



January 2022

COAST GUARD Assessment of a Risk-Based Approach for Conducting Gas Carrier Exams Is Needed

Accessible Version

GAO Highlight

Highlights of [GAO-22-105432](#), a report to congressional committees

Why GAO Did This Study

Gas carrier ships that transport liquefied natural gas and other products overseas can pose safety and environmental risks because the cargo is highly combustible. Further, gas carrier vessel traffic in U.S. ports has increased from about 1,200 in 2011 to more than 3,200 in 2020. The Coast Guard is the principal federal agency responsible for marine safety and is required by statute to conduct gas carrier compliance exams annually. The National Defense Authorization Act for Fiscal Year 2021 includes a provision for GAO to report on gas carrier compliance exam issues. This report addresses (1) Coast Guard marine inspector staffing levels and its ability to meet gas carrier compliance mission needs, (2) the extent to which the Coast Guard updates its gas carrier compliance exam policies and procedures, and (3) the extent to which the Coast Guard has assessed the efficiency of its policies and procedures in the context of risk. To address these objectives, GAO reviewed relevant laws and regulations; reviewed Coast Guard workforce planning documents, policies, and procedures; analyzed Coast Guard workforce and exam data from 2016 through 2020; and interviewed agency officials and a nongeneralizable sample of nine industry stakeholders.

What GAO Recommends

GAO recommends the Coast Guard conduct an assessment of adopting a risk-based approach to conducting gas carrier compliance exams and take actions, as appropriate and feasible. The Department of Homeland Security concurred with this recommendation.

View [GAO-22-105432](#). For more information, contact Heather MacLeod at (202) 512-8777 or MacLeodM@gao.gov.

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COAST GUARD

Assessment of a Risk-Based Approach for Conducting Gas Carrier Exams Is Needed

What GAO Found

The U.S. Coast Guard has an overall shortage of approximately 400 marine inspectors, according to its workforce modeling, which affects its ability to conduct gas carrier compliance exams. GAO analysis of the data shows that from 2016 through 2020 the Coast Guard staffed the key operational field units that conduct gas carrier exams at below 70 percent of their estimated need. Coast Guard officials stated they complete all required exams, but representatives from six of nine industry stakeholders told GAO they sometimes experienced costly delays because marine inspectors were not available. The Coast Guard has ongoing initiatives to address its marine inspection workforce challenges. Additionally, GAO, in a companion report, made a number of recommendations to strengthen the Coast Guard's workforce planning efforts.

Photo of Coast Guard Marine Inspectors Undergoing Gas Carrier Examiner Training



Source: U.S. Coast Guard. | [GAO-22-105432](#)

The Coast Guard regularly updates gas carrier exam policies and procedures to reflect industry changes. For example, according to Coast Guard officials, every 4 years they update the key guidance document for conducting the exams. Representatives from all nine gas carrier industry stakeholders stated marine inspectors are well trained and the exams are thorough.

The Coast Guard has not considered potential gas carrier exam efficiencies in the context of potential risks when assessing its policies and procedures. For example, it has not assessed the benefits and risks of adopting a risk-based inspections approach. GAO analysis of Coast Guard data shows that marine inspectors identified low instances of more serious deficiencies that pose a risk to the cargo, vessel, or crew during gas carrier compliance exams from fiscal years 2016 through 2020—about 12 percent (250 out of 2,075). Further, Coast Guard officials stated that gas carriers are generally well run. However, given the nature of their cargo, gas carriers present safety concerns. The Coast Guard previously considered developing legislative change proposals to reduce the annual exam requirement. However, it did not conduct a risk assessment for the potential legislative change. Conducting such an assessment and taking actions, as appropriate and feasible, would help ensure that the Coast Guard is efficiently and effectively using its marine inspection resources.

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Abbreviations

DHS	Department of Homeland Security
Gas Carrier Center of Expertise	Liquefied Gas Carrier National Center of Expertise
MISLE	Marine Information for Safety and Law Enforcement
NDA	National Defense Authorization Act
Qualship21	quality ship program

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January 12, 2022

The Honorable Maria Cantwell
Chair
The Honorable Roger F. Wicker
Ranking Member
Committee on Commerce, Science, and Transportation
United States Senate
The Honorable Peter A. DeFazio
Chairman
The Honorable Sam Graves
Ranking Member
Committee on Transportation and Infrastructure
House of Representatives

Gas carrier vessels that transport liquefied natural gas and other products overseas can pose safety and environmental risks because the cargo is highly combustible. Safety incidents are uncommon, but they can have dire consequences. In January 2019, two gas carriers caught fire while transferring liquefied propane gas from one vessel to another in waters near the Black Sea. The resulting explosion killed at least 10 crew members, and the fire on one vessel burned for 45 days, according to news reports. In December 2015, a fire started on a gas carrier at the Port of Houston. Emergency response teams quickly doused the flames preventing a catastrophic explosion and potential losses of life, but the incident caused the closure of about two miles of the Houston Ship Channel.

The U.S. Coast Guard, a multimission, maritime service within the Department of Homeland Security (DHS), serves as the principal federal agency responsible for marine safety. A key element of this mission is conducting vessel inspections and examinations (exams) through the marine inspection program.¹ Federal law requires each gas carrier to undergo a verification exam—called a Certificate of Compliance exam (compliance exam)—to ensure vessels are in compliance with the

¹The Coast Guard marine inspectors generally conduct inspections on U.S.-flag vessels and examinations on foreign-flag vessels, which are registered in jurisdictions other than the United States. Oversight processes of inspections and examinations differ in scope and depth.

appropriate statutory, regulatory, and international requirements.² Coast Guard marine inspectors are to conduct these compliance exams at the first U.S. port a gas carrier enters and at least annually thereafter. Gas carrier vessel traffic in U.S. ports increased from about 1,200 in 2011 to more than 3,200 in 2020, according to Coast Guard data, and industry expects such traffic to continue to grow.³

The National Defense Authorization Act for Fiscal Year 2021 (NDAA) includes a provision for us to report on issues pertaining to gas carrier compliance exams.⁴ Our report addresses (1) the Coast Guard's marine inspector staffing levels and its ability to meet gas carrier compliance mission needs, (2) the extent to which the Coast Guard updates its gas carrier compliance exam policies and procedures, and (3) the extent to which the Coast Guard has assessed the efficiency of its gas carrier compliance exam policies and procedures in the context of risk.

