividing the SAIDI by the SAIFI. Units of measure are minutes/year. The following is an example of how to calculate CAIDI from PWD Norfolk FY20 using notional data:

- CAIDI = SAIDI/SAIFI
- SAIDI = 410.86 [System Average Outage Duration (minutes/year)]
- SAIFI = 0.90 [System Average Outage Frequency (outage occurrences/year)]
- CAIDI = 410.86 / 0.90 = 456.51 minutes/year

2.4.1.5 Electrical PM Execution Rate

The PM Execution Rate takes electrical assets in the current FY from the authoritative Maximo™ database and contrasts current FY to the average of the last three (3) FYs. Consequently, this provides context for forensic root cause analyses to assess current system performance and improve reliability.

2.4.1.6 Power Quality (PQ)

PQ is the electrical transmission and distribution grid or network to; supply a clean and stable electrical power supply to end users. Ideally, high power quality creates a perfect power supply that is always available, has a pure noise-free and sinusoidal wave shape, and is always within voltage and frequency tolerances.

The optimal range for steady state service voltage is Range A (Utility system voltage), which is shown below and defined in ANSI Standard C84.1 (Ref. H):

- For 120 V to 600 V Systems: Maximum +5%, Minimum -5% from the nominal system voltage
- For Systems Greater than 600 V: Maximum +5%, Minimum -2.5% from the nominal system voltage

However, if steady state service voltage is not optimal, ANSI Standard C84.1 (Ref. H) indicates the following acceptable standards that fall under Range B which can be for short durations or unusual conditions:

- For 120 V to 600 V Systems: Maximum +5.8%, Minimum -8.3% from the nominal system voltage
- For Systems Greater than 600 V: Maximum +5.8%, Minimum -5% from the nominal system voltage

The optimal ranges for Frequency variations are:

- For 60 Hz: Maximum +60.5 Hz and Minimum 59.5 Hz (Per National Electric Reliability Council (NERC)
- For 50 Hz: Maximum +51 Hz and Minimum 49 Hz (Per National Electricity Market (NEM)

PQ issues are common and can be highly complex requiring professional utility personnel analytics to ascertain corrective measures. Utilities and Energy Management (UEM) should handle all issues or concerns regarding PQ and escalate the issues to the Facilities Engineering Command (FEC) as necessary. Appendix C provides additional details and tips for troubleshooting power quality issues.

2.4.2 Resilience

The Electrical Resilience Index (ERI) provides the tactical capacity of the utility to react quickly and/or cope with various incidents that have the potential to disrupt services. To indicate areas of improvement and increase resilience at Installations, the ERI allows Installations to answer a series of Yes/No questions to gauge Installation resilience. Table 2.2 below depicts the ERI.

Electrical Resilience Index (ERI)						
Installation Type	**Emergency Response Plan**	**Mutual Aid and Assistance**	**Emergency Power for Critical Operations**	**Ability to meet minimum demand during electrical production or grid casualty**	**Critical Parts and Equipment**	**Utility Staff Resilience**
Naval Shipyards, Air Station, Aviation Depots	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
Other Installations	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No

Table 2.2 - Electrical Resilience Index (ERI)

2.4.2.1 Mutual Aid and Assistance with Local Municipality

Any utility can significantly strengthen its resilience through the establishment of mutual assistance and mutual aid agreements among various utilities and states. The specialized expertise and equipment of utility peers are readily capable to provide a rapid, knowledgeable response to critical utility incidents. Participation in such written agreements is traditionally at no cost and does not obligate signatories to respond. Discuss potential mutual aid assistance packages with leadership at each base.

2.4.2.2 Emergency Power for Critical Operations

Electrical power is most often the greatest immediate requirement in the wake of a major disaster. A critical facility and/or utility should assume a minimum self-supplied generation requirement of 7 days for backup power for critical operations. This assumed limit provides the expected duration to represent either the minimum amount of time that it might take for service restoration or the deployment of an adequate generation of assets during the interim outage. The more power independent the utility, the stronger its resilience. This indicator considers the ability of the utility to maintain its critical operations independently.

2.4.2.3 Ability to Meet Minimum Demand

The ability to meet the minimum daily demand while electrical power generation or supply is nonfunctional and unavailable is a critical aspect of energy resilience. While taking into consideration the DON’s minimum fuel requirement, as shown in Table 2.3, of seven (7) days.

2.4.2.4 Lead Time for Critical Parts and Equipment

Calculate the longest lead-time to return critical equipment to service and fully restore operations, excluding larger built-to-order equipment (e.g. 20MVA transformer). Critical parts and equipment are the components that, upon failure, impede the capability to immediately return to operation and provide electrical power in adequate quantities and quality. Understand that lead times for each piece of critical equipment will vary depending upon the contracts and/or agreements put in place, as well as the backlogs from the manufacturer’s building or fixing the critical parts and/or equipment in need.

2.4.2.5 Utility Staff Resilience

Utilities personnel resilience is the percentage of on-call personnel designated for utility management, operation, and maintenance that have an identified competent backup. It is calculated as; number of emergency response utilities billets with identified backup personnel divided by the total number of emergency response utilities billets.

2.4.2.6 Electrical Resilience Requirements

It is important to summarize existing DON resilience requirements for mission critical and mission essential facilities. Table 2.3 below itemizes the requirements by CATCODE to address minimum design standards for redundancy, uninterruptible power requirements, and storage requirements for islanding from commercial power (Ref. I, J, K, L, M, N, O, P, Q, R).

In accordance with current UFC requirements, each DON installation shall meet the minimum electrical resilience requirements also summarized in Table 2.3.

- According to UFC 3-540-01, the minimum requirement for fuel storage is seven (7) days either in a dedicated on-site main fuel tank or from a confirmed delivery source (Ref. I). When the seven- (7) day requirement by a delivery source is accomplished, provide each generator set with a minimum local 24-hour capacity tank, based on the full-load fuel consumption rate of the engine.
- Regional Commanders can adjust the storage requirement, if documented in writing that mission operations require a different operational duration. Table 2.3 notes facilities having more stringent requirements than the UFC minimum.
- Note that planning and design for some facilities requiring specialized resilience requirements are not captured by the CATCODES in Table 2.3. Where CATCODES do not address the requirement, it must be identified in the facility's Basic Facility Requirements (BFR) document. Requirements not captured by the CATCODES in Table 2.3 must have appropriate documentation of the requirement and be approved by the Regional Commander (REGCOM).

UFC Source	Category Code	Facility Type	Redundancy Requirements	Uninterruptable Power Requirements	Fuel Storage Requirement
UFC 3-540-01	12330	Vehicle and Equipment Ready Fuel Storage	Emergency Generator	None	UFC Minimum
UFC 3-540-01	13120	Communications Relay Facility	Emergency Generator	UPS Required for communication equipment	UFC Minimum
UFC 3-540-01	13122	VHF/UHF Communications Facility	Emergency Generator	UPS Required for communication equipment	UFC Minimum
UFC 3-540-01	13135	Receiver Building	Emergency Generator	UPS Required for communication equipment	UFC Minimum
UFC 3-540-01	13140	Telephone Exchange Building	Emergency Generator	UPS Required for communication equipment	UFC Minimum
UFC 3-540-01	13150	Transmitter Building	Emergency Generator	UPS Required for communication equipment	UFC Minimum
UFC 3-540-01	13372	Military Terminal Radar Approach Facility	Emergency Generator	UPS Required for communication equipment	UFC Minimum
UFC 3-540-01	13373	Fleet Area Control Surveillance Facility	Emergency Generator	UPS Required for communication equipment	UFC Minimum
UFC 3-540-01	13374	Joint Control Facility	Emergency Generator	UPS Required for communication equipment	UFC Minimum
UFC 3-540-01	13375	Air Surveillance Radar Facility	Emergency Generator	None	Provide fuel storage capacity for 24 hours of continuous generator operation.

UFC Source	Category Code	Facility Type	Redundancy Requirements	Uninterruptable Power Requirements	Fuel Storage Requirement
UFC 3-540-01	14365	Operations Control Center	N+1 (Emergency Generator)	UPS Required for communication equipment	UFC Minimum
UFC 3-540-01	14380	Command, Control, Communication, Computers and Intelligence Facility (C4I)	N+1 (Emergency Generator)	UPS Required for communication equipment	UFC Minimum
UFC 3-540-01	14385	Joint Reserve Intelligence Center (JRIC)	N+1 (Emergency Generator)	UPS Required for communication equipment	UFC Minimum
UFC 3-540-01	51010	Hospital	N+1 (Emergency Generator)	UPS Requirements - See NFPA 110	Fuel Storage Requirements - NFPA 110
UFC 3-540-01	81159	Standby Generator Building	(See UFC for Specific Requirements)	None	UFC Minimum
UFC 3-540-01	81160	Standby Generator Plant	(See UFC for Specific Requirements)	UPS Requirements - See NFPA 70	UFC Minimum
UFC 4-010-05	N/A	Sensitive Compartmented Information Facilities (SCIF)	N+1 (Emergency Generator)	UPS Required for Facility	Twenty-four hours of uninterruptible backup power. This may be provided by batteries, uninterruptible power supply (UPS), or generators, or any combination
UFC 4-133-01N	13373/ 13372	Aviation Operation and Support Facilities Air Traffic Control and Air Operations Facilities	Emergency Generator	UPS Required for communication equipment	UFC Minimum
FC 4-141-05N	89051	NAVY AND MARINE CORPS FACILITY AND ENERGY OPERATIONS CENTERS	Emergency Generator	UPS Required for critical equipment and systems that cannot risk loss of data	UFC Minimum
UFC 3-230-03	84110	Potable Treatment Facilities	Emergency Generator	UPS Required for control equipment	UFC Minimum
UFC 3-230-03	83110	Wastewater Treatment Facilities	Emergency Generator	UPS Required for control equipment	UFC Minimum
UFC 4-150-02	N/A	Dockside Utilities for Ship Service	Emergency Generator	None	UFC Minimum

UFC Source	Category Code	Facility Type	Redundancy Requirements	Uninterruptable Power Requirements	Fuel Storage Requirement
FC 4-722-01N	72235	USN and USMC Dining Facilities	(See UFC for Specific Requirements)	None	72 hours Storage (Mass Care Facility)
UFC 4-730-04AN	73020	Military Police Facilities	(See UFC for Specific Requirements)	UPS Required for special service equipment	See comments
UFC 4-730-10	73010	Fire Stations	(See UFC for Specific Requirements)	None	UFC Minimum
DON Minimum Fuel Requirement (UFC 3-540-07)		Seven (7) days either in a dedicated on-site main fuel tank or from a confirmed delivery source, when the delivery source is used to meet the seven (7) day requirement. Provide each generator set with a minimum 24-hour local capacity tank based on the actual generator load fuel consumption rate of the engine (Ref. S).			

