



STATUS OF THE FEDERAL BUREAU OF INVESTIGATION'S IMPLEMENTATION OF THE SENTINEL PROJECT

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Introduction

This report is the eighth in the series of reviews that the Department of Justice Office of the Inspector General (OIG) has conducted to examine the Federal Bureau of Investigation's (FBI) progress toward developing and implementing Sentinel, its new information and investigative case management system.

According to the FBI's original plan, established in March 2006, Sentinel was to be developed in four phases at an estimated total cost of \$425 million and with an estimated completion date of December 2009. As we previously reported, as a result of lessons learned during the development of the first of the four phases, in 2008 the FBI and Lockheed Martin re-planned the remaining three phases of Sentinel. As a part of this replanning, the FBI increased the estimated total cost of Sentinel by \$26 million to \$451 million and extended the projected completion date to June 2010. In 2009 the FBI again extended the project's estimated completion date to September 2010.

In our last report on Sentinel, issued in October 2010, we expressed our concerns that the implementation of Sentinel had been delayed and was over budget. We found that while the deployment of Sentinel's Phase 2 in July 2010 had resulted in some improvements to the FBI's case management system, it had not delivered much of what it originally intended.¹ We noted that the Sentinel project was at a crossroads. The FBI issued a stop-work order to Lockheed Martin in July 2010, and in September 2010 the FBI announced its plans to complete the remaining two phases of Sentinel using a new Agile methodology development strategy.² With the Agile approach the FBI intended to assume direct management of the development of Sentinel and to greatly reduce Lockheed Martin's role.

The FBI stated through its new Agile approach it would complete the remainder of Sentinel's development by September 2011 and at a cost of approximately \$32.6 million, which would keep the total project costs within the revised \$451 million Sentinel budget. We observed in our last report,

¹ U.S. Department of Justice Office of the Inspector General (OIG), *Status of the Federal Bureau of Investigation's Implementation of the Sentinel Project*, Report 11-01 (October 2010).

² The Agile approach to software development focuses on the frequent delivery of capabilities through the close collaboration of users, developers, and testers. The Agile development approach seeks to deliver value to users quickly even in an environment where the requirements and technology are frequently changing. We describe the Agile development methodology adopted by the FBI in the following section of this report.

based on Sentinel's progress and spending at the time, as well as other cost estimates, that delivering Sentinel as originally planned likely would cost much more than \$451 million and would take longer than a year to complete.

In this report, we examine the current status of the Sentinel project using the Agile development approach to complete the project.³ When we submitted our draft report to the FBI in November for its review, we reported the completion target that FBI officials were stating at that time: that Sentinel would be deployed in January 2012. However, in December 2011, the FBI's Chief Technology Officer (CTO) stated that Sentinel's planned deployment had been delayed until May 2012. Because of problems encountered during an FBI-wide test exercise of Sentinel in October 2011, the CTO also stated that the schedule for completing Sentinel's development had been extended from December 2011 to February 2012. As a result of the exercise, which included 743 participants, the FBI identified deficiencies with Sentinel's performance. According to the FBI's Chief Information Officer (CIO), the problems were the result of insufficient hardware capacity and the FBI determined that it will have to purchase new hardware before Sentinel can operate properly when it ultimately is deployed to all Sentinel users. At the time of this report, the FBI was still determining the cost of the new hardware and the cost associated with the additional delay to Sentinel's development and deployment.

Because of the uncertainties associated with the hardware procurement and the cost associated with the additional delay to Sentinel's development and deployment, we remain concerned about the FBI's abilities to remain within its budget, even when including the use of Sentinel's operations and maintenance funds for the development and deployment of Sentinel. We also continue to believe it will be challenging for the FBI to meet this latest goal for deploying Sentinel to all FBI users in this timeframe.

³ The FBI's original Agile development schedule planned for Sentinel development to be completed in September 2011. As we discuss in this report, the FBI has extended this schedule and now estimates that it will deploy a fully functional Sentinel system in May 2012. This interim report, part of our ongoing audit, provides an update on the FBI's progress in using an Agile development methodology for completing Sentinel.

OIG Results in Brief

Since October 2010, the FBI has changed its approach to completing the development of Sentinel from a traditional phased and linear approach, known as a waterfall approach, to an Agile development methodology.⁴ As part of this transition, the FBI reduced the number of Lockheed Martin personnel working on the project from about 135 to approximately 10 employees.

As of August 2011, the FBI was expending significantly fewer dollars per month than it had in Phases 1 and 2 of the project when Lockheed Martin was primarily responsible for the development of Sentinel. By adopting an Agile development approach, the FBI reduced its rate of spending on Sentinel and instituted a more direct approach to monitoring the development of the system's functionality. As a result, the FBI reduced the risk that Sentinel will either exceed its budget or fail to deliver the expected functionality. As of August 12, 2011, the FBI had expended only 35 percent of its \$32.6 million Agile development budget.

In response to a draft of our report, the FBI reported that as of December 2, 2011, only 52 percent of Sentinel's \$32.6 million Agile development budget had been expended. Because the FBI reported this cost data to us after we had completed our fieldwork for this report, we were unable to verify the accuracy of this information. We will evaluate the accuracy of this data as we continue our audit, but the OIG, at the time of this report, makes no representations as to the accuracy of this reported budget figure.

The FBI's original schedule for developing Sentinel utilizing the Agile methodology was for development to be completed in September 2011. As of August 12, 2011, the FBI was 88 percent of the way through its original Agile development schedule, and it only had developed 50 percent of the system's planned functionality. As noted above, the Sentinel development schedule has been extended to February 2012 with an estimated May 2012 FBI-wide deployment.

During the Agile development of Sentinel, the FBI has revised its targeted dates for developing and deploying interim functionality and the

⁴ The waterfall development method is linear and sequential. Under the waterfall method, a project is broken into phases, such as design, development, and operations and maintenance. Each phase of the project has distinct goals. Once a phase of a project is completed, the development proceeds to the next phase and there is no returning to the previous phase.

final system to users. At the beginning of Agile development in October 2010, the FBI planned to release new functionality to all users through four releases on a quarterly basis, with the releases completed by October 2011. That plan changed in the spring of 2011, when the FBI planned to release Sentinel functionality to users through two releases, the first in September 2011 and a final deployment in November 2011. The first deployment, called the System of Record Release and planned for September 2011, was to provide all Sentinel users with the capability to perform all critical case management functions completely within the Sentinel system. For example, users were to be able to use Sentinel to open a case, add investigative documents, search for case information, and assign leads. The final deployment, called the Full Operating Capability Release and planned for November 2011, was to provide users with a fully-functional electronic case management system by adding functionality such as the ability to update the chain of custody on pieces of evidence.

However, the FBI then extended its Sentinel development and deployment schedules. As of August 2011, the development completion date for Sentinel was extended from September to December 2011, and a full, single deployment of Sentinel to all users was planned to occur in late January 2012. This release would again be called the Full Operating Capability Release and was intended to give Sentinel users complete electronic case management capability.

Instead of deploying Sentinel at the end of September 2011, on October 6, 2011, the FBI conducted a testing exercise, called the Sentinel Functional Exercise, during which 743 participants from across the FBI used Sentinel as the case management system. During the exercise, the system experienced two outages and the FBI later determined that the current hardware infrastructure was inadequate. As a result, in December 2011, after we provided the FBI with a draft of our report, the FBI Chief Technology Officer (CTO) informed us that due to problems encountered during the Sentinel Functional Exercise the FBI had extended the schedule for the completion of Sentinel's development to February 2012. The extension of the development also moved the planned deployment of Sentinel from January 2012 to May 2012.

The FBI has not yet procured the needed additional hardware nor has it fully assessed the personnel costs associated with the revised schedule. As a result, the CTO stated the FBI did not know the exact impact that the delay would have on Sentinel's \$451 million budget but he stated that he did not foresee exceeding the \$451 million ceiling. However, a senior FBI contracting official said that the FBI intended to pay for the new hardware with fiscal year 2012 Sentinel operations and maintenance funds.

Because of the uncertainties associated with this new procurement and the cost associated with the additional delay to Sentinel's development and deployment, we remain concerned about the FBI's abilities to remain within its \$451 million budget, even when using Sentinel's operations and maintenance funds for the development and deployment of Sentinel. We also continue to believe it will be challenging for the FBI to meet this latest goal for deploying Sentinel to all FBI users in this timeframe.