To address our first objective, we analyzed Coast Guard Sector Staffing Model data from 2016 through 2020—the most recent years available—to determine the number of required and actual marine inspectors in the marine inspection program.⁵ We also reviewed the tool the Coast Guard uses to assess gas carrier examiner training needs for fiscal year 2020—the most recent data available. To assess the reliability of the data, we conducted manual data testing for missing data, outliers, and obvious errors; reviewed agency documents, such as a user manual and an accreditation memorandum; and interviewed agency officials responsible for maintaining the data tools. We determined that the data were sufficiently reliable to (1) describe the marine inspection workforce needs and staffing levels overall and at locations that conduct the most gas carrier compliance exams in the aggregate⁶ and (2) report the number of

²See 46 U.S.C. § 3714.

³According to Coast Guard officials and Bureau of Transportation Statistics data, there are no U.S.-flagged gas carriers.

⁴Pub. L. No. 116-283, § 8254.

⁵The Sector Staffing Model is an analytical tool to align the number and type of marine inspectors and other personnel needed at specific sectors and subordinate field units with mission activity requirements.

⁶We aggregated sector staffing model data because the Coast Guard last updated certain Sector Staffing Model assumptions, including the estimated length of time to complete inspections, in 2014, which could affect the results at the unit level, according to Coast Guard officials.

certified gas carrier examiners.⁷ Further, we reviewed Coast Guard strategic plans and various workforce planning documents to understand the plans and activities the Coast Guard employed to address its workforce needs.⁸

We also interviewed Coast Guard headquarters and field officials to learn about marine inspection resources dedicated to gas carrier compliance exams. For example, we met with the Liquefied Gas Carrier National Center of Expertise (Gas Carrier Center of Expertise) and a nongeneralizable sample of five out of 37 sectors (i.e., operational field units).⁹ Further, we interviewed representatives from nine industry stakeholders—one international association, six gas carrier operators, and two facility operators—to discuss their perspectives on the Coast Guard’s gas carrier compliance exam policies and procedures.¹⁰ The results of our stakeholder interviews are not generalizable but provide us with first-hand information on how Coast Guard staffing affects gas carrier compliance exams.

To address our second objective, we reviewed relevant laws and regulations and Coast Guard policies and procedures relevant to gas carrier compliance exams. For example, we reviewed the Coast Guard’s *Marine Safety Manual* and the gas carrier tactics, techniques, and

⁷According to the Coast Guard, these marine inspectors are called foreign gas carrier examiners based on the competency they earn, because gas carriers are typically foreign flagged. For the purposes of this report, we refer to them as “gas carrier examiners.”

⁸See, for example, U.S. Coast Guard, *Coast Guard Strategic Plan, 2018-2022* (Washington, D.C.: Nov. 16, 2018); *Prevention Program Readiness Initiative Report FY2021-2026* (Washington, D.C.: Dec. 16, 2020); *LANTAREA FY20-21 Planning Assessment* (Washington, D.C.: Apr. 15, 2019); and *Maritime Commerce Strategic Outlook* (Washington, D.C.: October 2018).

⁹We interviewed the following sectors and their subunits: Corpus Christi, Delaware Bay, Houston-Galveston, New Orleans, and St. Petersburg. We selected sectors that had at least 20 marine inspectors and a range of marine inspector staffing levels, are training ports, represent sectors in different parts of the country, and conducted a range of gas carrier exams in fiscal year 2020.

¹⁰The membership of the association we interviewed represents 97 percent of the world’s liquefied natural gas vessels and terminals and more than half the global liquefied petroleum gas market, according to the association’s website. We selected gas carrier operators based on those with the greatest number of gas carrier arrivals in U.S. ports from January 2020 through November 2020—the most recent data available at the time of their selection— and to obtain a mix of different types of gas carrier operators. We selected facility operators located at different ports where the Coast Guard conducted a relatively large number of gas carrier compliance exams in 2020.

procedures document.¹¹ We interviewed the Coast Guard officials and industry representatives discussed above to understand how the Coast Guard implements and updates gas carrier compliance exam policies and procedures, including its training material to help inform compliance exam responsibilities. We also reviewed the NDAA for fiscal year 2021 to understand the nature of the required study on the efficiency of gas carrier compliance exam policies and procedures to be conducted by the National Academies in coordination with the Coast Guard, which could affect changes to policies and procedures.

To address our third objective, we reviewed Coast Guard assessments and plans regarding risk-based marine inspections to understand how the Coast Guard considers risk in the marine inspection program.¹² We also analyzed Coast Guard Marine Information for Safety and Law Enforcement (MISLE) data for fiscal years 2016 through 2020—the 5 most recent years available at the time of our review—to determine the number of gas carrier compliance exams completed, where these exams occurred, and deficiencies identified during the compliance exams. To assess the reliability of these data, we conducted electronic testing for missing data, and obvious errors; reviewed related documentation such as the MISLE user guide; and interviewed knowledgeable officials. We determined that the data were sufficiently reliable to provide counts (over the period of our analysis) of (1) the number of gas carrier compliance exams completed, (2) the location of the compliance exams, and (3) the extent to which Coast Guard marine inspectors identified more serious deficiencies during these exams.

We also analyzed the Coast Guard's November 2020 list of quality ship program (Qualship 21) participants to determine the number and percentage of gas carriers that the Coast Guard inspected from fiscal

¹¹U.S. Coast Guard, *Marine Safety Manual Volume II: Materiel Inspection, COMDTINST 16000.7B Change 2* (Washington, D.C.: July 2016) and *Foreign Gas Carrier Examiner Tactics, Techniques, and Procedures*, CGTTP 3-72.6A (Washington, D.C.: February 2020).