Table 2.3 - Electrical Resilience Requirements by Category Code

2.4.2.7 Business Case and Benchmarks

For Installations within electrical reliability benchmarks set in Table 2.1, there may be a business case to increase resilience if the cost impact of an electrical outage or multiple outages exceeds the investment cost of the resilience improvement. For example, if a Navy Shipyard, Air Station, or Aviation Depot experiences an extended, unplanned electrical outage, the stranded labor and productivity costs will likely exceed the cost of installing backup power. All feasible and cost-effective solutions that directly improve the electrical system's reliability shall be evaluated. Investments up to local controls shall evaluated.

The Department of Energy has developed a methodology to determine cost impacts of outages documented in the National Renewable Energy Laboratory (NREL) study, Valuing Energy Security: Customer Damage Function Methodology and Case Studies at DoD Installations. Refer to Section 5 of the NREL study for a sample business case analysis and illustration (Ref. T).

2.4.2.8 Central Plants, Microgrids, and Distributed Generation

Installations may be able to more efficiently meet the UFC backup power requirements through the use of a combination of central plants, microgrids and/or distributed generation. Note that all BFRs and UFC requirements are frequently updated and vary depend on the Region and Installation. Targeted evaluations (e.g. Commercial Power Outages) should be performed to properly match reliability and resilience deficiencies to the right technical solutions (e.g. microgrids and distribution system projects). Utility system owners and operators should lead evaluations. For additional guidance on microgrids, reference the P-601 Microgrid Design Guide (Ref. U).

2.4.2.9 N+1 Resiliency

N+1: A reliability term indicating that if a total of n units are installed, an additional unit is installed to ensure system reliability in the event of a single unit failure or to accommodate other activities such as periodic maintenance (Ref. I).

2.4.2.10 Prime Power Generator Plants

While commercial service may exist at some sites (Djibouti, Guam, GTMO, etc.), it may not be accessible by the base or reliable enough to meet the base's requirements. Prime power plants require special consideration for reliability, availability and maintainability.

2.4.2.11 Blue Sky Testing Microgrids for Black Sky Scenarios

Anticipate microgrid design capabilities with periodic testing of equipment in order to ensure the microgrid will perform as required under emergency conditions. Develop testing procedures and protocols for a full-scale test that includes operating all energy generation systems, infrastructure, and equipment. Testing should include islanding (disconnect from local commercial power) and black start of onsite generation. At a minimum, full-scale testing is recommended annually. Installations should track the number of black start exercises performed annually for microgrids and ensure compliance with conducting black start exercises every five (5) years (Ref. MM).

2.4.2.12 Utility Emergency Response Plan (ERP)

The Utility Emergency Response Plan provides a written plan of action with requisite steps necessary to provide an immediate response to major operational interruptions and permanently restore service. The Utility ERP must also include a process for prioritized restoration of critical electrical loads, which shall be conducted annually through tabletop exercises, walk-throughs, or live exercises.

2.4.3 Efficiency

Efficiency is a key component of energy security, because it minimizes energy use, directly saves resources, reduces the size of resilience solutions, extends the operational duration of stored fuel, and provides general benefits to improve overall security, all with the goal of reducing operating costs.

Section 431 of the Energy Independence and Security Act of 2007 (EISA) directed agencies to reduce energy intensity (the energy consumed per Gross Square Foot (GSF)) of Federal building space, to achieve a 30 percent annual electricity consumption reduction by FY 2015, compared to the FY 2003 baseline (Ref. V, W, X).

Performance measurement toward the energy reduction goal determines whether the agency has achieved a 30 percent reduction in energy intensity from FY 2003 and has demonstrated continued progress in reducing energy intensity in the reporting year.

Energy Independence and Security Act (EISA) of 2007 (Ref. V) requires installations to meet a 30% energy reduction from the 2003 baseline. However, if an Installation has not met the statutory reduction goal of 30%, each Installation must demonstrate progress towards a reduction goal EO 13834 (Ref. Y). Table 2.4 shows the energy efficiency requirements for different types of Installations.

Energy Efficiency Requirements		
Installation Type	**30% Reduction Goal Met**	**Current Year (CY) Progress**
Naval Shipyards, Air Station, Aviation Depots	Yes/No	Yes/No
Other Installations	Yes/No	Yes/No

Table 2.4 - Energy Efficiency Requirements

Aligned with the DON Energy Program's SECNAV INSTRUCTION 4101.3A, the Navy optimizes energy efficiency and shore operational effectiveness across all installations (Ref. Z). Effective efficiency programs include:

- Capable energy data management and analytics
- Planning, programming, and execution of diverse energy projects across all funding streams
- Integration of IT systems to enhance capabilities, which may include advanced technology such as Advanced Metering Data (AMI), Supervisory Control and Data Acquisition (SCADA), or Direct Digital Control (DDC)

Integrating central energy management and controls, as well as DDC, at facilities with the highest energy reduction potential will further increase opportunities to meet all mission essential energy security requirements.

Actively managing facilities with critical loads and the highest potential for consumption reduction enables:

- Cost-effective facility management
- Optimized load management
- Demand response programs
- Enhanced energy reliability and resilience

2.5 Energy Best Practices

The DON approaches energy readiness by engaging in best practices on an ongoing basis to improve energy reliability, resilience, and efficiency.

2.5.1 Reliability Best Practices

Reliability describes the availability of generation, transmission, and distribution systems to provide service to its customers and is closely tied to the configuration, condition, and age of infrastructure, as well as execution of comprehensive cybersecurity and preventive maintenance programs.

2.5.1.1 Utilities Infrastructure and Condition Assessment Programs (UICAPs) and Utility System Assessments

UICAPs look at the current state of the DON's utility infrastructure assets. Conduct UICAPs and electrical utility system assessments to assess utility risks and equipment inventory, perform periodic inspections identifying risks from single points of failure, and evaluate system capacities. Ensure to integrate data collected from assessments into Maximo™, iNFADS, and GIS authoritative databases. Conduct utility deep dives, nodal analysis, or root cause analyses for systems that are underperforming towards reliability goals. All in all UICAP looks at risk evaluation considerations and risk-based investment decisions to develop a comprehensive PM program (Ref. AA). Additional UICAP information can be found on the NAVFAC portal.

2.5.1.2 Tracking and Reporting

Tracking and reporting of utility outages is essential in order to make informed programmatic decisions for utility investments. Critical customers shall be tracked at the individual facility level in order to identify individual critical facility impacts. Navy installations shall follow BMS B-5.2.14 Utility Outage Reporting and Data Collection (Ref. G) and Marine Corps Installations shall follow the current USMCmax Desk Guide for Utilities Outage Reporting.

2.5.1.3 Coordination and Partner

Coordinate and collaborate with the utility provider to reduce outages. Utility providers can reduce outages by maintaining rights of way through active vegetation and animal management to avoid easily preventable outages.

2.5.1.4 Route Diversity

The National Defense Authorization Act (NDAA) encourages the DON to work with utility providers (Ref. BB, CC, DD). Coordinate and collaborate with the commercial utility to provide route diversity to improve utility reliability, and discuss potential options with the Contracting Officer. Request and negotiate with commercial utility providers for dual circuits to an Installation's primary electric substations to improve energy security when cost effective. Where these substations are equipped only with a single transformer, request and negotiate with the commercial power provider to install a second transformer in parallel for system redundancy. If Installations have two (2), three (3), four (4), etc. transformers and are in need of another, follow the same procedures to negotiate with the utility to obtain another transformer or electrical device for route diversity. Consider if critical facilities will be impacted if another piece of equipment is installed at an Installation. If electricity at critical facilities will be disrupted, determine a plan of action to minimize downtime in each facility. Also, think about which routes will cause the least amount of disruption across the Installation. Depending on the circumstances and mission assurance requirements, consider building distributed energy resources (DERs) or small power plants.

2.5.1.5 Preventive Maintenance Execution

Execute NAVFAC standard utility preventive maintenance (PM) on electrical systems in accordance with industry standards (ANSI/NETA MTS, NFPA 70B), DODI 4170.11, and UFC 3-550-07 optimizing equipment life and reliability (Ref. GG, HH). Facility backup generation shall be maintained by UFC 3-540-07 (Ref. S). PM execution shall include updates to equipment condition ratings within Maximo™ per the NAVFAC UICAP Sustainment Guide.

