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Acknowledged, agreed, and submitted by

Geneen Tobey, 1651337 Digitally signed by Geneen Tobey, 1651337
Date: 2023.06.08 11:45:22 -05'00'

Nominee's Signature | Date

Information Classification: General

Nominee’s Name (please print): Geneen M. Tobey

Title (please print): Director & Program Manager
GMD Systems Integration,Test, and Readiness
GMD DSC Operations and Sustainment

Company (please print): The Boeing Company

NOMINATION FORM

Name of Program: Ground Based Mid-Course Defense Operations and Sustainment Program

Name of Program Leader: Geneen M. Tobey

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☒ Customer Approved

- Date: June 6, 2023
- Customer Contact (name/title/organization/phone): Heather Cavailier, Team Lead, MDA, Public Affairs; 256-503-7802

☐ Supplier Approved (if named in this nomination form)

- Date:
- Supplier Contact (name/title/organization/phone):

PLEASE REFER TO PROGRAM EXCELLENCE DIRECTIONS AS YOU COMPLETE THIS FORM.

EXECUTIVE SUMMARY: Make the Case for Excellence
Value: 10 points
Use 12 pt. Times Roman typeface.

What is the vision for this program/project? What unique characteristics and properties qualify this program for consideration?

The mission of the Ground-based Midcourse Defense (GMD) program is to defend the U.S. homeland and its deployed military forces, friends and allies against an attack by long-range intercontinental ballistic missiles. As an element of the layered Missile Defense System (MDS), GMD provides the U.S. with uninterrupted capability to defend its all 50 States against intermediate- and long-range ballistic missile attacks (whether accidental, unauthorized or deliberate) from potential adversaries using "hit-to-kill" technology.

Since 2004, GMD has been the principal capability for the defense of the homeland against rogue ballistic missile threats. GMD uses multiple sensors, communications systems, fire control capabilities and Ground Based Interceptors (GBIs) to detect, track and destroy long-range ballistic missiles during the midcourse phase of flight. GMD's interceptors and ground systems are geographically distributed across 13 different locations worldwide, including interceptors emplaced at Fort Greely, Alaska, and Vandenberg Space Force Base, California, and GMD Fire Control (GFC) centers in Colorado and Alaska.

The Boeing-led GMD Operations and Sustainment (O&S) team executes all system readiness support tasks across operational sites providing a reliable and resilient 24/7 homeland defense capability. To ensure that the GMD system is available and ready to execute its mission, the O&S team works continuously to minimize the number of unscheduled maintenance actions while maximizing predictive and preventative maintenance schedules. This combination of unique tools and techniques ensures the GMD system maintains near-perfect system availability.

All GMD assets face sustainment challenges, but assets at Fort Greely deal with a variety of unique environmental and technical issues specific to interior Alaska, such as extreme weather and commercial power supply challenges. By conducting government and industry trade studies, our sustaining engineering teams have found ways to ensure the GMD system has the necessary power on-demand to execute the homeland defense mission. The studies found two major challenges. First, commercial power bumps were a significant contributor to unplanned corrective maintenance. Second, the ground systems lacked the necessary resiliency to endure frequent commercial power bumps. Understanding both the critical mission and unique operating environment, the Boeing-led design solution accelerated the planned upgrade to ground system hardware for individual silos to install a more robust Uninterruptible Power Supply (UPS) which enables hardware in the ground system to endure the frequent commercial power bumps and not generate the alarms that historically required unplanned corrective maintenance actions. Our teams successfully researched, revealed and corrected these problems in only 14 months, and these efforts provided lasting benefit to critical systems that protect our homeland.

The joint Boeing and Missile Defense Agency (MDA) team's assessment, design, procurement and employment of an improved ground system UPS in all Fort Greely site assets is an outstanding example of a special project with lasting program benefits deserving of Program Excellence Award consideration.

VALUE CREATION (Value: 15 points)

Please respond to the following prompt:

- **Clearly define the value of this program/project for the corporation; quantify appropriately**

The Boeing-led GMD O&S team's primary objective is to provide maximum GMD system availability, and the MDA has defined a System Availability (SA) metric that tracks GMD system readiness down to the second and rewards industry for desirable outcomes. The industry team's commitment to support the customer and its mission evaluates every program decision through the lens of mission readiness and takes decisive action to prioritize uninterrupted availability. The fielding of the 9355 UPS system has directly increased the availability delivered to the warfighter and, in turn, also increased the likelihood industry is capturing all available performance incentives.