We reviewed data available in August 2011 and found that the rate at which Sentinel is being developed needed to significantly increase for the FBI to meet its revised target deployment goal of January 2012, which as of December 2011 had been extended again to May 2012. We continue to be concerned about the FBI's ability to meet this new deployment goal, as any delay in the completion of the development of Sentinel could increase the cost of development and decrease the remaining budgeted funds. As of August 26, 2011, the FBI reported that it had developed 50 percent of the functionality originally planned for Sentinel during the first 44 weeks of its planned 60-week development phase.⁵

The amount of working functionality developed during a 2-week segment, known as a sprint, is the primary measure of an Agile project's progress. To be complete, functionality must be of a quality releasable to all Sentinel users and meet technical and usability criteria specified in Sentinel's Program Management Plan. We found that the FBI has not documented whether any of the functionality that it accepted as complete at the conclusion of any sprints met those criteria. Therefore, we cannot evaluate whether the FBI's reported development progress is accurate. In addition, we found that Sentinel personnel had identified developed functionality as complete before required testing had concluded. In our judgment, failure by project personnel to review developed functionality against Sentinel's predefined testing and acceptance criteria before acceptance unnecessarily increases the risk that undetected flaws in the system could surface at a point in the project where repair would require more time and funding than had the flaw been detected by a proper functionality assessment in the first instance. An FBI official stated that the Agile Team conducts additional testing after the conclusion of each sprint. As functionality is developed, the FBI tests it as part of the overall system. If at any point functionality fails to

⁵ In September 2011, the FBI revised its plan for completing the development of Sentinel and added 12 weeks of development, extending the development to 60 weeks with a conclusion date of December 2011. In December 2011, after the FBI reviewed a draft of our report, the FBI revised its plan for completing the development of Sentinel and added another 18 weeks of development, extending the development to 68 weeks with an estimated conclusion date of May 2012.

meet testing criteria, the FBI then changes the status of that functionality to incomplete, and the Agile Team must resolve the identified issue.

We are also concerned that information regarding the Sentinel project and its development has not been adequately shared with other project stakeholders. For example, the Independent Verification and Validation (IV&V) Team, which is made up of contractor staff, informed us that the FBI has prevented it from performing timely reviews of documentation of the FBI's development of the Sentinel system.⁶ According to the IV&V team, this restriction has inhibited the IV&V Team's ability to provide to the FBI early reviews and assessments of the maturity of Sentinel's design, and the way in which important elements of the system, such as search functionality and access controls, will work together to provide users with the capabilities that they require. The FBI CTO stated that the FBI believes that it has provided the IV&V Team with access to all relevant information necessary for the IV&V Team to complete its objectives. He also said that allowing the IV&V Team expanded access to information would risk interference with the progress that developers are making during each 2-week sprint.

As the completion of Sentinel development has now been extended beyond the FBI's target Agile development completion date of September 2011 to February 2012, additional costs will be incurred and could start to negatively affect the FBI's ability to deliver Sentinel within its budget. In 2006, the FBI originally planned to use Sentinel funds to support Sentinel operations and maintenance for 2 years after full implementation of the system. According to the FBI in July 2011, Sentinel's \$451 million budget was sufficient to fund the completion of Sentinel's development and its operations and maintenance through May 2012. However, according to FBI officials' statements that Sentinel will not be deployed until May 2012 it appears that the Sentinel budget will not fund operations and maintenance after Sentinel's planned deployment.⁷ To account for technological advances

⁶ IV&V is a standard Information Technology Investment Management process whereby an independent entity assesses the system as it is developed in order to evaluate whether the software will perform as intended.

⁷ According to the FBI, the FBI contracted with Lockheed Martin in 2007 for 5 years of operations and maintenance support, which began in May 2007 and will end in May 2012. Since Lockheed Martin is still fulfilling its contractual obligations, the FBI is receiving the full 5 years of operations and maintenance it contracted for at the outset of the Sentinel program. However, as we stated in our previous report, because Sentinel is behind schedule, the \$451 million will not fund the operations and maintenance of Sentinel for 2 years after its completion, as originally intended. (U.S. Department of Justice Office of the Inspector General, *Status of the Federal Bureau of Investigation's Implementation of the Sentinel Project*, Report 11-01 (October 2010))

and changes to the FBI's policies and business practices, the FBI plans to make additions and deletions to Sentinel's 7 year old requirements. As of August 2011, the FBI had neither finalized its revisions to the requirements nor supplied us with details concerning expected changes to the system. As a result, we cannot comment on the impact such changes will have on Sentinel's functionality or the cost and schedule impact of these changes.

Background

The FBI's attempt to move from a paper-based to an electronic case management system began in 2001 with the Virtual Case File (VCF), a major component of the FBI's Trilogy IT modernization project. Designed to replace the obsolete Automated Case Support (ACS) system, the FBI abandoned the VCF project in 2005 after spending \$170 million. As detailed in the OIG's February 2005 audit report, the VCF project failed for a variety of reasons, including poorly defined design requirements, a lack of mature management processes, high management turnover, and poor oversight.⁸

On March 16, 2006, the FBI announced the award of a \$305 million contract to Lockheed Martin as part of a \$425 million project to develop Sentinel, a new electronic case management system. The FBI expected to implement Sentinel in four overlapping phases, each lasting 12 to 16 months. Each phase was intended to provide a stand-alone set of capabilities upon which subsequent phases would add further capabilities. The fourth and final phase of Sentinel was originally scheduled to be completed by December 2009.

The FBI intended that Sentinel, when fully implemented, would provide FBI agents and analysts with a user-friendly, web-based electronic case management system that would give them the ability to manage evidence and automate the document review and approval process. Additionally, Sentinel was designed to be the official FBI records repository and provide users with expanded search capabilities, enhancing agents' ability to link cases with similar information. The FBI planned to migrate all data from ACS to Sentinel and eventually retire ACS.⁹

⁸ OIG, *The Federal Bureau of Investigation's Management of the Trilogy Information Technology Modernization Project*, Audit Report 05-07 (February 2005).

⁹ Implemented in October 1995, ACS is the FBI's current case management system. As of May 2011, ACS contained records for over 9.4 million cases. While ACS is an electronic repository of investigative documents, it does not have the capability for FBI employees to electronically sign documents. As a result, FBI agents and officials must sign printed copies of the documents contained in ACS. These printed copies of investigative documents are the official records.

On June 19, 2007, the FBI announced that it had fully deployed Phase 1 of Sentinel. Phase 1 delivered two key project components: a web-based portal to ACS and workboxes for FBI agents and supervisors that summarized case information.¹⁰

As a result of lessons learned during the development of Phase 1, the FBI and Lockheed Martin re-planned the remaining three phases of Sentinel. The FBI estimated that the total cost of Sentinel would increase from \$425 million to \$451 million and the projected completion date was extended from December 2009 to June 2010. Also, the FBI and Lockheed Martin adopted an incremental development methodology for the remaining portions of Sentinel that divided Phases 2 through 4 into segments, which were further divided into increments. A major reason for switching to this incremental development model was the FBI's desire to deliver new capabilities to users every 3 to 6 months. Phase 2 was divided into four segments. By July 2009, Lockheed Martin had delivered the first three segments of Phase 2.

In December 2009, the FBI conditionally accepted delivery of Sentinel's Phase 2, Segment 4, which included three of the eight electronic forms that the FBI expected to be delivered in Segment 4.¹¹ However, the FBI did not deploy Segment 4 to its agents and analysts at the time because the system had serious performance and usability issues, and it had received overwhelmingly negative user feedback from FBI agents and analysts who tested the system. The acceptance was conditioned on the premise that Lockheed Martin would resolve these issues before the FBI would fully accept and deploy Segment 4. In July 2010, the FBI deployed Segment 4 of Phase 2 to FBI agents and analysts. Lockheed Martin resolved the FBI's concerns and the FBI officially accepted Segment 4 in October 2010.

In July 2010, the FBI issued a stop-work order that directed Lockheed Martin to cease all work on the remaining phases of Sentinel – Phases 3

¹⁰ A personal workbook summarizes a user's cases and leads. A lead is a request from an FBI field office or a headquarters division for assistance in an investigation. A squad workbook helps supervisors manage personnel resources.

¹¹ The three forms delivered were: (1) Electronic Communication, (2) Lead Request, and (3) Report of Information That May Become the Subject of Testimony. The five forms not delivered were: (1) Intelligence Bulletin, (2) Search Results Document, (3) Payment Authorization, (4) Export Form, and (5) Import Form. In addition, Lockheed Martin delivered the capability to transfer all of the administrative case files – approximately 2 percent of all FBI case files – from ACS to Sentinel, an on-line user help tool, and interfaces to two FBI IT systems (the Document Conversion Laboratory and the Financial Management System).

and 4. The FBI was concerned about an independent assessment that projected it would take the FBI an additional 6 years and \$351 million to finish the project.¹² The FBI informed the OIG in September 2010 that it would assume full control and responsibility for Sentinel development from Lockheed Martin and complete the development of Sentinel using an Agile development methodology.

Transition to Agile Development Approach

Agile software development is not a set of tools or a single methodology, but an approach that leverages close collaboration between representatives of system users, system developers, and testers to deliver functionality in a compressed timeframe and on a continuous basis. The delivery of working software is the primary measure of progress, and satisfying customers through the delivery of valuable software is treated as the highest priority during development.

While an Agile methodology can be implemented in a variety of ways, the FBI is implementing a variation called Scrum, an iterative methodology which breaks the development effort into increments called sprints, each of which the FBI decided would last 2 weeks.¹³ At the conclusion of each sprint, User Stories – functions that a system user would typically perform – along with Architecture Stories – qualities that define the system software architecture and configuration – are planned and completed, and it is the successful completion of these stories that is measured as progress for the project.¹⁴ (See Appendix I for additional information on the Sentinel Agile Development Approach.)

Sentinel Project Status

In October 2010, the FBI assumed from Lockheed Martin direct control of, and responsibility for, Sentinel development activities and initiated an Agile approach to developing Sentinel. As of August 2011, the FBI's Agile

¹² The independent assessment was performed by Mitre, a federally funded research and development center that assists the government with scientific research and analysis; development and acquisition of large, complex systems; and systems engineering and integration.