2.5.1.6 Delivered Fuel, Delivery Mitigation Strategies, and Tactics

Reduce delivered fuels dependence, and investigate the cost availability and effectiveness of centralized natural gas distribution. Plan fuel switching, and utilize renewable energy investments to reduce financial exposure to volatility in fuel markets, as well as improve the Installation's fuel capacity, in the event of an energy supply disruption.

2.5.1.7 Local Power Generation

Increase local power generation to improve reliability. The need for distributed generation and microgrid facilities is especially acute when the commercial electricity supplier(s) does not meet the SAIDI standards described in Table 2.1 or facilities with high criticality do not have redundant power supplies. UEMs should investigate free resources, such as tax credits or rebates from utility companies to offset power generation and reliability costs. Installations should hold regular meetings with utility companies to discuss how to maximize local power generation for minimal costs at each Installation.

2.5.1.8 Mapping

It is critical to receive updated and accurate electrical system one-line diagrams and GIS maps to help facilitate quicker response actions during utility interruptions. IEMs and UEM should work with the utility to update one-lines and GIS maps. Ensure to adhere to BMS 5.2.20 Utilities Geographic Information System Data Maintenance (Ref. JJ).

2.5.1.9 Planning and Programming

Planning and programming reliability can be achieved by the following:

- Promoting the use of multiple and diverse sources of energy, with emphasis favoring energy resources originating on the Installation
- Promoting the installation of microgrids to ensure the energy security and energy resilience of critical missions
- Favoring the use of full-time, installed energy sources, as opposed to emergency generation for other than short-duration (minutes) outages, caused by nuances other than hostilities or terrorism

2.5.2 Resilience Best Practices

Resilience can be obtained through a combination of partnerships with commercial utilities, on-site distributed generation and storage capabilities, and grid and/or microgrid configurations. Generation and microgrid planning can encompass a wide range of objectives, ranging from serving the entire Installation to optimizing secondary uses (such as steam or chilled water) or providing adequate islanding capacity.

2.5.2.1 Coordinate and Partner

IEMs and UEMs should coordinate and collaborate with commercial utility providers to improve resilience by gaining access to equipment, material, and personnel from nearby commercial utilities, through mutual aid agreements can significantly reduce the amount of time required to restore power after a major disturbance.

2.5.2.2 Improve Installation Readiness

Collaborate with commercial utility managers and fuel suppliers to explore how they can help the DON improve installation energy readiness by:

- Establishing communication links with the serving utility at control centers during microgrid and smart grid planning and design
- Establishing a mutual aid agreement to allow sharing of compatible materials and personnel during emergency response situations (most utilities have model agreements in place that provide for both local and regional responses)
- Obtaining system one-line drawings from the commercial utilities serving the Installation to gain a better understand of the Installation's exposure to first and second contingency outages
- Obtaining the commercial electric utilities' rotating blackout and service restoration plans and negotiating for most favorable treatment

2.5.2.3 Critical Mission Resilience

Improve resilience to critical missions by assessing critical infrastructure configuration and condition. Evaluate the capability to deliver electrical power to critical loads. Critical customers shall be tracked at the individual facility level in order to identify individual critical facility impacts.

2.5.2.4 Underground Feeder Cost/Benefit Analysis

IEMs and UEMs should evaluate the cost and benefits of placing critical feeders underground and review bundling options with the utility provider. Depending on the Region, factor in seismic constraints when evaluating a cost/benefit analysis. Consider adding reclosers to improve resilience for overhead lines that are prone to vegetation outages when it is not justifiable to relocate the lines underground (Ref. HH).

2.5.2.5 Implement Smart Grid Technologies

Utilize smart grid technology to improve resilience through the ability to monitor the status of all energy supplies, distribution circuits, and load requirements which are centralized to distribution management especially when employing microgrids. This ability greatly enhances Installation assets by the monitoring AMI and electrical SCADA.

2.5.2.6 Implement Microgrid Technologies

Incorporate and integrate control and monitoring systems with the capability to respond to system status changes. There is no DON requirement to install a microgrid; however, pursuing microgrid projects where cost effective in order to support mission requirements are encouraged. Evaluate the capacity of existing and planned power generation and islanding capability when considering microgrids. Evaluate opportunities for cost savings when economical for the Installation. The Advancing Navy Commodities Cost Reduction (ANCCR) program at NAVFAC HQ performs the Business Case Analysis (BCA) for these efforts for all projects effecting utilities valued at $1M or greater. Appendix A provides a visualization outlining the design and function of a microgrid.

2.5.2.7 Fuel Requirement Sensitivity Analyses

Evaluate fuel requirements for backup and distributed generation to determine maximum operating time to serve critical loads in the event of grid failure, while factoring in mission assurance. Follow the same best practices as outlined in section 2.4.3.3 (Ability to Meet Minimum Demand), taking into consideration the DON's minimum fuel requirement, as shown in Table 2.3, of seven (7) days.

2.5.2.8 Renewable Energy Resources

Incorporate renewable energy, such as solar, wind, hydro, tidal, geothermal, or biomass energy, to reduce fuel consumption when cost effective. Utility owners and operators own the requirements and efforts to accurately analyze and identify impacts to existing utility generation and distribution assets. IEMs and UEMs should coordinate with utility owners and operators if renewable energy projects will be pursued. Refer to the DON's Strategy for Renewable Energy for a more in-depth overview of the DON's approach to implementing renewable energy into projects (Ref. KK).

2.5.2.9 Energy Storage Strategies

Integrate batteries, thermal energy storage, and other energy storage solutions when cost effective to optimize the use of renewable generation resources. Examples include, but are not limited to, lithium-ion batteries, flow-storage batteries, or kinetic-ion storage. Coordinate with the Office of Naval Research (ONR) Science & Technology (S&T) Department for questions, ideas, and/or opportunities to integrate energy storage into Installations (Ref. LL). The OSD Energy Resilience Analysis (ERA) Tool provides additional information on energy storage strategies.

2.5.2.10 Leveraging Existing Resources

When conducting the Analysis of Alternatives (AoA) during project planning and inception, consider integrating existing backup diesel generators into microgrids, when equipment meets environmental requirements and prime mover equipment is cost effective and practical.

2.5.2.11 Location of Backup Emergency Generation

The best practice for locating backup emergency generation sources (N, N+1, etc.) required for critical facilities is to collocate the backup emergency power generation asset at the facility, which will provide the highest resilience for the location. If the backup emergency power sources are located remotely from the facility (microgrid, distributed generation, central power plant, etc.), the electrical utility infrastructure, between the remotely located backup emergency power sources and the facility, must be evaluated. This will ensure high reliability and redundancy of the electric utility distribution equipment serving the facility. Furthermore, obtain higher levels of resilience when backup generation sources are at the facility coupled with central generation. The "N" backup emergency power sources located at the facility act as the first response to power interruptions. At a point past the interruption, the central and/or remote backup emergency power sources will assume the lead, and the facility backup emergency power sources will shut down, going on standby.

2.5.3 Efficiency Best Practices

Energy efficient shore facilities contribute to operational effectiveness, energy security, and energy affordability. Increasing the energy efficiency of existing facilities is the most effective way to reduce consumption, protect critical assets, and increase the impact of distributed energy resources.

2.5.3.1 3rd Party Financing

Third-party financing allows Installations to leverage limited annually appropriated funds by utilizing private capital to pay for investments up front, with repayments occurring over the life of the project. Utilizing third-party financing mechanisms such as ESPCs, UESCs, UP, and EULs can serve to increase efficiency across Installations and reduce capital outlay for energy projects.

Utilize a bundling approach where long payback Energy Conservation Measures (ECMs), coupled with short payback ECMs achieve a more complete and usable system (Ref. PP. Table 2.5 includes the different types and characteristics of third-party financing. Note that it is acceptable to combine third-party financing mechanisms to meet reliability, resilience, and/or efficiency requirements each individual mechanism would have difficulties satisfying.

Structure	Capital Source	Unique Attributes
Energy Savings Performance Contract (ESPC)	ESCO	Multi-year repayment based on guaranteed savings, can use existing DOE IDIQs, broader infrastructure focus
Utility Energy Service Contract (UESC)	Utility	Multi-year repayment based on performance contracting (energy reduction or other specified services), CONUS only, sole source awards more common, broader infrastructure focus
Enhanced Use Lease (EUL)	Developer or Utility	Leverages underutilized property, in-kind consideration for leased DON land, can be combined with other mechanisms
Power Purchase Agreement (PPA)	Developer or Utility	Predictability and stability of costs, diversify energy supply, tax benefits to private party, long term commitment, can serve non-critical loads
Utility Privatization (UP)	Utility	Maximum 50-year period transfer of ownership and operations contract, typically for major capital expenditures and infrastructure improvements
Intergovernmental Service Agreement (IGSA)	City/State Government	Creating economy-of-scale cost reductions by contracting and transferring responsibilities to local government to perform Installation maintenance
USC Modification	Utility	Modification of tariff/structure or request an increase in supply line capacity, route diversity, etc. to satisfy new requirements

Table 2.5 - Third-Party Financing Characteristics

2.5.3.2 Shore Operational Cost Savings

Operational cost savings from cost-effective ECMs and energy efficiency improvements can pay for the required investment. The DON strives to achieve its energy efficiency targets using the following strategies:

- Installations are to complete a comprehensive energy evaluation for approximately 25 percent of the covered facilities in a manner ensuring the evaluation of each such facility at least once every four years, per the Energy Independence and Security Act (EISA) of 2007 (Ref. V). Implementation of low or no-cost ECMs are highly recommended, but additional resources investigated to implement other cost-effective measures are acceptable.
- Invest in energy management systems such as DDC, utility SCADA, and AMI to provide installations with building-level reporting of energy consumption.
- Deploy smart grid systems to leverage all aspects of energy infrastructure. Smart grids have the potential to help sustain the benefits of investing in ECMs and facility maintenance through increased monitoring and control capabilities. In a cybersecurity environment, implement enabling infrastructure and initiatives to leverage data transfer and consolidation at central nodes in a uniform, secure, and affordable manner that reduces costs and increases energy security across Installations.

