



December 2018

MISSILE DEFENSE

Air Force Report to Congress Included Information on the Capabilities, Operational Availability, and Funding Plan for Cobra Dane

Accessible Version

GAO Highlights

Highlights of [GAO-19-68](#), a report to congressional committees

Why GAO Did This Study

First fielded in 1976 on Shemya Island in Alaska, the Cobra Dane radar faces growing sustainment challenges that DOD plans to address through modernization projects. Anticipating future needs, DOD began investing in new radar systems that share capabilities with Cobra Dane to support ballistic missile defense and space surveillance, including the LRDR (Alaska), the Space Fence (Marshall Islands), and the Pacific Radar (location to be determined).

The conference report accompanying a bill for the National Defense Authorization Act for Fiscal Year 2018 included a provision that GAO review the Air Force's report to Congress on the operation and sustainment of Cobra Dane. This report identifies information included in the Air Force's report and describes additional information that GAO reviewed on (1) the capabilities of the Cobra Dane radar and other planned radars to meet DOD's mission requirements, (2) Cobra Dane's operational availability and the plan to mitigate the effect on those missions when Cobra Dane is not available, and (3) DOD's funding plan and project cost estimates for the operation and sustainment of Cobra Dane and its site at Shemya Island. GAO reviewed the Air Force report and related documentation, and interviewed relevant officials.

View [GAO-19-68](#). For more information, contact Joe Kirschbaum at (202) 512-9971 or kirschbaumj@gao.gov.

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Air Force Report to Congress Included Information on the Capabilities, Operational Availability, and Funding Plan for Cobra Dane

What GAO Found

In its January 2018 report to Congress, the Air Force reported how the Cobra Dane radar and the Long Range Discrimination Radar (LRDR) have shared and unique capabilities to support ballistic missile defense and space surveillance missions. The report noted that the respective locations of both radar systems affect their ability to provide those capabilities. The Department of Defense (DOD) also has other radar investments—the Pacific Radar and the Space Fence, which, according to DOD officials, may reduce DOD's reliance on Cobra Dane to provide ballistic missile defense and space surveillance capabilities.

The Cobra Dane Radar on Shemya Island, Alaska



Source: Air Force. | GAO-19-68

The Air Force's report to Congress noted that Cobra Dane met its requirement for operational availability, which refers to the percentage of time that the radar is able to meet its missions. GAO found that the Air Force has developed procedures to mitigate risks when Cobra Dane is not available. For example, U.S. Northern Command and Missile Defense Agency (MDA) officials stated that they can mitigate risks when Cobra Dane is not available by using the Sea-Based X-band radar to provide support for ballistic missile defense. The Air Force would face some limitations in its ability to conduct space surveillance if Cobra Dane were not available, as Cobra Dane tracks objects no other radar can track. However, MDA officials noted there are no plans to take Cobra Dane offline long enough to compromise space surveillance.

The Air Force and MDA plan to contribute total funding of \$278.6 million for the operation and sustainment of Cobra Dane, according to their fiscal year 2019 budget plans. Specifically, the Air Force and MDA plan to share funding for the operation and maintenance of the Cobra Dane radar and for three modernization projects that make up their sustainment plan for the radar. Further, the Air Force report noted that the Air Force also plans to provide \$140 million in funding for the sustainment and maintenance of operational access to Cobra Dane's site at Shemya Island. In addition, GAO found that the Air Force developed a total cost estimate for one project—known as the transmitter group replacement—but not for its other two projects. Air Force officials plan to complete cost estimates for those two projects in conjunction with their fiscal year 2020 budget submission.

Contents

Letter		1
	Background	4
	Air Force Reported That Cobra Dane and LRDR Can Contribute to Various Missions, and We Found That Additional Radar Investments May Reduce Reliance on Cobra Dane	6
	Air Force Reported That Cobra Dane Generally Meets Its Requirements for Operational Availability, and We Found That the Air Force Can Mitigate Radar Downtime for Its Missions	11
	Air Force Reported That DOD Has Plans to Fund Cobra Dane and Its Site, and We Found That It Has Developed Cost Estimates for Some Projects	13
	Agency Comments	16
<hr/>		
Appendix I: GAO Contact and Staff Acknowledgments		18
	GAO Contact	18
	Staff Acknowledgments	18
<hr/>		
Tables		
	Table 1: Selected Radar Systems that Provide Ballistic Missile Defense or Space Surveillance Capabilities	5
	Table 2: Ballistic Missile Defense Capabilities of Cobra Dane and the Long Range Discrimination Radar	7
	Table 3: Planned Air Force and Missile Defense Agency (MDA) Funding for the Operation and Maintenance of Cobra Dane (in millions)	13
	Table 4: Planned Funding for the Three Projects in Cobra Dane's Sustainment Plan (in millions)	14
	Table 5: Funding Plan for the Operation and Sustainment of Shemya Island (in millions)	15
<hr/>		
Figures		
	Figure 1: The Cobra Dane Radar	2
	Figure 2: Illustration of Tracking Coverage Overlaps among AN/TPY-2, Cobra Dane, and the Long Range Discrimination Radar (LRDR)	9

