FSA Integration Partner

United States Department of Education

Federal Student Aid

Electronic Audited Financial Statements and Compliance Audits (EAFS)

a.k.a. eZ-Audit

Performance Test Plan

February 11, 2003

Version 1.0

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1 Executive Summary

1.1. Background

Under authority of Section 487 of the Higher Education Act of 1965 (HEA), as amended, the Department of Education collects financial statements and compliance audits in paper form from 8,500 proprietary, non-profit and public institutions that participate in Title IV programs. This function encompasses two distinct review processes led by two groups within Federal Student Aid Case Management and Oversight (FSA / CMO) – the Document Receipt and Control Center (DRCC) operated by 24 contractors, and regional Case Teams staffed with over 200 Federal employees.

Collecting, copying, screening, disseminating, reviewing and filing all these documents is an extremely awkward and time-consuming process. The tasks performed by the DRCC and Case Teams are labor intensive and involve constant document handling. Numerous manual data entry points create frequent data errors and slow a heavily resource-laden review process. The large volume of incoming paper further overloads the review process. In fiscal year 2000 the DRCC processed over 13,500 documents -- 7,200 compliance audits and 6,300 financial statements. One of the most difficult challenges facing the DRCC and Case Teams is balancing their resources throughout the year to handle the workload at peak periods.

This backlog can prevent the Department from efficient and effective identification of institutions that are not compliant with the Title IV program. It also adversely affects the quality of services the Department delivers to its customers through lost documents, review mistakes, and longer resolution periods. In addition to these existing problems, FSA must allocate over 1200 square feet to physically store multiple years of audits and financial statements. FSA's relocation to its new facility will make storage more costly and restrict space availability for staff. Another driver for the eZ-Audit initiative is the Government Paper Elimination Act (GPEA). It requires agencies to allow for electronic transactions, which applies to compliance audits and financial reports.

1.2. Introduction

This eZ-Audit initiative is designed to provide a paperless, single-point of receipt and access for financial statements and compliance audits for institutions participating in Student Financial Aid Title IV programs. The Electronic Audited Financial Statements (EAFS) & Compliance Reports application will reduce the cycle-time required to collect and process financial statements and compliance audits from more than 8,500 proprietary, non-profit, and public institutions. The application will enhance the ability of Case Teams and the Document Receipt and Control Center (DRCC) to accurately record and report status of school reporting; therefore, addressing concerns listed in a recent GAO audit. The quality of FSA service to institutions will also be improved by this application via the timely acceptance and processing of the audited financial statements and compliance reports. This initiative will focus on both

FSA audits and Office of Management and Budget (OMB) Circular A-133 audits (both compliance and financial).

1.3. Objectives

The purpose of the performance test is to:

1. Validate the N-Tiered architecture for eZ-Audit by testing six business processes.
2. Verify that the application will scale.
3. Verify the performance capability of eZ-Audit relative to capturing user experience.
4. Ability to withstand a 250-user load.
5. Find stress point of the application.

1.4. Expected Results

At the conclusion of each test cycle a test report will be prepared with the results of the test cycle and whether confirmation of the objectives was achieved. Generally, each subsequent test cycle bring the testing effort closer to its overall goal of an optimized application and architecture performance.

2 Performance Test Process

To achieve the overall goals, confirm capacity planning projections for eZ-Audit, and set specific goals for tests, a process is required. The steps below outline the process that will be followed in the performance test effort:

2.1. Establish a list of performance test areas that will be monitored.

Performance test areas include a wide range of indicators such as user response times, throughput, CPU and memory utilization, and number of concurrent users. These areas are established before the test so monitoring points can be derived, and provide teams with advance notice to schedule the right people to monitor the tests. Specific monitoring points will be analyzed to identify issues/bottlenecks and will also provide the necessary data for analysis and response times. Table 7.1 includes all the performance test areas that need to be monitored and the responsible party for each.

2.2. Establish the data and parameters that need to be collected.

Data will need to be collected for analysis during and after each test cycle. Table 7.1 outlines the type of data that should be monitored, collected, and the responsible party for each monitoring point. Section 3.2 outlines the data analysis deliverables that CSC, ITA, and eZ-Audit are to submit at the conclusion of each test cycle.