2.5.3.3 “Economies of Scale”

Evaluate opportunities to improve project economics for energy projects through distributed generation, Combined Heat and Power (CHP), and microgrids such as:

- Improving energy efficiency through waste heat recovery and utilization projects
- Combining peak shaving with other Installations served by the same utility or grid operator
- Providing the ability to operate in parallel with the commercial utility grid, in order to reduce power imports or export power to other segments of the microgrid
- Participating in utility demand response programs and ancillary services markets if available

2.5.3.4 Power Factor Correction

A high power factor signals maximum use of electrical power. On the other hand, a low power factor leads to purchasing more power to obtain the same load (kW), which increases costs in various ways on the utility bill. Capacitor and electronic means of power factor correction provide well-known benefits to electric power systems. Benefits include:

- Poor power factor penalty utility bill reductions
- Voltage support
- Reduced system losses

3 Water Security

Water security is the ability to have both assured access to reliable supplies of potable water and the ability to protect and deliver sufficient water quantities to satisfy mission essential requirements.

3.1 Water Performance Criteria

3.1.1 Water Reliability

Water Reliability is: the percentage of time water distribution systems (utilities) can serve customers (Facilities, Installations, and/or Regions) at acceptable regulatory standards, such as quality, pressure, and flow. Keep in mind that regulatory standards for water vary from Region to Region and are frequently updated. The following subsections describe measures for evaluating water reliability. Refer to Appendix B for an illustration of critical water demand prioritizations.

3.1.1.1 Potable Water Breaks per Mile

One way water reliability is captured is through the synthesis of data articulated to the number of potable water breaks per mile during the current fiscal year (FY). Evaluate the condition of the water system and how it is maintained, as well as the useful life of the water system. Contrasting current FY potable water breaks per mile to the cumulative potable water breaks per mile for the prior three (3) FYs provides a measurable reliability metric. The authoritative Maximo™ query allows for entering a number of potable water breaks per mile in the current FY. See Table 3.1 for the potable water breaks per mile recommended levels of service.

3.1.1.2 Potable Water Outages

The number of potable water outages shall be identified as incidents experiencing residual pressures less than 20 psi at the point of use for more than 5 minutes, per BMS B-5.2.14, Utility Outage Reporting and Data Collection, as returned from Maximo™ (Ref. G). See Table 3.1 for the potable water outages recommended levels of service.

3.1.1.3 Water Preventive Maintenance (PM) Execution Rate

The Preventive Maintenance (PM) Execution Rate for water assets in the current FY serve as another reliability metric and can be found from Maximo™. Contrasting the current FY's efforts to the average of the last three (3) FYs provides further context for any definitive root cause analyses. See Table 3.1 for the water PM execution rate recommended levels of service.

3.1.1.4 Water Recommended Levels of Service

The following Table 3.1 outlines the water recommended levels of service at Installations.

Water Recommended Levels of Service			
Installation Type	**Potable Water Breaks per Mile**	**Potable Water Outages**	**Water Preventive Maintenance (PM) Execution Rate**
Naval Shipyards, Air Station, Aviation Depots	10	6	95.0%
Other Installations	20	12	90.0%

Table 3.1 - Water Recommended Levels of Service

3.1.2 Water Resilience

Water resilience is the ability to avoid, prepare for, minimize, adapt to, and recover from water disruptions (anticipated or unanticipated) in order to ensure both water availability and reliability sufficient to provide for mission assurance and readiness, including task critical assets and other mission essential operations related to readiness, and to execute or rapidly reestablish mission essential requirements.

3.1.2.1 Water Resilience Index (WRI)

The Water Resilience Index (WRI) provides the tactical capacity of the utility to react quickly and/or cope with various incidents that have the potential to disrupt services. To indicate areas of improvement and increase resilience at Installations, the WRI allows Installations to answer a series of Yes/No questions to gauge Installation resilience. Table 3.2 below depicts the WRI.

Water Resilience Index (WRI)							
Installation Type	**Base Potable Water Supply**	**Emergency Response Plan**	**Mutual Aid and Assistance**	**Emergency Power for Critical Operations**	**Ability to meet minimum demand during production casualty**	**Critical Parts and Equipment**	**Utility Staff Resilience**
Naval Shipyards, Air Station, Aviation Depots	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
Other Installations	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No

Table 3.2 - Water Resiliency Index (WRI)

3.1.2.2 Base Potable Water Supply

Bases must have adequate potable water supply, including water quality, pressure, and volume (flow) metrics based on UFC 3-230-01, 3-230-03, and UFC 3-600-01 (Ref. M, QQ, RR).

3.1.2.3 Current Emergency Response Plan (ERP)

An ERP provides a written plan of action with requisite steps necessary to provide an immediate response to major operational interruptions and permanently restores service. INSIPP is the online data records cloud repository administered by Asset Management (AM) for storing electronic records enabling ease of access. The ERP must also include a process for prioritized restoration of critical water demands (Ref. SS).

3.1.2.4 Mutual Aid and Assistance with Local Municipality

Any utility can significantly strengthen its resilience through the establishment of mutual assistance and mutual aid agreements among various utilities and water authorities. The specialized expertise, equipment, and material inventories of utility peers are readily capable to provide a rapid, knowledgeable response to critical utility incidents. Participation in such written agreements is traditionally at no cost and does not obligate signatories to respond (Ref. SS). Discuss potential mutual aid assistance packages with leadership at each base.

3.1.2.5 Emergency Power Availability to Water Infrastructure Supporting Critical Operations

Power is most often the greatest immediate requirement in the wake of a major disaster. A utility should maintain the capability to supply water to critical operations that require continuous supplies of water during a water supply disruption of 72 hours. This assumed limit represents either the minimum amount of time it might take for water service restoration. The more power independent a utility is with water infrastructure, the stronger its resilience. This indicator reflects the utility’s ability to maintain critical operations independently (Ref. SS).

3.1.2.6 Ability to Meet Minimum Demand

The ability to meet the minimum daily demand while water production or supply is nonfunctional or unavailable is a critical aspect of energy resilience. Installations should determine how long their existing storage continues to meet demand, assuming the existing emergency generation is available (Ref. SS).

Installation and Mission Commanders must understand critical water load demands essential to meeting requirements. A formalized and critical water balance ability provides extended capability to support warfighting and warfighter capabilities. Combined with an effective leak detection program, a water-loss reduction program can positively impact the overall support of the mission.

3.1.2.7 Lead Time for Critical Parts and Equipment

Calculate the longest lead-time to return critical equipment to service and fully restore operations. Critical parts and equipment are the components that, upon failure, impede the capability to immediately return to operation and provide drinking water in adequate quantities, pressure and quality (Ref. SS). Understand that lead times for each piece of critical equipment will vary depending upon the contracts and/or agreements put in place, as well as the backlogs from the manufacturer's building or fixing the critical parts and/or equipment in need.

3.1.2.8 Utility Personnel Resilience

Utilities personnel resilience is the percentage of on-call staff monitored for utility management, operation, and maintenance that have an identified competent backup. It is calculated as a percentage of the combined relevant Installation positions with response-capable backup over the total positions. Cross training and integrated project delivery should be encouraged to improve/maintain this capability (Ref. SS).

3.1.3 Water Efficiency

Water efficiency is the use of the minimal water volume necessary to achieve the desired level of service. Aging infrastructures, outdated equipment, poor maintenance, lack of accountability on usage, and lack of cultural awareness can contribute to water inefficiencies.

The Energy Policy Act 2005 Installations to meet a 20% water reduction from the 2003 baseline. However, if an Installation has not met the statutory reduction goal of 20%, each Installation must demonstrate progress towards a reduction goal (Ref. Y). Table 3.3 shows the water efficiency requirements for different types of Installations.

Water Efficiency Requirements		
Installation Type	**20% Reduction Goal Met**	**Current Fiscal Year (CFY) Progress**
Naval Shipyards, Air Station, Aviation Depots	Yes/No	Yes/No
Other Installations	Yes/No	Yes/No

Table 3.3 - Water Efficiency Requirements

3.2 Water Best Practices

Water best practices are different across regions, as Installation water availability varies. A myriad of regional engineering practices provides added capabilities to meet water constraints unique to each region. These best practices incorporate other commodities such as electricity cross-pollinating commodity disciplines.

3.2.1 Coordinate and Partner

IEMs and UEMs should coordinate and collaborate with the respective Water Authority and Municipal Water utility providers to improve resilience by gaining access to equipment, material, and personnel from nearby commercial utilities, through mutual aid agreements can significantly reduce the amount of time required to restore potable water service after a major disturbance. The same is equally true for an Installation’s respective water purveyor.