Abbreviations

DOD	Department of Defense
LRDR	Long Range Discrimination Radar
MDA	Missile Defense Agency

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December 17, 2018

Congressional Committees

The Cobra Dane radar faces growing sustainment challenges that the Department of Defense (DOD) plans to address through modernization projects. The Air Force fielded Cobra Dane in 1976 on Shemya Island, Alaska. In subsequent years, Cobra Dane has undergone upgrades and changes to its mission. From 1977 to 1994, the Air Force used Cobra Dane to support a primary mission of intelligence gathering, and to provide early warning of missile threats and conduct space surveillance (tracking objects in space) as additional missions.¹ In 1994, the Air Force stopped using Cobra Dane to support missile warning. The Air Force also ceased using Cobra Dane for space surveillance for 5 years, but continued to operate the radar in a limited capacity to support intelligence gathering. In 2004, the Missile Defense Agency (MDA) completed upgrades to Cobra Dane so that it could contribute to a new ballistic missile defense mission. Since MDA completed the upgrades, the Air Force has used Cobra Dane to support ballistic missile defense and space surveillance missions. In anticipating future needs, DOD began investing in new radar systems that will provide varying mission capabilities. However, DOD does not intend for any one of these systems to be a complete replacement for Cobra Dane. Radar investments include the Long Range Discrimination Radar (LRDR) at Clear Air Force Station in Alaska; the Space Fence at Kwajalein Atoll, Marshall Islands; and the Pacific Radar. See figure 1 for a photo of the Cobra Dane radar.

¹Specifically, Cobra Dane was constructed to provide intelligence gathering to verify a treaty between the United States and the Soviet Union to limit the quantities of ballistic missiles armed with nuclear warheads.

Figure 1: The Cobra Dane Radar



Source: Air Force. | GAO-19-68

Congress has expressed interest in DOD’s plan to use Cobra Dane to meet various mission requirements and how it would maximize the radar’s reliability and minimize life-cycle costs. Specifically, the conference report accompanying a bill for the National Defense Authorization Act for Fiscal Year 2018 (“the Act”) included a provision that the Air Force, in coordination with MDA and U.S. Northern Command, submit a report on the Cobra Dane radar to the congressional defense committees with its fiscal year 2019 budget request.² The report was to outline the capabilities of Cobra Dane and alternative radars, DOD’s plan for the operation and sustainment of Cobra Dane, and the costs to sustain Cobra Dane and its site at Shemya Island. The Air Force submitted the report in January 2018.

²H.R. Rep. No. 115-404, at 1047 (2017) (Conf. Rep.). In addition, House Report 114-537, the House report accompanying a bill for the National Defense Authorization Act of Fiscal Year 2017, also contained a provision for U.S. Strategic Command to report on the Cobra Dane radar. Specifically, it contained a provision that U.S. Strategic Command report on the cost, schedule, and program plans to upgrade DOD’s ballistic missile defense and space surveillance assets to maintain and eventually replace Cobra Dane. U.S. Strategic Command submitted a briefing in May 2017 that asserted DOD would continue to require Cobra Dane until it could be replaced with a system that provided equal or greater capability for ballistic missile defense.

The conference report accompanying the Act also included a provision that we review the Air Force's report to Congress.³ This report identifies information included in the Air Force's report and describes additional information that we reviewed on (1) the capabilities of the Cobra Dane radar and other planned radars to meet DOD's mission requirements, (2) Cobra Dane's operational availability and the plan to mitigate the effect on those missions when Cobra Dane is not operationally available, and (3) DOD's funding plan and project cost estimates related to the operation and sustainment of Cobra Dane and its site at Shemya Island.

For all objectives, we reviewed the Air Force report to Congress and identified information related to requirements outlined in the conference report. We interviewed officials from Headquarters Air Force, Air Force Space Command, the Air Force Life Cycle Management Center, MDA, U.S. Northern Command, and U.S. Strategic Command to discuss information contained within the Air Force report, and to identify other information and documentation relevant to each of our three objectives.

For objective one, we also reviewed documentation that outlined the capabilities of Cobra Dane and other radar investments. Our review included MDA's reports on the LRDR and its analysis of alternatives on ballistic missile defense sensors. We also reviewed a U.S. Strategic Command briefing for information on the capabilities of Cobra Dane and alternative radar systems. We did not independently review the quality of the technical materials or the process by which MDA or U.S. Strategic Command assessed the capabilities of Cobra Dane or other radar systems because doing so was beyond the scope of our review to describe additional information on the capabilities of Cobra Dane and other radar investments.

