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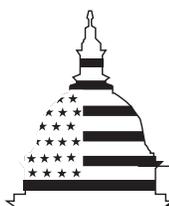# GAO

Report to the Committee on Small Business, U.S. Senate

YEAR 2000 COMPUTING CHALLENGE

SBA Needs to Strengthen Systems Testing to Ensure Readiness

GAO

Accountability ★ Integrity ★ Reliability

B-283376

August 27, 1999

The Honorable Christopher S. Bond
Chairman
The Honorable John F. Kerry
Ranking Minority Member
Committee on Small Business
United States Senate

The Small Business Administration (SBA) relies on automated information systems to fulfill its mission to provide assistance to small businesses and victims of disaster. To prevent disruptions of assistance caused by the Year 2000 (Y2K) computing problem, SBA has repaired and tested its mission-critical information systems and acted to address its external data exchanges. However, further actions are needed for the agency to have reasonable assurance that its systems are Y2K ready.

Because of the importance of the agency's Y2K program, you requested that we verify (1) that SBA has completed repair and replacement work for its mission-critical systems and (2) the extent to which data exchanges with outside entities have been addressed. This report provides a summary of information presented at our July 19, 1999, briefing to your staff and presents recommendations we are making to SBA to assist it in addressing its Y2K testing weaknesses. We performed our work from February through mid-July 1999 in accordance with generally accepted government auditing standards, and incorporated SBA's comments into our briefing before delivering it to your staff. The briefing slides are presented in appendix I, and our objectives, scope, and methodology in appendix II.

Results in Brief

SBA completed systems renovations and unit testing for its 42 mission-critical systems, and implemented the renovated systems by the Office of Management and Budget's (OMB) October 1, 1998, deadline. Since then, SBA performed integration testing and system acceptance testing to ensure the renovated mission-critical systems will operate correctly after the turn of the century--those tests were completed at the end of May 1999. Despite these efforts, however, weaknesses inSBA's Y2K testing increase the risk that its mission-critical systems are not yet Y2K ready. First, SBA's integration tests are incomplete because key business processes were not specifically tested, and tests were not tracked to verify

that all key business processes were actually tested. Second, system acceptance tests are incomplete because users did not review test plans, guidance, procedures, or data, or participate in the tests. Third, testing of SBA's mission-critical systems has not been independently validated, and these systems have not been certified as being Y2K ready.

SBA has been addressing the Y2K problem for its external data exchanges. It has reported testing or reaching agreements with 38 of its 58 external data exchange partners, including its largest, which accounts for about 90 percent of SBA's external data exchange activity. SBA is continuing to pursue testing or agreements with its remaining partners.

In addition, SBA's approach to end-to-end testing is not adequate because it (1) does not ensure that software supporting key business areas or functions has been tested and (2) leaves many potential issues, such as interoperability of internal and external systems, untested. Because of these testing weaknesses, SBA lacks reasonable assurance that its systems will function correctly and adequately support its key business areas and functions beyond 1999.

Background

SBA provides financial, technical, and management assistance to the nation's small businesses as well as offering disaster recovery assistance to individuals, families, and businesses. In fiscal year 1997, SBA provided $10.9 billion in new loan guarantees and $2.4 billion in new venture capital, and approved more than 49,000 disaster loans totaling $1.1 billion. If not adequately addressed, the Y2K computing problem poses significant risks to SBA's ability to provide these services to more than 490,000 small businesses nationally.

SBA has been working to ensure that the Y2K problem does not disrupt its ability to provide services to businesses and victims of disaster. Under the leadership of its Office of the Chief Information Officer, SBA has identified 42 mission-critical systems and 58 external data exchanges to be renovated and tested before 2000. SBA estimates the cost of its Y2K program will be $10.6 million for fiscal years 1996 through 2000.