3.2.2 Improve Installation Readiness

Collaborate with respective Water Authority and Municipal Water providers and suppliers to explore how they can help the DON improve an Installation's water readiness by:

- Establishing communication links with the serving utility at control centers during microgrid and smart grid planning and design
- Establishing a mutual aid agreement to allow sharing of compatible equipment, materials, and personnel during emergency response situations (most utilities have model agreements in place that provide for both local and regional responses)
- Obtaining system one-line drawings from the respective Water Authority/Municipal utilities water system serving the Installation to gain a better understanding of the Installation’s exposure to water outages
- Implementing water conservation measures (building level) is not expected to adversely impact system flushing requirements necessary to maintain water quality

3.2.3 Critical Mission Resilience

Improve resilience to critical missions by assessing critical infrastructure configuration and condition. Evaluate the capability to deliver water to critical service locations. Critical customers shall be tracked at the individual facility level in order to identify individual critical facility impacts.

3.2.4 System Hardening

Evaluate the cost and benefits of hardening critical water distribution single point of failure (SPF).

3.2.5 Implement Smart Grid Technologies

Utilize smart grid technology to improve resilience through the ability to monitor the status of all water supplies, distribution piping, cybersecurity, and water requirements, which are centralized to water distribution management especially when employing water-energy microgrids. This ability greatly enhances Installation assets by the monitoring AMI.

3.2.6 Implement Water-Energy Microgrid Technologies

Incorporate and integrate control and monitoring systems with the capability to respond to system status changes. There is no DON requirement to install a microgrid; however, pursuing microgrid projects where cost effective in order to support of mission requirements are encouraged. Evaluate the capacity of existing and planned water and power generation and islanding capability when considering water-energy microgrids. Appendix A provides a visualization outlining the design and function of a microgrid, and Appendix D gives a visual of water-energy microgrid illustration.

3.2.7 Fuel Requirement Sensitivity Analyses

Evaluate fuel requirements for backup and distributed generation to determine maximum operating time to serve critical water infrastructure in the event of grid failure, while factoring in mission assurance. Balance this need with the maximum water inventory that might be available. Follow the same best practices as outlined in section 3.1.2.6 (Ability to Meet Minimum Demand), while also taking into consideration the DON's minimum fuel requirement, as shown in Table 2.3, of seven (7) days.

3.2.8 Renewable Energy Resources

UEMs and IEMs should work with installations to incorporate renewable energy to reduce fuel consumption if possible and when cost effective.

3.2.9 Energy Storage Strategies

Integrate batteries, thermal energy storage, and other energy storage solutions when cost effective to optimize the use of renewable generation resources. Examples include, but are not limited to, lithium-ion batteries, flow-storage batteries, or kinetic-ion storage. Coordinate with the Office of Naval Research (ONR) Science & Technology (S&T) Department for questions, ideas, and/or opportunities to integrate energy storage into Installations (Ref. LL). The OSD Energy Resilience Analysis (ERA) Tool provides additional information on energy storage strategies.

3.2.10 Leveraging Existing Resources

When conducting the Analysis of Alternatives (AoA) during project planning and inception, consider integrating existing backup diesel generators into water-energy microgrids when equipment meets environmental requirements and prime mover equipment is cost effective and practical.

3.2.11 Efficiency Best Practices

Water efficient shore facilities contribute to operational effectiveness, water security, and water affordability. Operational effectiveness and improvement through resource reductions is needed to sustain and support operations. Increasing the water-efficiency of existing facilities is the most effective way to reduce consumption, protect critical assets, and increase the impact of limited water resources.

3.2.11.1 Third-Party Financing

Third-party financing allows Installations to leverage limited annually appropriated funds by utilizing private capital to pay for investments up front, with repayments occurring over the life of the project. Utilizing third-party financing mechanisms such as ESPCs, UESCs, UP, and EULs can serve to increase efficiency across Installations and reduce capital outlay for energy projects.

Utilize a bundling approach where long payback Energy Conservation Measures (ECMs), coupled with short payback ECMs achieve a more complete and usable system (Ref. PP. Table 3.4 includes the different types and characteristics of third-party financing. Note that it is acceptable to combine third-party financing mechanisms to meet reliability, resilience, and/or efficiency requirements each individual mechanism would have difficulties satisfying.

2912 funding stipulates that projects should address efficiency and conservation requirements.

Installations should place a greater emphasis on addressing efficiency gaps and incorporating efficiency projects into their portfolios. For more information on funding authorities, refer to Appendix H.

Structure	Capital Source	Unique Attributes
Energy Savings Performance Contract (ESPC)	ESCO	Multi-year repayment based on guaranteed savings, can use existing DOE IDIQs, broader infrastructure focus
Utility Energy Service Contract (UESC)	Utility	Multi-year repayment based on performance contracting (energy reduction or other specified services), CONUS only, sole source awards more common, broader infrastructure focus
Enhanced Use Lease (EUL)	Developer or Utility	Leverages underutilized property, in-kind consideration for leased DON land, can be combined with other mechanisms
Power Purchase Agreement (PPA)	Developer or Utility	Predictability and stability of costs, diversify energy supply, tax benefits to private party, long term commitment, can serve non-critical loads
Utility Privatization (UP)	Utility	Maximum 50-year period transfer of ownership and operations contract, typically for major capital expenditures and infrastructure improvements
Intergovernmental Service Agreement (IGSA)	City/State Government	Creating economy-of-scale cost reductions by contracting and transferring responsibilities to local government to perform Installation maintenance
USC Modification	Utility	Modification of tariff/structure to satisfy new requirements

Table 3.4 - Third-Party Financing Characteristics

3.2.11.2 Shore Operational Cost Savings

Operational cost savings from cost-effective WCMs and water efficiency improvements, when combined with increased metering and leak detection, can often pay for the required investment. The DON strives to achieve its water efficiency targets using the following strategies:

- Installations are to complete a comprehensive water audit for approximately 25 percent of the covered facilities in a manner ensuring the evaluation of each facility at least once every four years, per the Energy Independence and Security Act (EISA) of 2007. Implementation of low or no-cost WCMs are highly recommended, but additional resources investigated to implement other cost-effective measures are acceptable (Ref. V).
- Invest in water management systems, such as AMI, to provide Installations with building-level reporting of water consumption.
- Institute an intensive water audit process combined with a leak detection program to both identify water loss and compliance with the water conservation measures being proposed.

- Deploy smart grid systems to leverage all aspects of water infrastructure. Smart grids have the potential to help sustain the benefits of investing in WCMs and facility maintenance through increased monitoring and control capabilities. In a cybersecurity environment, implement enabling infrastructure and initiatives to leverage data transfer and consolidation at central nodes in a uniform, secure, and affordable manner that reduces costs and increase water security across Installations.

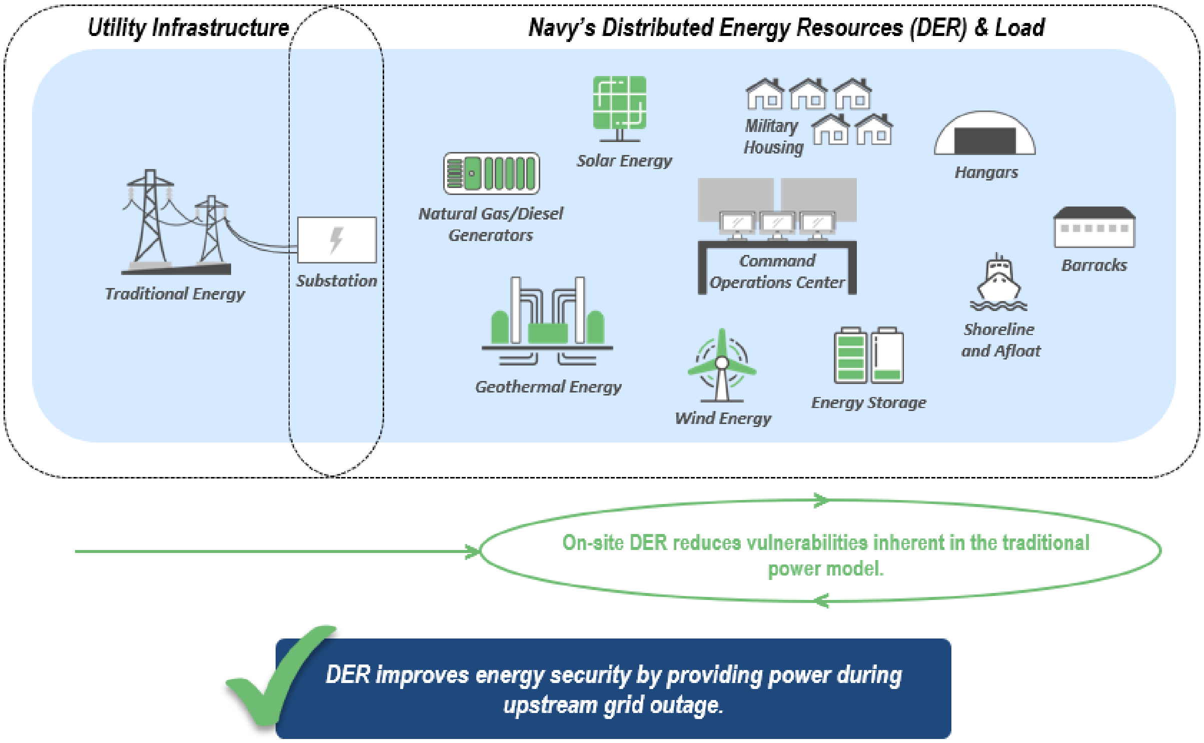
3.2.11.3 “Economies of Scale”

Evaluate opportunities to improve project economics for water projects through bundling with distributed generation, Combined Heat and Power (CHP), and water-energy microgrids such as:

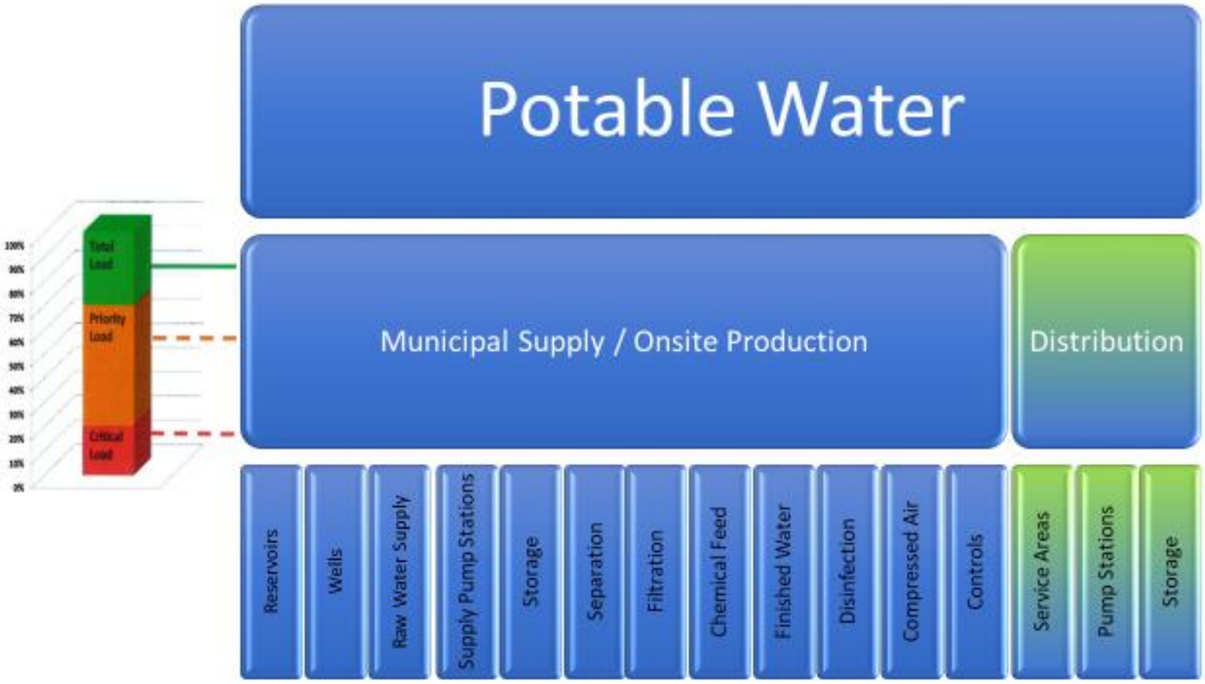
- Improving water efficiency through bundling with waste heat recovery and utilization projects
- Investigating potential water participation in utility demand response programs and ancillary services markets as available

4. Appendices

Appendix A: Illustrations of Microgrid Design and Function



Appendix B: Illustration of Critical Water Demand Prioritizations



Installation and Mission Commanders must understand critical water load demands essential to meeting requirements. A formalized and critical water balance ability provides extended capability to support warfighting and warfighter capabilities. Combined with an effective leak detection program, a water-loss reduction program can positively impact the overall support of the mission.

Appendix C: Power Quality Troubleshooting and Best Practices

Common problems affecting power quality and mitigation strategies. If available, first use AMI meter data to evaluate PQ issues applicable to all Tips.

1. Under-Voltage (UV) - Dips or Sags

Dips or sags are responsible for ~80% of all power quality issues. A dip or sag occurs when the system voltage drops to 90% or less of nominal system voltage for a half-cycle to one minute. Common UV symptoms may include:

- Circuit breakers with under voltage protection may open
- Computer lockup
- Electronic equipment shutdown with specious cause
- Loss of data
- Incandescent lights dimming
- Glitches in relay control

Tips for troubleshooting

Monitor at the load where the dip symptoms first occur. From there, compare the time of the equipment's failure to when the voltage dip happened. If there is no correlation, then a voltage dip likely is not the problem plaguing the machine. Proceed to troubleshoot by monitoring power farther upstream at the facility's advanced meter. Faults on the high voltage distribution systems at the installations will cause voltage sags until system protective devices clear the fault. The faults usually clear in less than 30 cycles. In addition, large motor loads starting can cause sags in facilities and, if the large motor is medium voltage, the distribution system could sag.

2. Over-Voltage Swells or Surges

Occurring about half as often as dips, voltage swells or surges are increases in system voltage for short periods up to a cycle or more. These inevitably lead to bigger problems and, as with all power quality problems, monitor for a period, then observe, and interpret the results.

Common symptoms include the immediate failure of equipment, typically the power supply section of electronics. Some failures might not be as instantaneous because of voltage swells that occur over a period and prematurely break down components.

Tips for troubleshooting

If analysis of electronic equipment reveals faulty power supplies, monitor voltage trends on the feeders and branch circuits feeding the equipment. Where possible, compare failure rates of similar equipment operating on portions of systems known not to be experiencing swells.

Look for any sudden line-to-ground faults on a single-phase line when analyzing power quality survey results. Large plant loads abruptly dropping offline and power factor correction capacitor switching can cause voltage swells.

3. Voltage Transients

Transients, sometimes referred to as spikes, are significant surges in voltage that last for only microseconds. Common causes include mechanical switching and lightning strikes.

Other causes of transients include:

- Switching of capacitors or capacitor banks
- Reenergizing systems after a power failure
- Switching of motor loads
- Turning off or on fluorescent and high-intensity discharge (HID) lighting loads
- Switching transformers
- Sudden stoppage of certain equipment

Tips for troubleshooting

For transient conditions, monitor at the load and correlate the equipment's operational problems or failure with distribution system events. Normal arcing across contacts by interrupting large loads can be a cause of transients. Use the facility one-lines or one-line diagrams to move the monitoring farther upstream in the distribution system until the source is found.

4. Voltage Interruptions

Voltage interruptions will last anywhere from two to five seconds, or even longer. Interruptions that endure beyond the 5-second periodicity refer to sustained interruptions. Equipment stops operating, and many motor-control circuits will not reboot after a brief power interruption.

Tips for troubleshooting

If voltage interruptions occur when equipment is not being monitored or watched, it will be a very difficult task to properly identify root causes of the equipment shutdown. However, with a power quality analyzer, one can continuously monitor and correlate the time of any power interruptions to the time of equipment issues in identifying voltage interruptions.

5. Voltage Unbalance

Three-phase systems face voltage unbalance regularly, but it is often unnoticed and can result in irreversible equipment damage. Unbalance can occur at any point throughout the distribution system.

Furthermore, equally divided loads across each phase of a panel board mitigate issues. If one-phase burdens higher when compared to the other phases, voltage will inevitably be lower on that phase. Transformers and three-phase motors fed from that panel may run hotter, atypically noisy, vibrate excessively, and/or undergo untimely failure.

Tips for troubleshooting

A voltage unbalance of 2.3% on a 230V motor results in a current unbalance of almost 18%, causing a temperature rise of 30° C. Technicians can execute calculations with a digital multimeter (DMM) for averaging voltage readings; however, a power quality analyzer provides the most accurate information about unbalance.

Monitoring over time is the key to capturing unbalance. In a three-phase system, the maximum variation in voltage between phases should be no more than 2% (the V_{neg} % value on the analyzer), or significant equipment damage can occur.

6. Harmonics

Harmonics are voltages and currents whose frequency is said to be an integer multiple of the fundamental frequency. These unwanted frequencies cause many symptoms, including overheating in neutral conductors and the transformers supplying these circuits. Reverse torque creates heat and efficiency losses in motors.

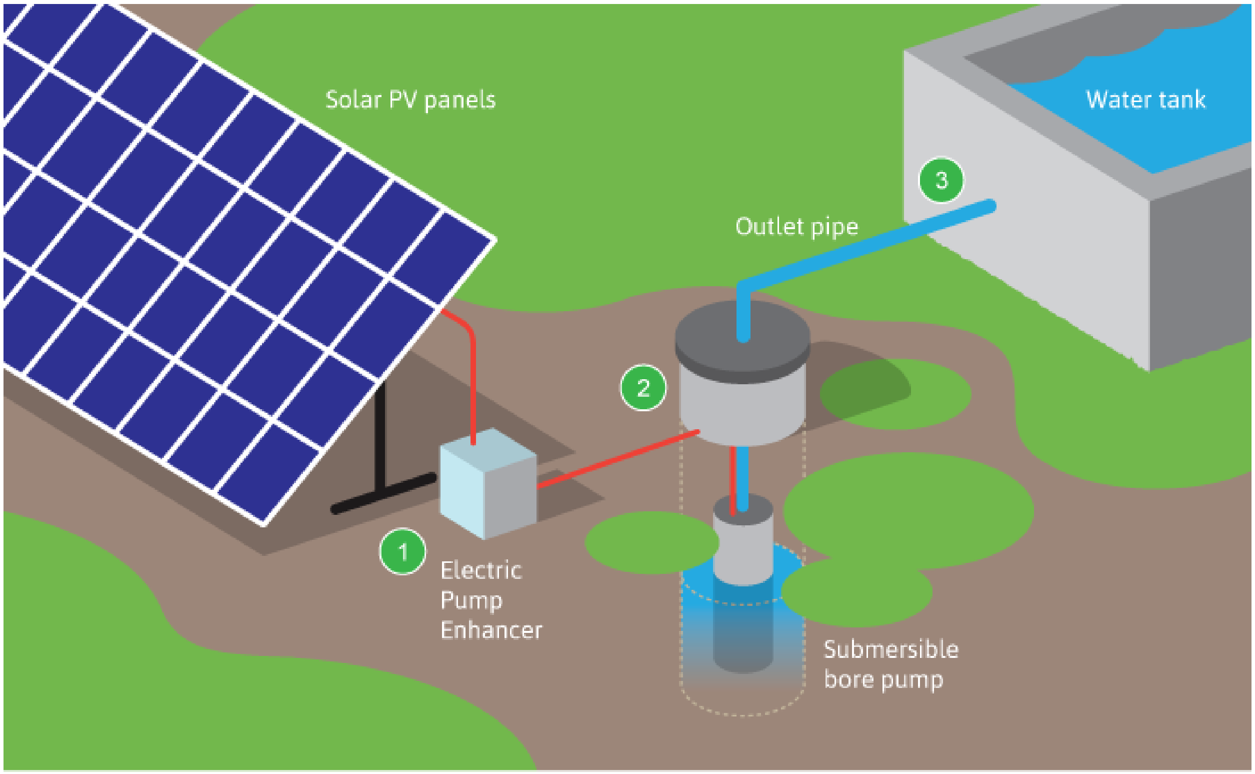
The most severe symptoms created by harmonics typically are the result of the harmonics distorting the fundamental 60 Hz sine wave found in facilities. This sine wave distortion results in improper operation of electronic equipment, false alarms, data losses, and often reported as mysterious problems that confound engineers and maintenance technicians.