For objective two, we also reviewed documentation related to the operational availability of Cobra Dane and the associated effects if Cobra Dane is not available, including Air Force data on the operational availability and space surveillance performance of Cobra Dane. We asked cognizant Air Force officials questions about the reliability of their operational availability data and reviewed relevant documentation on how they calculate that data. We determined that we could use these data for the limited purpose of describing the reported operational availability of Cobra Dane compared to its requirement. We also reviewed U.S.

³H.R. Rep. No. 115-404, at 1047 (2017) (Conf. Rep.)

Northern Command's analysis on the abilities of various radar systems to track missile threats targeting U.S. locations.

For objective three, we also reviewed documentation related to DOD's plans to fund the operation and sustainment of Cobra Dane and to identify project cost estimates. Specifically, we reviewed documents from the Air Force and MDA, such as budget submissions, funding profiles, and cost estimates. We did not independently assess the underlying budget data or cost estimates from the documentation we reviewed because doing so was beyond the scope of our review to describe additional information on DOD's funding plan and project cost estimates.

We conducted this performance audit from June 2018 to November 2018, in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on audit objectives.

Background

Cobra Dane and other radar systems can provide capabilities that contribute to a range of missions, such as ballistic missile defense, space surveillance, and intelligence-gathering missions.⁴ DOD uses Cobra Dane and other radar systems to provide information over a short period of time to ground-based interceptors so they can hit their targets. Such radar systems contribute to ballistic missile defense by tracking incoming missile threats, classifying the missile threat, and determining if a threat was intercepted successfully. In addition, some radar systems can provide discrimination capabilities, which allow for that radar to identify a warhead when a missile threat deploys decoys at the same time. Radar systems can also have the capability to contribute to a space surveillance mission, which provides an awareness of space objects within or near the Earth's orbit and their movements, capabilities, and intent. Finally, radars can also contribute intelligence-gathering capabilities. Each radar system's ability to contribute to various missions can be dependent on that radar's inherent capabilities and physical location.

⁴In a November 2016 memo, U.S. Northern Command stated that it has a preferred capability that radar systems should meet multiple missions.

See table 1 for a description of selected radar systems that can provide some or all of these capabilities.

Table 1: Selected Radar Systems that Provide Ballistic Missile Defense or Space Surveillance Capabilities

Radar system	Location	Operational	Description of radar system
Cobra Dane	Shemya Island, Alaska	Yes	According to the Air Force report to Congress, Cobra Dane has the capabilities to track and classify missile threats, as well as to provide space surveillance and intelligence-gathering. The Air Force and the Missile Defense Agency (MDA) plan to operate the radar through at least fiscal year 2030.
Long Range Discrimination Radar (LRDR)	Clear Air Force Station, Alaska	No – Planned for fiscal year 2021	Our prior work found that LRDR (once established) is intended to provide capabilities to support ballistic missile defense, such as tracking incoming missiles and discriminating the warhead-carrying vehicle from decoys and other non-lethal objects. ^a In addition, the Air Force report to Congress stated that LRDR will be able to contribute to space surveillance and intelligence gathering.
Space Fence	Kwajalein Atoll, Marshall Islands	No – Planned for fiscal year 2019	Our prior work found that the Air Force is developing a collection of ground-based radars to provide space surveillance capabilities. ^b Further, we found that the Air Force intends for the Space Fence to have the capability to detect smaller objects than can be currently detected.
Pacific Radar	Location in Pacific to be determined	No – Planned for fiscal year 2025	According to MDA’s fiscal year 2019 budget submission, MDA intends for this radar system to track incoming missile threats and discriminate the warhead-carrying vehicle. This radar is intended to provide additional ballistic missile defense coverage for the United States once it is fielded. MDA anticipates that this radar system can contribute to space surveillance.
Sea-Based X-band Radar	Mobile radar	Yes	DOD documentation describes the Sea-Based X-band Radar as a transportable radar system that can be temporarily positioned at various locations in the Pacific Ocean. It provides tracking and discrimination of missile threats. Further, the Sea-Based X-band Radar can be positioned to supplement existing radar systems, or to provide unique coverage.
AN/TPY-2	Shariki and Kyogamiskai Communications Site, Japan	Yes	Our prior work found that the AN/TPY-2 radars are transportable high-resolution radars, capable of tracking ballistic missiles of all ranges and discriminating the warhead-carrying vehicle. ^a

Source: GAO summary of DOD documentation. | GAO-19-68

^aGAO, Missile Defense: The Warfighter and Decision Makers Would Benefit from Better Communication about the System’s Capabilities and Limitations, [GAO-18-324](#) (Washington, DC: May 30, 2018).

