



January 2018

# COMMERCIAL SPACE LAUNCH INSURANCE

## FAA Needs to Fully Address Mandated Requirements

Accessible Version

# GAO Highlights

Highlights of [GAO-18-57](#), a report to congressional committees

## Why GAO Did This Study

The federal government shares liability risks with the commercial space launch industry for accidents that result in damages to third parties or federal property. This arrangement requires space launch companies to have a specific amount of insurance to cover these damages. The government is potentially liable for damages above that amount, up to a cap GAO estimated to be \$3.1 billion in 2017, subject to appropriations in advance.

CSLCA, enacted in 2015, directed the Department of Transportation, of which FAA is a part, to evaluate its MPL methodology and, if necessary, develop a plan to update that methodology. The act also included a provision requiring GAO to assess FAA's evaluation and any actions needed to update the methodology.

This report discusses the extent to which (1) FAA's evaluation report addresses the requirements in CSLCA and (2) FAA has addressed previously identified weaknesses in the MPL methodology. GAO reviewed documents and interviewed FAA on its loss methodology evaluation and actions to address weaknesses.

## What GAO Recommends

FAA should fully address mandated requirements in evaluating its MPL—probability thresholds, direct costs, and stakeholder consultations—and establish an estimated completion date for developing guidance on tools and methods to use for specific launch scenarios. The Department of Transportation concurred with the recommendations, and provided technical comments.

View [GAO-18-57](#). For more information, contact Alicia Puente Cackley at (202) 512-8678 or [cackleya@gao.gov](mailto:cackleya@gao.gov).

January 2018

# COMMERCIAL SPACE LAUNCH INSURANCE

## FAA Needs to Fully Address Mandated Requirements

## What GAO Found

The Federal Aviation Administration's (FAA) report evaluating its maximum probable loss (MPL) methodology did not fully address the evaluation and consultation requirements specified by the U.S. Commercial Space Launch Competitiveness Act (CSLCA).

- **Balance of Risk.** CSLCA required FAA to include ensuring that the federal government is not exposed to greater indemnification costs and that launch companies are not required to purchase more insurance coverage than necessary as a result of FAA's MPL methodology. FAA said that it ensured this balance by improving its methodology, but it did not reevaluate its probability thresholds after revising its methodology. These thresholds are used to divide the risk of loss between launch companies and the government.
- **Impact on Costs.** The act required FAA to consider the costs to both the industry and the federal government of implementing an updated methodology. FAA's report discussed the impact on indirect costs, such as data collection, but did not discuss direct costs: insurance premiums for launch companies and indemnification liability for the federal government.
- **Consultation.** The act also required FAA to consult with the commercial space sector and insurance providers in evaluating its MPL methodology in accordance with the preceding requirements. While the agency consulted with some stakeholders, these consultations were limited in scope.

FAA officials said they have not been able to take the actions needed to fully satisfy the mandated elements because of issues such as resource limitations and the lack of available data. However, by not resolving these issues, FAA lacks assurance that launch companies are not purchasing more insurance than needed or that the federal government is not being exposed to greater indemnification costs than expected.

FAA has addressed two of three previously identified weaknesses in its MPL methodology but has not yet dealt with the remaining weakness. Specifically, the agency has revised its methodology for estimating the number of potential casualties for a launch and changed the factor it uses to derive estimated property damage from estimated casualties. However, FAA has not updated the amount used for the cost of an individual casualty. GAO recommended in a March 2017 report (GAO-17-366) that FAA update this amount. Not doing so could understate the amount of insurance launch companies are required to purchase, exposing the federal government to excess risk.

GAO also determined that while FAA has two tools and methods it can use in making its MPL estimates, it does not have guidance on determining which are most appropriate for a given launch scenario. For example, one tool is more comprehensive but also labor intensive to use, while the other is inappropriate for certain launch scenarios and could result in misleading MPL amounts. Officials said they have begun to create such guidance but do not have an estimated completion date. Without such guidance, FAA cannot ensure that the most appropriate MPL methodology is used for each launch.