In addition to the performance incentives, this project is in alignment and reinforces two key Boeing corporate values:

1. Start with engineering excellence
2. Be accountable — from beginning to end

Applying these values in the execution of GMD has helped Boeing create an engineering foundation that the MDA and the warfighter can depend on, while defining specific lines of responsibility in our teams. Our commitment to the MDA customer and achieving the U.S. Northern Command's mission objectives is apparent in the way we execute every day. The following paragraphs detail just a few of the engineering processes that we leverage in support GMD and in particular the decision to field the 9355 UPS system.

GMD is a complex system and requires a chain of events to be successful: sensors (to detect a launch), command and control (to orchestrate how the threat is tracked and to calculate an intercept solution), ground systems (to provide the necessary commands to the GBI itself (Figure 1). Any disruption in that chain of events that results in system downtime will count against the budget of hours for any given month. To minimize those downtime hours, the Boeing O&S team continuously assesses system performance to look for opportunities to eliminate disruptions that could impact that System Availability (SA) metric.

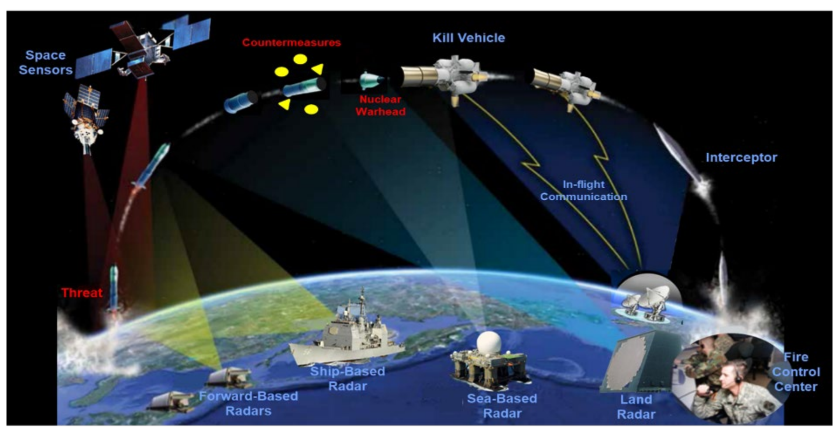

Figure 1: GMD Architecture

In looking for opportunities, our team found data that a frequent cause for unscheduled maintenance were alarm resets and component replacements as a result of "dirty" commercial power that feeds the Silo Interface Vaults (SIVs) at Fort Greely. The commercial power infrastructure in Alaska has been the victim of its harsh environment for decades. High winds, extreme cold temperatures and frequent ice storms all could cause the power that is provided to Fort Greely from Fairbanks (more than 90 miles away) to drop. The GMD system has its own backup power plant that will automatically pick up the load for GMD prime mission equipment, but that transition from commercial power to GMD power frequently results in power bumps. When such a power bump reaches the SIV that supports a particular Ground Based Interceptor in an adjacent silo, there was limited UPS capability to support all the non-mission critical circuity. This non-mission circuitry, by design, provides health status for systems that support SIV heating, cooling and humidity control. For example, because of cold weather, each silo has heat traces that are embedded in hardware to prevent freezing of mission critical hardware. A heat trace alarm is considered a “nuisance” alarm but needs to be reset regardless. To reset a heat trace, a maintenance team must be deployed to the site to physically enter the SIV and reset the circuitry. For the duration of this time for this maintenance action, the Ground Based Interceptor must be taken offline so as not endanger the maintenance crew doing the work. That downtime impacts that assets availability and may have a direct impact on the SA metric and the corresponding incentive fee.

In a parallel effort by our obsolescence management team, using a Boeing developed tool, we found that the existing UPSs for a mission critical piece of hardware called the Launch Support Equipment (LSE) were obsolete and spares were no longer available for purchase. These LSE UPSs are critical in keeping the Ground Based Interceptor that it supports fully mission-capable and have to be resilient to handle these incoming commercial power bumps. Once these LSE UPS spares are consumed, any future disruption of one of these LSE UPSs would result in that asset being unavailable.