To help agencies reduce the risk of potential Y2K-induced disruptions to their operations, we prepared the Year 2000 Computing Crisis: An

Assessment Guide[1] and the Year 2000 Computing Crisis: A Testing Guide.[2] The assessment guide identifies five phases that cover key steps necessary to complete Y2K work, and the testing guide identifies a complete Y2K testing approach that complements the five phases described in the assessment guide.

Mission-Critical Systems Have Been Renovated But Testing Processes Are Weak

SBA has completed renovation and unit testing of its mission-critical systems. However, we found weaknesses in SBA's Y2K integration testing, system acceptance testing, and independent verification and validation (IV&V). As a result, SBA does not yet have reasonable assurance that its systems are Y2K ready.

Mission-Critical Systems Have Been Renovated

SBA has performed repair work and unit testing for its 42 mission-critical systems. This included developing date conversion software so the 2,032 software programs that constitute the 42 mission-critical systems would not need to be renovated individually. SBA performed unit tests of those software programs, and the test results were reviewed and validated by SBA programmers and users. In addition, the Office of Inspector General's (OIG) technical contractor reviewed the results of about 30 unit tests. Renovations and unit tests were completed and software programs were placed into production by OMB's October 1, 1998, deadline. SBA also completed the migration of its systems to a Y2K-compliant hardware environment in late June 1999.

Integration Testing Is Incomplete

Our Y2K guidance recommends performing integration testing to verify that software programs, when combined, work together as intended. Typically, this includes identifying key business processes and testing the software that supports those processes, including developing specific test cases, data, and identifying expected outcomes for each key business process. In accordance with our guidance, SBA developed an integration test plan for its mission-critical systems, which identified key business processes to be tested, such as approving loans, increasing or decreasing loan amounts, and canceling and reinstating loans.

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[1]Year 2000 Computing Crisis: An Assessment Guide (GAO/AIMD-10.1.14, September 1997).

[2]Year 2000 Computing Crisis: A Testing Guide (GAO/AIMD-10.1.21, November 1998).

However, SBA did not follow its test plan in that it did not develop specific test cases to test most of its key business processes. Instead, SBA used (1) all transaction data for one day to test daily, weekly, monthly, and some quarterly, semiannual, and annual processing and reports and (2) some test scripts and manually-entered transactions. In addition, SBA did not track its integration test procedures, cases, and results to verify that all key business processes were actually tested. According to SBA's Y2K program manager, testing systems with actual transactions using typical production processes (i.e., daily, weekly, monthly, etc., processing) provides adequate assurance that key business processes are Y2K ready because SBA uses most of those processes on a daily basis. However, SBA could not provide information on which of its business processes were tested or the extent of such testing because it did not plan, conduct, or track its tests and testing procedures to ensure sufficient testing of key business processes. As a result, SBA lacks reasonable assurance that all systems supporting its key business processes have been adequately tested and will function beyond 1999.

System Acceptance Testing Is Incomplete

Our Y2K guidance states that user participation in system acceptance testing is essential to ensure that systems perform correctly and are acceptable to users. User involvement should include participation in (1) reviews of test plans, guidance, procedures and data, (2) systems tests, and (3) validating that the systems perform correctly. SBA combined system acceptance testing of its mission-critical systems with its integration tests by having SBA users review integration test results for validation and acceptance. However, except for tests of 3 of the 42 mission-critical systems, user groups did not review test plans, guidance, procedures, and data, and did not participate in the tests. SBA's Y2K program manager told us that he believes that user review and validation of integration test results provides adequate assurance that systems performed correctly. However, without participation in all test processes, SBA does not have reasonable assurance that systems have been adequately tested and will perform correctly beyond 1999.

Independent Verification and Validation Is Incomplete

Our Y2K guidance recommends engaging an independent quality assurance or IV&V group to ensure adequate testing and validation of mission-critical systems. Typically, these groups review test plans, procedures, and data; witness test execution; and certify that systems are Y2K ready. SBA's OIG, with assistance from its technical contractor, has been reviewing SBA's Y2K work, including its test plans and procedures. However, this review

does not represent a complete IV&V as recommended in our guidance because neither the OIG nor its technical contractor are validating the systems testing or certifying that SBA's mission-critical systems are Y2K ready. As a result, SBA lacks reasonable assurance that testing has been adequately planned, conducted, and documented to ensure that its systems will be Y2K ready.