^bGAO, Space Situational Awareness: Status of Efforts and Planned Budgets, [GAO-16-6R](#) (Washington, DC: Oct. 8, 2015).

Note: The Department of Defense intends for these radar systems to be multi-mission, meaning that those radars can provide a mix of ballistic missile defense, space surveillance, and intelligence gathering, and other capabilities. For purposes of this table, we summarized selected mission capabilities provided by each radar system that are related to the Cobra Dane radar.

Various offices within the Air Force, in coordination with MDA, are responsible for the operation and sustainment of the Cobra Dane radar. Since 2013, Air Force Space Command has overseen the operation of

Cobra Dane, and contributes to the sustainment of Cobra Dane's site at Shemya Island. The Air Force Life Cycle Management Center has overall responsibility of the sustainment of the Cobra Dane radar. In addition, MDA works in coordination with the Air Force and combatant commands to develop, test, and field ballistic missile defense assets. MDA also shares funding with the Air Force to operate and sustain Cobra Dane.

U.S. Northern Command and U.S. Strategic Command define priorities for the overall radar infrastructure and establish the various missions that those radar systems are intended to meet. U.S. Northern Command oversees the homeland ballistic missile defense mission, and establishes operational objectives for radar systems operating in its region. U.S. Northern Command officials told us that they are the end user for Cobra Dane. U.S. Strategic Command has established a ballistic missile defense and a space surveillance mission, both of which are supported by Cobra Dane. Further, U.S. Strategic Command's components coordinate global missile defense and space operations planning.

Air Force Reported That Cobra Dane and LRDR Can Contribute to Various Missions, and We Found That Additional Radar Investments May Reduce Reliance on Cobra Dane

Air Force Reported That Cobra Dane and LRDR Contribute Both Shared and Unique Capabilities to Their Respective Missions

In its January 2018 report to Congress, the Air Force described how Cobra Dane and LRDR can meet mission requirements through their shared and unique capabilities, as well as how their locations affect their ability to provide those capabilities for DOD's ballistic missile defense mission. MDA studies we reviewed found that locating LRDR at Clear Air Force Station allows for operational advantages and cost savings.

Ballistic Missile Defense and Space Surveillance Missions

The Air Force included information in its report to Congress on the ballistic missile defense capabilities of Cobra Dane and LRDR, and the effects of each radar's location on those capabilities. Specifically, the Air Force report stated that both radars have the capabilities to track and

classify missile threats. However, the report incorrectly stated that both radar systems have the inherent capability to determine if a missile threat is successfully intercepted. MDA documentation that we reviewed shows that Cobra Dane does not yet have this capability. When we shared our finding with Air Force and MDA officials, they agreed that this reported capability was incorrectly identified in the Air Force report to Congress. MDA officials also told us that Cobra Dane could provide this capability in the future if it implements software changes, but they are unlikely to do this until calendar year 2025.

The Air Force report also noted that LRDR would have a unique capability, once it is operational, to discriminate missile threats from any deployed decoys. See table 2 for a summary of what the Air Force reported for the ballistic missile defense capabilities of Cobra Dane and LRDR.

Table 2: Ballistic Missile Defense Capabilities of Cobra Dane and the Long Range Discrimination Radar

Capability	Cobra Dane	Long Range Discrimination Radar
Track Missile Threats	Yes	Yes
Classify Missile Threats	Yes	Yes
Determine if a Missile Threat is Successfully Intercepted	No ^a	Yes
Discriminate Missile Threats from Deployed Decoys	No	Yes

Source: Air Force and MDA documentation. | GAO-19-68

^aThe Air Force report noted that Cobra Dane had this capability, but its geographic location prevented the radar from providing operationally-useful information for this function. We identified in Missile Defense Agency (MDA) documentation that Cobra Dane does not have this capability, but MDA officials told us that software changes may allow Cobra Dane to provide this in the future.

In addition to identifying ballistic missile defense capabilities of each radar, the Air Force report noted that both Cobra Dane and LRDR will have the inherent capabilities to support space surveillance and intelligence-gathering missions.⁵ DOD officials we spoke to confirmed that they have plans to use those inherent capabilities to support these other missions. For example, U.S. Strategic Command identified that DOD

⁵The Air Force report noted that LRDR can provide an inherent intelligence-gathering capability, but its location at Clear Air Force Station does not allow it to provide operationally-useful information.