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### **Abbreviations**

COMSTAC	Commercial Space Transportation Advisory Committee
CSLCA	U.S. Commercial Space Launch Competitiveness Act
FAA	Federal Aviation Administration
MPL	maximum probable loss

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January 16, 2018

The Honorable John Thune  
Chairman  
The Honorable Bill Nelson  
Ranking Member  
Committee on Commerce, Science and Transportation  
United States Senate

The Honorable Lamar Smith  
Chairman  
The Honorable Eddie Bernice Johnson  
Ranking Member  
Committee on Science, Space, and Technology  
House of Representatives

Since 1988, the federal government has sought to assist in the development of the commercial space launch industry by sharing liability risks for accidents leading to damages to third parties or federal property and personnel.<sup>1</sup> This risk-sharing arrangement requires that space launch companies—firms that launch satellites or other payloads into space or reenter vehicles from space—purchase insurance against claims by third parties and for loss or damage to federal property and personnel up to a maximum probable loss (MPL) amount. This amount is to be determined by the Federal Aviation Administration’s (FAA) Office of Commercial Space Transportation.<sup>2</sup> For claims that exceed the MPL threshold, the federal government is potentially liable for damages, subject to

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<sup>1</sup>Commercial Space Launch Act Amendments of 1988, Pub. L. No. 100-657, § 5, 102 Stat. 3900, 3901-3905 (1988).

<sup>2</sup>The office serves several purposes, including the regulation of the U.S. commercial space transportation industry to protect the public health and safety, safety of property, and national security and foreign policy interests of the United States, as well as encouraging and promoting commercial space launches and reentries by the private sector.

appropriation, up to \$3.1 billion in 2017 (the equivalent to \$1.5 billion in 1988).<sup>3</sup>

In November 2015, Congress passed the U.S. Commercial Space Launch Competitiveness Act, (CSLCA) which required FAA to evaluate its MPL methodology and report the results of that evaluation to Congress. In addition, it required the agency, as part of its evaluation, to consult with the commercial space sector and insurance providers and, if necessary, develop a plan to update that methodology so the federal government is not exposed to greater costs than intended and launch companies are not required to purchase more insurance than necessary.<sup>4</sup> Although FAA was required to submit its report on updating its methodology to Congress by May 2016, it did not do so until April 2017, citing an internal agency review process for the delay.

CSLCA also includes a provision for us to assess, among other things, the analyses conducted and conclusions made in FAA's MPL evaluation report to Congress.<sup>5</sup> This report examines (1) the extent to which FAA's mandated report addresses the requirements in CSLCA and (2) the extent to which the agency has addressed previously identified weaknesses in the MPL methodology.

To address the first objective, we analyzed the CSLCA requirements for FAA's report and evaluated the information included in FAA's report, as well as additional information provided by officials from FAA's Office of Commercial Space Transportation. Specifically, we analyzed supporting documentation, including contractor reports and meeting minutes;

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<sup>3</sup>51 U.S.C. § 50915(a)(1). The federal government would only make payments for damages to the extent that the funds were provided in advance by appropriations law. The law also provided that additional legislative authority could be enacted to provide for paying claims in a compensation plan. The law called for the \$1.5 billion cap to be adjusted for post-1988 inflation. To estimate the 2017 cap on federal liability indemnification, we used averages of monthly indexes from the U.S. Department of Labor, Bureau of Labor Statistics, from 1988 to 2015 and estimated inflation data from the Congressional Budget Office for 2016 and 2017. For more information, see Congressional Budget Office, *An Update to the Budget and Economic Outlook* (Washington, D.C.: August 2016).

<sup>4</sup>U.S. Commercial Space Launch Competitiveness Act, Pub. L. No. 114-90, § 102(b), 129 Stat. 704, 705 (2015).

<sup>5</sup>CSLCA also required GAO to evaluate the implementation schedule proposed by FAA, but because FAA did not create an implementation schedule GAO was only able to evaluate FAA's documents.

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interviewed FAA officials; and compared this evidence to federal internal control standards and GAO guidance on conducting an economic assessment.<sup>6</sup>

To address the second objective, we reviewed prior GAO recommendations, and weaknesses in the MPL methodology identified by us and other entities.<sup>7</sup> We assessed FAA's efforts to address these recommendations and weaknesses using documentation from and interviews with Office of Commercial Space Transportation officials about the steps that FAA has taken or plans to take. We also interviewed these officials, and reviewed documentation on guidance on determining the most appropriate analytical tool to use calculate MPL values for a given launch scenario. We also assessed the reasonableness of FAA's actions and plans using federal internal control standards where appropriate.<sup>8</sup>

For both objectives, we reviewed information collected for our March 2017 report on the agency's revisions to its MPL methodology, including the actions the agency has taken to address the weaknesses we and others had previously identified.<sup>9</sup> For the purposes of this current report, we are updating the information collected for the March 2017 report as appropriate.

We conducted this performance audit from May 2017 to January 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

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<sup>6</sup>GAO, *Standards for Internal Control in the Federal Government*, [GAO-14-704G](#) (Washington, D.C.: September 2014); and GAO *Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Capital Program Costs*, [GAO-09-3SP](#) (Washington, D.C.: March 2009).