Tips for troubleshooting

When symptoms of harmonics occur, troubleshoot by observing total harmonic distortion (THD). A significant increase in THD under varying load conditions warrants a percentage comparison of each individual harmonic current level, as compared to the total fundamental current flow in the system. Knowing the effects created by each harmonic current and comparing them to identified symptoms will aid in troubleshooting. The source of the harmonic must then be isolated and corrected.

Persistent monitoring with a power quality analyzer helps keep electrical maintenance professionals informed about their motor’s health and efficiency, while providing opportunities to catch symptoms before they manifest as unplanned downtime. Knowing the common power quality problems, how to identify their potential causes, and then troubleshoot pushes each facility to operate from a more-ideal state of sustained energy efficiency and financial security.

Appendix D: Water-Energy Microgrid Illustration



Appendix E: Energy Definitions

Definitizing Energy Security is to have assured access to reliable supplies of energy and the ability to protect and deliver enough energy to meet mission essential requirements (Ref. C).

Energy Reliability Definitions

Term	Definition
Reliability	Energy reliability looks to improve mission readiness and is considered the percentage of time energy delivery systems (utilities) can serve mission functions at acceptable mission essential requirements, as well as serve customers at acceptable regulatory standards. Reliability metrics are measured by the frequency and duration of service disruptions to customers, and the value of reliability depends on the magnitude of adverse effects an electrical outage has on customers. Reliability is determined by the adequacy, security, and quality of two primary elements: supply (i.e. generation availability) and delivery (i.e. electricity or power to an Installation). Outages occur when critical control parameters for electricity fall outside allowable ranges for voltage, current, and frequency. Key attributes of a reliable electrical transmission and distribution systems include: • System monitoring and control by keeping parameters within acceptable limits during normal operating conditions • System controls limiting the impact and scope of instability and cascading faults when outages occur • Prompt system operation restoration if power is lost Regular systems maintenance and testing per current industry standards, which differ from Region to Region
Energy Route Diversity	The number of delivery pathways a form of energy can use, such as electrical feeds, natural gas pipelines, and fuel delivery trucks. A singular pathway anywhere in route to the customer, i.e. the military installation, represents a vulnerability and risk to mission. This vulnerability identification refers to a Single Point of Failure (SPF) and should be considered in discussions with utility providers and/or mitigated where possible through route diversification and ensuring that multiple feeds are available through the commercial provider.
Utility Interruption	Unplanned or planned loss of utility service to one or more customers resulting from one or more outages on the distribution system for more than five minutes. Outages, excluding planned outages, are those detected at a customer's meter from any commercial or installation cause. If commercial power is lost, yet facilities continue to provide power to a certain customer's meter (e.g. dropping non-essential loads and continuing to run co-generation), that event is not considered an outage for customers that continue to have sustained power.
Power Quality	Electric power quality, or simply power quality, involves voltage, frequency, and waveform. Good power quality is defined by three components: a steady supply of voltage that stays within a prescribed range, steady alternating current frequency close to the rated value, and smooth voltage curve waveform.

Energy Resilience Definitions

Term	Definition
Resilience	Per 10 U.S.C. § 101(e), energy resilience is defined as "…the ability to avoid, prepare for, minimize, adapt to, and recover from anticipated and unanticipated energy disruptions in order to ensure energy availability and reliability sufficient to provide for mission assurance and readiness, including mission essential operations related to readiness, and to execute or rapidly reestablish mission essential requirements" (Ref. C). Threats that may cause a disruption include weather events, accidents, animals, vegetation, geo-magnetic storms, terrorism, fire, cyber-attack, and the effects of climate change e.g. sea level rise (Ref. D, E). All in all, considering energy resilience enhances warfighting capabilities and ensures the DON's Installations will have the ability to prepare for and recover from utility interruptions impacting mission assurance.
Contingency Outage Assessment	A form of risk assessment unique to electrical systems that involves the deliberate modeling of the effects of the failure of each component of the system in terms of capacity and load support. Modeling includes component failure and corridor disruptions (e.g., a truck takes down a pole with two circuits on it). Plan development should accommodate the largest single contingency outage. Supporting Infrastructure for Critical Assets (SICA) should be reviewed at least one node beyond the fence line (Ref. TT).
DON Installation Microgrid	An integrated electrical energy system consisting of multiple interconnected loads and distributed energy resources, which act as an integrated system controlled from a central location (see Appendix A). Microgrids normally operate connected to and are synchronous with the traditional centralized grid but can disconnect and function autonomously as physical and/or economic conditions dictate. NAVFAC P-601 Microgrid Design Guide (Ref. U) provides DON Installations with a basic understanding of microgrid technology and a common methodology to identify requirements and develop conceptual designs. Key components of a microgrid are sensors and controls that provide rapid reconfiguration capabilities to an electric distribution system to operate differently, with one or more of the following objectives: • Isolate damaged distribution line segments and possibly back-feed loads downstream from the damage. • Optimize the balance of distributed generation, renewable energy, and grid supplies for economic or other reasons. • Prioritize loads served by constrained or curtailed sources of power.
Fuel Switching	The ability to meet energy requirements using more than one fuel such as an electric generator that can run on natural gas or diesel fuel.
Islanding Capacity	Identifies meeting the number of hours or days of critical energy from resources internal to the installation such as stored or renewable energy sources when an installation is disconnected) from the grid for any reason.
Mission Critical Facilities	Designations stem from analysis of all threats and hazards, facility vulnerabilities, and importance to mission success or failure. Multiple commands or organizations may identify facilities as critical based on differing policy or requirements. The OPNAV N46 Mission Assurance (MA) Assessment program will identify Task Critical Assets (TCAs) which are assets termed critical from a DoD perspective. During MA assessments additional identification of Supporting Infrastructure for Critical Assets (SICA) occurs. Installation level organizations may identify facilities as critical/essential for local and/or DON missions. The Installation Commanding Officer (ICO)

Term	Definition
	assesses facility or asset priorities, as this is a prerequisite for annual Continuity of Operations Plan (COOP) reviews. Refer to Table 2.3, Electrical Resilience Requirements by Category Code, for threshold criteria for identification of critical facilities with selected approaches approved by the installation ICO.
Mutual Aid	A contingency plan in partnership with local utilities for obtaining temporary emergency services, replacements for critical equipment, or work force resources to aid in restoration.
Redundancy	Systems or sub-systems that mitigate vulnerabilities to Single Points of Failure (SPF).
Restoration Priority	The priority given to the repair and re-energizing of electric system components following a fault or failure. Commercial utilities are federally required to assign restoration and load shedding priorities to their facilities, including those that serve DON Installations. Advanced Metering Infrastructure (AMI) metering, microgrids, distribution automation, and facility-energy management systems are deploying technologies within an installation to assure system resilience through monitoring and rapid restoration (Ref. UU).

Efficiency Definitions

Term	Definition
Efficiency	The use of the minimal energy required to achieve the desired level of service. Aging infrastructure, outdated equipment, poor maintenance, and lack of awareness (cultural) contribute to inefficiency.
Covered Facilities	EISA 2007 (Ref. V) defines federal facilities, including central utility plants and distribution systems and other energy intensive operations, that constitute at least 75% of facility energy use. The DON definition follows the Defense Utility Energy Reporting Systems (DUERS) Guidance (Ref. VV) which clarifies covered facilities as DUERS Goal Subject Facilities (iNFADS infrastructure), enclosed, portable or re-locatable structures serviced by utilities.
Curtailment	Load shedding demand response, and interruptible utility commodity service agreements allow for the ability to reduce the demand for a specific source of energy when requested. Many commercial suppliers provide economic incentives for coordinating types of agreements. For specifics, reach out to ANCRR.
Distributed Energy Resources (DER)	Resources capable of operating in parallel with commercial power or operating synchronously with all assets online during an islanding event. Note that some forms of emergency generation do not fit this definition. DERs may not: facilitate long operational periods (as opposed to units that are “continuous” or primary power rated), have appropriately rated or configured switchgear to synchronize to a grid, or have environmental ratings to allow long run times (such as a Tier 3 or Tier 4 EPA designation).
Renewable Energy Goals	Renewable energy resources contribute to energy supply diversification and can extend the hours of operation from other forms of fuel storage. They are determined on an executive level based on the percentage of energy derived from renewable (or alternative) sources of energy.
Smart Grid	A cyber-secure integration of distribution system automation, system control and data acquisition (SCADA), building energy management and control systems, and AMI. It is a mechanism to optimize the use of equipment and facilities to better manage cost and resources.