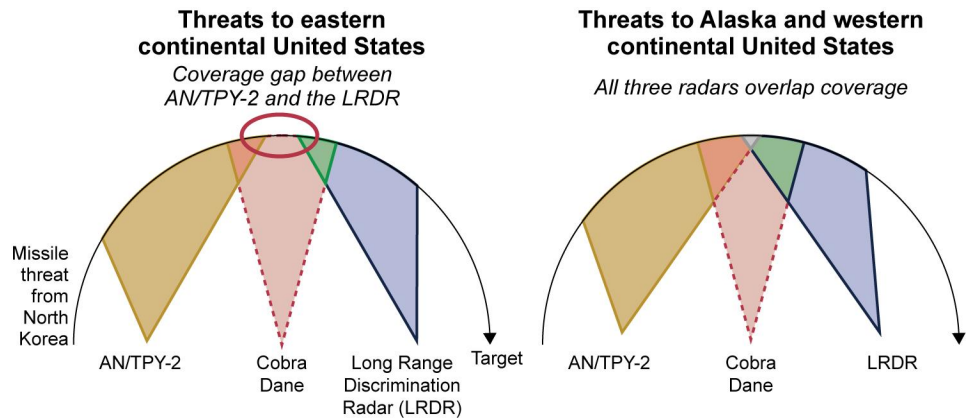
needs Cobra Dane to support its space surveillance mission.⁶ Further, Air Force and MDA officials told us that they use Cobra Dane to track small objects that no other radar system can track. MDA officials told us that LRDR could be used for space surveillance. However, Air Force and U.S. Strategic Command officials stated that there are no plans to use LRDR's space surveillance capabilities as a replacement for Cobra Dane. Additionally, Air Force officials told us that neither Cobra Dane nor LRDR is required to support an intelligence-gathering mission.

The Air Force also included information in its report on how the locations of Cobra Dane and LRDR affect their abilities to contribute to the ballistic missile defense mission. For example, the Air Force reported that Cobra Dane's location at Shemya Island, Alaska, allows it to track missile threats from North Korea earlier in their trajectories than LRDR would be able to track at Clear Air Force Station, Alaska. This is consistent with an MDA analysis that we reviewed that outlined additional advantages provided by Cobra Dane's location at Shemya Island.⁷ According to that analysis, Cobra Dane can begin tracking missile threats approximately 210 seconds earlier than LRDR. Air Force officials told us that the additional time to track missile threats allows the warfighter an earlier opportunity to intercept a missile threat and deploy additional interceptors if the first attempt fails. Further, the MDA analysis described a tracking gap between the areas covered by LRDR—once it is operational at Clear Air Force Station—and the two sets of AN/TPY-2 radars that are currently located in Japan. Without Cobra Dane's coverage of this gap, the analysis found that the warfighter would have a more limited opportunity to intercept a missile threat from North Korea. Figure 2 shows how Cobra Dane covers a gap between the LRDR (once operational) and the two AN/TPY-2 radars in Japan.

⁶U.S. Strategic Command, *Sustainment and Modernization of the Cobra Dane Radar* (May 23, 2017). We did not independently assess the conclusions on mission needs identified in this briefing.

⁷MDA, *Future Ballistic Missile Defense (BMD) Sensors Analysis of Alternatives (AOA): Final Report* (February 9, 2017). GAO has established best practices for conducting an analysis of alternatives; however, we did not review the MDA's analysis against these best practices to assess its quality or evaluate the technical details of the report.

Figure 2: Illustration of Tracking Coverage Overlaps among AN/TPY-2, Cobra Dane, and the Long Range Discrimination Radar (LRDR)



Source: GAO analysis of Missile Defense Agency documents. | GAO-19-68

Note: According to a Missile Defense Agency (MDA) analysis, neither Cobra Dane nor LRDR provide full tracking coverage of missile threats from North Korea to Hawaii. However, Air Force officials told us that Cobra Dane can offer tracking for some limited trajectories to Hawaii.

The Air Force report also noted that LRDR’s geographic location has its own advantages in contributing to ballistic missile defense compared to Cobra Dane’s location. For example, the Air Force report noted that LRDR’s location would allow it to track missile threats later in their trajectories beyond Cobra Dane’s coverage as those threats make their way to the continental United States. We also found that MDA has determined LRDR will have other advantages due to its location. For example, an MDA analysis that we reviewed found that LRDR’s location will allow for the radar system to contribute to ballistic missile defense from North Korean and Iranian threats. Absent LRDR, this analysis determined that there are no other radar systems that are located in a position to provide the capability to discriminate missile threats and determine if a threat was successfully intercepted.