In looking at what could be done to minimize the impact of these power bumps, a number of options were examined. One of the options explored was to provide a more robust UPS for the SIVs. An upgrade to all SIVs at Fort Greely to the next generation of ground systems was being planned – that upgrade includes installation of a large capacity UPS (hereafter called a SIV UPS) that would provide power to all mission critical equipment in the SIV as well as to the circuitry that was shown to be susceptible to these power bumps (the heat trace circuitry). These SIV UPSs would also mitigate the risk associated with the LSE UPSs and potential spares depletion – the SIV UPSs would enable our team to put those LSE UPSs into a bypass mode and effectively eliminating any potential corrective maintenance action for a affected LSE UPS. The original LSE UPS upgrade schedule was not due to start install until the fall of 2023. Working through our company best practice trade study process, the recommendation was made to accelerate the installation of these SIV UPSs in advance of the next generation of ground system upgrade.

The recommendation was accepted by O&S and GMD program leadership, and engineering drawing updates and planning for the early installation of these SIV UPSs was initiated. Installation of the SIV UPSs was done in three phases starting in spring of 2021 and completing in the summer of 2022. Since the installation was completed for all the SIVs at Fort Greely, there has not been a single heat trace related nuisance alarm attributed to a commercial power bump. This has saved hundreds of maintenance manhours and supported our achievement of maximum mission support and maximum incentive fee for each month. Pictures of installation of these SIV UPSs is shown below (Figure 2).

Figure 2: SIV UPS Hardware Installation and Checkout

- **Clearly define the value of this program/project to your customer**

As discussed above, the role of GMD to defend the U.S. homeland against incoming ballistic missile attacks is critical. GMD must be available with the maximum number of Ground Based Interceptors possible to intercept ballistic threats. When we eliminate maintenance actions, we streamline processes and bolster our defense posture. Since the installation of all these SIV UPSs has been completed, GMD has not had to request permission to take a Ground Based Interceptor off-line to reset a site's heat trace alarm.

From a historical perspective, there were 78 recorded power bumps between 2012 and 2020. Each of these power bumps resulted in multiple maintenance actions across a multitude of Ground Based Interceptor sites to address these nuisance alarms. As an example, on June 5, 2017, a power bump impacted all 34 sites at Fort Greely that did not have a SIV UPS – each of those sites had to have a maintenance team of three people go to the site, open up the SIV, reset circuitry and close up the SIV. It takes about an hour to do that for each site. Each of the sites was unavailable to the warfighter while a maintenance team reset the system.

- **Clearly define the value of this program/project to members of your team; quantify if possible**

Fort Greely, being located in the interior of Alaska, experiences some of the most extreme cold and adverse weather conditions on the planet. Sub-zero temperatures and high winds can last for weeks at a time. Every time a maintenance technician has to suit up to head to a maintenance site puts strain on any human body. Eliminating those times when a team has to go to a site to reset these nuisance alarms is very much appreciated by the team at Fort Greely. They no longer have to dread those flickering lights at the site knowing that those lights would mean multiple trips to the field to reset alarms.

Additionally, each entry onto the Missile Defense Complex required transiting the Entry Control Facility where soldiers would thoroughly inspect vehicles and personnel. This time consuming, labor intense process is completely avoided by the installation of the SIV UPS which is greatly appreciated by the soldiers defending the site and their military leadership. This was exceptionally important in the latter phase of the COVID 19 pandemic.

- **Clearly define the contribution of this program/project to the greater good (society, security, etc.)**

The GMD O&S team's successful execution of this project has directly enhanced the ability of the U.S. Northern Command to defend the United States homeland from missile attack. With the goal of providing uninterrupted readiness of the GMD system, this project is also in direct support of the MDA's top strategic goal – to "support the warfighter." Boeing's commitment to the GMD program is enabling the system to maintain a defensive capability in a rapidly evolving global threat environment.