¹³ Sprints can last from 2 weeks to 4 weeks. The FBI has chosen for its sprints to last 2 weeks.

¹⁴ User Stories define functions that a system user would typically perform such as opening and closing a case or completing a form. Architecture Stories identify the hardware that the FBI will use to build Sentinel. These stories also describe the way in which the FBI will configure that hardware.

development of Sentinel appeared to be under its allotted budget of \$32.6 million; however, its scheduled deployment had been extended to January 2012. The FBI had estimated that development of Sentinel would conclude in December 2011 and a fully functional Sentinel system would be deployed to users in January 2012.¹⁵ This estimate represented a departure from its most recent previous plan in which the FBI had anticipated that it would conclude development in September 2011 and deploy a fully functional Sentinel system to users in November 2011. In December 2011, after we provided the FBI with a draft of our report, the FBI CTO informed us that due to problems encountered during testing, the FBI had again extended the schedule for the completion of Sentinel's development to February 2012. The extension of the development also moved the planned deployment of Sentinel from January 2012 to May 2012. The FBI's \$451 million estimate of Sentinel's cost has remained unchanged since our last report, issued in October 2010. However, the FBI is currently assessing the impact that the schedule extension will have on Sentinel's budget.

Budget

In our October 2010 report, we reported that as of August 2010, the FBI had spent about \$405 million of the \$451 million budgeted for the Sentinel project.¹⁶ Of the \$48.5 million remaining in the overall Sentinel budget at the beginning of FY 2011, the FBI budgeted \$32.6 million for functionality development. The FBI reported spending a total of about \$11.3 million on functionality development between October 2010 and August 2011, or approximately 35 percent of its \$32.6 million budget. During the same period, the FBI reported that it developed 50 percent of Sentinel's functionality. In response to a draft of our report, the FBI reported spending a total of about \$17 million on functionality development between October 2010 and December 2, 2011, or approximately 52 percent of its \$32.6 million budget. Because the FBI reported this cost data to us after we had completed our fieldwork for this report, we were unable to verify the accuracy of this information. We will evaluate the accuracy of this data as we continue our audit, but the OIG, at the time of this report, makes no representations as to the accuracy of this reported budget figure.

¹⁵ The FBI Chief Information Officer (CIO) stated that the FBI would test and make adjustments to the system for approximately 6 weeks after the Agile Team had concluded development in December 2011 to help increase the likelihood of a successful deployment of system functionality to all Sentinel users, which at the time was planned for January 2012.

¹⁶ After we issued our last report, the FBI revised the amount spent through September 30, 2010, to \$402.5 million.

However, as discussed in the following section of this report, we are concerned about the FBI's ability to complete development by February 2012, which would affect the FBI's ability to fully deploy Sentinel to all users by May 2012. Any delay in the completion of the development of Sentinel could increase the cost of development and decrease the remaining budgeted funds. Notwithstanding the potential for any cost and schedule increases, the cost and schedule for completing Sentinel using Agile development is substantially less than Mitre's projection that it would take an additional 6 years and \$351 million to finish the project.

While the FBI appeared to be within its \$451 million budget, we note that schedule slippage and the elimination of unneeded Sentinel project staff positions have been contributing factors to this apparent adherence, and the FBI's development budget no longer includes 2 years of operations and maintenance activities after development concludes. When the \$451 million currently budgeted for the entire Sentinel program was approved, the FBI intended that amount to include operations and maintenance costs for 2 years after full implementation of the entire project.¹⁷ According to the FBI, the \$451 million is now sufficient to only fund the completion of Sentinel's development. Because the FBI does not plan to complete the development of Sentinel until May 2012, the \$451 million will not fund the operations and maintenance of Sentinel for 2 years after its full development is completed, as originally intended. Because of the uncertainties associated with the FBI's December 2011 decision to extend Sentinel's schedule and the newly planned procurement of additional computer hardware, we remain concerned about the FBI's abilities to remain within its \$451 million budget, even when including the use of Sentinel's operations and maintenance funds for the development and deployment of Sentinel.

¹⁷ The purpose of operations and maintenance is (1) to maintain and support functionality, and (2) to manage and implement necessary modifications to functionality after the conclusion of the development phase.

Development Progress

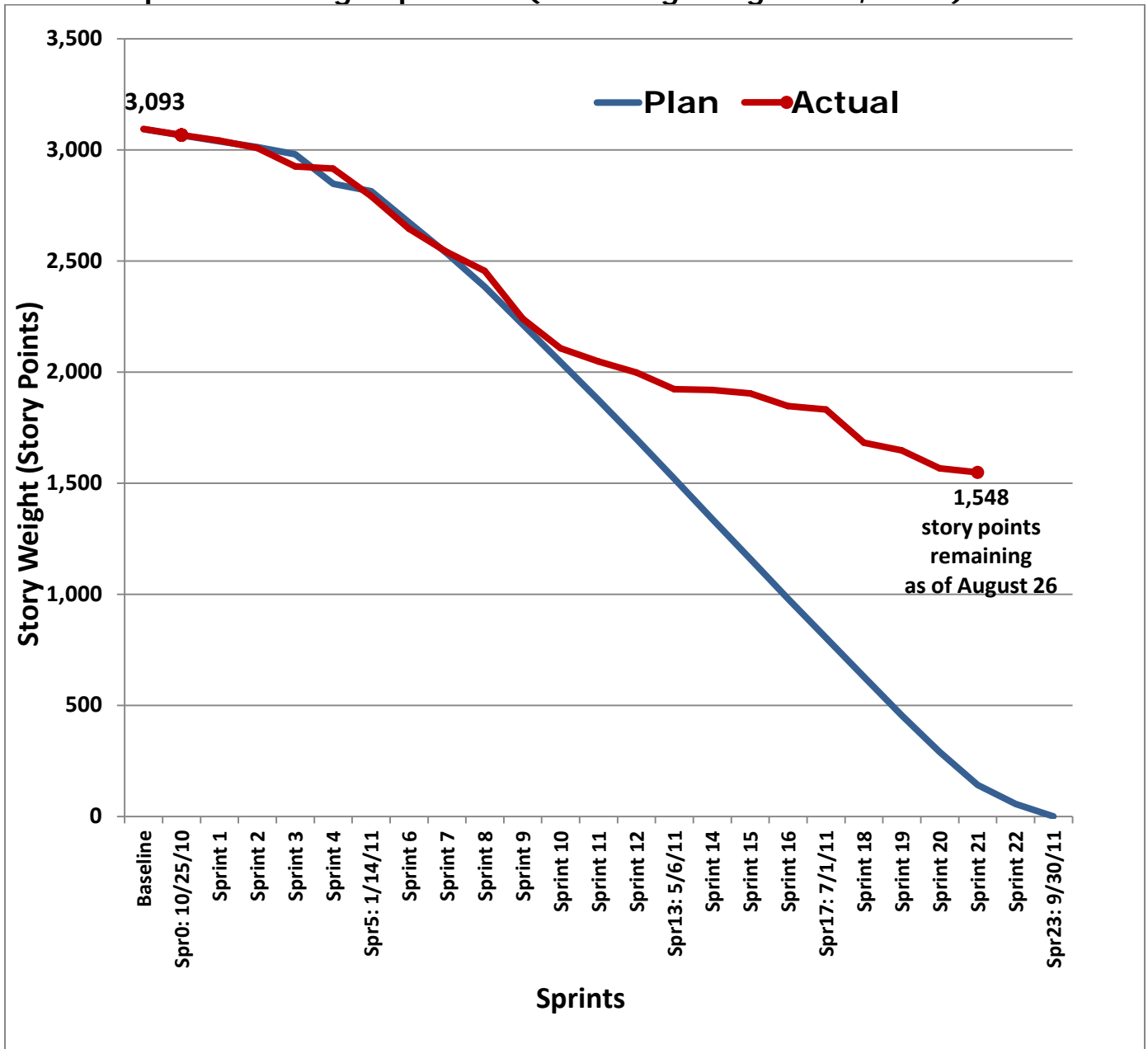
As of August 26, 2011, the FBI had completed 22 of 24 planned sprints.¹⁸ Under the Scrum approach, a project's progress and amount of work remaining is measured using a burndown chart, which depicts how factors such as the rate at which a development team completes work (a team's velocity) and changes in a project's scope affect its likelihood of staying on schedule and within budget over time. This information can be used by project management and project stakeholders to estimate the duration of the project or the amount of work that can be completed within an identified amount of time. As shown in the following chart, during the first 22 sprints (Sprint 0 through Sprint 21), the FBI had completed 1,545 of the 3,093 story points (1,548 remaining) that it identified at the beginning of the project, or about 50 percent.¹⁹

¹⁸ The first sprint is named Sprint 0, so Sprint 21 was the twenty-second sprint. In September 2011, the FBI added six additional sprints to the development schedule, extending the development end date to December 2011. We discuss both the 24-sprint and 30-sprint timelines in our analyses that follow.

In December 2011, after we provided the FBI with a draft of our report, the FBI CTO informed us that due to problems encountered during testing, the FBI had again extended the schedule for the completion of Sentinel's development by three sprints to February 2012. As of December 2, 2011, the FBI reported that it had completed 28 of 33 planned sprints. This extension to the Sentinel development plan also moved the planned deployment of Sentinel from January 2012 to May 2012.