<sup>7</sup>GAO, *Commercial Space Launch Insurance: Weakness in FAA's Insurance Calculation May Expose the Federal Government to Excess Risk*, [GAO-17-366](#) (Washington D.C.: Mar. 23, 2017); [GAO-14-704G](#) and GAO, *Commercial Space Launches: FAA Should Update How It Assesses Federal Liability Risk*, [GAO-12-899](#) (Washington, D.C.: July 30, 2012); Justin C. Mary, Evan Schlessinger, Joseph Simons, Dorit Stein, IDA Science and Technology Policy Institute, *FAA Cost of a Casualty Value for Determining Licensee Insurance Requirements* (May 2016); Randolph L. Nyman, Erik Larson, ACTA Inc., and Federal Aviation Administration, *Maximum Probable Loss Procedure* (January 2016).

<sup>8</sup>[GAO-14-704G](#).

<sup>9</sup>[GAO-17-366](#).

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the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

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## Background

The Commercial Space Launch Act Amendments of 1988 established the foundation for the current U.S. policy to potentially provide federal payment for a portion of claims by third parties for injury, damage, or loss that results from a commercial launch or reentry accident.<sup>10</sup> A stated goal of the act was to provide a competitive environment for the U.S. commercial space launch industry. The act also provided for, among other things, government protection against some losses—referred to as indemnification—while still minimizing the cost to taxpayers. All FAA-licensed commercial launches and reentries by U.S. companies, whether unmanned or manned and from the United States or overseas, are covered by federal indemnification for third-party damages that result from the launch or reentry.<sup>11</sup> According to agency officials, in 2016 FAA issued five active licenses, which had an average third-party MPL of about \$51 million and ranged from \$10 million to \$99 million.

The amount of insurance coverage that FAA requires launch companies to purchase—the MPL value—is intended to reflect the greatest dollar amount of loss to third parties and the federal government for bodily injury and property damage that can be reasonably expected to result from a launch or reentry accident.<sup>12</sup> FAA calculates separate MPL values for potential damages to third parties and the federal government. For each

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<sup>10</sup>Payments by the federal government are subject to appropriation. Damages to parties involved in launches and reentries—for example, space flight participants—are not eligible for indemnification coverage. Regulation defines third parties to launches and reentries as any person other than: (i) the United States, any of its agencies, and its contractors and subcontractors involved in launch or reentry services for a licensed or permitted activity; (ii) a licensee, permittee, and its contractors and subcontractors involved in launch or reentry services for a licensed or permitted activity; (iii) a customer and its contractors and subcontractors involved in launch or reentry services for a licensed or permitted activity; (iv) a member of a crew; and (v) a space flight participant. Government personnel, as defined in this section, are considered to be third parties. See 14 C.F.R. § 440.3.

<sup>11</sup>51 U.S.C. § 50904(a); 51 U.S.C. § 50914(a)(1)(A); 51 U.S.C. § 50915. Launches and reentries by foreign entities are also licensed by FAA if they take place from or into the United States and are covered by federal indemnification.

<sup>12</sup>14 C.F.R. § 440.3. This amount includes potential damages from accidents that could occur in both the preflight and flight phases of a launch.



launch license that it issues, FAA determines MPL values for third parties with the intent of estimating the greatest dollar amount of losses that reasonably could be expected from a launch or reentry accident, which have no less than a 1 in 10 million chance of occurring. For damages to the federal government, FAA determines MPL values with the intent of estimating the greatest dollar amount of losses that reasonably could be expected from a launch or reentry accident, which have no less than a 1 in 100,000 chance of occurring. According to FAA, the agency defines these probability thresholds to estimate the federal government's exposure to losses above the MPL. Agency officials said that the current probability thresholds are set such that losses are very unlikely to exceed launch companies' private insurance and become potential costs for the government under CSLCA.

FAA's process for determining the MPL value for a launch or reentry license generally includes three elements:

1. **Number of casualties.** Estimating the number of third-party casualties involves adding the number of direct and secondary casualties that could result from a launch accident. Direct casualty estimates include serious injuries and deaths. Secondary casualties include those resulting from fires and collapsing buildings.
2. **Cost of casualties.** FAA uses \$3 million as an estimate of the average loss per casualty, which is multiplied by the number of estimated casualties.
3. **Property damage.** FAA applies a predetermined factor—which it recently changed from 50 percent to 25 percent—to the estimated cost of casualties to derive estimated losses from property damage.

The total MPL is equal to the estimated cost of casualties plus property damage.

FAA has revised two components of its MPL methodology since our 2012 report. For example, in April 2016, the agency adopted a new method for estimating the number of casualties, known as the risk profile method. This method uses different tools to simulate a range of possible scenarios to create a distribution of potential casualty numbers and the simulated probability of different levels of casualty numbers. The risk profile method replaced FAA's "overlay method," which was a method it had used since the early 1990s which the agency said did not work well for launches of small launch vehicles in remote areas, or for reentries. In addition, FAA reduced the factor it uses to estimate losses due to property damage,

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based on tests of a new process for estimating such losses that showed the previous factor was too high.