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Appendix G: Acronyms and Abbreviations

AKA	Also Known As
AMI	Advanced Metering Infrastructure
ANCCR	Advancing Navy Commodities Cost Reduction
ANSI	American National Standards Institute
AWWA	American Water Works Association
BCA	Business Case Analysis
BFR	Basic Facility Requirement
BMS	Business Management System
BUMED	Bureau of Medicine and Surgery
CATCODE	Category Code
CBA	Cost Benefit Analysis
CEM	Certified Energy Manager
CHP	Combined Heat Power
CNIC	Commander Navy Installations Command
COOP	Continuity of Operations
CFY	Current Fiscal Year
CY	Current Year
DASN	Deputy, Assistant Secretary of the Navy
DC	District of Columbia
DCIP	Defense Critical Infrastructure Program
DDC	Direct Digital Control
DER	Distributed Energy Resource
DFARS	Defense Federal Acquisition Regulations Supplement
DMM	Digital Multimeter
DoD	Department of Defense
DODI	Department of Defense Instruction
DOE	Department of Energy
DON	Department of Navy
DR	Demand Response
DUERS	Defense Utility Energy Reporting System
ECM	Energy Conservation Measure
E.G.	For Example
EISA	Energy Independence and Security Act
EO	Executive Order
EPACT	Energy Policy Act
EMIG	Energy Mission Integration group
EPA	Environmental Protection Agency
ERCIP	Energy Resiliency Conservation Investment Program
ERI	Electrical Resilience Index
ERP	Emergency Response Plan
ESCO	Energy Services Company
ESF	Energy Security Framework
ESPC	Energy Savings Performance Contract
ETC.	Et cetera
EUL	Enhanced Use Lease
FAR	Federal Acquisition Regulation
FM&S	Facilities Management & Sustainment

FSC	Facility Support Contract
FY	Fiscal Year
GIS	Geographic Information Systems
HQ	Headquarters
HZ	Hertz
IC	Installation Commanding Officer
I.E.	That Is
IEEE	Institute of Electrical and Electronic Engineers
IKC	In Kind Consideration
INFADS	Internet Facilities Assets Data Store
INSIPP	Internet Navy Shore Infrastructure Planning Platform
LCCA	Life Cycle Cost Analysis
LCC	Life Cycle Cost
M&V	Measurement and Verification
MA	Mission Assurance
MCN	Military Construction, Navy
MCNR	Military Construction, Naval Reserve
MG	Microgrid
MILCON	Military Construction
MIN	Minute(s)
MTS	Maintenance Testing Specifications
MVA	Mega Volt Ampere
NAVAIR	Naval Air Systems Command
NAVFAC	Naval Facilities Engineering Systems Command
NAVSEA	Naval Sea Systems Command
NDAA	National Defense Authorizations Act
NEG	Negative
NETA	National Electrical Testing Association
NFPA	National Fire Protection Association
O&M	Operation and Maintenance
O&MN	Operations, Maintenance, Navy
OMT	Operation Maintenance Testing
OPNAV	Chief of Naval Operations
OSD	Office Secretary Defense
PL	Product Line
PM	Preventive Maintenance
PMP	Project Management Professional
PNNL	Pacific Northwest National Laboratory
POC	Point of Contact
PPA	Power Purchasing Agreement
PPBE	Planning Programming Budgeting Execution
PQ	Power Quality
PSI	Pounds Square Inch
PV	Photo Voltaic
PW	Public Works
PWD	Public Works Department
RAMCAP	Risk Analysis and Management for Critical Asset Protection
REF	Reference
SAIDI	System Average Interruption Duration Index

SAIFI	System Average Frequency Interruption Index
SCADA	System Control and Data Acquisition
SE	Southeast
SICA	Supporting Infrastructure for Critical Infrastructure
SME	Subject Matter Expert
SMIG	Shore Mission Integration group
SPF	Single Point of Failure
TCAs	Task Critical Assets
THD	Total Harmonic Distortion
TRANS	Transportation
UESC	Utility Energy Services Contract
UFC	Unified Facilities Criterion
UM	Utilities Management
UMIG	Utilities Mission Integration group
UP	Utility Privatization
UPS	Uninterruptable Power Supply
U.S.	United States
USMC	United States Marine Corps
U.S.C. or USC	United States Code
USC	Utility Service Contract
USN	United States Navy
UV	Under Voltage
V	Volt(s)
WCM	Water Conservation Measure(s)
WRI	Water Resilience Index

Appendix H: Funding Authorities

a. Title 10 United States Code (U.S.C.) § 2922a Power Purchase Agreement (PPA).
    1) Contract for the provision/operation of energy production facilities and the purchase of energy produced from such facilities
        - Up to 30 years
        - Facilities may be on Navy or private land
        - Facilities must be new
        - Office of Secretary of Defense (OSD) approval required
        - FY21 National Defense Authorization Act (NDAA), prioritize energy security / resilience

b. Title 40 U.S.C. §501, FAR Part 41 – Utility Service Contract (USC).
    1) Acquire utility services for a period not to exceed 10 years.
        - "Utility services" include furnishing electricity, natural or manufactured gas, water, sewerage, thermal energy, chilled water, steam, hot water, or high temperature hot water

c. Title 10 U.S.C. § 2917 - Development of Geothermal Energy.
    1) Develop/authorize geothermal energy resources for the benefit of DoD on Navy land or public land under Navy jurisdiction
        - FY21 NDAA, consider energy security when designing/developing a geothermal project under this section

d. Title 10 U.S.C. § 2916 - Sale of Electricity
    1) Sell electricity produced from alternate energy sources and co-gen plants
        - Revenue is retained by the military department ('no-year' funds)
        - Revenue may be spent as Operations and Maintenance (O&M) or Military Construction (MILCON), with some restrictions

e. Title 10 USC § 2667
    1) Out-lease non-excess property to developer for fair market rental value of land
        - 5 years or longer with Deputy, Assistant Secretary of the Navy (DASN) approval
        - Cash or in-kind consideration (IKC)
        - FY21 NDAA, when utility services are provided as IKC, prioritize resilience in the event of a grid outage

f. Title 42 U.S.C. § 8287 Energy Savings Performance Contracts (ESPC)
    1) Enter into contracts "for the purpose of" achieving energy savings.
        - DoD uses Department of Energy (DoE) authority
        - Example of "third-party financing"; contract is between the agency and an Energy Service Company (ESCO)
        - Up to 25-year contract term
        - ESCO incurs the cost of implementing energy savings measures; ESCO is paid back over time with energy savings, which are guaranteed
        - Measurement and Verification (M&V) of energy savings is required
        - FY21 NDAA allows Navy to aggregate efficiency and resiliency measures in life cycle cost analysis

g. Title 10 U.S.C. § 2913 Utility Energy Service Contracts (UESC)
  1) Enter into agreements to design and implement cost-effective demand and conservation incentive programs ("third-party financing")
    - Contract is between Navy and gas/electric utility
    - Up to 25-year contract term Defense Federal Acquisition Regulations Supplement (DFARS 241.103(2))
    - Includes energy management services, facility alterations, installation of energy savings devices and technologies
    - FY21 NDAA allows Navy to aggregate efficiency and resilience measures in life cycle cost analysis

h. Title 10 U.S.C. § 2688 Utilities Privatization
  1) Convey a utility system to a municipal, private, regional, district, or cooperative utility company or other entity (a.k.a. "UP").
    - "Utility System" includes electricity, water, wastewater, steam, natural gas, and telecommunications
    - Conveyance may be sole source
    - Navy may receive consideration equal to the fair market value of the utility system conveyed
    - Consideration may be a lump-sum payment or a reduction in utility bill(s)
    - FY21 NDAA allows Navy to require that the conveyed utility system be operated to meet energy resilience/reliability requirements

i. Title 10 U.S.C. § 2914 Energy Resiliency & Conservation Investment Program (ERCIP)
  1) OSD managed authority to carry out MILCON for energy resilience, security or conservation
    - Formerly ECIP (conservation focus) prior to FY16
    - DoD budget ~$150M per year / FY19 Department of Navy (DON) allocation of $82M
    - Services compete for 5-yr MILCON appropriation each year
    - FY21 NDAA allows us to aggregate efficiency and resilience measures in life cycle cost analysis

j. Military Construction, Navy (MCN) or Military Construction, Navy Reserve (MCNR)
  1) Construction projects including energy savings performance contracts and utility energy services contracts

k. Operations, Maintenance, Navy (O&M,N) funding
  1) Facility sustainment, restoration and modernization funds for Navy shore energy
  2) Navy shore energy

l. Title 10 U.S.C. § 2912 Availability and Use of Energy Cost Savings
  1) SECNAV direction on 2912 funding stipulates that projects should address efficiency and conservation requirements
    i. Navy received approximately $20M in funding for 2912 projects
    ii. CNIC leveraged the SECNAV and prioritized Installation Energy Program Summaries to identify shovel-ready projects
    iii. CNIC identified top eROI/SIR projects with potential for the highest energy savings and produced a cut line based on available funding