¹⁹ As we discuss in more detail in the Sentinel Governance section of this report, we were unable to verify whether the FBI had completed the reported number of story points because we were unable to verify whether the FBI had applied its completion criteria to all of the accepted stories. In December 2011, after the FBI had received a copy of our draft report, the FBI reported to us that as of December 2, 2011, it had completed 2,345 story points and that 748 remained to be completed.

Sentinel Functionality Burndown Chart Sprint 0 through Sprint 21 (or through August 26, 2011)



Source: The FBI

According to FBI officials, after five sprints have been completed, the velocity, or rate at which an Agile team completes story points, can be used to project the completion rate of future work. During Sprints 5 through 21, the Sentinel team's average velocity was 80 story points per sprint. During our review, we estimated that if the team's velocity remained at 80 story points per sprint, the FBI would complete about 55 percent of the intended functionality by the end of the project's originally planned 24 sprints on September 23, 2011. At that rate of development we estimated that Sentinel will be completed in June 2012.

On September 6, 2011, the FBI CIO stated that the FBI had added six development sprints to Sentinel's development schedule and that the FBI then planned to end development on December 16, 2011, after 30 sprints. After development ended, the FBI planned to test Sentinel for about 6 weeks and then deploy the system to all users in January 2012. During the additional development sprints, the FBI planned to finish the functionality work that it previously planned to complete by September 23, 2011. Based on the average velocity of 80 story points per sprint, and the number of remaining story points to be completed (1,548) we estimated that the FBI would complete about 71 percent of the intended functionality by the end of the project's 30 development sprints on December 16, 2011.

On December 1, 2011, the FBI again extended the schedule for the completion of Sentinel. The CTO stated that the FBI had added four development sprints to Sentinel's development schedule and that the FBI now plans to end development in February 2012, after 34 sprints. After development, the FBI plans to test Sentinel for about 12 weeks and then deploy the system to all users in May 2012. During this testing period, the FBI plans to test Sentinel's hardware and execute a test of all major Sentinel functionality that will involve personnel from across the FBI.

Also in December 2011, after the FBI received a copy of our draft report, the FBI reported to us that during Sprints 5 through 28 it had completed 2,167 story points, an average of 90 story points per sprint – 10 more story points than its average rate as of September 2011. Based on this average velocity and the number of remaining story points to be completed (748) during the final 5 sprints under this plan, the Sentinel team must increase its average velocity to approximately 150 story points per sprint. However, the six sprints between the end of development and deployment – during which the FBI will test Sentinel – could also have story points assigned to them that the FBI is not accounting for at this time, and as a result the total number of story points to complete the project could increase. Without including such an increase, the FBI would need to average about 68 story points per sprint over the total 11 sprints remaining before

the planned May 2012 deployment. We have not verified this latest information provided by the FBI and make no representations regarding the FBI's most recent plan for the delivery of Sentinel or the ability of the FBI to meet its goal. As we continue our review we will evaluate the accuracy of the FBI's latest information and its latest revised plan for completing Sentinel.

Another measure of Sentinel's progress is how it meets the Sentinel System Requirements Specification (SRS), the official set of project requirements. The Sentinel SRS identifies 1,098 numbered requirements and their associated functionality for the FBI to fully develop, test, and provide to Sentinel users. According to project officials, as of August 12, 2011, the FBI had satisfied 56 percent (615 of 1,098) of Sentinel's SRS requirements.²⁰

Additionally, because Sentinel's requirements are now nearly 7 years old, the FBI plans to add and delete SRS requirements. The requirements will be changed due to changes in the FBI's policies and business practices over the past 7 years, as well as changes in the technologies that are now available to the project. These changes will likely have an impact on the number of SRS requirements the FBI has satisfied as of August 2011, but the FBI has neither finalized its revisions to the SRS nor supplied us with details concerning expected changes to the system. Therefore, we cannot comment on the impact such changes will have on Sentinel's functionality and development requirements.

Data Migration

One of the requirements the FBI plans to modify is the requirement that all data currently in ACS be transferred to Sentinel. ACS is the FBI's current repository for electronic case management data. Deployed in 1995, ACS contains over 9 million cases. While the migration of data from ACS to Sentinel is not a numbered SRS requirement, the SRS states that legacy data from subsumed FBI systems will be migrated to Sentinel. During Phases 1 and 2 of Sentinel, Lockheed Martin and the FBI spent considerable time and effort to determine how to transfer case and administrative data from ACS to Sentinel. The FBI and Lockheed Martin agreed that because the

²⁰ On December 6, 2011, the FBI reported to us that as of December 1, 2011, it had satisfied 88 percent (944 of 1,070) of Sentinel's SRS requirements. However, the FBI did not explain why the number of SRS requirements had decreased by 28, from 1,098 to 1,070. Further, any reduction to SRS requirements must be approved by the FBI's Executive Steering Council, which FBI officials stated was scheduled to meet on December 14, 2011. Moreover, we have not yet corroborated this information and make no representations as to its accuracy.

method that they identified to migrate the administrative case data would take too long, a new migration strategy would be needed to transfer case files to Sentinel.

During Agile development of Sentinel, the FBI's plans for ACS data have evolved. After switching to Agile development, the FBI initially determined that it would not migrate any data from ACS to Sentinel as it had originally planned. The FBI later revisited the issue and planned to migrate some case data from ACS to Sentinel, mainly information about administrative aspects of cases such as the case title, case number, and the start date. In November 2011, the FBI said that data from open cases and the text of investigative documents stored in ACS will be migrated to Sentinel when agents choose to migrate cases based on activity.

Project Status – Functionality Deliverables

As previously noted, as of August 2011, none of the functionality developed under the Agile approach has been deployed to all Sentinel users. In March 2011, the FBI provided us with a briefing describing its plan to deploy Sentinel in three releases. As part of that plan, the FBI intended to replace the functionality delivered to Sentinel users during Phases 1 and 2 with new versions developed as part of the Agile development effort. Additionally, the FBI planned to deliver the remaining functionality associated with the SRS requirements that were not satisfied during Phases 1 and 2. The following table compares the project milestones and target dates in the FBI's March 2011 plan with the actual dates those milestones were achieved and the FBI's updated December 2011 plan for achieving any unfinished milestones.

**Sentinel Milestones
(October 2010 through Project Completion)**

Task	Start Date	Original Proposed End Date as of March 2011	Revised Projected End Date as of December 2011
System of Record (SOR) Functionality Development	10/1/2010	7/1/2011	7/1/2011 Completed
Sentinel Advisory Group (SAG) Testing	3/30/2011	3/31/2011	3/31/2011 Completed
Sentinel Functional Exercise	10/6/2011	N/A ²¹	10/6/2011 Completed
SOR Functionality Deployment		9/1/2011	Discontinued
Full Operating Capability (FOC) Functionality Development ²²	7/1/2011	9/23/2011	February 2012
FOC Functionality Testing ²²	9/23/2011	11/18/2011	April 2012
FOC Functionality Deployment²²		11/18/2011	May 2012

Source: OIG analysis of FBI data

The first deployment the FBI planned was a User Validation Release, which the FBI presented to the Sentinel Advisory Group (SAG) in late

²¹ The Sentinel Functional Exercise was not part of the FBI's original deployment plan.

²² After reviewing a draft of our report, the CTO provided the revised dates for completing Sentinel development, functional testing, and deployment. These dates had not been approved by the FBI's Executive Steering Council, which was scheduled to meet in December 2011 regarding the Sentinel project.

March 2011.²³ The SAG is composed of 24 FBI employees and is intended to serve as an independent functionality validation group of Sentinel users who will test newly developed Sentinel functionalities before they are deployed.

The SAG conducted its first review of Sentinel on March 30 and 31, 2011 by testing the functionality developed through Sprint 8, which ended February 25, 2011.²⁴ The SAG reviewed several functional areas of the system, including tasks and forms that agents and analysts frequently complete. The areas tested included: (1) creation of electronic communications (EC) and attachments; (2) creation of FD-302 forms; (3) creation of Import Forms and attachments; and (4) leads, routing, and workflow.²⁵

According to the SAG Meeting Report, on a scale from 1 (least favorable) to 5 (most favorable), on average, users rated each of the functional areas a 4 or higher. In general, SAG members said the basic functions of Sentinel were easy to use. However, testers suggested some improvements such as making notifications of new or unread work items more prominent on the screen.

In addition, we note that 3 of the 4 forms that the FBI delivered to the SAG had been previously deployed to Sentinel users in July 2010 as part of

²³ The Sentinel Program Manager formed the SAG to serve as an independent validation group for the continuing development of Sentinel. The SAG, which first met in March 2011, represents all FBI Sentinel users that will rely on Sentinel as the FBI's official electronic recordkeeping and case management system. The 24 FBI employees on the SAG are intended to be a functional and geographic representation of the approximately 30,000 FBI employees who will use Sentinel. Collectively, the group's members have current or previous experience as special agents, investigative support personnel, intelligence analysts, and general clerical and administrative technicians. They have worked at 17 field offices, 13 headquarters divisions, and 3 resident agencies and have an average of 15 years experience with the FBI in a variety of investigative, intelligence, and administrative programs. The SAG is expected to review and validate Sentinel once every 6 weeks through September 2011. The SAG members are expected to provide feedback to the Sentinel development team prior to that functionality being deployed to all users, including identification of functionality that does not work properly.