SBA Continues To Address External Data Exchanges

SBA is continuing to address the Y2K problem for its external data exchanges. It has identified 58 external data exchange partners and has reported testing or reaching testing agreements with 38 data exchange partners, including its largest, which accounts for about 90 percent of SBA's external data exchange activity. SBA is actively pursuing testing or agreements with its remaining data exchange partners, and has followed-up with letters and telephone calls. SBA has not established a completion date for its data exchange work since finalizing testing agreements is contingent upon the cooperation of its data exchange partners.

End-to-End Testing Is Incomplete

Our Y2K guidance recommends end-to-end testing to verify that a set of systems, including those external to the organization, interoperate as intended to support key business areas or functions. According to SBA officials, the agency performed some end-to-end testing because it (1) used typical transactions processed from inception to completion, (2) tested internal data exchanges as part of its integration testing, and (3) tested external data exchanges separately. However, SBA has not ensured that key business functions, such as those supporting SBA's loan servicing function, have been tested. In addition, SBA's approach to integration testing leaves many potential issues, such as the interoperability of internal and external systems, untested. As a result, SBA lacks reasonable assurance that the systems will work together to support SBA's key business functions beyond 1999.

Recommendations

To address the weaknesses in its Y2K software testing, we recommend that SBA's Administrator take the following actions, as stated in our July 19, 1999, briefing:

- ensure that SBA's key business processes have been adequately tested and validated, and develop specific test scripts and cases to test all key business processes that were not adequately tested;
- ensure user participation in all phases of additional testing, including development of test scripts and cases, and validation that systems perform correctly;
- obtain independent quality assurance or IV&V of the testing and validation processes to certify that each mission-critical system is Y2K ready; and
- plan and conduct end-to-end testing with data exchange partners for each key business area or function.

Agency Comments

SBA officials provided comments on a draft of this briefing, and we incorporated those comments as appropriate. SBA officials stated that they are implementing our recommendations and ensuring the completion of adequate Y2K readiness testing. In this regard, SBA officials told us that they are currently working with users to document the extent of business process testing and, if needed, SBA's technical and user staff will develop additional test cases to ensure that all business processes have been tested adequately. Also, SBA users will participate in all phases of any additional testing. To address the weaknesses in its IV&V efforts, SBA is working with the OIG's technical contractor to identify additional work needed to review testing and validation processes and results. Finally, SBA plans to conduct additional end-to-end testing with its internal and external data exchange partners to ensure that its key business functions are Y2K ready.

We are sending copies of this report to The Honorable Aida Alvarez, Administrator of the Small Business Administration; The Honorable John Koskinen, Chairman of the President's Council on Year 2000 Conversion; and The Honorable Jacob Lew, Director of the Office of Management and Budget. Copies will be made available to others upon request.

Should you or your staff have any questions concerning this report, please contact me at (202) 512-6253. I can also be reached by e-mail at *willemssenj.aimd@gao.gov.* Other points of contact and key contributors are listed in appendix III.

Joel C. Willemssen
Director, Civil Agencies Information Systems

Contents

Abbreviations

IV&V	independent verification and validation
OIG	Office of Inspector General
OMB	Office of Management and Budget
SBA	Small Business Administration
Y2K	year 2000

Briefing on Small Business Administration Year 2000 Readiness

GAO   Accounting and Information Management Division

Small Business Administration
Year 2000 Readiness

Briefing to the Senate Small
Business Committee

July 19, 1999

G A O
Accountability * Integrity * Reliability

GAO   Overview

- Background

- Objectives, scope, and methodology

- Mission-critical systems renovated but testing is incomplete

- Small Business Administration (SBA) continuing to address external data exchanges

- Other observations

- Conclusions

- Recommendations

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GAO Background

- SBA provides financial, technical, and management assistance to small businesses

- 23 million small businesses employ more than 50 percent of the private workforce

- In fiscal year 1997, SBA provided

  - $10.9 billion in new loan guarantees

  - $2.4 billion in venture capital

- SBA helps businesses and families recover from disasters. In fiscal year 1997, it approved more than 49,000 disaster loans totaling $1.1 billion

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GAO   Background (cont'd.)