¹²See, for example, U.S. Coast Guard, *Deputy Commandant for Operations Program Plans Compilation: Maritime Prevention* (Washington, D.C.: November 2019); *Mission Analysis: Examination of Commercial Compliance Activities within the Marine Safety Mission* (Washington, D.C.: March, 2017); and *Maritime Prevention Program Performance Plan Fiscal Year 2014–2019* (Washington D.C.: August 2013).

years 2016 through 2020 that participate in the program.¹³ We also interviewed Coast Guard officials about their efforts to assess the efficiency of gas carrier compliance exam policies and procedures. Finally, we compared the Coast Guard's efforts to assess its gas carrier compliance exam policies and procedures with the Coast Guard Strategic Plan 2018-2022.¹⁴

We conducted this performance audit from October 2020 to January 2022 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 our audit objectives.

Background

Liquefied Gases and Maritime Transportation

The U.S. and other countries use natural gas and other hydrocarbon gases, including ethane, propane, butane, and pentane, for energy production and manufacturing.¹⁵ Processes for liquefying and transporting natural gas pose several safety and environmental risks. For example, an uncontrolled release of liquefied natural gas poses a fire hazard or, in confined spaces, an explosion. Further, if the gas spills near an ignition source, evaporating gas will burn above the liquefied natural gas pool, resulting in a "pool fire." A pool fire is intense, burns hotter and more rapidly than oil or gasoline fires, and it cannot be extinguished—all the gas must be burned before the fire goes out. Because a liquefied natural gas pool fire is so hot, its thermal radiation may injure people and damage property a considerable distance from the fire itself. Because of

¹³We chose the November 2020 data because they were available at the time of our review and overlapped with the timeframe of the Coast Guard inspection data. The Coast Guard's Qualship21 program recognizes vessels that have successfully met specified safety, regulatory, and quality requirements when calling on U.S. ports. Criteria include prior inspection results and country of registry.

¹⁴U.S. Coast Guard, *Coast Guard Strategic Plan 2018-2022* (Washington, D.C.: Nov. 16, 2018).

¹⁵Hydrocarbon gasses are those extracted from natural gas and oil resources.

these risks, the Coast Guard provides security escorts for gas carriers, as shown in figure 1 below.

Figure 1: Coast Guard Cutter Providing a Security Escort to a Gas Carrier Entering a U.S. Port



Source: U.S. Coast Guard. | GAO-22-105432

Marine Safety Mission and Inspection Program

Marine safety is one of the Coast Guard's 11 statutory missions, as outlined in the Homeland Security Act of 2002, as amended.¹⁶ To carry out the marine safety mission, the Coast Guard is to enforce laws that prevent death, injury, and property loss in the marine environment. A key part of the marine safety mission is the marine inspection program, which works in partnership with industry and ports to ensure compliance with regulations.¹⁷

To execute its marine inspection program, the Coast Guard employs a multi-level organizational structure. Coast Guard headquarters is

¹⁶U.S.C. § 468(a).

¹⁷Other marine safety programs include inspections of waterfront and offshore facilities and maritime accident investigations.

responsible for developing national strategies and policies for operations, while field units implement these policies. The Coast Guard organizes its field structure under two area commands (Atlantic and Pacific). The two area commands oversee nine districts across the United States, which are further broken down across 37 sectors. Marine inspectors who conduct the vessel inspections are generally stationed at one of 37 sectors, or their subunits.¹⁸ The Coast Guard trains and certifies marine inspectors on specific competencies to be able to conduct multiple types of vessel inspections. More than 12 percent (90 out of more than 700) of Coast Guard marine inspectors are certified to conduct gas carrier compliance exams, as of fiscal year 2020.¹⁹

The Coast Guard has also established national centers of expertise for certain vessel types, including gas carriers. The Gas Carrier Center of Expertise in Port Arthur, Texas maintains trained experts on the liquefied gas shipping industry. The seven Gas Carrier Center of Expertise staff serve as in-house consultants to the Coast Guard and as participants in technical forums and decision-making collaborations; provide technical advice to both the industry and the Coast Guard; are involved in gas carrier compliance exams; train other Coast Guard marine inspectors; and conduct outreach and develop partnerships with the international, national, and local industry and government stakeholders.

Gas Carrier Compliance Exam Process

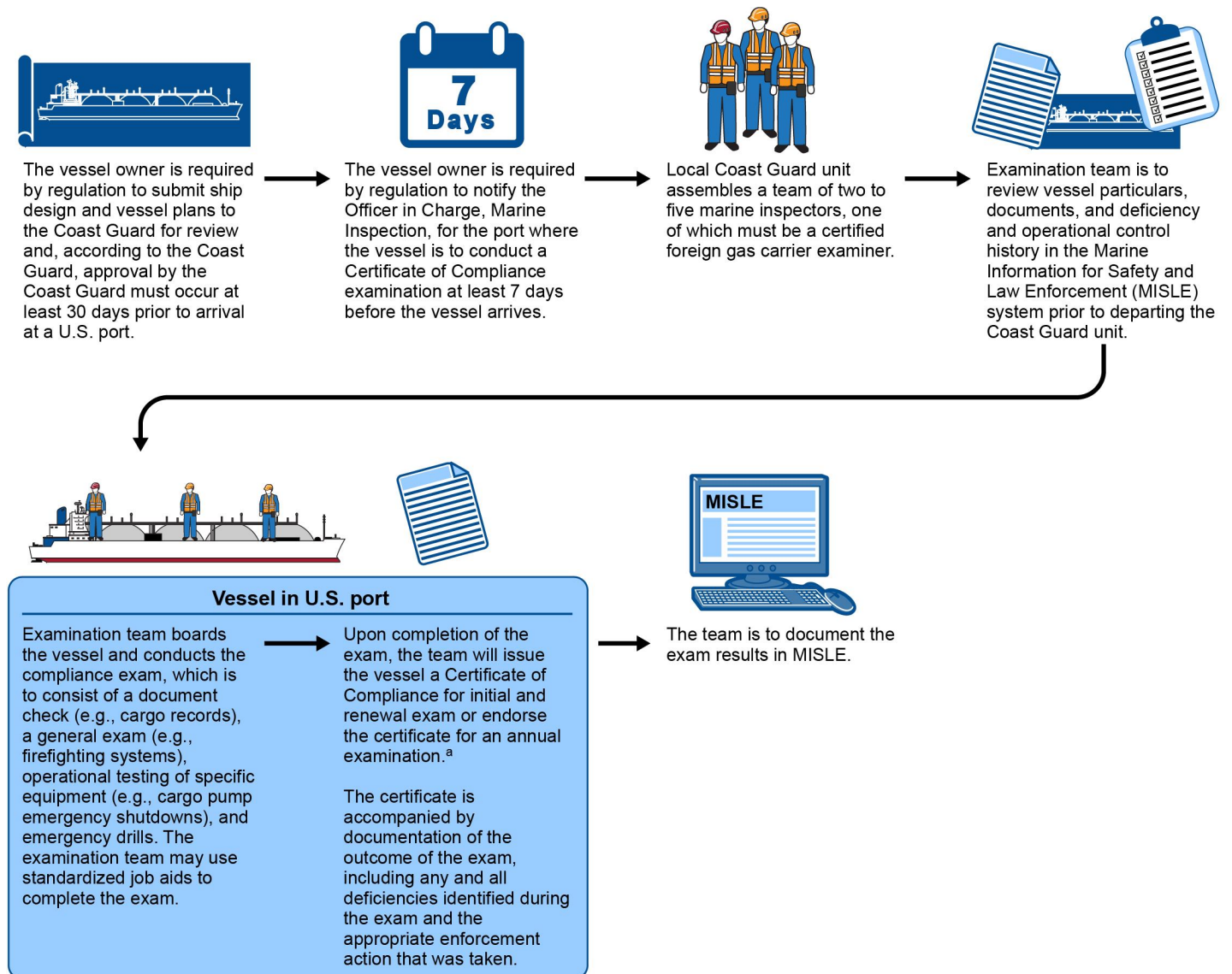
The Coast Guard's gas carrier compliance exam process includes assembling a team of marine inspectors who (1) review documentation about the vessel prior to the vessel's arrival, including its history and the results of previous Coast Guard inspections; (2) board the vessel to review additional documentation and observe and test such things as ship systems and crew knowledge (e.g., using fire-fighting equipment) to identify any deficiencies; and (3) document the results of the exam in the

