Anchorage Bowl Infrastructure Resilience Project Concepts

An application of the Air Force's Regional Identification of Gaps for Operational Resilience (RIGOR) process

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EXECUTIVE SUMMARY

The Regional Identification of Gaps in Operational Resilience (RIGOR) process is a comprehensive approach for assessing and strengthening the resilience of infrastructure feeding military installations. Through the application of the RIGOR process, the Air Force and lifeline sector infrastructure operators can develop a shared, specific understanding of regional infrastructure interdependencies, create and deepen relationships, and jointly develop project concepts and action plans aligned to strengthen the resilience posture of the region.

Need for RIGOR

Presidential Policy Directive 21 (PPD-21) identifies 16 critical infrastructure sectors that would be debilitating if disabled.[1] RIGOR particularly focuses on the four "lifeline sectors" as identified by the National Infrastructure Protection Plan - energy, water, communications, and transportation, which are inextricably intertwined with security and safety of communities.[2]

The U.S. Department of Defense (DoD) is increasingly concerned about the infrastructure relied upon by domestic installations. Critical infrastructure is increasingly at risk of cascading failure due to degradation, interdependencies across infrastructure sectors, and threats from environmental disruptions and determined adversaries. Meanwhile, DoD installations are increasingly embedded in the regions and communities in which they reside.

Joint Base Elmendorf Richardson (JBER) is located in Anchorage, Alaska. The 673d Air Base Wing (673 ABW) is the host wing of the installation, which supports the headquarters for the United States Alaskan Command, the 11th Air Force, U.S. Army Alaska, and the Alaskan North American Aerospace Defense Command Region. The 673 ABW is comprised for 5,500 joint military and civilian personnel, which supports and enables three Air Force wings, two Army brigades, and 75 associate and tenant unites.

The city of Anchorage and its surrounding areas are vulnerable to natural disasters and determined adversaries by its geographic location and climate. They rely on a limited point of entry for goods, people, and services. Anchorage is served by two pipelines, though neither is capable of meeting peak load conditions alone. JBER relies on private utility providers to provide services required to conduct its day to day and mission critical operations. Through the application of the RIGOR process, the Air Force, the city of Anchorage, and other regional stakeholders can develop a specific understanding of regional infrastructure interdependencies, create and deepen relationships with infrastructure operators, and jointly develop project concepts and action plans.

RIGOR Pilot at Joint Base Elmendorf Richardson

In fiscal year (FY) 2019, the Office of the Deputy Assistant Secretary of the Air Force (Environment, Safety, and Infrastructure)-SAF/IEE and Air Force Office of Energy Assurance (USAF OEA), sponsored a pilot applying the RIGOR process to the Anchorage region which surrounds JBER. The RIGOR pilot convened more than 30 participants from JBER, utility companies, the U.S. Departments of Energy and Homeland Security, the city of Anchorage, the state of Alaska, and others.

The facilitated RIGOR workshop generated five project concepts for strengthening natural gas supply and distribution, resilient energy systems for critical infrastructure, and communications initiatives for coordinating disaster response. Most importantly, the RIGOR pilot forged new relationships and collaborations between those who will be most important during disruptive events. State and local representatives reviewed analyses of their infrastructure conducted by the RIGOR team and shared their organization's requirements and goals to achieve a

[1] https://obamawhitehouse.archives.gov/the-press-office/2013/02/12/presidential-policy-directive-critical-infrastructure-security-and-resil
[2] https://www.dhs.gov/cisa/national-infrastructure-protection-plan

more resilient system. As illustrated by the RIGOR Team's analysis, natural gas supply and distribution are core to JBER's operation and Anchorage's ability to withstand a long-term outage, as it is the foundational commodity in the region for heating and electricity generation. The Port of Alaska is important for major goods and fuel delivery from the valve yards, and communications with the state and local government entities, and critical asset owners and operators is key to ensure planning and restoration efforts are coordinated. These were areas of focus throughout the RIGOR workshop and for project development. The project concepts were developed with multi-stakeholder groups to ensure that the resilience requirements identified by the infrastructure owners and the installation were addressed.