- SBA has identified 42 mission-critical systems

    - 10 loan accounting

    - 6 loan origination

    - 16 loan servicing

    - 10 administrative

- SBA has identified 58 external data exchanges

    - 38 federal agencies

    - 20 commercial entities

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GAO   Background (cont'd.)

- SBA's Year 2000 (Y2K) program

  - is being led by the chief information officer, who is also responsible for coordinating Y2K efforts of the offices of the chief financial officer and disaster assistance

  - is being reviewed by the Office of Inspector General (OIG), assisted by a technical contractor

- SBA estimates its Y2K program costs will be $10.6 million for fiscal years 1996 through 2000

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GAO   Objectives

- Verify that SBA has completed repair and replacement work for its mission-critical systems

- Verify the extent to which data exchanges with outside entities have been addressed

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GAO Scope and Methodology

To verify that SBA has completed repair and replacement work, we

- reviewed SBA's guidance for repairing its mission-critical systems and the date conversion software used by 39 of 42 of those systems

- reviewed about 100 unit test plans and results, and technical and user validation of test results

- reviewed integration and system acceptance test plan, 61 test results, and technical and user validations

- discussed SBA's repair and replacement work with SBA, technical contractor, and OIG officials

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GAO   Scope and Methodology (cont'd.)

- To verify the extent to which SBA has addressed external data exchanges, we
  - reviewed SBA's inventory of data exchanges
  - reviewed letters sent by SBA to its data exchange partners
  - reviewed results of testing with SBA's largest data exchange partner
  - discussed data exchanges with SBA, technical contractor, and OIG officials
- We performed our work from February through June 1999 in accordance with generally accepted government auditing standards

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GAO Systems Renovated But Testing is Incomplete--Repair Work Performed

- SBA has performed repair work on its 42 mission-critical systems

  - all mission-critical systems software was renovated to address Y2K issues

  - no replacements were made to mission-critical software components

- SBA completed migrating to a Y2K-compliant hardware environment at the end of June 1999

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GAO   Systems Renovated But Testing is Incomplete--Unit Testing Performed

- Performed unit testing to verify that software modules work as intended. Unit test results were

    - validated by SBA programmers and technical contractor

    - reviewed, validated, and accepted by users

- OIG's technical contractor reviewed the results of about 30 unit tests

- Renovations and unit testing were completed and software modules placed into production by OMB's October 1, 1998, deadline

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GAO   Systems Renovated But Testing is Incomplete--
Testing Weaknesses Increase Risks

- Although SBA completed renovation and unit testing, Y2K work for its mission-critical systems is not yet complete
  - Integration testing is incomplete
  - Systems acceptance testing is incomplete
  - Independent quality assurance (QA) or independent verification and validation (IV&V) is incomplete
- As a result, SBA does not yet have reasonable assurance that systems are Y2K ready

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GAO   Systems Renovated But Testing is Incomplete--
Testing Guidance

Testing recommended in GAO Y2K guidance

- Integration test--verify that software modules, when combined, work together to meet specified requirements

- System acceptance test--verify that completed systems are acceptable to users

- Engage a QA or an IV&V group to

  - ensure that tests are complete and accurate and test standards are met

  - certify, in writing, that systems are Y2K ready

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GAO   Systems Renovated But Testing is Incomplete--
Integration Testing Guidance