Determination of LRDR Location

In addition to what the Air Force reported, we found that DOD decided to locate LRDR at Clear Air Force Station in Alaska after considering the advantages and disadvantages of other locations. For example, MDA completed studies that examined how LRDR could perform at various locations in Alaska, and the cost-effectiveness of constructing and sustaining the radar at those sites. In a June 2015 analysis, MDA compared how LRDR could perform in discriminating missile threats when co-locating it with Cobra Dane at Shemya Island or placing it at

Clear Air Force Station.⁸ MDA determined that LRDR could provide more real-time discrimination information for missile threats targeting Alaska and the continental United States if it constructed the radar at Clear Air Force Station versus Shemya Island.⁹ Additionally, MDA identified in an October 2016 study that the department could obtain operational advantages and cost savings by constructing LRDR at Clear Air Force Station, Alaska, when compared to constructing it at Shemya Island, Alaska.¹⁰ Specifically, MDA determined that Clear Air Force Station could provide better results for 11 of the 13 factors it reviewed compared to Shemya Island.¹¹ For example, MDA determined that locating LRDR at Clear Air Force Station would result in lower costs and enhanced system performance.

DOD Has Made Other Investments in Radar Systems That May Reduce Its Reliance on Cobra Dane to Meet Mission Requirements

According to DOD officials and documents we reviewed, other radar investments may reduce the department's reliance on Cobra Dane for ballistic missile defense and space surveillance, given that U.S. Northern Command identified it has a need for Cobra Dane after DOD begins operating LRDR in fiscal year 2021. Specifically, the Pacific Radar and Space Fence may reduce DOD's reliance on Cobra Dane to support ballistic missile defense and space surveillance, respectively.

⁸MDA, *Long Range Discrimination Radar Analytical Performance Data* (June 9, 2015). We did not independently assess or review the findings of this analysis.

⁹MDA's study also determined that neither location could provide useful discrimination coverage of Hawaii. MDA found that LRDR could provide coverage of Hawaii if located at Shemya Island, but the information would be delayed and therefore not useful in the discrimination of missile threats.

¹⁰MDA, *Executive Summary: Long-Range Discrimination Radar Siting Study* (October 17, 2016). We did not independently assess or review the findings of this analysis.

¹¹According to the MDA study, the LRDR could have better performance results at Clear Air Force Station versus Shemya Island for 11 of 13 factors: (1) Communications Operational Effectiveness, (2) Existing Infrastructure, (3) Logistics, (4) Environmental Impact, (5) Site Attributes, (6) Physical Security and Force Protection, (7) Cost Effectiveness, (8) Risk to Schedule and Operations, (9) System Performance, (10) Risk to Adverse Natural Events, and (11) Quality of Life. Alternatively, the study determined that LRDR would have better performance at Shemya Island compared to Clear Air Force Station for 2 of 13 factors: (1) Operational Effectiveness—Field of Views and (2) Electro-Magnetic Environment.

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- **Pacific Radar:** According to DOD officials, the department may no longer need Cobra Dane to meet the ballistic missile defense mission after MDA fields a new radar in the Pacific region in fiscal year 2025. MDA began developing the Pacific Radar to provide additional missile threat tracking and discrimination capabilities. According to U.S. Northern Command and MDA officials, the Pacific Radar may fill the gap in tracking missile threats currently covered by Cobra Dane.
 - **Space Fence:** The Air Force has also determined it will no longer have a requirement for Cobra Dane to provide space surveillance once the Space Fence is fully operational. The Air Force plans for the Space Fence to be operational in fiscal year 2019. According to a U.S. Strategic Command briefing, the Space Fence will provide the same capabilities as Cobra Dane.¹² Air Force officials noted that they want to continue relying on Cobra Dane for space surveillance when the Space Fence is operational, as long as the radar is available and used to contribute to ballistic missile defense.

Air Force Reported That Cobra Dane Generally Meets Its Requirements for Operational Availability, and We Found That the Air Force Can Mitigate Radar Downtime for Its Missions

In its January 2018 report to Congress, the Air Force noted that Cobra Dane met its requirement for operational availability—i.e., the percentage of time that the radar system is able to meet its ballistic missile defense and space surveillance missions. Specifically, the Air Force report noted that Cobra Dane had been available an average of 91 percent of the time over a 2-year period (January 2016 through December 2017), which exceeded the 90 percent requirement for operational availability.

Information that we reviewed from a more recent 2-year period (August 2016 through July 2018) showed that Cobra Dane's 2-year average for operational availability had declined to approximately 88 percent—below the 90 percent requirement. Air Force officials stated that the decline in the operational availability over the more recent two-year period was due to a few instances where they needed to take Cobra Dane off-line for

¹²U.S. Strategic Command, *Sustainment and Modernization of the Cobra Dane Radar* (May 23, 2017).

extended periods of scheduled downtime (e.g., regular operations and maintenance, calibration of instruments). Further, they noted that when Cobra Dane is not operationally available, the reason is usually due to scheduled downtime.

