THERMAL ENERGY SYSTEMS RESILIENCE AT JOINT BASE ELMENDORF RICHARDSON (JBER)

Introduction

Joint Base Elmendorf-Richardson (JBER) is the largest installation in Alaska and home to about 16,000 Arctic Warriors, with 74,600 acres. JBER supports two main missions; Air Force operations for F-22 Raptors and C-17 Globemasters, as well as being the deployment platform and training grounds for US Army Alaska (USARAK).

JBER's unique and diverse lands range from tidal wetlands to alpine ridges. JBER's high value natural infrastructure supports healthy populations of moose, brown and black bears, bald eagles, wolves, and all five species of Pacific salmon. The endangered Cook Inlet beluga whale inhabits marine waters adjacent to the base. The local climate can be harsh with wintertime temperatures to -25 °F and fewer than 6 hours of daylight.

Thermal Energy Sources

- Anchorage Municipal Light & Power supplies the majority of electrical power to the base through two feeds at 34.5 kilovolts (kV).
- The electrical distribution on base is split between JBER-Elmendorf (JBER-E) and JBER-Richardson (JBER-R). All substations and electrical infrastructure on JBER-E are owned and maintained by the USAF. On JBER-R, electrical distribution is privatized to Doyon Utilities LLC (Doyon), which maintains and operates it.
- Doyon Utilities operates a landfill gas (LFGP) to electricity generating plant on JBER-R with the capacity to provide up 75% (7.2MW) of JBER-R requirements.
- The electrical distribution infrastructure on JBER-R and JBER-E can be physically connected, and ML&P and Doyon are working to execute the required wheeling agreement.
- Approximately 60% of electrical distribution is overhead. Remaining infrastructure is susceptible to groundwater penetration and frost.
- The primary source of backup power on JBER-E is distributed diesel generators.
- JBER-R has centralized diesel backup power generators with a total of 9 megawatts (MW) of capacity located on D-street. Generators are maintained and operated by Doyon and under most conditions, when combined with LFGP) can power all of JBER-R. Each 3 MW generator has a 20,000-gallon fuel storage tank providing for a minimum of 72 hours of operation. JBER-R also employs distributed diesel generation as a secondary means of backup power to key mission loads.
- Natural gas is used primarily for heating and service hot water.
- The utility supplying gas to JBER is ENSTAR.
- A single natural gas pipeline serves the entire Anchorage Bowl.

Critical Missions

The critical missions at JBER are combined into mission sets and grouped thematically based on factors such as location on base, functional requirements, and similarity of mission operations. The critical mission sets at JBER are as follows:

- Alaska Mission Operations Center (AMOC) Mission
- Alaskan Command (ALCOM) Mission
- United States Army Alaska (USARAK) Mission
- Alaska Army National Guard (AKARNG) Mission
- Manned Flying Missions
- Medical Group Mission
- Non-Mission Critical Facilities

Progress toward resiliency

JBER's approach to the energy resiliency starts with an Energy Management (EM) program of the 673d Civil Engineering Squadron (CES). The program begins with facility audits which involve completing energy surveys of buildings. This consists of field inspections of various buildings to determine deficiencies, coupled with building inhabitant reports of deficiencies. The JBER Energy Team continually highlights specific steps everyone can take in their jobs to conserve energy. Through the use of social media, site visits and daily interactions, our objective is to get into and maintain an energy state of mind every day. We leverage October Energy Action Month as a means getting information on current energy initiatives and savings ideas to a local populace of 32,000; made up of military personnel, their dependents and civilian workforce.

Design Guidelines

JBER 673CES uses the Installation Facilities Standards (IFS) for Elmendorf and Richardson, which is part of the Whole Building Design Guide (WBDG).

JBER also uses Unified Facility Criteria for design guidance:

Envelope:

- UFC 1-200-01 DoD Building Code
- UFC 1-200-02 High Performance and Sustainable Building Requirements, with Change 4

- UFC 3-101-01 Architecture, with Change 5 – has information regarding wall insulation types and quantities (R-values).
- UFC 3-110-03 Roofing, with Change 4 – has information regarding roof insulation types and quantities (R-values)

Mechanical Engineering. (HVAC):
- UFC 3-401-01 Mechanical Engineering, with Change 1
- UFC 3-410-01 Heating, Ventilating, and Air Conditioning Systems, with Change 5
- UFC 3-410-04 Industrial Ventilation
- UFC 3-430-01FA Heating and Cooling Distribution Systems
- UFC 3-440-01 Facility-Scale Renewable Energy Systems
- UFC 3-470-01 Utility Monitoring and Control System (UMCS) Front End and Integration

HVAC Infrastructure

For nearly two decades, JBER has employed a successful Energy Management Control System (EMCS) to monitor and control facility ventilation, heating and air-conditioning systems. Approximately one-third of eligible facilities are currently tied into the JBER EMCS system, allowing monitoring for the previously listed functions as well as maintenance scheduling, and programing/adjusting system operation and set-points. This system is managed and maintained by JBER 773d CES.