1. BACKGROUND AND NEED

More than 95% of Department of Defense (DoD) installations are reliant on the civilian electric grid for power, and the reliability of the civilian electric grid underpins the U.S. economy and national security. Challenges to grid reliability are changing rapidly as natural disasters increase in frequency and severity, human cyber-physical threat vectors grow, and an aging and expansive grid infrastructure incorporates digital technology and distributed energy resources that further complicates these challenges. These issues are found across the 16 critical infrastructure sectors identified in the Presidential Policy Directive 21 (chemical; commercial facilities; communications; critical manufacturing; dams; emergency services; energy; financial services; food and agriculture; government facilities; healthcare and public health; information technology; nuclear reactors; materials, and waste; transportation systems; water and wastewater systems).

The Air Force funded Regional Identification of Gaps in Operational Resilience (RIGOR) process is a comprehensive approach for assessing and strengthening the resilience of infrastructure feeding military installations and is intended to expand Air Force efforts to include discussions with other regional stakeholders. Although DoD installations, state and local critical infrastructure, and utilities face common challenges and threats, tactics for mitigating and responding are seldom coordinated and often run in parallel. An effective response to common threat profiles must be based on a common understanding and process for identifying, quantifying, and solving common problems. RIGOR is a process that brings together multiple regional stakeholders to characterize and prioritize common challenges related to energy threats and vulnerabilities. The effort results in avenues of response to these vulnerabilities with the goal of coordinating energy resilience projects to support Air Force installations and the state and city surrounding them.

Idaho National Laboratory (INL), Converge Strategies (CSL), and Launch Alaska (together, the “RIGOR Team”) were selected by the Air Force to develop and execute the RIGOR effort for the USAF OEA based on experience with the All Hazards Assessment (AHA) methodology and Air Force Mission Thread Analyses, military energy resilience facilitation efforts, and a detailed understanding of the Alaska community.

This report overviews the RIGOR process conducted at Joint Base Elmendorf Richardson (JBER) and the surrounding Anchorage Bowl (Section 2), a summary of results of the Anchorage AHA assessment (Section 3), an overview of the Anchorage Bowl project concepts developed from the RIGOR process (Section 4), and the recommended next steps (Section 5).

2. RIGOR PROCESS CONDUCTED AT JBER

The RIGOR process followed a three phase, six step process outlined in Table 1 below and discussed in Sections 2.1–2.6.

Table 1. RIGOR process.

Phase	Step	Description
1 Assess	1	Site Selection
	2	Preliminary Analysis and Key Local Stakeholders Engagement
2 Convene	3	Intermediate Analysis and Preliminary RIGOR Participant Identification
	4	RIGOR Workshop Planning and Final Analysis
3 Collaborate	5	RIGOR Workshop
	6	Post- RIGOR Workshop Product Development and Project Team Tag-ups

Phase 1: Assess

2.1 Site Selection

The United States Air Force selected JBER and the surrounding Anchorage Bowl area based on an assessment of the criticality of the Installation, the engagement of the local community, and the dependency of the Installation on civilian infrastructure due to the relative islanding of Anchorage. The engaged set of stakeholders were also motivated by the magnitude 7.1 earthquake that hit South Central Alaska in November 2018.

JBER hosts the 673d Air Base Wing, which consists of four groups that operate and maintain the joint base for air sovereignty, combat training, force staging, and throughput operations in support of worldwide contingencies. JBER also hosts the headquarters for the United States Alaskan Command, 11th Air Force, U.S. Army Alaska, and the Alaskan North American Aerospace Defense Command Region.

2.2 Preliminary Analysis and Key Local Stakeholders engagement

After JBER was selected as the pilot location, a preliminary analysis was conducted using publicly available data, prior Department of Homeland Security (DHS)-sponsored assessments surrounding critical DoD Installations, and recent energy studies and plans developed and underway at JBER. The RIGOR Team identified critical infrastructure sectors in Anchorage and JBER, including natural gas, liquid fuels, electricity, telecommunications, and water/wastewater. The AHA capability developed by INL was exercised to identify and display critical infrastructure dependencies, interdependencies, and impacts for the Anchorage region, to include JBER.