¹⁸The headquarters-based Traveling Staff is a specialized group of six senior marine inspectors that serve as a traveling technical resource to assist field units, as well as industry, with unique or high-risk vessels. Sector subunits include marine safety units and marine safety detachments.

¹⁹According to the Coast Guard, there are 274 qualified foreign gas carrier examiners, of which 90 are currently certified to conduct gas carrier exams. Certified inspectors are those actively conducting gas examinations. Those qualified but not actively conducting exams may be serving in other units or serving in leadership roles.

MISLE system.²⁰ Figure 2 provides more detail on the gas carrier compliance exam process.

Figure 2: Key Steps in the Coast Guard's Gas Carrier Compliance Examination Process



Source: GAO analysis of U.S. Coast Guard information. | GAO-22-105432

^a46 C.F.R. Part 154.

²⁰See 46 C.F.R. § 153.809.

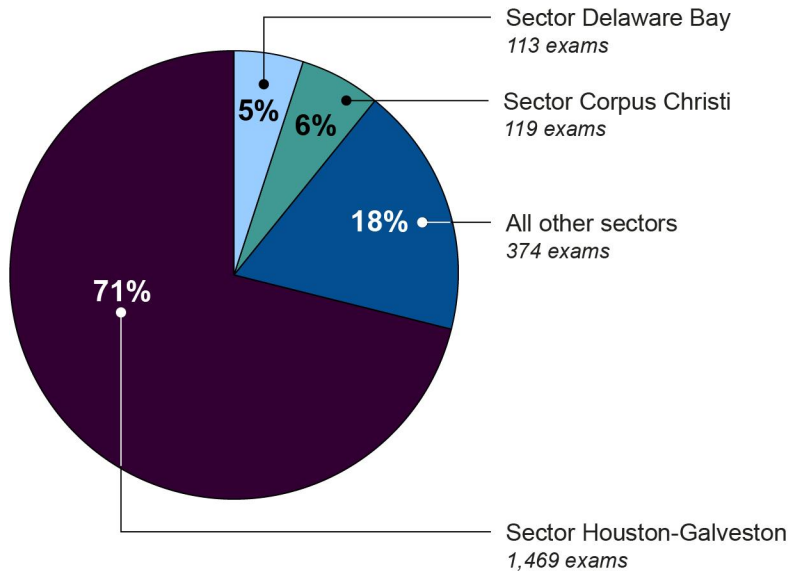
Gas carrier compliance exams generally take between 4 and 6 hours, according to Coast Guard officials. Upon completion of the exam, the Coast Guard issues a Certificate of Compliance to the vessel. The certificate is valid for 24 months, provided that an annual exam is completed within 90 days of the 1 year anniversary of the Certificate of Compliance's issue date.²¹ Although gas carrier exams represent less than 2 percent of all Coast Guard vessel inspections, gas carrier compliance exams have increased from about 300 in fiscal year 2016 to 550 in fiscal year 2020.²² Three sectors—Houston-Galveston, Delaware Bay, Corpus Christi, and their respective subunits—conducted 82 percent of these exams from 2016 through 2020 (see fig. 3).²³

²¹See U.S. Coast Guard, *Marine Safety Manual Volume II: Materiel Inspection*, COMDTINST 16000.7B Change 2.

²²The total number of gas carrier compliance examinations also includes any special examinations required by local Coast Guard units. For example, Coast Guard officials stated that marine inspectors conduct an exam on each gas carrier entering Boston Harbor to satisfy local requirements. However, these exams are abbreviated in scope and are not compliance exams to issue or renew a Certificate of Compliance.

²³For example, gas carrier numbers for Sector Houston-Galveston include Marine Safety Units Port Arthur, Lake Charles, and Texas City. Additionally, 26 percent of the compliance exams during this period involved liquefied natural gas carriers, while 72 percent involved vessels that carry other liquefied hydrocarbon gases such as propane. The remainder involved vessels that transport ammonia.