GAO Y2K guidance for integration testing recommends

- identifying business processes and developing corresponding test cases, data, and expected outcomes to test software that supports business processes

- tracking test procedures, cases, and expected outcomes to business processes to ensure proper testing

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GAO Systems Renovated But Testing is Incomplete--
Integration Test Performed

SBA performed integration testing of its mission-critical systems

- Developed a single test plan to provide guidelines for testing every date-related path in the systems defined as mission-critical

- SBA's test plan identified key business processes to be tested, including:

  - loan approvals

  - increase or decrease in loan amounts

  - cancellation or reinstatement of loans

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GAO   Systems Renovated But Testing is Incomplete--
Integration Test Performed (cont'd.)

- Integration tests were performed using
  - all transactions for 1 day as data to test daily weekly, monthly, and some quarterly, semi-annual, and annual processing and reports
  - test scripts and manually entered transactions
- Tests were completed by the end of May 1999
- Test results
  - have been reviewed and validated by SBA programmers and technical contractor
  - are being reviewed for validation and acceptance by users

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GAO   Systems Renovated But Testing is Incomplete--
Integration Testing Weaknesses

SBA did not ensure that its key business processes
were tested

- SBA did not carry out its test plan--specific test
  cases were not developed for most key business
  processes

- SBA did not track integration test procedures,
  cases, and expected outcomes to verify that all
  key business processes were actually tested

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GAO   Systems Renovated But Testing is Incomplete--
Integration Testing Weaknesses (cont'd.)

- An SBA official told us they believe testing systems with actual transactions provided adequate assurance that key business processes are Y2K-ready because SBA uses most of the processes on a daily basis to do its work

- However, SBA could not provide information on which business processes have been tested or the extent of such testing

- As a result, SBA lacks reasonable assurance that all systems supporting key business processes have been tested and will function beyond 1999

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GAO Systems Renovated But Testing is Incomplete--
System Acceptance Test Guidance

GAO guidance states that user groups' participation
in all aspects of system acceptance testing is
essential to ensuring that systems perform
correctly. User groups should

- review test plans and guidance

- review test procedures and data

- participate in the tests

- acknowledge that systems perform correctly

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GAO   Systems Renovated But Testing is Incomplete--
       System Acceptance Test Performed

- SBA combined system acceptance testing with integration testing of its mission-critical systems

- Users are reviewing test results for validation and acceptance

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GAO   Systems Renovated But Testing is Incomplete--
System Acceptance Testing Weaknesses

- Except for tests of 3 systems, user groups did not

    - review test plans or guidance

    - review test procedures and data

    - participate in tests

- An SBA official told us that they believe user review and validation of test results provided adequate assurance that systems perform correctly

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GAO Systems Renovated But Testing is Incomplete--
System Acceptance Testing Weaknesses (cont'd.)

- However, without participation in all test processes, SBA does not have assurance that systems have been adequately tested and perform correctly

- As a result, SBA lacks reasonable assurance that the systems will perform correctly beyond 1999

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GAO   Systems Renovated But Testing is Incomplete--
IV&V Guidance

GAO guidance recommends engaging an independent QA group or IV&V group to ensure that mission-critical systems are adequately tested and validated. Typically, these groups

- review test plans

- review test procedures and data

- witness test execution

- certify that systems are Y2K-ready

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GAO   Systems Renovated But Testing is Incomplete--
IV&V Testing Weaknesses

- SBA's work is being reviewed by its OIG, with technical assistance from a contractor
- However, the review is not a complete IV&V
  - the OIG or its contractor did not witness integration and system acceptance tests
  - the OIG or its contractor are not validating or certifying that SBA systems are Y2K ready
- As a result, SBA lacks reasonable assurance that testing has been adequately planned, conducted, and documented to help ensure that its systems will be Y2K ready

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GAO   SBA Continuing to Address External Data
Exchanges

- Sent letters to most data exchange partners beginning in 1998 to establish testing agreements

- Reported testing or making testing agreements with 38 of 58 data exchange partners

  - 28 federal agencies

  - 10 commercial entities

- Tested exchanges with the largest data exchange partner, who accounts for about 90 percent of SBA's external data exchange activity

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GAO   SBA Continuing to Address External Data Exchanges (cont'd.)