### GAO Previously Reviewed FAA's MPL Methodology

We have previously reviewed FAA's MPL methodology in 2012 and 2017. In 2012 we examined the U.S. government's indemnification policy, the federal government's potential costs for indemnification, and the effects of ending indemnification on the competitiveness of U.S. launch companies, among other aspects of FAA's MPL methodology.<sup>13</sup> In 2017 we examined the extent to which FAA had revised its MPL methodology since our 2012 report to address previously cited weaknesses and the potential effect of any changes to that methodology on financial liabilities for the federal government.<sup>14</sup> The findings and recommendations of those reports, including any unaddressed weaknesses, are discussed later in this report.

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## FAA Did Not Fully Address the CSLCA's Three Mandated Requirements

CSLCA required FAA to evaluate its MPL methodology incorporating three requirements, but the agency's report did not fully address these requirements.

- First, the act required FAA to ensure a balance of risk between launch companies and the federal government. However, agency officials told us that they did not re-evaluate the probability thresholds—which are used to divide the risk of loss between launch companies and the federal government—as part of evaluating its MPL methodology when implementing the risk profile method due to resource constraints.
- Second, the act required FAA to consider the cost impact of implementing an updated MPL methodology, but the agency did not evaluate the impact of implementing its revised methodology on the direct costs to launch companies (insurance premiums) and to the federal government (indemnification liability).

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<sup>13</sup>[GAO-12-899](#). We discuss the status of FAA's MPL methodology in greater detail later in this report.

<sup>14</sup>[GAO-17-366](#).

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- Third, the act required FAA to consult with the commercial space sector and insurance providers in evaluating its MPL, but they did not consult such parties in response to the act.

Without fully addressing CSLCA's mandated requirements, FAA cannot ensure that the federal government is not exposed to greater liability costs than intended or that launch companies are not required to purchase more insurance coverage than necessary.

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### FAA Has Not Fully Evaluated the Balance between Government Liability Exposure and Industry Insurance Costs

In its report, FAA states that implementing an updated MPL methodology in April 2016—the risk profile method—helps ensure that the federal government is not exposed to greater liability costs than intended and that launch companies are not required to purchase more insurance coverage than necessary, as required under CSLCA.<sup>15</sup> Further, agency officials told us that their updated methodology is technically more valid and improves their ability to avoid overestimating MPL values (which can cause launch companies to purchase more insurance coverage than necessary) or significantly underestimating MPL values (which can expose the federal government to greater costs than intended).

While an improved model may provide a more realistic calculation of the MPL, by changing the resulting estimates it can also change the balance between the federal government's exposure to liability costs and the amount of insurance launch companies are required to purchase. For example, if the more realistic results produced by the revised methodology increased the MPL estimates, this would increase insurance costs for the launch companies and reduce the federal government's exposure, thereby shifting the balance of costs between the two and suggesting a reevaluation of the thresholds.

In addition, FAA officials told us that they had not reevaluated the probability thresholds upon implementing the revised MPL methodology, although defining these thresholds is their primary mechanism for adjusting the balance of risk between launch companies and the federal

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<sup>15</sup>Federal Aviation Administration, *Report to Congress: FAA's Development of an Updated Maximum Probable Loss Method* (April 2017).

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government.<sup>16</sup> Agency officials acknowledged that an examination of the thresholds' continued appropriateness would be warranted in the future. However, they told us that changing the probability thresholds would require significant effort because it would require them to change federal regulations and that resources are currently allocated to other rulemaking priorities.<sup>17</sup> Nevertheless, without evaluating the appropriateness of the probability threshold as part of the mandated evaluation of the MPL methodology, FAA cannot ensure that the federal government is not exposed to greater liability costs than intended or that launch companies are not required to purchase more insurance coverage than necessary.

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### FAA Evaluated Only Indirect Costs to Industry and Government of Implementing a New Methodology

CSLCA also required FAA to consider the cost impact on both the commercial space launch industry and the federal government of implementing an updated MPL methodology. In its report to Congress, the agency discussed indirect costs to launch applicants and the federal government. For example, FAA discussed indirect data burden costs on launch company applicants and FAA analysts associated with the agency's risk profile method implementation. The report states that the risk profile method requires more data from a launch applicant than the previous method, but that the added burden is minimal because the

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<sup>16</sup>As previously discussed, for the purposes of determining MPL values for third parties, federal regulations define the probability threshold as losses that can reasonably be expected as those that have a probability of occurrence of no less than 1 in 10 million. For the purposes of determining MPL values for government property or personnel, federal regulations define the probability threshold as losses that can reasonably be expected as those that have a probability of occurrence of no less than 1 in 100,000. In calculating a launch or reentry's MPL value, FAA uses a risk profile method to calculate the potential losses from casualties and property damage at these probability thresholds. Launch companies must obtain liability insurance (or demonstrate financial responsibility) in the amount of the MPL value assigned by FAA for each launch license, and are responsible for losses up to that amount. The federal government is potentially liable for third-party claims above the launch license's MPL value, up to an estimated \$3.1 billion in 2017 subject to congressional appropriation in advance.