ORGANIZATIONAL BEST PRACTICES AND TEAM LEADERSHIP (Value: 35 points)

Please respond to the following prompts:

- ***15 points:* Describe the innovative tools and systems used by your team, how they contributed to performance and why**

The key to maintaining near-perfect system availability is to eliminate those times when unplanned/unscheduled maintenance has to be done. Boeing's Reliability, Availability, Maintainability and Testability (RAMT) team (as part of the O&S team) has a mission to review operational data and identify trends as early as possible. For this project, the impacts of power bumps were readily known to the team. The RAMT team looked beyond the obvious and looked at the potential impact of power bumps long term on SIV hardware – the team found that there was a 32% chance of a power bump causing a disruption in other hardware within two weeks. In looking at the data for the year following a power bump, the team found that there was a 29% of SIVs/silos showed an increase in disruption of greater than 9.58%. The team also looked across all silos and found that there was a correlation to the number of disruptions experienced per year at the site and the number of power bumps that site experienced (Figure 4).

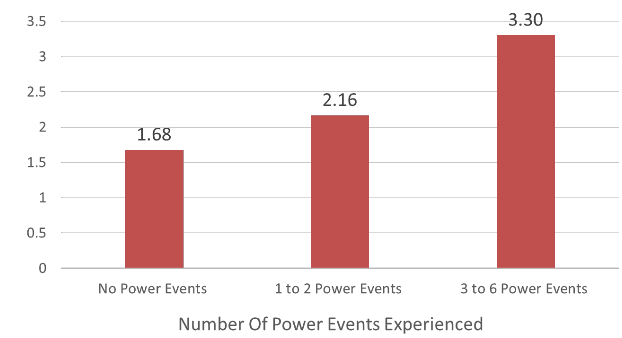

Figure 3: Power Event and Disruption Correlation

In parallel with the work that was being done by the RAMT team, our GMD O&S obsolescence team was also looking at the impacts of power bumps on components life the cycle. As noted by the RAMT team, we were beginning to see an increase in the disruption rates associated with hardware in the SIVs. One specific example of that was disruptions occurring with the UPSs that were integrated into the LSE racks in the SIVs. The obsolescence team used a structured obsolescent management process (Figure 5).

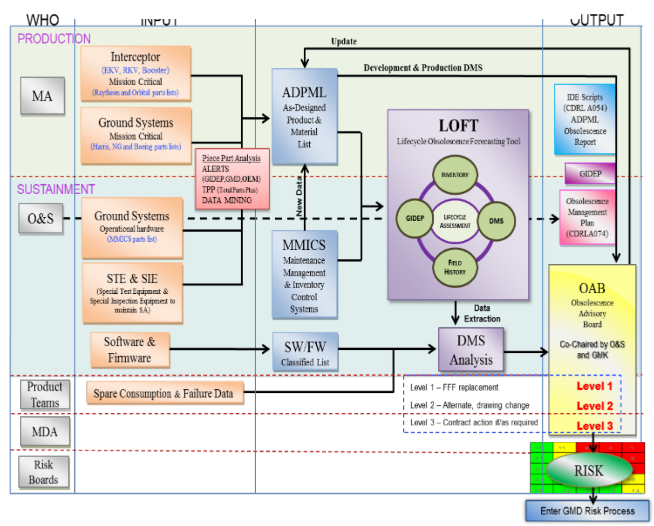

Figure 4: LOFT Processes Flow

This process with a unique tool called the Life-cycle Obsolescence Forecasting Tool (LOFT) identified specific risks associated with the LSE rack UPSs that helped to further cement the need for a project to address the adverse impacts of these commercial power bumps on GMD hardware. LOFT will be described in more detail in a following section.

Once the need for a solution to the issues caused by became clear, the Boeing O&S team partnered with other organizations on GMD to execute a structured trade study process to identify the optimal solution. This trade study process methodically walked through a set of decision criteria and identified a recommendation for program leadership represented by the courses of action (COAs) below (Table 1).