Figure 3: Percentage and Number of Gas Carrier Compliance Exams Completed by Sector, Fiscal Years 2016 through 2020



Source: GAO analysis of U.S. Coast Guard data. | GAO-22-105432

Accessible Data Table for Figure 3

	Number of exams	Percentage
Sector Houston-Galveston	1469	71%
Sector Corpus Christi	119	6%
Sector Delaware Bay	113	5%
All other sectors	374	18%

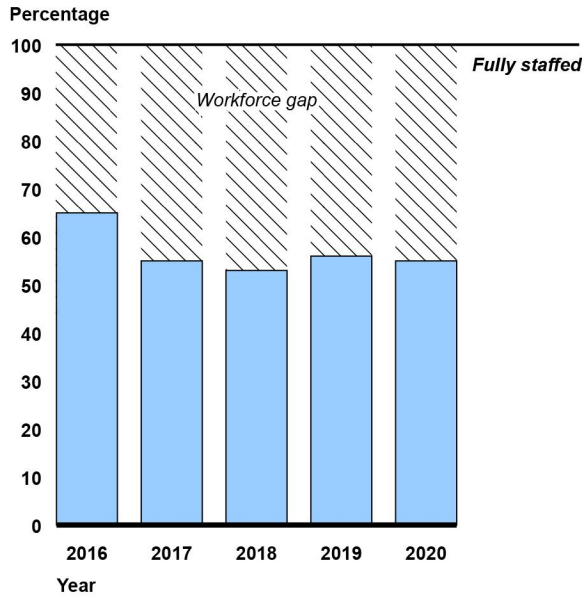
Note: There are 37 Coast Guard sectors.

Gas Carrier Compliance Exams Affected by Inspector Shortages, but Improvement Initiatives Underway

The Coast Guard has an overall shortage of approximately 400 marine inspectors, according to its workforce modeling, which affects the availability of marine inspectors to conduct gas carrier compliance exams and can lead to delays. Since 2012, the Coast Guard has used an analytical tool, called the Sector Staffing Model, to align the number and type of marine inspectors and other personnel needed at specific sectors and subordinate field units with mission activity requirements. Our analysis of Sector Staffing Model data shows that the Coast Guard has staffed Sectors Houston-Galveston, Delaware Bay, and Corpus Christi—which conduct the majority of gas carrier compliance exams—below 70 percent of their estimated full capacity from 2016 through 2020 (see fig 4).²⁴

²⁴As we reported in January 2022, the Coast Guard has had a marine inspector workforce gap since 2012. See GAO, *Coast Guard: Enhancements Needed to Strengthen Marine Inspection Workforce Planning Efforts*, [GAO-22-104465](#) (Washington, D.C.: Jan. 12, 2022).

Figure 4: Percentage of Marine Inspection Workforce Staffed at Key Sectors That Conduct Gas Carrier Compliance Exams, Compared with the Sector Staffing Model’s Full Capacity Estimates, 2016 through 2020



Source: GAO analysis of U.S. Coast Guard Sector Staffing Model data. | GAO-22-105432

Accessible Data Table for Figure 4

Year	Percentage staffed
2016	65%
2017	55%
2018	53%
2019	56%
2020	55%

Note: Key sectors that conduct the majority of gas carrier compliance exams are Houston-Galveston, Delaware Bay, and Corpus Christi. According to the Sector Staffing Model results, fully staffed means that there is a sufficient number of marine inspectors to complete the estimated number of inspections. This figure does not include data on marine inspectors assigned to marine safety detachments, which are sector subunits.

Coast Guard officials we interviewed in all three sectors stated that they complete all required exams—by working longer hours, for example—but their units have shortages of marine inspectors in general and gas carrier examiners in particular. Coast Guard headquarters and field officials told us that marine inspectors who are certified to conduct gas carrier compliance exams are usually some of the most experienced marine inspectors and are expected to also train new marine inspectors and conduct exams on a number of other vessel types. According to the Atlantic Area fiscal year 2020-2021 planning assessment, maritime

industry growth of liquefied natural gas exceeds Coast Guard preparedness to manage it, and the shortfall of trained personnel is at a critical level in many field units.²⁵

Staffing shortages of marine inspectors in sectors that conduct the majority of gas carrier compliance exams can lead to delays for industry. Representatives from six of nine gas carrier industry stakeholders told us that they sometimes experienced delays because the Coast Guard did not have gas carrier examiners available to conduct a compliance exam on their vessel.²⁶ According to representatives from one gas carrier operator, their vessels can face delays of 1 to 3 days in obtaining a needed compliance exam because marine inspectors certified to conduct gas carrier compliance exams were not available. Representatives from this operator also said delays can result in significant financial losses—\$60,000 to \$80,000 per day—and increase congestion in U.S. ports. Representatives from another gas carrier operator stated that delays are particularly problematic on the weekend.

The Gas Carrier Center of Expertise has taken steps to mitigate delays by sending its staff to assist sectors with compliance exams each year, according to Coast Guard officials. For example, in fiscal year 2021, officials reported assisting sectors conduct 100 compliance exams. Further, the Gas Carrier Center of Expertise has developed a tool to help decide which sectors to prioritize when determining the marine inspectors to select for future gas carrier training courses. According to center of expertise officials, they prioritize sectors that have the greatest need for marine inspectors certified to conduct gas carrier compliance exams.

The staffing shortage is part of a larger workforce planning challenge for the Coast Guard. In January 2022, we reported on steps taken by the Coast Guard intended to address its marine inspection workforce needs, which could help reduce gas carrier compliance exam delays.²⁷ Specifically, we found that the Coast Guard has developed action plans and implemented initiatives addressing marine inspection workforce gaps in four key areas—training and skills, technology, workforce staffing levels, and workforce structure. For example, the Coast Guard added 65 new marine inspector positions between fiscal years 2020 and 2021 to

²⁵U.S. Coast Guard, *LANTAREA FY20-21 Planning Assessment*.

²⁶We did not specifically ask industry stakeholders a specific question on the delays they experience, but they offered views on the issue.