Based on the results of this preliminary analysis, and in partnership with Launch Alaska (the Alaskan energy innovation incubator), a series of meetings in Anchorage with JBER, Alaska Department of Homeland Security, and Region X DHS officials were scheduled to further socialize the RIGOR project concept and goals. These meeting helped to gain stakeholder buy-in, identify possible dates and locations to host the RIGOR workshop, and most importantly to refine the preliminary list of stakeholders to involve in the process.

Phase 2: Convene

2.3 Intermediate Analysis and Preliminary RIGOR Participant Identification

The preliminary analysis identified the critical infrastructure components in Anchorage and JBER. The site visit and meetings with local stakeholders were key steps to begin engaging with the representatives from critical infrastructure organizations and other stakeholders.

To conduct the intermediate analysis, the RIGOR Team used the AHA tool with open-source information available from state and local agencies, regulatory information, and other publicly available data.

As the analysis was being conducted, the team was engaged with the representatives from the major utility companies and energy asset owners to request their participation in the RIGOR workshop. The partnership with Launch Alaska was critical to identifying the appropriate attendees from the identified organizations. The team took a tiered approach to invitations, identifying the most critical attendees and working their way through the list to ensure a diverse and knowledgeable group. Unfortunately, some of the key infrastructure owners or representatives were unable to attend.

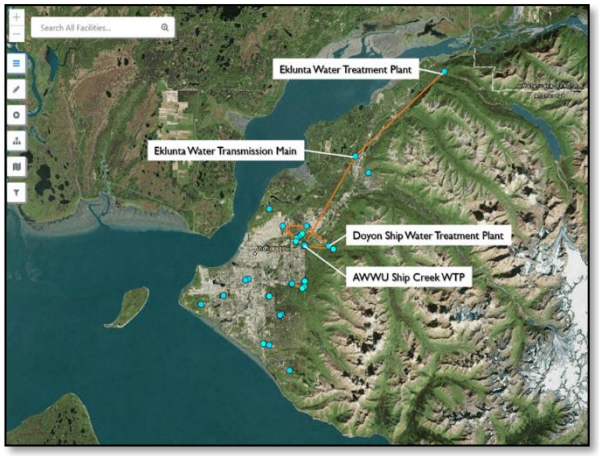

Figure 1. AHA Output

2.4 RIGOR Workshop Planning and Final Analysis

The RIGOR Team collected data about Anchorage's electric, water, communication, and oil and gas systems to build a more complete model of the region's major infrastructure. To validate the gathered data and fill in any gaps in information, the team requested meetings with representatives from one of the electric companies, a natural gas company, water and wastewater utility, and a major communications company to validate and edit the team's findings on the sector-specific resilience challenges.

Phase 3: Collaborate

2.5 RIGOR Workshop

The RIGOR Workshop was held to bring together public and private sector stakeholders from the Anchorage area to create common threat prioritization, identify common vulnerabilities, and coordinate a way forward on mitigation solutions. The RIGOR Workshop was set up with three objectives:

1. Develop a shared understanding of critical infrastructure and interdependencies.
2. Generate clear problem statements to support future resources and advocacy.
3. Create project concepts and action plans.

The flow of the RIGOR Workshop and the various facilitated activities were all focused on supporting one or more of those objectives. USAF OEA kicked off the event by identifying their interest in secure and resilient infrastructure that is owned and operated by other public and private sector entities, followed by the Mayor of Anchorage who reiterated the importance that all organizations work together to improve regional resilience.

The RIGOR Team introduced the AHA tool to the RIGOR Workshop participants. The AHA model displayed major critical infrastructure locations on a map of the area and the overall system of utilities and energy assets in the region. The RIGOR Team demonstrated the AHA tool's capabilities to model the interconnections between multiple utilities and demonstrate the effects of a disruption to one or more systems.

Figure 2. Small group working sessions

Following introductions, the critical infrastructure asset owners presented slides on the electricity, natural gas, fuel, water/wastewater, and communication infrastructure in the Anchorage region. The presentations included a description of each issue related to the system, the importance to the asset owner and/or the region, the challenges or risks within the system, and the interdependencies that exist between systems.