<sup>17</sup>In our August 2015 report we evaluated their commercial space staffing needs and determined that they had not provided detailed information on their staffing needs, and recommended they do so. Since then, FAA has provided more information on their staffing needs and we have closed this recommendation. Nevertheless, as the commercial space transportation industry continues to grow, we are continuing to examine FAA's staffing needs and resources. In July 2017 we began work looking at how FAA can improve the management of its resources for licensing and permitting.

information is similar to the type of information required by FAA for a risk analysis.<sup>18</sup> Agency officials also said that the risk profile method requires more of an FAA analyst's time than the overlay method, but that the added burden is minimal because the work done by FAA on risk analysis provides much of the foundation for an MPL analysis.

However, FAA's report did not include an evaluation of the direct costs to launch companies and the federal government of implementing an updated MPL methodology. The report identifies the direct cost to the launch industry as insurance premiums, and the direct cost to the federal government include potential indemnification payments. Agency officials also told us that the agency does not track commercial space launch insurance costs, and that they do not have meaningful insights on insurance premiums paid by commercial launch companies. FAA officials told us that they only have a general notion of insurance premiums because the industry is reluctant to share such information. FAA officials also told us that, outside of the work done for the report, they have not evaluated the economic implications for launch companies of implementing an updated MPL methodology. Without evaluating direct costs to both the launch companies and the federal government, FAA will be limited in its ability to consider the impact of the cost to both the industry and the federal government of implementing an updated methodology.

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## FAA Obtained Limited Input from the Commercial Space Sector and Insurance Providers

Although CSLCA required FAA to consult with the commercial space sector and insurance providers in evaluating its MPL methodology for the mandated report, it obtained limited input. For example, FAA officials told us that they obtained input from their Commercial Space Transportation Advisory Committee (COMSTAC) in April 2016 about what to include in

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<sup>18</sup>In April 2015, FAA modified its procedures to replace its previous "overlay method," in use since the early 1990s, with a more technically valid "risk profile" method. Under this previous overlay method, FAA estimated the size of the area where people without shelter would become casualties due to the inert debris field that would result in the event of vehicle breakup. The population density of areas exposed to launch or reentry hazards were factored into a calculation to produce the number of probable casualties due to debris impact. From the casualty amount, FAA then calculated additional casualties from secondary effects such as fires and collapsed buildings using a factor of 1.5 in the launch area. The total number of casualties was then given a value of \$3 million each. FAA estimated third-party property damage by multiplying the cost of casualties by 0.5.

their report to Congress, but did not consult with the commercial space sector and insurance providers to evaluate their MPL methodology in response to CSLCA.<sup>19</sup>

FAA officials also said that, to respond to CSLCA's consultation requirement, they did not think they needed to repeat the consultations they took in 2013. In January 2013, the agency solicited input from COMSTAC's Business/Legal Working Group about how to best conduct a review of FAA's methodology for calculating MPL, in response to our July 2012 report.<sup>20</sup> FAA also briefed the Business/Legal Working Group in May 2013 to solicit input on MPL methodologies, including the risk profile method. In the January 2013 meeting, a COMSTAC member suggested several contractors for a study by outside experts of the complete MPL methodology, and FAA subsequently hired one of these contractors to develop the risk profile method that it implemented in April 2016.<sup>21</sup> However, the agency did not solicit input from COMSTAC about its risk profile methodology prior to its April 2016 implementation or following CSLCA's November 2015 mandated evaluation. As a result, FAA lacks input on the effect of its revised MPL methodology on launch companies and the federal government, making it difficult to evaluate the balance of risk between the two.

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<sup>19</sup>COMSTAC was established in 1984 to provide information, advice, and recommendations to the FAA Administrator on critical matters concerning the U.S. commercial space transportation industry. COMSTAC membership consists of senior executives from the commercial space transportation industry; representatives from the satellite industry, both manufacturers and users; state and local government officials; representatives from firms providing insurance, financial investment and legal services for commercial space activities; and representatives from academia, space advocacy organizations, and industry associations.

<sup>20</sup>[GAO-12-899](#).