²⁷See [GAO-22-104465](#).

help address a shortfall of over 400 marine inspectors. However, we also found that some of these initiatives are ongoing and face implementation challenges. Therefore, it is too soon to tell whether these initiatives will fully address the Coast Guard's marine inspection workforce needs. In that report, we made five recommendations to help improve the Coast Guard's workforce planning efforts.²⁸

Coast Guard Regularly Updates Gas Carrier Policies and Procedures to Reflect Industry Changes

The Coast Guard regularly assesses gas carrier compliance exam policies and procedures and updates them to reflect current regulations and practices in the rapidly changing and highly complex field.²⁹ For example, according to Coast Guard officials, every 4 years the Coast Guard updates its *Foreign Gas Carrier Examiner Tactics, Techniques, and Procedures*—a key guidance document gas carrier examiners use to conduct their work.³⁰ Coast Guard officials told us they completed a comprehensive revision to this gas carrier examiner's guidance in 2016 to reflect updated changes to the international gas carrier code.³¹

The Coast Guard issued its most recent update to this guidance in February 2020. This update expanded the guidance on examining certain systems, such as electrical and gas detection systems, which have historically been among the top five deficiencies found on gas carriers,

²⁸The recommendations are aimed to improve workforce forecasting efforts, data collection and analysis, monitoring, and performance evaluation.

²⁹According to the Coast Guard *Maritime Commerce Strategic Outlook*, emerging technologies, including the increased complexity in vessel designs, propulsion systems and operations; automation, interconnectivity, robotics and networked systems; and new methods for offshore natural resource exploration, production and transportation pose challenges.

³⁰U.S. Coast Guard, *Foreign Gas Carrier Examiner Tactics, Techniques, and Procedures*, CGTTP 3-72.6A.

³¹According to the International Maritime Organization, the aim of the IA104E International Code of the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code) (2016) is to provide an international standard for the safe carriage by sea in bulk of liquefied gases, among other substances. The code prescribes the design and construction standards of gas carriers and the equipment they should carry so as to minimize the risk to the ship, to its crew, and to the environment.

according to the Gas Carrier Center of Expertise. Additionally, Coast Guard officials said the Gas Carrier Center of Expertise makes smaller changes on an annual basis to incorporate technology advances that have occurred in the industry (e.g., the introduction of electric chemical sensors). These officials further said the Gas Carrier Center of Expertise also assists the Office of Commercial Vessel Compliance when it updates policies and procedures, such as the *Marine Safety Manual*, to ensure that they reflect the latest gas carrier compliance exam practices.³²

According to Coast Guard officials, they developed detailed guidance intended to assist gas carrier examiners when conducting their work. For example, the 2017 Foreign Gas Carrier Job Aid includes checklists and flow charts to help marine inspectors determine if a vessel is in compliance or exhibits a deficiency that must be addressed. According to Coast Guard officials we interviewed in all five sectors, Coast Guard gas carrier compliance exam policies and procedures, including the guidance, are effective. The Chief of Prevention in one sector we interviewed stated that the *Foreign Gas Carrier Examiner Tactics, Techniques, and Procedures* update was well done and is user friendly. Additionally, representatives from five of nine industry stakeholders we interviewed stated that Coast Guard gas carrier compliance exams are standardized, and marine inspectors all use the same guidance.³³

The Coast Guard may also update policies and procedures as a result of statutory requirements. For example, in January 2020, the Coast Guard was statutorily required to conduct a review of its approach to conducting gas carrier compliance exams. Specifically, the NDAA for Fiscal Year 2021 required the Coast Guard to enter into an agreement with the National Academies to conduct an evaluation of the constraints and challenges pertaining to gas carrier compliance exams.³⁴ The NDAA also directed the National Academies to issue recommendations for changes to resources, regulations, policies, and protocols to maintain the efficiency of the gas carrier compliance program. The study is to evaluate certain

³²U.S. Coast Guard, *Marine Safety Manual Volume II: Materiel Inspection, COMDTINST 16000.7B Change 2*.

³³Representatives from three of the remaining four industry stakeholders did not comment on this issue, and one noted exam inconsistencies between locations.

³⁴Not later than 6 months after we publish this report, the Coast Guard is to enter into an agreement with the National Academies to conduct the study (Pub. L. No. 116-283, §8254).

alternatives, including conducting gas carrier compliance exams at the Panama Canal (a high-transit location), increasing the number of civilian marine inspectors who have the gas carrier examiner competency, and managing marine inspectors with this competency at the district instead of the sector level.³⁵ Depending on the results of this study, the Coast Guard may update its policies and procedures for conducting gas carrier compliance exams.

As a result of the periodic changes to gas carrier compliance exam policies and procedures, the Coast Guard updates gas carrier examiner training. For example, the Gas Carrier Center of Expertise posts training videos on its website on an ongoing basis. The Gas Carrier Center of Expertise developed some of these videos in-house and obtained others from public sources. These videos provide marine inspectors with guidance on a wide range of topics, including the top deficiencies identified on gas carriers, logs and manuals examination, and examination of specific systems (e.g., electrical systems). According to Coast Guard officials in one sector, the Gas Carrier Center of Expertise informs marine inspectors of changes that occur in the industry and how they affect the compliance exam process.

Further, the Coast Guard developed an additional gas carrier examiner training program to better meet sector training needs. Traditionally, to earn the gas carrier examiner competency, a marine inspector attends a 5-day Coast Guard training in Maryland and then completes on-the-job training at the marine inspector's home unit. However, in 2017, the Gas Carrier Center of Expertise developed the Liquefied Gas Carrier Accelerated Program that combines 3 to 4 weeks of classroom and on-the-job training at the Gas Carrier Center of Expertise's location in Port Arthur, Texas, as Port Arthur and surrounding ports in Sector Houston-Galveston receive a high volume of gas carriers. According to Coast Guard officials, the accelerated training is particularly beneficial for marine inspectors stationed at sectors without much gas carrier traffic where they cannot typically earn the competency through traditional on-

³⁵Certain industry stakeholders told us that the Coast Guard should consider implementing the alternatives laid out in the NDAA. For example, representatives from seven of the nine industry stakeholders we met with stated that conducting gas carrier compliance exams outside of U.S. ports, such as at the Panama Canal, could help reduce congestion in U.S. ports or help Coast Guard marine inspectors manage their workloads better. However, since the Coast Guard and the National Academies are to complete their own assessment, we did not study the issue further.

the-job training. Figure 5 shows marine inspectors participating in on-the-job training during the accelerated course.

Figure 5: Coast Guard Marine Inspectors Conduct Examination of a Cargo Tank Relief Valve during a Liquefied Gas Carrier Accelerated Program Course



Source: U.S. Coast Guard. | GAO-22-105432

The Coast Guard's training program for gas carrier examiners is well regarded by participants and industry. For example, the MIPSA 2019 Interim Progress Report identified the Liquefied Gas Carrier Accelerated Program as a success, and Coast Guard officials in the three sectors that conduct the most gas carrier compliance exams also told us that it is

effective.³⁶ In addition, representatives from all nine of the gas carrier industry stakeholders we met with stated that Coast Guard gas carrier examiners are professional and well trained, and the compliance exams are thorough.