The subsequent one and a half days of the event focused on facilitated activities to walk the attendees through problem identification, solution prioritization, concept development, and planning. Critical asset owners had the opportunity to bring forth their concerns, discuss common issues with their counterparts from other sectors, and create a level of candid sharing among the workshop participants. Section 3 outlines the five projects concepts that were developed through the course of the RIGOR Workshop.

2.6 Post- RIGOR Workshop Product Development and Team Tag-ups

After the completion of the RIGOR event, a survey was distributed to the group to collect feedback on the preparation for the event, the AHA presentation, and the facilitated RIGOR Workshop content and approach. Pictures of the products completed at the end of each facilitation session were turned into RIGOR notes and were distributed to the RIGOR workshop attendees and can be provided as requested.

Additionally, among other products, this report (***Anchorage Bowl Infrastructure Resilience Project Concepts: An application of the Air Force's RIGOR process)*** was developed to provide an overview to senior leaders at USAF OEA and Anchorage area stakeholders of what was done, what came out of it, and what the next steps are specific to the Anchorage area.

The RIGOR Team also held follow-up calls with their individual project teams to check on the progress of the action plans during the RIGOR Workshop and identified if there was any additional support needed from the RIGOR Team.

3. AHA INTERDEPENDCY ANALYSIS

3.1 AHA Model Overview and Analysis

The AHA tool is used to develop function-based infrastructure dependency models. These models provide the foundation to rapidly evaluate and understand the potential consequences of manmade and natural disasters on infrastructure systems or to identify limitations of systems. The RIGOR Team created an AHA model of the Anchorage/JBER region which displayed multiple views and analyses of the major critical infrastructure locations on a map (e.g. Figure 3). Each data point was color-coded according to which asset it represented so that participants were able to identify the overall system of utilities and energy assets in the region. The AHA model displayed the interconnections between those assets, represented by lines drawn between nodes.

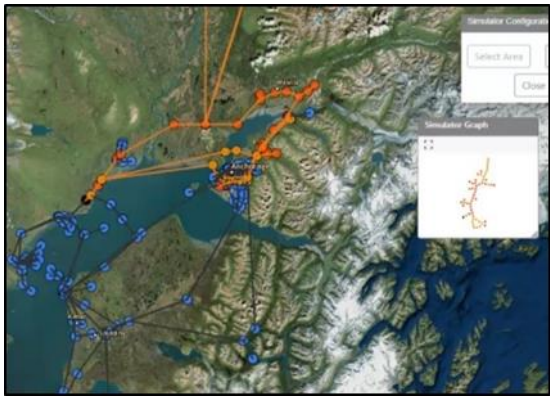

Figure 3. Anchorage AHA Demonstration

The RIGOR Team provided multiple short and hard-hitting demonstrations of the AHA model's capabilities by creating simulated disruptions to systems in the Anchorage area. One simulation included an interruption of a natural gas transmission pipeline on the west side of Cook Inlet. The effects of the disruption spread through the interconnected nodes on the map, subsequently turning off those nodes as a representation of natural gas pipelines and/or facilities shutting down. This demonstration provided RIGOR Workshop participants with a visual understanding of how the region's systems affect each other and the interconnections that exist.

3.2 Critical Asset Owner Resilience Presentations

The infrastructure asset owners were asked to present slides at the workshop on their current infrastructure in the Anchorage area based on the AHA findings and their understanding of their system. The presentations included a description of each issue related to the system, the importance to the asset owner and/or region, the challenges or risks within the system, and the interdependencies that exist between systems. This exercise provided critical asset owners the opportunity to bring forth their concerns, discuss common issues with their counterparts from other sectors, and create a level of candid sharing among the participants at the kickoff of the RIGOR Workshop.

Figure 4.Infrastrucutre Asset Owner Briefings

Some of the issues identified in the Anchorage region included the reliance on natural gas for electricity and the region's dependence on natural gas production within Cook Inlet on the Kenai Peninsula, as it cannot be imported. In addition, the water and wastewater facilities and communication systems in the Anchorage area rely on commercial electricity and refined fuel products for continued operation. Natural gas is also the primary heating fuel for Southcentral Alaska, and the electric utilities there rely heavily on natural gas for power generation. The asset owner presentations also revealed the proximity of facilities to one another, including Southcentral Power Plant, International Power Plant, Fire Island connection, Control Center, etc. where a disruption of infrastructure at one asset could impact surrounding facilities.