- Pursuing testing or agreements with remaining external data exchange partners

  - Made follow-up telephone calls to non-responding partners

  - Sent additional letters in early 1999

- SBA has not established a final completion date for data exchange work; finalizing testing agreements is contingent upon the cooperation of partners

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GAO Other Observations--SBA Performing Some End-to-End Testing

- GAO Y2K guidance recommends end-to-end testing to verify that a set of systems, including those external to the organization, interoperate as intended to support core business areas or functions
- According to officials, SBA performed some end-to-end testing
  - using typical transactions processed from inception to completion during integration testing
  - testing internal data exchanges as part of its transaction processing during integration testing
  - testing external data exchanges separately

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GAO   Other Observations--End-to-End Testing Not Yet
Complete

- SBA's testing approach did not ensure that software supporting core business areas or functions, such as loan servicing, was tested

- In addition, SBA's approach, using actual transactions, was not adequate because it leaves many potential issues, such as interoperability of internal and external applications, untested

- As a result, SBA lacks reasonable assurance that the systems will work together to support SBA's core business functions beyond 1999

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GAO   Conclusions

Because of weaknesses in its Y2K software testing, and despite completing software repairs and performing integration and acceptance testing of its mission-critical systems, SBA lacks reasonable assurance that

- software supporting key business processes has been tested and will function beyond 1999;

- systems will perform correctly beyond 1999;

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GAO   Conclusions (cont'd.)

- testing was adequately planned, conducted, and documented to help ensure that its systems will be Y2K ready; and

- its core business functions will be adequately supported and operate properly beyond 1999.

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GAO   Recommendations

We therefore recommend that SBA continue to conduct additional Y2K testing during 1999 to eliminate test deficiencies and reduce risks of Y2K failures. Specifically, SBA should

- ensure that (1) its business processes have been adequately tested and validated, and (2) develop specific scripts and cases to test all key business processes that were not adequately tested;

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GAO   Recommendations (cont'd.)

- ensure user participation in all phases of additional testing, including development of test scripts and cases, and validation that systems perform correctly;

- obtain independent QA or IV&V of the testing and validation processes and results to certify that each mission-critical system is Y2K ready;

- plan and conduct end-to-end testing, with data exchange partners, for each core business area or function.

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Objectives, Scope, and Methodology

As requested by the Senate Committee on Small Business, our objectives were to verify (1) that SBA has completed repair and replacement work for its mission-critical systems and (2) the extent to which data exchanges with outside entities have been addressed.

To meet our first objective, we reviewed SBA's guidance for repairing its mission-critical systems, as well as the date conversion software program written to address the Y2K problem for most of those systems. We reviewed about 100 unit test plans and results, and technical and user validation of those test results. We reviewed SBA's integration and system acceptance test plan, 61 test results, and technical and user validation of those results. We discussed SBA's repair and replacement work, and its Y2K testing methodologies and results with SBA and its technical contractor, OIG officials, and the OIG's technical contractor. To meet our second objective, we reviewed SBA's inventory of external data exchanges. We also reviewed letters sent by SBA to its external data exchange partners, as well as the results of testing with SBA's largest data exchange partner. We discussed data exchanges with SBA and OIG officials, and the OIG's technical contractor.

We performed our work at SBA's headquarters in Washington, D.C., and at SBA's Office of the Chief Financial Officer in Denver, Colorado. We requested and received comments on a draft of our briefing from SBA and incorporated those comments as appropriate. We performed our work from February through mid-July 1999 in accordance with generally accepted government auditing standards.

GAO Contacts and Staff Acknowledgements

GAO Contacts

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