Gas Carrier Compliance Exam Policies and Procedures Have Not Been Assessed in the Context of Potential Risks

The Coast Guard has not assessed whether its gas carrier compliance exam policies and procedures reflect the most efficient use of its workforce resources in the context of potential risks. However, the Coast Guard previously identified potential efficiencies of adopting a risk-based approach for gas carrier compliance exams and recognized the need to consider potential benefits in the context of potential risks. For example, in 1991, we reported that Coast Guard officials believed they were wasting limited resources because procedures required them to conduct equally detailed examinations of all tankships (which includes gas carriers), including those operated by companies with a strong commitment to safety and with programs in place to ensure safe operation.³⁷ The officials, at the time, told us they would like to devote more resources to “problem” vessels and described an initiative to establish specific criteria that might allow for examination flexibilities. Additionally, the Coast Guard’s 2017 mission analysis of marine safety found that examination interval requirements are mostly based on fixed schedules and not on updated risk assessments, which hampers the Coast Guard’s ability to prioritize workloads, reduce maritime risk, and allocate resources efficiently and effectively.³⁸ According to the 2017 analysis and Coast Guard officials, the Coast Guard could better incorporate vessel risk into inspection decisions. Further, in 2019, the Coast Guard developed plans to expand the use of risk-based inspections to focus marine inspections on higher-risk systems and vessels. For example, the Coast Guard has already implemented risk-

³⁶U.S. Coast Guard, *Marine Inspector Performance Support Architecture (MIPSA) 2019 Interim Progress Report*, (Washington, D.C.: December 2019).

³⁷GAO, *Coast Guard: Inspection Program Improvements Are Under Way to Help Detect Unsafe Tankers* [GAO/RCED-92-23](#) (Washington, D.C.: Oct. 8, 1991).

³⁸U.S. Coast Guard, *Mission Analysis: Examination of Commercial Compliance Activities within the Marine Safety Mission*.

based inspection programs for certain vessel types, such as foreign and small passenger vessels.

While conducting risk-based gas carrier compliance exams could generate efficiencies, the Coast Guard has also recognized potential consequences of such an approach. Specifically, according to the *2014 Maritime Prevention Performance Plan*, conducting risk-based inspections could have negative effects, such as reduced detection of safety and security discrepancies and an uptick in incidents and accidents. Because of the combustible nature of their contents, gas carriers pose safety and environmental risks, and a safety incident or accident could have dire consequences.

Following multiple tanker accidents in the 1970s, Congress enacted measures designed to strengthen vessel safety.³⁹ According to Coast Guard officials we met with, gas carriers are currently generally well run. They noted that there have been no serious accidents involving gas carriers at U.S. ports, and lowering the frequency of gas carrier compliance exams would free up resources to focus inspections on riskier vessels. Additionally, our analysis of Coast Guard data from fiscal years 2016 through 2020 shows that marine inspectors identified low instances of more serious deficiencies that pose a risk to the cargo, vessel, or crew during gas carrier compliance exams—about 12 percent (250 out of 2,075). These more serious deficiencies include problems identified with firefighting water spray systems, testing and calibration of gas detectors, and electrical systems, according to Coast Guard data. Further, 29 percent (238 of 831) of gas carrier vessels the Coast Guard examined during this time period participated in the Coast Guard's quality ship (Qualship 21) program as of November 2020. This program requires participating ships to be lower risk.⁴⁰ Moreover, cargo ships that participate in the Qualship 21 program are inspected less frequently, while gas carriers, even if considered lower risk through the Qualship 21

³⁹Ports and Waterways Safety Act of 1972 and Port and Tanker Safety Act of 1978. See also, 46 U.S.C. § 3714.

⁴⁰The Coast Guard's Qualship 21 program recognizes vessels that have successfully met specified safety, regulatory, and quality requirements when calling on U.S. ports. Criteria include prior examination results and country of registry.

program, are still statutorily required to receive an annual compliance exam.⁴¹

The Coast Guard has identified the importance of risk-based planning and mission execution. For example, the *Coast Guard Strategic Plan 2018-2022* states that innovation requires smart risk taking and that the Coast Guard must establish clear risk tolerance levels across the full spectrum of operational and support missions.⁴² In the case of gas carrier compliance exams, establishing risk tolerance could involve assessing the potential workforce efficiencies of reducing the frequency of gas carrier compliance exams against potential consequences associated with conducting less frequent gas carrier compliance exams. The plan also states that the workforce structure must be needs driven and based on operational and support requirements that are objectively determined and continually assessed. In addition, according to the *2014 Maritime Prevention Performance Plan*, to successfully perform missions in a declining budget environment requires the Coast Guard to identify areas where it can add efficiencies to current activities.⁴³ One way this can be accomplished, according to the plan, is through the submission of a legislative change proposal to lower the required inspection frequency, as any changes to frequency would require a change in current law.

Coast Guard officials stated that they previously considered assessing the benefits and risks of reducing the frequency of the gas carrier compliance exam requirement through their legislative change proposal process. Coast Guard headquarters officials stated that one alternative would be to continue to conduct the compliance exam every 2 years but selectively conduct the interim renewal exam based on risk, including the age of the vessel, prior exam history, and participation in the Coast Guard's Qualship 21 program. However, these officials said the Coast Guard has prioritized completion of other legislative change proposals and has not completed an assessment of the benefits and risks of adopting a risk-based approach for conducting gas carrier compliance exams.

Until the Coast Guard conducts an assessment, it will not have the information it needs to determine whether adopting a risk-based approach

⁴¹See 46 U.S.C. § 3714.

⁴²U.S. Coast Guard, *Coast Guard Strategic Plan 2018-2022*.

⁴³U.S. Coast Guard, *Maritime Prevention Program Performance Plan: Fiscal Years 2014-2019*.

or maintaining the current approach to conducting gas carrier compliance exams is appropriate. Conducting such an assessment of the benefits and risks, and taking actions, as appropriate and feasible, would help ensure that the Coast Guard is efficiently and effectively using its marine inspection resources.