<sup>21</sup>FAA's contractor, ACTA, Inc., has provided flight risk and safety hazard analyzes of space launches for the U.S. Air Force and the National Aeronautics and Space Administration.

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## FAA's Revised MPL Methodology Does Not Fully Address Certain Previously Identified Weaknesses

Our 2012 report identified concerns with all three components of FAA's MPL methodology: estimating the number of casualties, estimating the cost of casualties, and deriving estimated property damage costs from estimated casualty costs. In that report we recommended that the agency reassess its methodology, including the reasonableness of several key elements. As noted in our 2017 report, FAA has since made improvements to its methodology. However, it still has not yet updated the cost of a casualty. In addition, in our 2017 report we also noted that there are instances where deriving estimated property damage from estimated casualty costs is inappropriate. As of November 2017, FAA does not have guidance to identify such instances or to guide decisions on which tools to use in developing the MPL estimate.

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### FAA Has Made Improvements to Its MPL Methodology but Has Not Updated the Cost-of-Casualty Amount

FAA has taken steps designed to improve two of three elements of its MPL methodology, including revising its methodology for estimating the number of potential casualties for a given launch and changing the factor it uses to derive estimated property damage from estimated casualties. However, the agency has not updated the third element, the amount it uses for the cost of an individual casualty, leaving a previously identified weakness unaddressed.

Our 2012 report raised concerns with each of the three components of FAA's MPL calculation methodology.<sup>22</sup>

- First, we found that FAA's method for estimating the number of casualties involved use of a single loss scenario instead of applying the insurance industry's standard practice of catastrophe modeling, and that the agency's method might significantly understate the number of potential casualties. Catastrophe modeling, unlike the single-loss approach, generally estimates losses by using various

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<sup>22</sup>[GAO-12-899](#).

tools to simulate tens of thousands of scenarios to create a distribution of potential losses and the simulated probability of different levels of loss.

- Second, we reported that FAA had been using an outdated and likely understated figure of \$3 million to estimate the cost of a single casualty—including injury or death—which Office of Commercial Space Transportation officials said has not been updated since they began using it in 1988.
- Third, we reported that the agency’s approach of estimating potential property damage by adding a flat 50 percent to the estimated casualty damage could lead to estimates that were too high in some cases.

Given these weaknesses, we recommended that FAA reassess its MPL methodology, including assessing the reasonableness of the cost-of-casualty amount and other assumptions used. Because the agency took actions to assess its MPL methodology, we closed the recommendation as implemented.

In March 2017 we reported that FAA had taken steps to address weaknesses in two of these three areas. Specifically, we reported that FAA’s adoption of the risk profile method in April 2016 had improved its estimates of the number of potential casualties associated with a particular license launch. In addition, we reported that the agency had revised the factor it uses to estimate losses from property damage in the MPL calculation from 50 percent to 25 percent. This change has resulted in property damage estimates that FAA officials believe are still conservative but more realistic than previous estimates.

However, in our March 2017 report we also determined that FAA had not yet addressed weaknesses in the cost-of-casualty amount we had previously identified; despite the conclusion by a contractor it had hired to study the cost-of-casualty that it was too low. Agency officials told us that they had not addressed this weakness because of other priorities. Given the significance of the cost-of-casualty amount to the MPL calculations, we recommended that FAA prioritize the development of a plan to address the identified weakness in the cost-of-casualty amount, including setting time frames for action, and update the amount based on current information. In October 2017, FAA officials told us that they had not yet updated the cost-of-casualty because they have continued to prioritize completing other work with their limited resources, such as reviewing launch applications and fulfilling other safety responsibilities. As a result, our recommendation remains open.



FAA officials told us that they have identified potential steps to update the cost-of-casualty amount, including seeking public input on whether and how to revise the amount, but that they do not expect to make a decision on whether to make any changes to the cost-of-casualty amount until June 30, 2018, at the earliest. FAA officials told us that in order to prioritize the development of a plan to address the identified weakness in the cost-of-casualty amount they will need to consult with both the commercial space and insurance industries about the necessity and implications of any potential increase in the cost-of-casualty amount. Agency officials said that they plan to do such consultations through COMSTAC. However, because COMSTAC was just reestablished in June 2017 after not having been active since November 2016 and new members had not been approved as of October 2017, the anticipated decision date of June 2018 could be further delayed.

As we reported in March 2017, an understated cost-of-casualty amount can lead to an inaccurate loss calculation, which in turn understates the amount of insurance a launch company must obtain. This could increase the potential exposure to the federal government, as the insurance amount would be less than the potential losses associated with the launch activity and the property would be inadequately protected. Because of this potential exposure, we maintain that addressing this weakness is a priority.