Officials also told us there was one instance of unscheduled downtime (e.g., part or system failure) in that 2-year period which required emergency maintenance on the radar's mission control hardware. We also reviewed Air Force data on the frequency of unscheduled downtime between August 2016 and July 2018, which show that Cobra Dane is able to contribute to its missions without unscheduled downtime 99.7 percent of the time.

According to U.S. Northern Command and MDA officials, they can mitigate the effect on the ballistic missile defense mission if they know far enough in advance that Cobra Dane will not be operationally available—such as during scheduled downtime. Officials stated that they do this by moving a transportable radar, known as the Sea-Based X-band radar, to specific locations in the Pacific Ocean to provide additional tracking coverage of missile threats. A U.S. Northern Command analysis that we reviewed describes how DOD can deploy the Sea-Based X-band radar at particular locations in the Pacific Ocean to supplement Cobra Dane.¹³ This analysis found that U.S. Northern Command can lose the ability to track some missile threat trajectories if Cobra Dane is not available and the Sea-Based X-band radar is not deployed.

We also reviewed Air Force data on space surveillance, which shows that the Air Force would face some limitations in its ability to complete its space surveillance mission when Cobra Dane is not operationally available. According to the data, Cobra Dane tracks 3,300 space objects each day that cannot be tracked by any other radar system. Air Force officials noted that when Cobra Dane is not operationally available for space surveillance for short periods (less than 24 hours), they can overcome that downtime without losing track of those unique objects. However, officials told us that it would take six months to reacquire all of the small space objects that Cobra Dane tracks, if they encounter any

¹³We did not independently assess or review the findings of U.S. Northern Command's analysis because it was outside the scope of this report.

significant scheduled or unscheduled downtime.¹⁴ MDA officials told us there are no scheduled plans to take Cobra Dane down long enough to compromise DOD’s ability to conduct space surveillance.

Air Force Reported That DOD Has Plans to Fund Cobra Dane and Its Site, and We Found That It Has Developed Cost Estimates for Some Projects

Air Force Reported the Funding for the Operation and Sustainment of Cobra Dane, and We Found That DOD Has Developed Cost Estimates for Some Modernization Projects

In its January 2018 report to Congress, the Air Force projected that the Air Force and MDA would contribute total funding of \$278.6 million based on their fiscal year 2019 budget plans for the operation and sustainment of Cobra Dane. According to the report, the Air Force and MDA plan to share funding for the operation and maintenance of the Cobra Dane radar, and for three modernization projects that make up their sustainment plan for the radar. Table 3 outlines the plan for how the Air Force and MDA will share funding for the operation and maintenance of Cobra Dane.

Table 3: Planned Air Force and Missile Defense Agency (MDA) Funding for the Operation and Maintenance of Cobra Dane (in millions)

Funding source	Fiscal year 2019	Fiscal year 2020	Fiscal year 2021	Fiscal year 2022	Fiscal year 2023	Total funding
Air Force	\$22.5	\$20.0	\$22.3	\$22.4	\$22.8	\$110.0
MDA	\$20.0	\$20.0	\$20.0	\$20.0	\$20.0	\$100.0

¹⁴According to Air Force officials, they coordinate plans for Cobra Dane’s scheduled downtime with other Air Force stakeholders involved in space surveillance management, including the Combined Space Operations Center and the 18th Space Control Squadron. Those stakeholders indicate the extent to which they can use other space surveillance radars to cover objects tracked by Cobra Dane. Officials told us that they can reacquire objects that only Cobra Dane can track with relative ease for short periods (less than 24 hours) of scheduled downtime.

Funding source	Fiscal year 2019	Fiscal year 2020	Fiscal year 2021	Fiscal year 2022	Fiscal year 2023	Total funding
Total funding	\$42.5	\$40.0	\$42.3	\$42.4	\$42.8	\$210.0

Source: GAO summary of Air Force report. | GAO-19-68

In addition, the Air Force included information in its report on how the Air Force and MDA plan to share funding to support Cobra Dane’s three modernization projects. Specifically, the Air Force and MDA plan to redesign parts for three sets of obsolete systems: (1) mission system replacement; (2) traveling wave tubes; and (3) transmitter groups.¹⁵ The Air Force has identified that it no longer has vendors that manufacture some critical parts, and failure of any of the three systems could result in Cobra Dane not being available to meet mission requirements. As such, the Air Force determined that it could sustain these three systems more effectively if they were redesigned. Table 4 summarizes the reported funding for the three projects that make up the Cobra Dane sustainment plan.