²⁴ According to the FBI, the User Validation Release represented the FBI's completion of 184 of the 670 stories in the Sentinel Product Backlog.

²⁵ FD-302 Forms are used by the FBI to record investigative activity such as interviews. The Import Form will allow users to add forms created outside of Sentinel to cases that are stored in Sentinel. Leads are a formal mechanism to track accountability on assignments. Routing is the capability to assign leads to appropriate personnel. Workflow is the automation of a business process, in whole or in part, during which documents, information, or tasks are passed from one participant (human or machine) to another for action, according to a set of procedural rules.

the pre-Agile development Phase 2, Segment 4 release. Thus, these ratings should be expected to be positive because they had previously gone through one phase of user testing. Also, we reviewed the results of the FBI's survey of SAG users in March 2011 and found that the closed-end survey items and the presentation of the ratings were structured in a way that elicited positive responses. Specifically, the statements included positive assumptions about a user's experience with Sentinel. For example, the following survey item assumes that a user found Sentinel easy to use: "The Sentinel functionality was easy to use." Also, the most positive responses appeared first on the rating scale. Survey participants may be more likely not to read all of the alternatives when presented with a positive response first. We found no evidence, however, that the FBI chose the structure of the closed-end survey items or the presentation of the ratings with the intent of eliciting positive responses.

In response to a draft of our report, the FBI disagreed with our concerns about the closed-end survey questions, stating that the survey had been reviewed by survey experts and was designed using industry best practices. An FBI official stated the survey also included questions that asked participants for narrative responses such as, "Did you have any concerns/challenges with this Sentinel functionality? If so, please explain." In addition, this official also said that the FBI believes that the FBI's survey has provided valuable feedback to the Sentinel program regarding what users liked and disliked as well as suggestions for improvement.

From October 2010, when the FBI began the Agile development of Sentinel, to August 2011, the FBI planned a minimum of two deployments of functionality to all Sentinel users for use with official data. Prior to August 2011, the FBI had planned to deploy the first release, called the System of Record (SOR) Release, to all Sentinel users in September 2011. According to the FBI's original plan, the SOR Release deployment would have included the FBI's completion of 357 of the 670 stories in the Sentinel Product Backlog. According to the FBI CIO, if successfully deployed as planned, the SOR Release would have given all Sentinel users the capability to perform all critical case management functions completely within Sentinel. For example, users would have the ability to: (1) manage leads, (2) electronically create and process several forms through their entire associated workflow, (3) manage all cases, and (4) perform searches of data stored in ACS and Sentinel.²⁶ (See Appendix I for additional information on the Sentinel Agile Development Approach.)

²⁶ The FBI had planned to give users the ability to create the following forms when it would have deployed SOR Release functionality in September 2011: (1) EC, (2) FD-302, (3) Import Form, and (4) Victim Notification Form.

In June and July 2011, the FBI piloted the SOR Release of Sentinel at its field offices in Washington, D.C.; Chicago, Illinois; and Memphis, Tennessee. The results of the pilot tests were less positive than the SAG test. Specifically, the results of the Washington, D.C., and SAG pilot tests, which included on-site Sentinel experts, were similar. The results of the Chicago and Memphis pilot tests, which did not include on-site Sentinel experts, were less positive. On average, the managers, agents, and analysts who participated in the pilot rated Sentinel's functionality and responsiveness a 3 on a scale from 1 (least favorable) to 5 (most favorable).²⁷

In early August 2011, the FBI Chief Technology Officer (CTO) said that the FBI decided to not deploy the SOR Release at the end of September, as the FBI had planned, because of two other events that were expected to increase the workload of the FBI's agents during that month. The first event was the 10-year anniversary of the September 11, 2001, terrorist attacks, which the FBI anticipated would result in an increased threat environment. The second event was the release of a new FBI Domestic Investigations and Operations Guide.²⁸

Instead of deploying Sentinel at the end of September, the FBI conducted a testing exercise on October 6, 2011, during which 743 participants from the FBI's 56 field offices, several Headquarters Divisions, and several overseas offices used Sentinel as the case management system. According to the FBI's CTO, the exercise, called the Sentinel Functional Exercise, simulated 13 scenarios intended to require users to complete typical case management tasks using Sentinel. During the exercise, Sentinel operated on the FBI's network and employed the same infrastructure it will use when it is deployed to all FBI agents and analysts. The objectives of the exercise were to:

- examine Sentinel functionality in a simultaneous, enterprise-wide exercise environment;
- conduct usability tests to determine if Sentinel meets user needs and functions as designed;

²⁷ We reviewed the results of the FBI's survey of the pilot of the SOR Release in June and July 2011 and found that the survey questions and the presentation of the ratings were structured in a way that could have elicited more positive responses.

²⁸ The Domestic Investigations and Operations Guide describes the procedures FBI employees must follow when conducting domestic investigations.

- promote user awareness in Sentinel prior to its deployment to all users; and
- obtain user feedback.

In our judgment, the Sentinel Functional Exercise was an important step in Sentinel's testing. The results of the exercise should provide useful information to project executives so that they will be better able to more effectively, efficiently, and accurately chart Sentinel's course to development completion. However, we are concerned that Sentinel's performance during the exercise may inhibit users' acceptance of Sentinel once it is fully deployed. Following the exercise, the FBI's Chief Knowledge Officer stated that his preliminary review of the exercise's participant feedback indicated that users liked Sentinel's usability and functionality but that poor system performance and two system outages during the 4-hour exercise could have undermined users' trust and interest in using the system. In our opinion, the FBI would benefit from conducting an additional exercise prior to releasing system functionality to all users. An FBI official stated that project personnel collected extensive user feedback and survey data during the Sentinel Functional Exercise and analysis of the data by the FBI is ongoing.

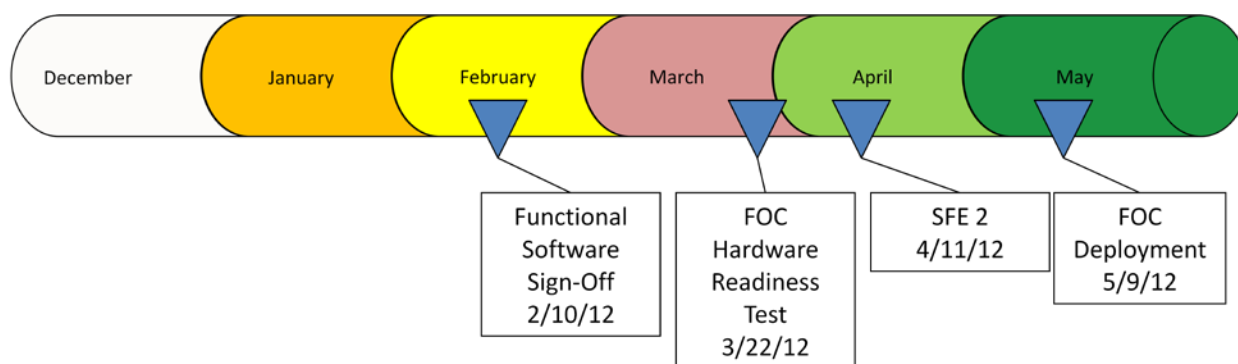
Under the FBI's September 2011 plan, the first and only full deployment to all Sentinel users, called the Full Operating Capability (FOC) Release, was scheduled to be deployed to users in January 2012. FBI officials stated that the FOC Release would include the completion of all of the stories in the Product Backlog. The FBI CIO stated that, originally, the FBI would have used the FOC Release to refine the functionality that it intended to deliver to users during the SOR Release deployment and add capabilities that would have enhanced usability and efficiency. For example, the FBI anticipated adding the capability for users to create reports, index documents, and manage evidence. Instead, the FBI will deploy all Sentinel electronic case management functionality, including those capabilities, to users during the FOC Release.

As described above, Sentinel experienced significant performance problems during the Sentinel Functional Exercise. The FBI attributed these performance problems to either the system architecture or the computer hardware. According to the FBI, subsequent operational testing confirmed the inadequacy of the legacy hardware and the requirement to significantly expand the infrastructure before the system could be deployed to all users. In November 2011, the FBI requested that Lockheed Martin provide a cost proposal for this additional hardware. The hardware is under negotiation, and a senior FBI contracting official said that the FBI intended to pay for the

new hardware with fiscal year 2012 Sentinel operations and maintenance funds.

As a result, in December 2011, after we provided the FBI with a draft of our report, the FBI again extended the schedule for the completion of Sentinel. As shown in the following chart, FBI officials stated that the FBI now plans to complete the development of Sentinel in February 2012 and deploy it to all users in May 2012.