Decision Support Matrix

			COA #1		COA #2		COA #3		COA #3a	
			Maintain LSE UPSs		Equivalent Substitute Part		Early Fielding of Eaton 9355s		Early Fielding of Eaton 9355s – non-GS Drawing Support	
	CRITERIA	Weighting	Raw	Weighted Score	Raw	Weighted Score	Raw	Weighted Score	Raw	Weighted Score
1	WS Resliency	3.5	0.1	0.4	**0.5**	**1.8**	0.9	3.2	0.9	3.2
2	WS Availability	2	0.2	0.4	**0.1**	**0.2**	0.8	1.6	0.8	1.6
3	Timeline	1.5	0.9	1.4	**0.7**	**1.1**	0.5	0.8	0.7	1.1
4	Spares Availability	1	0.1	0.1	**1.0**	**1.0**	1.0	1.0	1.0	1.0
5	Engineering Resouces	1	0.9	0.9	**0.8**	**0.8**	0.3	0.3	0.8	0.8
6	Cost	1	0.9	0.9	**0.5**	**0.5**	0.3	0.3	0.3	0.3
		10		**4.0**		**5.3**		**7.1**		**7.9**

Table 1: Weighted Decision Details

➢ ***10 points:*** **Define the unique practices and process you used to develop, lead and manage people?**

As described above, the GMD O&S team used a variety of tools to support the process used to identify the issue, validate the data and come up with a recommended solution. The majority of these tools are industry standard tools like Excel (for RAMT analysis) and decision tools. The one unique tool developed by the Boeing team is LOFT. LOFT was developed in 2013 as a means to combine data from multiple sources to identify potential risks associated with diminishing manufacturing sources, depleted spares and observed disruption rates.

LOFT offers the following capabilities:

- Automates all previous manual processes
- Interactive User Interface with forecasting capabilities
    - Forecasted Critical Dispatch Date (CDD)
- Prioritization of at-risk parts based on obsolescence, spares and current mitigation plans.
- Visual Timeline of Part Availability, CDD, etc.
- Interactive charts with breakdowns of obsolescence and spares numbers for parts
- Real-time Information pulled from both PMP and CIMMS databases
- Oracle/Cold Fusion based programming allowing for significant future increases in the number of parts being tracked.
- Generates supplier surveys/engineering surveys
- Exportable and printable metrics

LOFT's database will maintain a set of key trigger points to support program efforts to ensure no component ever reaches its CDD:

- Production trigger
- Repair trigger
- Spares stock trigger

The set points for each of these triggers can varied as we gain experience. These trigger points will be used by the tool to flag the obsolescence team to make proactive decisions about end of life buys, alternate repair sources, etc. Individual components obsolescence risk assessments will be a combination of the CDD (for the likelihood) and a consequence determined by the appropriate Engineering Problem Resolution Board and then be brought through the standard risk board process (Figure 6).

As components approach their CDDs (like in the case of the LSE rack UPSs), risks are brought through the risk process and mitigations are defined. Once the trade study process identified the candidate solution to our power bump issue (which also served as a mitigation for our LSE rack UPS obsolescence), the execution plan was captured as a risk mitigation plan and tracked through closure.

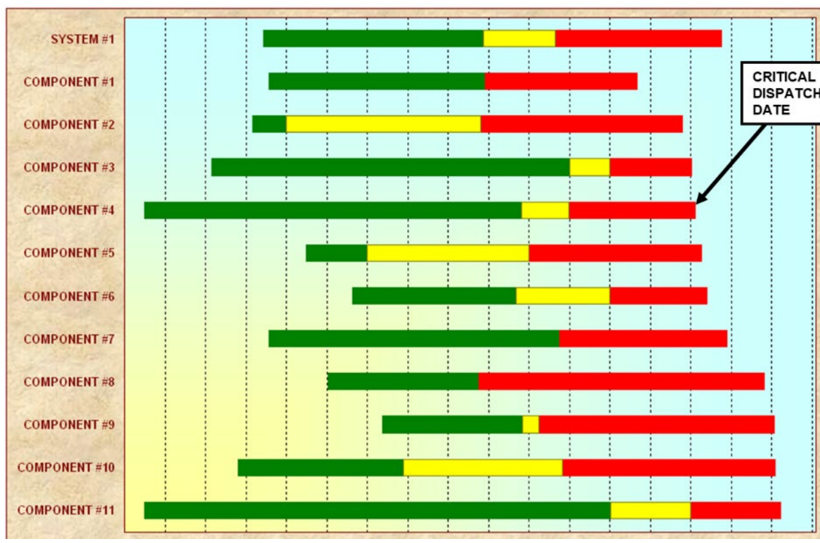

Figure 5: Critical Dispatch Trigger Points

- ➢ ***10 points:* How did you leverage skills and technologies of your suppliers?**