4. OVERVIEW OF ANCHORAGE BOWL RESILIENCE PROJECT CONCEPTS

4.1 Protecting Operations with Electricity Resilience (POWER)

Description	POWER envisions a future where all critical infrastructure in the Anchorage region has reliable power in a contingency. To achieve this, POWER outlines a process by which critical infrastructure owners, local utilities, and municipalities work together to identify the region's critical infrastructure and prioritize critical infrastructure for microgrid design.
Vulnerabilities Addressed	RIGOR participants recognized that there is no process to holistically identify, prioritize, and enhance the resilience of the region's critical infrastructure. As such, JBER remains an ad hoc stakeholder in regional microgrid development projects.
Stakeholders	JBER, electric utilities, critical infrastructure owners (e.g., the port, hospitals, airports, railroad, and others), municipalities
Benefits	The missions and operations of JBER benefit from power assurance at critical infrastructure in the Anchorage region. The POWER process would ensure that energy resilience development information in the region is shared more completely with JBER. JBER can then anticipate energy resilience project development and play a more deliberate partner role in projects that most protect its missions.
Next Steps	POWER will conduct small group meetings to identify resources to organize a kickoff workshop for the POWER process.

4.2 Port Power Pro (PPP)

Description	PPP is an innovative energy resilience project designed to ensure power delivery to the Port of Alaska (POA), in a contingency that disrupts the larger electric grid. The project design concept incorporates switch gear, a battery energy storage system (BESS) or flywheel, solar PV generation, and the ability to draw approximately 6MW of emergency backup power from locomotive power generation.
Vulnerabilities Addressed	The POA is critical infrastructure which provides goods and services to the entire Anchorage region. During grid outages, the POA only has backup power to bring operations to a halt safely but does not have sufficient power to reliably deliver goods and services to primary and secondary customers.
Stakeholders	The POA, Alaska Railroad, electric utilities, JBER, communications utilities, airport, oil and gas industry
Benefits	The missions and operations of JBER benefit from power assurance at critical infrastructure in the Anchorage region. The PPP concept would effectively island the POA in a grid outage and ensure power for the port's essential operations to continue supplying goods and services to the Anchorage region.

Next Steps	After the RIGOR Workshop, Department of Energy Office of Electricity (DOE-OE) funded a feasibility study to explore the project concept further. The PPP RIGOR small group team should continue to conduct with other essential stakeholders in the region to ensure there is sufficient buy-in and no barriers to implementation, and Air Force and DOE officials to determine what other advocacy and funding opportunities there are to support implementation depending on the results from the DOE OE funded feasibility study. Natural Gas Supply Sustainability

4.3 Natural Gas Supply Stakeholder Meeting

Description	The Natural Gas Supply Sustainability concept seeks balance future natural gas supply with demand in the Anchorage region to protect local consumers from 1) increasing natural gas prices, and 2) from complete loss of service in the event that a small number of production facilities were disabled in a contingency.
Vulnerabilities Addressed	Natural gas supplies decline at a rate of approximately 15% annually in the Anchorage region. Declining supply would ultimately drive up the price of natural gas and electricity negatively impacting local economies. Further, with current production capabilities, only a few natural gas wells would need to be disabled to significantly disrupt supply to large customers like JBER. Currently, the natural gas supply is not of concern to many of the large consumers since their current requirements are met. The Group's focus was to help focus consumers on this future, inevitable program, despite there not being a need for additional gas supply currently.
Stakeholders	Major natural gas purchasers, ENSTAR, commercial and residential customers
Benefits	Before sustainability of future natural gas can be addressed, the major stakeholders need to understand the impacts to their ability to meet their energy requirements in the event of an outage or steep decline in natural gas production. The first step of the project is to develop a stakeholder engagement plan before identifying the project opportunities to address the risks. Some potential project options for the stakeholders to consider are: new natural gas production facilities will provide a layer of redundancy to current facilities and an increased number of natural gas wells will ensure the availability of natural gas. Demand side changes such as natural gas consumption reduction and the increase in renewable energy projects are also projects to consider.
Next Steps	The next steps from this group are to conduct meetings to share the concerns of the natural gas supply with relevant stakeholders in order to move solution identification forward.