Sentinel Milestones as of December 1, 2011 (December 2011 through May 2012)²⁹



The Functional Software Sign-Off, scheduled for February 10, 2012, will be the official end of the development of Sentinel's software. At that time, project officials expect to receive FBI executive approval of completed Sentinel functionality. In March 2012, the FBI plans to test the system hardware using the software developed and approved through the Functional Software Sign-Off. In April 2012, the FBI plans to conduct a second Sentinel Functional Exercise. On May 9, 2012, a complete version of Sentinel is scheduled to be deployed for use by all FBI agents, analysts, managers, and other personnel with a need for a case management system. According to the FBI CTO, the FBI has not yet procured the needed additional hardware nor has it fully assessed the personnel costs associated with the revised schedule, and as a result, the FBI does not know the impact that the delay will have on Sentinel's \$451 million budget. However, a senior FBI contracting official said that the FBI intended to pay for the new hardware with fiscal year 2012 Sentinel operations and maintenance funds. Because of the uncertainties, we remain concerned about the FBI's abilities to remain within its budget, even when including the use of Sentinel's operations and

²⁹ The milestones and dates contained in this chart are not final and subject to approval by the FBI's Executive Steering Council, which FBI officials stated was scheduled to occur on December 14, 2011.

maintenance funds for the development and deployment of Sentinel. We also continue to believe it will be challenging for the FBI to meet this latest goal for deploying Sentinel to all FBI users in this timeframe.

Completion Criteria

According to the Sentinel Program Management Plan, functionality developed during each sprint must be of releasable quality before project personnel can describe it as completed during each biweekly end-of-sprint demonstration. The Sentinel Program Management Plan identifies criteria that Agile Development Team personnel are required to review and satisfy before functionality developed during a sprint can be labeled complete. In broad terms, the FBI's completion criteria, which incorporates the Scrum approach, calls for any functionality described as completed at the conclusion of the sprint to: (1) have been fully tested during the corresponding sprint, (2) be ready for deployment to all users, and (3) be demonstrable to project stakeholders at the demonstration held at the end of each sprint. If the functionality does not meet the criteria, the associated story should not be accepted and the incomplete functionality should be returned to the Sentinel Product Backlog to be addressed in subsequent sprints.

While we found that the FBI has identified completion criteria, the FBI did not document, and it was not apparent, whether any of the functionality that was developed during Sprints 0 through 21 met those criteria. An Agile Development Team official stated that required testing had not been completed within the established time parameters because testing personnel have encountered difficulty setting up testing programs, software, and procedures. The Sentinel Product Owner, the person responsible for tracking the completion of project work, stated that the completion criteria only broadly informs project personnel whether functionality development has been completed at the end of each sprint, and does not specifically address whether functionality is completed.

The Scrum method is an incremental approach that builds upon the work completed in previous sprints. Because of this incremental process, we believe it is vital that the Agile Development Team only claim fully tested functionality as complete during the biweekly demonstration of a sprint's completion.

Based upon the presentations at the biweekly sprint demonstrations, we had no basis to determine whether the functionality demonstrated at the end of each sprint was "field ready" as required under the Scrum approach. We are concerned that without a consistent application of completion

criteria, including verification that functionality is field ready, for the identification of completed work, the FBI is unable to accurately assess either the amount of remaining work or the reliability of the functionality that it has designated as complete.

Contractual Changes

In March 2011, approximately 5 months after the FBI initiated development work using an Agile development methodology, the FBI modified its existing contract with Lockheed Martin to reflect that transition.³⁰ Under that contract modification, the FBI reduced Lockheed Martin's personnel working on the project from about 135 to approximately 10 employees, all of whom are engaged in operations and maintenance activities. Instead, the project is now staffed by a mix of contractor and government personnel totaling 55 positions. This modification gave the FBI more direct access to Lockheed Martin's subcontractors assigned to the Sentinel project. The FBI's CTO stated that Lockheed Martin is no longer contractually obligated to satisfy the requirements in the Sentinel System Requirements Specification (SRS); rather, it is solely the FBI's responsibility, and Lockheed Martin's role in the completion of the SRS will be one of support.³¹ In addition, the FBI has incorporated into the contract modification one option year for additional Agile development of Sentinel functionality.³²

In addition to Lockheed Martin and its subcontractors, the FBI has continued to utilize, under its Scrum approach, the services and expertise of several support contractors. An FBI official stated that as of March 2011, the FBI has not identified final cost proposals for these support contractor services and therefore has not finalized the corresponding contract modifications. The Sentinel Contracting Officer stated that the FBI will finalize these contract modifications after Sentinel Agile Development Team management provides final approval of its staffing requirements, and the

³⁰ This contract modification did not change the project's total budget of \$451 million. The operations and maintenance contract remains as-is with Lockheed Martin until at least 2012, when the FBI Information Technology Services Branch could begin to manage Sentinel operations and maintenance activities using its own personnel and contractors.

³¹ The Sentinel System Requirements Specification identifies the functionality that Sentinel must provide to users.

³² This option year is part of the contract modification with Lockheed Martin to account for changes in the FBI's development approach. This option year, valued at \$4.5 million, would allow the FBI to engage Lockheed Martin for an additional year of development activities from October 17, 2011, through October 19, 2012.

support contractors will operate under their pre-existing Sentinel contracts until then.

Sentinel Governance

In the early stages of the Trilogy project, the OIG and U.S. Government Accountability Office (GAO) recommended that the FBI establish Information Technology Investment Management processes to guide the development of its IT projects. In response, the FBI issued its Life Cycle Management Directive (LCMD) in 2004. The LCMD covers the entire life cycle for the FBI's IT systems, including planning, acquisition, development, testing, and operations and maintenance. As a result, the LCMD provides the framework for standardized, repeatable, and sustainable processes and best practices for the FBI in developing IT systems. Application of the IT systems life cycle within the LCMD can also enhance guidance for IT programs and projects, leverage technology, build institutional knowledge, and ensure that development is based on industry and government best practices.

System Documentation

The FBI's LCMD established policies and guidance applicable to all FBI IT programs and projects, including Sentinel. However, while the LCMD discusses several development approaches, it does not include criteria for the implementation of an Agile development methodology. As a result, it is not clear which system documents Sentinel project personnel must submit to FBI IT project governance personnel and which reviews the project must pass to achieve compliance with the FBI's LCMD.

We found that Sentinel program personnel disagree with FBI IT project governance personnel and other Sentinel stakeholders about what documents are required for the Sentinel project, what information those documents should contain, when the documents should be delivered, and to whom. Several entities, internal and external to the FBI, have expressed concerns that the Sentinel program has not provided either necessary or sufficient documentation for them to carry out their functions as they relate to the Sentinel project.³³ For example, FBI IT governance officials expressed concern that they were not provided documentation to establish that security features were built into the foundation of Sentinel's architecture.

³³ These entities include, but may not be limited to, the: (1) Sentinel IV&V Team, (2) FBI IT governance personnel, (3) FBI Sentinel Operations and Maintenance Transition Support Unit, (4) FBI Product Assurance Unit, (5) Electronic Record Keeping Certification personnel, (6) FBI Records Management Division, and (7) FBI Security Division.

Additionally, during Phases 1 and 2, Sentinel program personnel prepared risk registers, which were required by the Sentinel Risk Management Plan.³⁴ Although Sentinel personnel are still required by the Program Management Plan to prepare risk registers, Sentinel management stated that program personnel had not been preparing them initially during Agile development because they are not sufficient on their own to manage risk, and Sentinel project personnel are not preparing documentation unless it adds value to the program. Sentinel management also stated that program personnel are engaged in other Agile development activities intended to help manage risk and those activities may be more effective at managing risk. In response to a draft of this report, the FBI CTO stated that he meets regularly with Sentinel staff to review and address risk and, beginning in February 2011, Sentinel project personnel resumed preparing risk registers.³⁵ In our judgment, the FBI should resolve these varying expectations of which documentation is necessary to adequately manage Sentinel. Resolution of such issues will best ensure that all parties involved in development, post-development, and oversight can assess Sentinel's adherence to its budget and schedule and most effectively determine whether Sentinel is being properly managed.³⁶

Finally, according to the Independent Verification and Validation (IV&V) Team, which is made up of contractor staff, the FBI has prevented it from performing timely reviews of documentation of the FBI's development of the Sentinel system.³⁷ This restricted access to documentation has inhibited the IV&V Team's ability to provide to the FBI early reviews and assessments of the maturity of Sentinel's design, and the way in which important elements of the system, such as search functionality and access controls, will work together to provide users with the capabilities that they require. The FBI CTO stated that the FBI believes that it has provided the IV&V Team with access to all relevant information necessary for the team to complete its objectives. Specifically, he told us that the IV&V Team has

³⁴ A risk register is a tool used in project management to identify, analyze, and manage potential project issues that could negatively affect the project's budget or schedule.

³⁵ Although risk registers have been available since February 2011, we were neither made aware of nor received any such documentation until October 2011.

³⁶ FBI officials responsible for IT project governance acknowledged that the LCMD should include Agile development methodologies and said that a new version of the LCMD would include standards for those methodologies.

³⁷ IV&V is a standard Information Technology Investment Management process whereby an independent entity assesses the system as it is developed in order to evaluate whether the software will perform as intended.

access to the code for any completed sprints and that the only code it does not have access to is the code being developed in the current sprint. The FBI CTO said that expanding the IV&V Team's access would risk interference with the progress that developers are making during each 2-week sprint.