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### FAA Does Not Have Guidance for When to Estimate Property Damage Separately from the Number of Casualties and Which Analytical Tool to Use

As noted above, in our 2012 report we raised concerns about the first element of FAA's MPL methodology, which is estimating the number of potential casualties. FAA officials said that they have implemented two tools for estimating the number of potential casualties, and that each tool requires a different level of resources and is more appropriate for different launch scenarios. The Range Risk Analysis Tool creates physics-based simulations of possible accidents using launch vehicle data, such as launch trajectory and types of failures, and assigns each simulated accident a probability of occurrence based on the failure rates of the different elements of the launch vehicle. According to agency officials, the Range Risk Analysis Tool is a comprehensive, high-fidelity tool and is the most appropriate tool for coastal launch sites, which are often located in heavily populated areas, and is labor intensive. The Risk Estimator Sub-orbital and Orbital Launch Vehicle and Entry tool, which in contrast to the

Range Risk Analysis Tool, is a medium-fidelity tool that can be used for low-risk launches, such as launch sites located in very sparsely populated areas and reentry operations that do not need the use of a high-fidelity tool. According to FAA, this tool significantly reduces the time required to estimate the risk from launch and reentry vehicle operations.

In our 2017 report, we also reiterated that there are cases where the third element of FAA's methodology, deriving estimated property damage from estimated casualties, could lead to misleading MPL calculations.<sup>23</sup> Specifically, in March 2017 we reported that estimating losses from property damage as a percentage of losses from casualties could lead to overestimates.<sup>24</sup> For example, FAA's contractor found that, if a launch accident affected a residential area, the agency's practice of estimating property damage based on casualties would likely overstate property damages because residential structures have relatively low values compared to losses from casualties. We also reported in March 2017 that in some accidents the number of casualties may be low but property losses could still be very large, in which case FAA's estimating property losses based on casualties would likely understate potential property damage. For example, a launch vehicle could strike an unoccupied structure that is very expensive, such as a neighboring launch complex. Agency officials said that while deriving property losses from casualty losses is a simpler method that may be an effective use of limited FAA resources, it could be inappropriate in scenarios where the number of casualties might be low but property losses could still be very large.

In October 2017, agency officials said that FAA had not developed guidance for determining, for a given launch license, which of the available tools would be most appropriate to estimate the number of potential casualties, and whether it would be more appropriate to estimate property losses separately rather than derive them from estimated casualties. While FAA officials said they believe their current decision process is adequate and that they do not need more formal guidance at this time, they also told us that they were in the process of developing internal guidance on the most appropriate tool to use for future launches. The officials said that they did not have a projected completion date for

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<sup>23</sup>We did not make a recommendation on this issue at that time because FAA told us it was testing a new process for estimating property damage and had not determined whether to implement it.

<sup>24</sup>[GAO-17-366](#).

the guidance, primarily because the agency has other priorities and resource limitations. As noted earlier, these priorities include reviewing commercial space launch license applications and managing program safety.

Federal internal control standards state that, as part of an entity's risk assessment component, management should identify, analyze, and respond to risks to achieving objectives.<sup>25</sup> For example, the standards state that management should design control activities in response to the entity's objectives and risks to achieve an effective internal control system.

Without such guidance, FAA could face challenges in ensuring that it is using the most appropriate method to calculate an MPL for a given launch and is making the most efficient use of its resources. Such guidance could become more important as the number of commercial space launches increases, potentially creating greater demands on its resources. We have previously reported that the commercial space launch industry has experienced significant growth in the number and complexity of launches in the past half-decade.<sup>26</sup> FAA has also reported that its licensed launches have increased 60 percent and industry revenue has increased 471 percent since 2012.

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## Conclusions

FAA's MPL methodology is critical in balancing the encouragement of the U.S. commercial space industry with the need to manage the federal government's risk exposure because it determines how much risk each party will bear for third-party damages resulting from potential space launch accidents. However, despite changes to the methodology, the probability threshold that the agency uses to achieve this balance of risk has been the same since the 1990s, and has not been reviewed for appropriateness. In addition, while FAA evaluated the effect of its MPL methodology on the indirect costs of launch companies and the federal government, it did not similarly evaluate direct costs. Further, although FAA has obtained input from some stakeholders on certain aspects of its

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<sup>25</sup>GAO-14-704G.

<sup>26</sup>GAO, *Commercial Space: FAA Should Examine How to Appropriately Regulate Space Support Vehicles*, GAO-17-100 (Washington, D.C.: Nov. 25, 2016).