The Boeing-lead O&S team relies heavily on the skills and technologies of key suppliers and partners. Their expertise on their assigned individual components and systems is critical in the sustainment of the GMD weapon system. As discussed previously, managing system availability is all about maximizing the use of planned preventative maintenance and minimizing any unplanned/unscheduled actions. In addition to the use of the Boeing LOFT tool, our suppliers each have their own set of tools and processes to assess the fielded operational reliability of the products they provide. The combination of these prime/supplier inputs are key in maintaining the integrity of the LOFT database. As components are identified with looming CDDs or also known as spares depletion dates, our suppliers are first to the table with recommended mitigations to ensure the GMD system is never down due to a depletion of spares and no way to restore a critical asset.

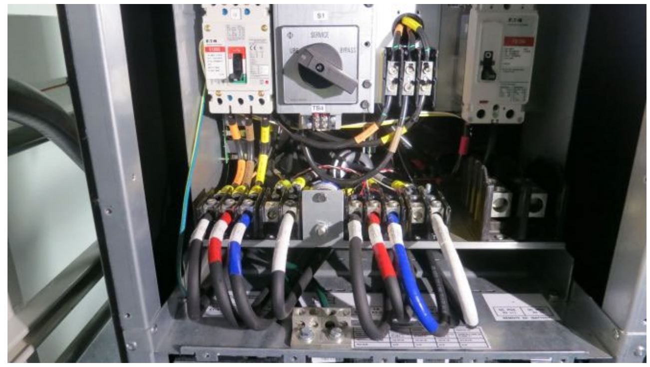

Figure 6: UPS System Wiring

When it came to execution of the installation of the SIV UPSs, our GMD O&S team relied on the skills and experiences of a variety of suppliers for the installation of the 32 UPSs at Fort Greely in a variety of weather conditions. Electricians from a local small business partner provided the expertise to re-wire the power infrastructure of the SIV to put the SIV UPSs in place (Figure 7) and to perform those tasks necessary to seismically secure the UPSs to the SIV floor. The GMD regional partnerships and supply chain/base is key to our deployed teams' success and has provided valuable support for more than two decades to the program.

DEALING WITH PROGRAM COMPLEXITY (VOLATILITY, UNCERTAINTY, COMPLEXITY, AMBIGUITY, or VUCA) - Value: 25 points

Please respond to the following prompts:

- ***10 points:*** **Describe UNIQUE areas of VUCA faced by your program and why. (Please avoid the issues surrounding Covid-19 pandemic, which was faced by all programs.)**

Volatility – As has been recently demonstrated by North Korea's increased ballistic missile testing, the importance of maximizing GMD availability has never been more critical. There is a very structured process used by the warfighting community that carefully reviews every request for access to components in the GMD system. Preventive maintenance tasks, which are by definition scheduled events, can be analyzed to determine if the task can be executed without impacting GMD's capability to defend the U.S. Any unscheduled maintenance action (especially for those for a mission critical asset) also go through the same rigorous assessment process – in many cases, approval to execute an unscheduled maintenance action will resulted in the postponing of a preventative maintenance action. GMD has also been impacted by the volatility of the component supply base and availability of components critical to maintaining 24/7/365 readiness. Our LOFT database is continuously updated with the latest information from suppliers to minimize the impact of this volatility on GMD system availability.

Uncertainty – As GMD is a defensive system, it will always operate in uncertainty. As rouge nations continue to develop long range missile technology, it is unknown when GMD could be called on to execute its mission. Supporting the tenant of maximizing readiness, our entire O&S team works to minimize/eliminate unscheduled maintenance actions that would take the system or assets away from the warfighter.