The FBI has spent approximately \$5.5 million since 2006 for Sentinel IV&V Team assessments. From October 2010 through March 2011, the FBI spent approximately \$527,000 on IV&V.³⁸ Yet, since that time, the FBI has restricted the IV&V Team's ability to analyze whether Sentinel will function as the FBI has intended. An IV&V Team official stated that the FBI has limited the IV&V Team's access to project information because it is the FBI's position that such access would distract the Agile Team developers from their daily responsibilities. As a result, we are concerned that the FBI has not and cannot fully realize the value of its investment in the IV&V Team's service, particularly since the FBI's transition to an Agile development methodology.

An IV&V Team official told us in April 2011 that the FBI had broadened the IV&V Team's access to some of the information necessary for the team to assess Sentinel's progress. Nevertheless, we remain concerned that the FBI has continued to limit information that would allow for the IV&V to be completed. We recommend that the FBI grant the Sentinel IV&V Team access to the critical documentation and information repositories that will provide the information necessary for the IV&V Team to properly assess Sentinel's design, structure, functionality, and development status.

In addition to IV&V, Sentinel is subject to several requirements that are imposed by entities internal and external to the FBI.³⁹ During our review, a Sentinel Agile Team member stated that development team personnel had to re-develop a component of Sentinel's digital signature

³⁸ The current Sentinel IV&V contract year began in January 2011 and is valued at \$544,400.

³⁹ Internally, the FBI Security Division must execute, and the system must pass, a Certification and Accreditation assessment. Externally, the system must satisfy National Archives and Records Administration (NARA) requirements to become the FBI's System of Record. Specifically, Sentinel must satisfy NARA Electronic Record Keeping Certification (ERKC) requirements. NARA ERKC is a process used to ensure that electronic recordkeeping requirements, including the proper creation, maintenance, use, and disposition of FBI records, are incorporated into the design and deployment of information and knowledge management systems such as Sentinel. Access controls are an essential part of records management, and controlling and safeguarding FBI records, while also making them accessible for use, is a necessary component of the design. The system must also meet Federal Information Security Management Act of 2002, National Institute of Standards and Technology, and Department of Justice requirements.

functionality because it was not compliant with the National Institute of Standards and Technology's Federal Information Processing Standards and had not been tested for compliance when it was initially developed. In our judgment, failure to integrate such requirements in initial development efforts and the subsequent need for either additional or redundant development work is an inefficient use of resources that could cause the project to either exceed its budget or extend its schedule. If progress toward meeting these requirements is properly monitored and managed, then the FBI could mitigate the risk of associated increased costs and schedule delays. Therefore, we suggest that the FBI consider either hiring or designating an FBI official who would be charged with monitoring, coordinating, and ensuring that the project achieves, and remains in, compliance with Sentinel's mandates and any other external or internal compliance requirements that may currently be in existence or that could be issued at a future date.

Agile Team Staffing

The Sentinel Program Management Plan states that the project must develop and utilize a staffing plan to manage staffing and keep track of personnel. Further, the Sentinel Program Management Plan specifies that the staffing plan should include details about the structure of the Sentinel team, such as the specific duties and responsibilities of each team member. As of September 2011, the FBI had not developed a Sentinel staffing plan for use in conjunction with its Agile development approach. The FBI CIO said that the cost of preparing a staffing plan would exceed the benefits provided by such a plan and that the Sentinel organizational chart provided sufficient information to manage Sentinel's staffing. However, because the FBI has not developed a staffing plan for Sentinel, we are concerned that Sentinel's managers are unable to make fully informed and effective staffing decisions. For example, a former member of the Agile Development Team stated that he had very few responsibilities and was assigned only a minimal amount of work during the 4 months he was assigned to the team. In our judgment, a staffing plan would increase the likelihood that Sentinel's managers could avoid the unnecessary costs associated with inefficient staffing decisions.

Conclusion

The value of finally moving the FBI from a paper-based records system to a paperless system that allows the FBI's agents and analysts to electronically share information in a reduced amount of time should not be overlooked. While the FBI appeared to be within its \$451 million budget, we note that schedule slippage and elimination of unneeded Sentinel staff

positions have been contributing factors to this apparent adherence, and the FBI's development budget no longer includes 2 years of operations and maintenance activities after development concludes. However, if the FBI can finish the development of Sentinel without using all of its management reserve, then the remaining funds could be applied to Sentinel's operations and maintenance.

The FBI's transition to an Agile development approach has reduced the risk that Sentinel will either exceed its budget or fail to deliver the expected functionality by reducing the rate at which the FBI is spending money on Sentinel and by instituting a more direct approach to the FBI's monitoring of the development of Sentinel. When we provided our initial draft of this report to the FBI in October 2011, we expressed concern that the rate at which the FBI was developing Sentinel's functionality indicated the project was at risk of falling behind the FBI's then planned January 2012 deployment date. In December 2011, after we completed our fieldwork for this report and after we provided the FBI with a revised draft report, FBI officials told us that the FBI extended the Sentinel deployment date to May 2012. While we have not had the opportunity to fully review the FBI's plan to meet these revised completion dates, we continue to believe it will be challenging for the FBI to meet this latest goal for deploying Sentinel to all FBI users in this timeframe.

It is too early to judge whether the FBI's Agile development of Sentinel will meet its newly revised budget and completion goals and the needs of FBI agents and analysts. While the Sentinel Advisory Group responded positively to the version of Sentinel it tested, results from wider testing were not as positive. Also, none of the Agile-developed Sentinel has been deployed to all users to give them the ability to enter actual case data and assist FBI agents and analysts in more efficiently performing their jobs.

Despite the FBI's self-reported progress in developing Sentinel, we are concerned that the FBI is not documenting that the functionality developed during each sprint has met the FBI's acceptance criteria. Our concerns about the lack of transparency of Sentinel's progress are magnified by the apparent lack of comprehensive and timely system testing. Our concerns about the lack of transparency also extend to Sentinel's cooperation with internal and external oversight entities, to which Sentinel did not provide the necessary system documentation for them to perform their critical oversight and reporting functions. We believe that this issue could be resolved, at least in part, with a revision to the FBI's Life Cycle Management Directive to include standards for Agile development methodologies.

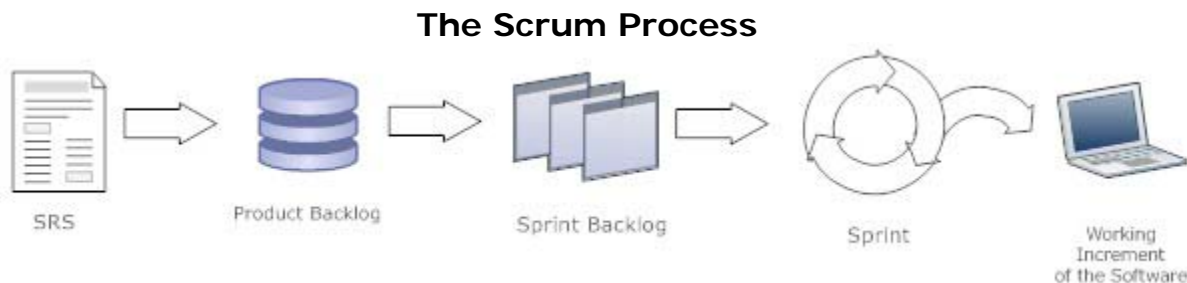
Recommendations

We recommend that the FBI:

1. Ensure that the software presented at the biweekly end-of-sprint demonstrations has been tested in accordance with Sentinel's Program Management Plan.
2. Revise the Life Cycle Management Directive to include requirements for Agile development, including the Scrum methodology.
3. Confer with the Sentinel IV&V Team to resolve access issues so that the IV&V team can adequately fulfill its objectives.
4. Conduct additional Sentinel Functional Exercises to help ensure that Sentinel adequately performs when operated on the FBI's network.

SENTINEL AGILE DEVELOPMENT APPROACH

In October 2010 the FBI identified a total of 670 stories for the Sentinel Product Backlog, or the compilation of all of the project's stories. The FBI has mapped the Product Backlog to each of the requirements in Sentinel's Systems Requirements Specification (SRS), which serves as an important control to ensure that the backlog, and the stories it contains, cover all of Sentinel's requirements. The FBI also assigned weighted amounts, or "story points," to each story in the Product Backlog based on the difficulty of the work associated with each story. The FBI assigned a total of 3,093 story points to its 670 stories in the Sentinel Product Backlog. The following illustration outlines the Scrum process that the FBI is using to develop Sentinel.



Source: OIG adaptation of FBI data and graphic

The Sentinel development team identifies the functionality that will be developed over the course of each of the planned sprints during planning meetings that occur on the first day of each sprint.⁴⁰ Each sprint ends after 2 weeks, regardless of whether the development team has completed the planned work.⁴¹ On the last day of each sprint, the Scrum approach calls for any functionality identified as being completed to: (1) have been fully tested during the corresponding sprint, (2) be ready for deployment to all users, and (3) be demonstrable to project stakeholders, including representatives from various FBI divisions, during the demonstration held at the end of each sprint.⁴² Following this process, the development team demonstrates the functionality that has been successfully developed and tested during each sprint.

⁴⁰ The sprints began in October 2010 and were planned to end in September 2011. However, in December 2011, the FBI CIO stated that the FBI plans to add additional development sprints to the project so that development will conclude in February 2012.

⁴¹ Any stories assigned to a sprint that are not completed are returned to the Product Backlog for additional work after assignment to a subsequent sprint.