MPL methodology, it has not consulted with launch providers and insurance companies to evaluate effects on key potential costs to launch companies and the federal government, as required under CSLCA. FAA officials told us that resource issues and pursuing other priorities have prevented them from taking these actions. However, the longstanding nature of these issues, as well as their importance in determining the federal government's financial exposure, makes their completion a priority.

FAA has also begun improving other aspects of its MPL process, but important actions remain incomplete. For example, the cost of a casualty, a key component of the methodology, has not been updated since 1988. While FAA has identified potential steps to update this amount, it has not implemented these steps and our March 2017 recommendation to prioritize the updating of this amount remains open. Further, agency officials said they have begun to develop internal guidance on how to determine which methodological tools should be used for a given launch, but are not sure when this process will be completed. These are important steps to help ensure the validity of the MPL methodology and the results obtained for each launch, which in turn determine the balance between the amount of insurance launch companies are required to purchase and the potential financial exposure for the federal government.

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## Recommendations for Executive Action

We are making the following four recommendations to FAA:

The FAA Administrator should fulfill the CSLCA mandate to include ensuring a balance of risk between the federal government and launch companies as part of FAA's MPL methodology evaluation by reexamining the current probability thresholds. (Recommendation 1)

The FAA Administrator should fulfill the CSLCA mandate to analyze the cost impact of implementing its revised MPL methodology by evaluating the impact on the direct costs of launch companies and the federal government. (Recommendation 2)

The FAA Administrator should fulfill the CSLCA mandate to evaluate its MPL methodology in consultation with the commercial space sector and insurance providers by consulting with those entities on the cost impact of its revised MPL methodology, including an updated cost-of-casualty

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amount, on the launch industry and the federal government.  
(Recommendation 3)

The FAA Administrator should establish an estimated completion date for developing and implementing a plan to establish guidance on the most appropriate MPL methodologies and tools to use for each launch.  
(Recommendation 4)

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## Agency Comments

We provided a draft of this report to the Department of Transportation for their review and comment. In its comments, reproduced in appendix I, the Department of Transportation concurred with our recommendations. The Department of Transportation also provided technical comments, which we incorporated as appropriate.

We are sending copies of this report to interested congressional committees and the Secretary of the Department of Transportation. In addition, this report will be available at no charge on GAO's website at <http://www.gao.gov>.

If you or your staff have any questions or would like to discuss this work, please contact Alicia Puente Cackley at (202) 512-8678 or [cackleya@gao.gov](mailto:cackleya@gao.gov). Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. Individuals making key contributions to this report are listed in appendix II.



Alicia Puente Cackley  
Director, Financial Markets and Community Investment

## Appendix I: Comments from the Department of Transportation



**U.S. Department of  
Transportation**

Office of the Secretary  
of Transportation

Assistant Secretary  
for Administration

1200 New Jersey Avenue, SE  
Washington, DC 20590

DEC 19 2017

Alicia Puente Cackley  
Director, Financial Matters and Community Investment  
U.S. Government Accountability Office (GAO)  
441 G Street NW  
Washington, DC 20548

Dear Ms. Cackley:

The Federal Aviation Administration (FAA) believes it has implemented, and it will continue to update, the risk sharing regime established by the Commercial Space Launch Act Amendments of 1988. FAA's actions have helped the commercial space transportation industry compete in the world market while also protecting the interests of the United States. In consultation with the commercial space transportation industry and insurance providers, the FAA greatly improved its maximum probable loss methodology, providing a more rational basis for determining insurance requirements than its prior method.

We appreciate the opportunity to review GAO's draft report. FAA concurs with all the recommendations and will provide a detailed response to each recommendation within 60 days of the final report's issuance. Please contact Madeline Chulumovich, Director, Audit Relations and Program Improvement, at (202) 366-6512 with any questions.

Sincerely,

A handwritten signature in black ink, appearing to read "Keith Nelson", written over a horizontal line.

Keith Nelson  
Deputy Assistant Secretary for Administration

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## Appendix II: GAO Contact and Staff Acknowledgments

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### GAO Contact

Alicia Puente Cackley at (202) 512-8678 or [cackleya@gao.gov](mailto:cackleya@gao.gov)

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### Staff Acknowledgments

In addition to the contact named above, Patrick Ward (Assistant Director), Jessica Artis, Isidro Gomez (Analyst in Charge), Courtney La Fountain, Maureen Luna-Long, Jessica Sandler, Jennifer Schwartz, Joseph Silvestri, and Shana Wallace made key contributions to this report.

## Appendix III: Accessible Data

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### Agency Comment Letter

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Text of Appendix I: Comments from the Department of  
Transportation

DEC 19, 2017

Director, Financial Matters and Community Investment

U.S. Government Accountability Office (GAO) 441 G Street NW

Washington, DC 20548

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Keith Nelson

Deputy Assistant Secretary for Administration



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