4.4 Anchorage Cross-Town Pipeline

Description	Like Project 4.3, the Anchorage Cross-Town Pipeline concept focuses on augmenting existing natural gas infrastructure to enhance supply-side natural gas resilience in the Anchorage region. This concept connects the Kenai and Beluga pipelines through the center

	of Anchorage to enhance transmission and distribution capabilities in the event of a contingency.
Vulnerabilities Addressed	Currently, the Anchorage metro area is served on the north and south sides by the Beluga and Kenai pipelines, respectively. Without a high-pressure pipeline connecting the two lines across Anchorage, neither pipeline is capable of independently delivering the quantity of gas required in peak load conditions. In a contingency (e.g., cut line), ENSTAR may not be able to ensure natural gas delivery to large customers in the Anchorage region, including JBER.
Stakeholders	JBER, gas customers, hospitals, DHS, ENSTAR, State of Alaska, Municipality of Anchorage, Federal Emergency Management Agency (FEMA)
Benefits	ENSTAR can more effectively ensure reliable delivery of natural gas in the event of a major contingency if the Beluga and Kenai pipelines are connected through Anchorage.
Next Steps	Anchorage Cross-Town Pipeline is conducting meetings to begin studies, system modeling, and preliminary engineering to engage stakeholders and gain support for the project.

4.5 Reinvigorate Alaska Land Mobile Radio (ALMR)

Description	Reinvigorate ALMR is a concept to ensure statewide cross-sector emergency communications using an existing, but unused, backup communications system – the ALMR.
Vulnerabilities Addressed	Traditional communications channels (e.g., cell phones) are used to communicate between JBER, emergency management services, utility sectors in the event of a contingency. However, if a contingency disrupts these traditional communications channels, there is high likelihood that these organizations may not be able to rapidly communicate to address natural, cyber, or adversarial threats in the region.
Stakeholders	Utilities, telecommunications, state and local government, JBER, emergency management services, Alaska Railroad, airports, POA
Benefits	ALMR uses existing infrastructure, a closed network, to ensure emergency communications between JBER, emergency services, telecommunications, and other utilities in the event of a major regional contingency which disrupts traditional communications.
Next Steps	Reinvigorate ALMR is developing a project plan, timeline for execution, and plan to gain consensus from relevant stakeholders. After completing a consensus-building meeting with the project team, the group will focus on identifying requirements and ALMR limitations.

5. PROPOSED NEXT STEPS

The development and pilot application of the RIGOR process in Anchorage presents multiple opportunities for further development, as outlined below and summarized in Table 2.

Table 2. Proposed next steps.

Proposed Next Step	Description	Stakeholder(s)
1.	USAF OEA, in coordination with JBER, should continue to track and/or participate in the five project concepts that were developed in the RIGOR Workshop. RIGOR inquiries should be submitted to the OEA Storefront to effectively monitor and track potential projects and concepts.	• USAF OEA • JBER
2.	The State of Alaska, the city of Anchorage, and other officials should consider pursuing alternative federal grant funding opportunities for the projects and vulnerabilities identified through the RIGOR analysis. Funding opportunities could include the DoD Office of Economic Adjustment grants and FEMA disaster mitigation grants.	• State and local officials • RIGOR Participants • USAF OEA • JBER

Appendix A

Acronyms

AHA	All Hazards Analysis
ALMR	Alaska Land Mobile Radio
CSL	Converge Strategies, LLC
DHS	Department of Homeland Security
DoD	Department of Defense
DoD OEA	Department of Defense, Office of Economic Adjustment
DOE	Department of Energy
DOE-OE	Department of Energy Office of Electricity
FEMA	Federal Emergency Management Agency
INL	Idaho National Laboratory
JBER	Joint Base Elmendorf Richardson
POA	Port of Alaska
RIGOR	Regional Identification of Gaps for Operational Resilience
SAF/IEE	Office of the Deputy Assistant Secretary of the Air Force (Environment, Safety, and Infrastructure)
USAF OEA	United States Air Force, Office of Energy Assurance

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