⁴² Each sprint may not add enough "field-ready" functionality to warrant releasing it to all users. The completion of several sprints may be required for a release of the new features to all users.

THE FEDERAL BUREAU OF INVESTIGATION'S RESPONSE TO THE REPORT



U.S. Department of Justice

Federal Bureau of Investigation

Washington, D. C. 20535-0001

December 19, 2011

Cynthia A. Schnedar
Acting Inspector General
Office of the Inspector General
U.S. Department of Justice
Suite 4706
950 Pennsylvania Avenue, N.W.
Washington, D.C. 20530

Dear Ms. Schnedar:

The Federal Bureau of Investigation (FBI) appreciates the opportunity to review and respond to your draft report entitled, "Status of the Federal Bureau of Investigation's Implementation of the Sentinel Project" (hereinafter "Report").

We are pleased with your conclusion that, by adopting an Agile development approach, the FBI has "reduced its rate of spending on Sentinel" and instituted a more "direct approach to monitoring the development of the system's functionality." Indeed, as the FBI's figures included in this Report demonstrate, while we have expended only 52% of the Agile development budget of \$32.6 million, as of December 6 we had completed 88% of the required system functionality. The percentage of functionality completed has further increased during the time that has passed since your report was last updated.

This accomplishment is significant. In mid-2010, the FBI charted a new course for completing the remaining two phases of the Sentinel program using an Agile development approach, which represented a substantial departure from its prior development activities. As a result, you concluded in this Report that the FBI is "expending significantly fewer dollars per month than it had in Phases 1 and 2 for the project." In sum, we agree with your conclusion that the FBI's transition to an Agile development approach has "reduced the risk that Sentinel will either exceed its budget or fail to deliver the expected functionality." As you note, "at this point in time, the FBI does not foresee exceeding the \$451 million budget to complete the Sentinel project."

With that in mind, we are mindful of the short delay we have recently encountered under our new "Agile" approach. The Sentinel development schedule has recently been extended by two months (from December 2011 to February 2012), and the FBI-wide deployment is now scheduled for May 2012, as described in this Report. This modest extension is due primarily to the need to implement a standard five-year "refresh" of computer hardware, so the Sentinel software will provide the required functionality as intended. Indeed, you have determined that, given the pace at which the program has proceeded under the Agile approach over the time period you reviewed, your estimate for completion is essentially the same -- June 2012.

We have one concern with the current draft of the Report. We request that you note that the hardware we are acquiring for the refresh, which is being purchased using fiscal

year 2012 operations and maintenance funds, is separate from the development activities being carried out by the Agile team under the development budget. The refresh is part of the normal and expected operations and maintenance activities of the FBI, and such a refresh is a common maintenance activity where hardware has reached its expected replacement threshold. We do not agree that the FBI is using operations and maintenance funds for the development of Sentinel, as suggested throughout the Report; we ask that you make this revision.

In conclusion, based upon a review of the Report, the FBI concurs with the four recommendations directed to the FBI and has already taken steps to implement them. We look forward to your continued oversight of this project and commend the professionalism of your auditing staff on this report. Please feel free to contact me at 202-324-6165 should you have any questions.

Sincerely yours,



Chad L. Fulgham
Executive Assistant Director and
Chief Information Officer
Information and Technology Branch

OIG Status of the Federal Bureau of Investigation's Implementation of the Sentinel Project

Recommendation #1 – “Ensure that the software presented at the biweekly end-of-sprint demonstrations has been tested in accordance with Sentinel’s Program Management Plan.”

FBI Response to Recommendation #1: Concur. The Sentinel Program Management Plan is currently being revised to document the improved testing that has been conducted in an effort to ensure the thoroughness of the Sentinel software testing.

Recommendation #2 – “Revise the Life Cycle Management Directive to include requirements for Agile development, including the Scrum methodology.”

FBI Response to Recommendation #2: Concur. Currently, the Information Technology (IT) Engineering Division and the Sentinel Program are working closely with the IT Management Division to update the Life Cycle Management Directive with applicable requirements for Agile and Scrum development methodologies.

Recommendation #3 – “Confer with the Sentinel IV&V Team to resolve access issues so that the IV&V team can adequately fulfill its objectives.”

FBI Response to Recommendation #3: Concur. In an effort to resolve access issues with IV&V Team, the FBI’s Chief Technology Officer will confer with the IV&V Team so they can adequately fulfill their objectives.

Recommendation #4 – “Conduct additional Sentinel Functional Exercises to help ensure that Sentinel adequately performs when operated on the FBI’s network.”

FBI Response to Recommendation #4: Concur. To ensure that Sentinel adequately performs when operated on the FBI’s network, a second Sentinel Functional Exercise has been tentatively planned for April 2012.

OFFICE OF THE INSPECTOR GENERAL ANALYSIS AND SUMMARY OF ACTIONS NECESSARY TO CLOSE THE REPORT

The OIG provided a draft of this report to the FBI for its review and comment. The FBI's response is incorporated as Appendix II of this report. The following provides the OIG analysis of the FBI's response and summary of the actions necessary to close the report.

Analysis of FBI Response

In response to our report, the FBI concurred with our recommendations. In addition, the FBI requested that we note in our report that the hardware it is purchasing with fiscal year (FY) 2012 operations and maintenance funds is separate from the development activities being carried out by the Agile team under the development budget. The FBI also stated that the purchase of the hardware is part of the normal and expected operations and maintenance activities of the FBI and that replacement of hardware is a common maintenance activity when hardware has reached its expected replacement threshold.

As we discuss in our report, the FBI found that it will not be able to deploy Sentinel using Sentinel's current hardware. According to documentation provided by the FBI, the FBI's need for the additional hardware was not part of a scheduled update of Sentinel's infrastructure. Instead, as a result of performance issues experienced during the Sentinel Functional Exercise, the FBI determined that it needed to expand the system infrastructure before Sentinel could be deployed to all users.

Specifically, on October 6, 2011, the FBI conducted a testing exercise, called the Sentinel Functional Exercise, during which 743 participants from across the FBI used Sentinel as the case management system. During the exercise, the system experienced two outages. The FBI attributed these performance problems to either the system architecture or the computer hardware. According to the FBI, subsequent operational testing confirmed the inadequacy of the existing hardware and the requirement to significantly expand the infrastructure before the system could be deployed to all users. In November 2011, the FBI requested that Lockheed Martin provide a cost proposal for this additional hardware. The hardware procurement is under negotiation, and a senior FBI contracting official said that the FBI intended to pay for the new hardware with FY 2012 Sentinel operations and maintenance funds.

We state in our report that we are concerned about the FBI's ability to remain within its overall budget of \$451 million, which includes Sentinel expenses both for development and for operations and maintenance, because of the uncertainties associated with the hardware procurement and the cost associated with the additional delay to Sentinel's development and deployment. In 2006, the FBI originally planned to use Sentinel funds to support Sentinel operations and maintenance for 2 years after full implementation of the system. According to the FBI in July 2011, Sentinel's \$451 million budget was sufficient to fund the completion of Sentinel's development and its operations and maintenance through May 2012. However, according to FBI officials' statements that Sentinel will not be deployed until May 2012, it appears that the Sentinel budget will not fund operations and maintenance after Sentinel's planned deployment.⁴³

Finally, as our report states and as the FBI's response acknowledges, the full deployment of Sentinel is now planned for May 2012. While the extensions to the FBI's Agile development schedule are essential to effect the full development of the system, the FBI's original plan using the Agile development methodology was to deploy a fully functional Sentinel by October 2011. While in its response the FBI indicates that the May 2012 estimated deployment date is a "modest extension," it is in fact a 7 month extension, which we believe is significant even if it is necessary to develop the full system and in light of the FBI's previous development delays.

Analysis of Actions Necessary to Close the Report

1. **Resolved.** The FBI concurred with our recommendation. This recommendation can be closed when the FBI demonstrates that it is ensuring the software presented at the biweekly end-of-sprint demonstrations is tested in accordance with Sentinel's Program Management Plan.

⁴³ According to the FBI, it contracted with Lockheed Martin in 2007 for 5 years of operations and maintenance support, which began in May 2007 and will end in May 2012. Since Lockheed Martin is still fulfilling its contractual obligations, the FBI is receiving the full 5 years of operations and maintenance it contracted for at the outset of the Sentinel program. However, as we stated in our previous report, because Sentinel is behind schedule, the \$451 million will not fund the operations and maintenance of Sentinel for 2 years after its completion, as originally intended. (U.S. Department of Justice Office of the Inspector General, *Status of the Federal Bureau of Investigation's Implementation of the Sentinel Project*, Report 11-01 (October 2010)).

2. **Resolved.** The FBI concurred with our recommendation. This recommendation can be closed when the FBI provides documentation evidencing that it revised the Life Cycle Management Directive to include requirements for Agile development, including the Scrum methodology.
3. **Resolved.** The FBI concurred with our recommendation. This recommendation can be closed when the FBI demonstrates that it conferred with the Sentinel IV&V Team and resolved access issues so that the IV&V team can adequately fulfill its objectives.
4. **Resolved.** The FBI concurred with our recommendation. This recommendation can be closed when the FBI conducts additional Sentinel Functional Exercises to ensure that the Sentinel adequately performs when operated on the FBI's network.