The JBER Energy Team and the 773d CES is currently researching adding seismic sensors to the JBER EMCS for additional resiliency. At the occurrence of a seismic event, facility system sensors and programming will initiate shutdown and isolation sequence where pipe failure is detected. Alert notifications will be broadcast to the applicable shops for corrective action in order to minimize damage to the building and allow repair prioritization.

Facility systems energy optimization is obtained through multiple means at JBER:

- Air system mixing boxes are used at multiple facilities to take advantage of available free cooling and heating opportunities.
- Some conference room ventilation are dedicated systems and operate only when in use.
- General building ventilation is scheduled to activate only during programmed occupied periods.
- Hangar floor spaces are being converted from an all-air heating system to low intensity gas-fired infra-red heating. Infra-red heating is also being used for vehicle storage and maintenance shops.

- Annual project submittals to include HVAC Upgrades and boiler upgrades in multiple buildings. The potential for four projects each year is planned. Each upgrade will increase resiliency in each facility as well as save energy.
- Existing facility heating boilers are replaced with multiple boilers sized at 60% total building load. This optimizes boiler operation at low load periods and also lower first cost. Boilers are equipped with full modulating gas-fired burners to allow boilers to match the heating load. Multiple boilers allow back-up capability as well as additional load capacity.

Building Envelope

Facilities at JBER with 1950s vintage construction provide the energy team an opportunity to improve building envelopes for energy conservation. Several buildings at JBER have completed an envelope upgrades with one additional facility under construction and an additional project submitted for funding. Most facilities at JBER are 1950s construction and were constructed with wall and roof insulation well below current standards listed in the "Design Guidelines" section. More recently constructed facilities are designed to meet R-38 insulation levels for roofs and R-20 for walls.

Hangar 15 is a 79,043 S.F. hangar constructed in 1956 with and had a major envelope enhancement and infrared heating installation. This hangar is averaging a 30% reduction in natural gas consumption due to increased thickness of wall and roof insulation since project completion in September 2010. Building 6254 an 8,000 S.F. vehicle operations facility constructed in 1952. Building 6315 (Parachute Packing Facility) has been submitted for funding. Each building had previously used hot air overpressure as its principle means of keeping the building interior warm. Other facilities that have been upgraded are obtaining similar improvements.

The energy team is developing a program to improve the windows and building insulation (both wall and roof) for the buildings constructed in the 1950s, and do not meet current practices for cold climate wall and ceiling /roof insulation.

Building 6315 also includes a complete replacement of all windows from single pane glass to double pane thermo-pane glass. During the winter, much cold air enters the windows through the single edges, allowing ice to form on the interior side of the windows. The replacement with high efficiency thermos-pane windows will keep the building sealed tightly to prevent heat loss.

Increased wall and ceiling insulation and improved window insulation will improve the efficiency of heating and cooling building interiors, as energy costs only seem to increase. Estimates of heating with fossil fuels indicate that these fuels will rise significantly in cost as fuel quantities decrease over the next four decades.

Micro-grids

The JBER energy Team's 50 year vision includes micro-grids following the Air Force definition, "a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid. A microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or island-mode." The goal at JBER will be to develop multiple small "islands" both electricity and heat that is capable of mutual support through a base wide utilidor system. This utilidor will be designed to contain all base utilities simplifying utility inspection, maintenance and repairs.

EMCS Analysis

Prior to the loss of funding at the end of FY2012, JBER had an EMCS Analyst under contract. This critical position used the EMCS as a method of achieving additional energy savings. The analyst surveyed facilities to determine occupancy schedules and apply this data to the EMCS to ensure optimal efficiency while keeping comfort levels adequate for the occupants. During the short life of this program, $2 million in savings was achieved.

Challenges/Opportunities

Barriers to the overall vision for JBER, specifically microgrids, include approval of the concept and funding. The JBER Energy team is evaluating several funding paths including Energy Savings Performance Contracting (ESPC) and Utility energy Savings Contracts (UESC).

Challenges include climate change considering extent and duration is unknown. At what point in time should we consider both heating and cooling capabilities for our buildings? Using the current model for load calculation using multi-year average data does not address current conditions that need to be dealt with now.