Table 4: Planned Funding for the Three Projects in Cobra Dane’s Sustainment Plan (in millions)

Project name	Fiscal year 2019	Fiscal year 2020	Fiscal year 2021	Fiscal year 2022	Fiscal year 2023	Total funding
Transmitter Group	\$16.0	\$30.0	\$24.0	\$24.0	\$0.0	\$94.0
Traveling Wave Tubes	\$0.0	\$11.0	\$5.0	\$5.0	\$5.0	\$26.0
Mission System Replacement	\$0.0	\$16.0	\$28.4	\$16.2	\$8.0	\$68.6

Source: GAO summary of Air Force report. | GAO-19-68

In addition to what the Air Force reported, we identified that the Air Force developed a total cost estimate for its transmitter group replacement, but not for its other two projects. For the other two projects, Air Force officials stated that they plan to complete estimates for the total costs in conjunction with their fiscal year 2020 budget submission. In August 2016, the Air Force estimated that the transmitter group replacement would have a total cost of \$91.2 million, but reported it would fund this project at \$94.0 million through fiscal year 2023 (see table 4). Air Force officials plan to request the transfer of any unused funding to the other projects once it completes the transmitter group project. The Air Force also completed a partial cost estimate for the traveling wave tube

¹⁵The mission system replacement, known as the automated data processing equipment rehost, refers to the replacement of primary and secondary mission computers, and the Signal Processor and Radar Controller. The traveling wave tubes and transmitter groups are both critical systems for powering the radar face of Cobra Dane.

redesign—covering the redesign of the parts and replacement of 1 of 12 groups of parts—estimating that the first phase would cost \$16.0 million. Further, Air Force officials told us that they have not yet developed a total cost estimate for the mission system replacement.

We also found that the Air Force and MDA expedited Cobra Dane’s mission system replacement project, but Air Force officials told us they face challenges in expediting the other two projects without compromising Cobra Dane’s operational availability. For the mission system replacement, MDA requested additional funding in fiscal year 2018. Air Force and MDA officials told us that the additional funding they received allowed them to prioritize the mission system replacement and advance its timeline earlier that year. Air Force officials stated that they explored ways to expedite the two other projects: the traveling wave tubes and transmitter groups. However, they stated that replacing too many parts at the same time will result in their having to take Cobra Dane off-line for longer periods of time. According to Air Force and MDA officials, they may look for opportunities to expedite timeframes for their other two projects as long as the amount of scheduled downtime is kept to acceptable levels.

The Air Force Reported the Funding for the Operation and Sustainment of Shemya Island

In its report to Congress, the Air Force identified that it plans to provide \$140 million in funding for the sustainment and maintenance of operational access to Cobra Dane’s site at Shemya Island based on its fiscal year 2019 budget plans. According to the report, the Air Force is solely responsible for funding all work related to the operation and sustainment of Shemya Island, shared between two of its major commands: Air Force Space Command and Pacific Air Forces. Table 5 summarizes the information the Air Force included in its report on how funding will be shared for Shemya Island.

Table 5: Funding Plan for the Operation and Sustainment of Shemya Island (in millions)

Funding source	Fiscal year 2019	Fiscal year 2020	Fiscal year 2021	Fiscal year 2022	Fiscal year 2023	Total funding
Air Force Space Command	\$7.6	\$7.7	\$7.8	\$8.0	\$8.1	\$39.2
Pacific Air Forces	\$19.7	\$19.9	\$20.2	\$20.4	\$20.6	\$100.8
Total funding	\$27.3	\$27.6	\$28.0	\$28.4	\$28.7	\$140.0

Source: GAO summary of Air Force report. | GAO-19-68

We also reviewed a support agreement between Air Force Space Command and Pacific Air Forces that identifies how they will sustain the site and the calculation for sharing costs. The agreement describes the specific work to sustain the site, including maintaining the airfield, support facilities, and communication infrastructure. Air Force officials told us that they are constantly addressing challenges related to operational access to the site at Shemya Island, but Air Force Space Command and Pacific Air Forces work together to address those challenges.

Agency Comments

We provided a draft of this report to DOD for review and comment. DOD told us that it had no comments on the draft report.

We are sending copies of this report to the Secretary of Defense; the Under Secretary of Defense for Acquisitions and Sustainment; the Secretary of the Air Force; the Director of the Missile Defense Agency; and the Commanders of U.S. Northern Command and U.S. Strategic Command. In addition, the report is available at no charge on the GAO website at <http://www.gao.gov>.

If you or your staff have any questions about this report, please contact Joe Kirschbaum at (202) 512-9971 or kirschbaumj@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made contributions to the report are listed in Appendix I.



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Director
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Appendix I: GAO Contact and Staff Acknowledgments

GAO Contact

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Staff Acknowledgments

In addition to the contact named above, Kevin O'Neill (Assistant Director), Scott Bruckner, Vincent Buquicchio, Martin De Alteriis, Amie Lesser, and Richard Powelson made key contributions to the report.

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