Complexity – GMD is a weapon system comprised of more than 65,000 parts, 100 million lines of code and uses more than 20,000 miles of fiber optic cabling as well as Satellite Communications (SATCOM). The sequence of events required to execute an intercept of an incoming ballistic threat is very precise. Sensors, command control, ground systems and Ground Based Interceptors execute a choreographed launch sequence. Once the Ground Based Interceptor is airborne, it receives additional inflight updates on the position and characteristics of the incoming threat all taking place across 15 time zones (Figure 8).

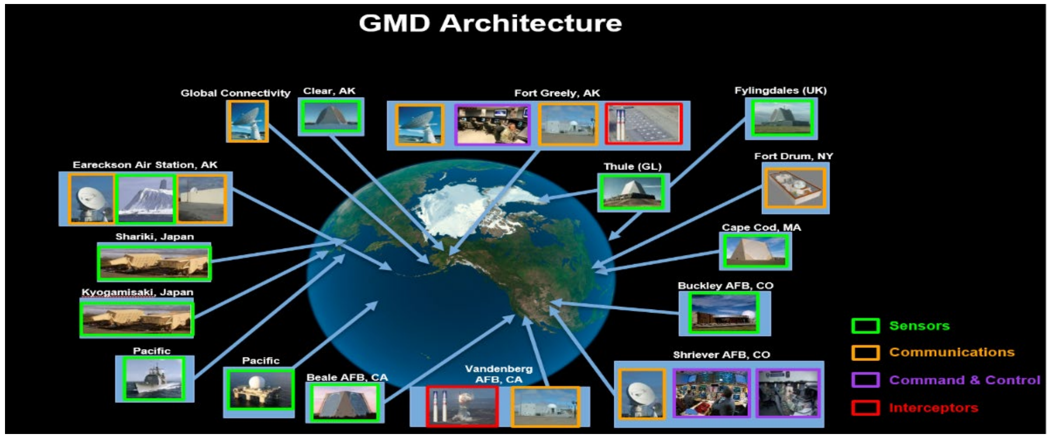

Figure 7: GMDs Complex Architecture

Ambiguity – GMD's non-traditional fielding and eventual operational status carries with its conditions that are normally resolved in the acquisition lifecycle. Our current contract vehicle executes development, test and operations allowing for the O&S team to engage with tester-developers to resolve issues or unrecognized gaps. While helpful to have all teams under one umbrella, this also creates

ambiguity on true lines of authority and responsibility for the system and its components. When O&S finds an issue or opportunity it often has to take ownership of the task to walk through the development and test cycle prior to fielding. While not a typical role of O&S, our team depth of experience provides the much-needed continuity of tasks.

➢ ***15 points:* Explain how your team responded to these challenges. What changes did you make, what were the results?**

With the challenges noted above, our GMD O&S Team has been laser focused on maximizing GMD SA. GMD, when first fielded in 2004, did not come with a well-established supportability infrastructure due to the pressures of the Presidential mandate to rapidly deploy an Initial Operational Capability. Over the next 18-plus years, the program focused on capability and capacity growth – more Ground Based Interceptors, more sensors and improved communications. As a result, a dedicated approach to ensuring long-term sustainability was not pursued. In 2020, the new GMD O&S director, Geneen Tobey, forged a partnership with our counterparts in MDA, and embarked on a campaign to ensure the system is ready, reliable and resilient. This became known as the GMD Weapon System Resiliency Campaign. This campaign's stated objective was to complete the transition of the GMD system into the operations and sustainment phase of its system lifecycle. The campaign focused on developing the logistics and engineering products and processes never fully defined for critical heritage GMD subsystems, critical PSE, and tooling.

The campaign tailored the Cybersecurity Framework (CSF) to our program and defined a six-phase approach:

1. Prioritize and scope
2. Orient

3. Create a current profile
4. Conduct a risk assessment
5. Create a target profile
6. Determine, Analyze and Prioritize gaps

One of the first recommendations coming out of this campaign was to address the Fort Greely commercial power bumps – the subject of this project nomination.

METRICS - Value: 15 points

Please respond to the following prompts, where predictive metrics indicate items that provide a view of how yesterday's actions and today's actions will affect the future timeline, cost or other requirement.