Conclusions

U.S. exports of liquefied gases are expected to continue to increase, which can pose safety and environmental risks in U.S. ports because these commodities are highly combustible. However, some of these ships participate in the Coast Guard's Qualship21 program—a program reserved for vessels that have successfully met specified safety, regulatory, and quality requirements when at U.S. ports. In addition, 2016 through 2020 inspection results for all gas carriers, whether in the Qualship 21 program or not, show low instances of more serious deficiencies that pose a risk to the cargo, vessel, or crew on these vessels. However, the Coast Guard is statutorily required to conduct annual compliance exams for gas carriers, regardless of risk.

The Coast Guard continues to face a shortage of marine inspectors in key sectors that conduct gas carrier compliance exams, which can lead to examination delays. The Coast Guard has identified the importance of risk-based approaches and conducts risk-based inspections for other vessels, but the Coast Guard has not assessed the benefits and risks that could result from adopting a risk-based compliance exam approach for gas carriers. Coast Guard officials told us that there have been no serious accidents involving gas carriers at U.S. ports and that lowering the frequency of gas carrier compliance exams would free up resources to focus inspections on riskier vessels. The Coast Guard also previously considered assessing the benefits and risks of reducing the frequency of the gas carrier compliance exam requirement but did not complete this effort. Conducting such an assessment and taking actions, as appropriate and feasible, would help ensure that the Coast Guard is efficiently and effectively using its marine inspection resources.

Recommendation for Executive Action

The Commandant of the Coast Guard should conduct an assessment of adopting a risk-based approach for conducting gas carrier compliance

exams and take actions to address the results, as appropriate and feasible. (Recommendation 1)

Agency Comments

We provided a draft of this report to DHS for review and comment. In its comments, reproduced in appendix I, DHS concurred with our recommendation that the Coast Guard should conduct an assessment of adopting a risk-based approach for conducting gas carrier compliance exams and take actions to address the results, as appropriate and feasible. DHS also provided technical comments, which we incorporated as appropriate.

We are sending copies of this report to the appropriate congressional committees and the Secretary of the Department of Homeland Security. In addition, the report is available at no charge on the GAO website at <https://www.gao.gov>.

If you or your staff members have any questions about this report, please contact Heather MacLeod at (202) 512-8777 or macleodh@gao.gov. Contact points for our Office of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributors to this report are listed in appendix II.

A handwritten signature in black ink, appearing to read "H MacLeod". The signature is stylized and cursive.

Heather MacLeod
Acting Director, Homeland Security and Justice Issues

Appendix I: Comments from the Department of Homeland Security

U.S. Department of Homeland Security
Washington, DC 20528



December 15, 2021

Heather MacLeod
Acting Director, Homeland Security and Justice Issues
U.S. Government Accountability Office
441 G Street, NW
Washington, DC 20548

Re: Management Response to Draft Report GAO-22-105432, "COAST GUARD:
Assessment of a Risk-Based Approach for Conducting Gas Carrier Exams is
Needed"

Dear Ms. MacLeod:

Thank you for the opportunity to comment on this draft report. The U.S. Department of Homeland Security (DHS or the Department) appreciates the U.S. Government Accountability Office's (GAO) work in planning and conducting its review and issuing this report.

The Department is pleased to note GAO's recognition that:

1. the Coast Guard regularly assesses, and updates, gas carrier compliance exam policies and procedures to reflect current regulations and practices in a rapidly changing and highly complex field; and
2. representatives from all nine industry stakeholders contacted by the GAO stated that the Coast Guard has well-trained and professional marine inspectors and that the exams are thorough.

DHS remains committed to ensuring that the Coast Guard is efficiently and effectively using its marine inspection resources in as much as possible considering competing mission priorities and demands, as appropriate.

The draft report contained one recommendation for the Coast Guard with which the Department concurs. Attached find our detailed response to the recommendation. DHS previously submitted technical comments addressing accuracy and sensitivity issues under a separate cover for GAO's consideration.

**Appendix I: Comments from the Department of
Homeland Security**

Again, thank you for the opportunity to review and comment on this draft report. Please feel free to contact me if you have any questions. We look forward to working with you again in the future.

Sincerely,

JIM H CRUMPACKER Digitally signed by JIM H
CRUMPACKER
Date: 2021.12.15 15:17:05 -05'00'

JIM H. CRUMPACKER, CIA, CFE
Director
Departmental GAO-OIG Liaison Office

Attachment

**Attachment: Management Response to Recommendation
Contained in GAO-22-105432**

GAO recommended that the Commandant of the U.S. Coast Guard:

Recommendation 1: Conduct an assessment of adopting a risk-based approach for conducting gas carrier compliance exams and take actions to address the results, as appropriate and feasible.

Response: Concur. The Coast Guard's Office of Commercial Vessel Compliance (CG-CVC) will conduct an assessment of adopting a risk-based approach to gas carrier examinations and take actions to address the results, as appropriate and feasible. However as noted in GAO's draft report, it is important to note that the Coast Guard is statutorily required to conduct compliance exams at least annually for gas carriers, regardless of risk (see 46 U.S.C. § 3714). Estimated Completion Date: December 30, 2022

Agency Comment Letter

Text of Appendix I: Comments from the Department of Homeland Security

Page 1

December 15, 2021

Heather MacLeod
Acting Director, Homeland Security and Justice Issues
U.S. Government Accountability Office
441 G Street, NW
Washington, DC 20548

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Page 2

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JIM H. CRUMPACKER, CIA, CFE
Director
Departmental GAO-OIG Liaison Office

Attachment

Page 3

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Appendix II: GAO Contact and Staff Acknowledgments

GAO Contact

Heather MacLeod at (202) 512-8777 or macleodh@gao.gov

Staff Acknowledgments

In addition to the contact named above, Paul Hobart (Assistant Director), Dawn Hoff (Assistant Director), Susanna Kuebler (Analyst-in-Charge), Elizabeth Dretsch, Eric Hauswirth, Dave Hooper, Wyatt Hundrup, Dainia Lawes, Matt Lowney, and Kevin Reeves made key contributions to this report.

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