Provide charts/graphs that illustrate performance to these metrics:

- **What are your predictive metrics?**

With respect to a metric associated with maximizing GMD weapon system readiness, the metric is called SA – calculated by total number of hours in a given month minus any downtime for an asset that breaks the predefined classified kill chain divided by the total number hours. The metric does make allowances for any time that the government directs Boeing to execute tasks that knowingly break the kill chain. While this metric is used for determine monthly incentive fee awarded to Boeing, Boeing uses this metric as a mechanism to predictively drive performance to meet the desired outcome. Leveraging the model of power-driven disruptions our RAMT team was able to project the future impacts of unmitigated power disruptions (Figure 8 detailed in Figure 3 is the cross section of power-driven disruptions, averages and the projected disruption avoidance by implementing the 9355 UPS system).

From an obsolescence metrics perspective, the obsolescence team has a metric that is presented to joint Boeing and MDA obsolescence advisory board that tracks how the program is managing known obsolescence issues. The metric (shown below), looks at each major element of ground systems (network communications, command & control, Ground Based Interceptor inflight communications, and launch control systems) and looks at the number of obsolete items, the number of obsolete items that have been mitigated and the number of unfunded and unmitigated items. Unfortunately, because of classification issues, we can't share the specific numbers and specific hardware being tracked but the metric does show how we are predictively identifying areas before they become a problem for fielded hardware. Similar obsolescence metrics are also used for software and firmware.

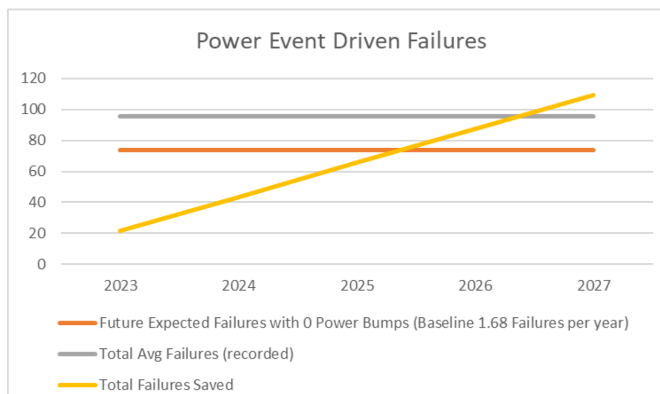

Figure 8: Predictive Model of Power-Driven Disruptions

- **How did you perform against these metrics?**

Evident in Figure 8 our 9355 UPS system has greatly reduced the number of responsive sustainment actions driven by power events. As an extension of this individual reduction the GMD O&S team has done extremely well against the system availability metric in providing maximum warfighter readiness. The actual system availability metrics we have averaged an incentive fee capture greater than 99% since 2015.

Similar to our availability performance, our obsolescence team/processes have provided exceptional value to the mission. Key to this success is our ability to use metrics in identifying and mitigating obsolescence issues prior to being realized. Table 2 presents an unclassified summary of our recent obsolescence advisory board meeting where this metrics drive action.

Obsolescence Snapshot						
System	Total Items	Total Obsolete Items	Mitigated Items	Unfunded Mitigation	Unmitigated Items	Total % Coverage
Ground Systems Hardware						
System #1	3,824	237	237		0	100%
System #2	292	140	140		0	100%
System #3	4,072	166	165	1	0	100%
System #4	1,510	257	257		0	100%
System #5	1,596	66	58		8	87.9%
System #5	753	26	26		0	100%
GS HW - Combined	12,047	892	883	1	8	99.1%

Table 2: Obsolescence Summary

- **How do your predictive metrics drive action toward program excellence? Please provide examples.**

Sustaining an operational weapon system in an evolving threat environment compels our team to capture, interpret and act on metric data repeatedly. Led by metric data, tools and processes described above the GMD RAMT team was able to clearly link power disruptions to labor intensive alarm resets and increased frequency of component disruptions. Compounding the increasing disruption rate, the obsolescence process identified the accelerated depletion of LSE rack spares would have an earlier than expected impact on available stock. Independently, these two conditions were assessed via boards and working groups. Initially recognized as challenges, these two factors converged and helped create the velocity needed to execute the 9355 UPS solution, enabling increased readiness and removed the reliance on obsolete parts.