2.3. Definitions

1. **Concurrent Sessions** – when each user logs into the application, a session is created on the application server. The session is a memory allocation of data about the individual user. Each individual active login is equal to one concurrent session.
2. **Active Sessions** – This is the estimate for how many of the concurrent sessions are being used at any give time. Sessions don't time out until 20 minutes of inactivity have passed. So if a user leaves the eZ-Audit website for another site, their session will remain in memory for 20 minutes.
3. **Idle Sessions** – This estimate is based on the number of active sessions subtracted from the number concurrent sessions. The resultant equates to the number of users who logged in, performed necessary operations and the left the web site. This could also account for temporary breaks, like printing a document for review and then returning to perusal of the application.

2.4. Issue Resolution Plan

For all performance times greater than 10 seconds per page, the eZ-Audit team will investigate the requests being made. Depending on the action being performed (i.e. complex search), 10 seconds may not be a problem, but eZ-Audit team will validate that for all issues.

If the problem relates to the performance test environment, the ITA performance team will assist in optimizing the environment configuration.

2.5. Fixes and Changes made to the environment and application code.

Based on the analysis and recommendations of the team, configuration changes may need to be made after each test cycle. These changes are typically expected to return higher performance results in the next test cycle.

2.6. Specific Goals set for the next eZ-Audit test cycle.

Specific goals for each test cycle are outlined in Section 5. After data have been collected, analyzed, and the required fixes made, there will be the opportunity to modify specific goals for the next test cycle.

2.7. Results are documented and eZ-Audit environment is validated.

Final deliverable is assembled with information and data from each of the test runs. The data are used to estimate any areas that may need close attention in the future. Additionally, the data will be used for capacity planning and establishing the eZ-Audit production environment.

3 eZ-Audit Business Processes

These are the business processes that we will be targeting in our performance testing. These business processes will drive the creation of our scripts for the performance testing cycles.

3.1. Business Processes

The following list outlines the business processes that will be executed by LoadRunner:

1. Annual Submission
2. Search
3. Create users
4. Login / Institution home
5. Login / Co-Team home
6. DDIF or ACD

These business functions were chosen because they represent the more complex functions and exercise application logic that is common across multiple functions. For example, while DDIF and ACD are distinct business processes, the same application code is executed for each.

3.2. Business Processes Table

The following table outlines the architecture components that make up the EAFS Application. These components are EAFS web server, EAFS application server, and EAFS Database servers. Each business process test script will test the outlined architecture components.

Business Process	Web Server	Application Server	Oracle DB
Annual Submission	X	X	X
Search	X	X	X
Create Users	X	X	X
Login / Institution home	X	X	X
Login / Co-Team home	X	X	X
DDIF or ACD	X	X	X

3.3. Data Requirements

The following are minimum data requirements. It is anticipated that the data will be reused for each test cycle.

- Annual Submission – 60 concurrent users – unique OPE ID only, other data is reusable

- Search – 20 concurrent users – reusable data records
- Create users – 20 concurrent users
- Login / Institution home – 70 concurrent users
- Login / Co-Team home – 20 concurrent users
- DDIF or ACD – 20 concurrent users – unique data records

4 Application Usage Assumptions

4.1. School Usage Assumptions

1. Submissions using eZ-Audit: 4500
2. Peak submissions in a given month: 1000
3. Average working days per month: 20
4. Average hours per day the system is used: 12
5. Average time required to complete a submission: 1 hour
6. Percentage of submissions in the peak month done in a single week: 40%
7. Peak hour of peak week multiplier: 5
8. Pages required for a submission, including login including reviews: 15
9. Average times per year a school will check a submissions status: 5
10. Percentage of schools submitting more than just an annual submission: 25%
11. Average time it takes for other submissions: 30 minutes
12. Average number of users created per school: 5
13. Pages per user creation: 3

4.2. FSA Usage Assumptions

1. Number of FSA Users: 300
2. Percentage of FSA users logged in at peak: 45%
3. Percentage of users logged in with active sessions (i.e. not reviewing a print out, in a meeting, or on the phone reviewing information): 15%
   Average time spent per page: 5 minutes (12 pages per hour)

5 Performance Test Goals and Key Metrics

The goal of the eZ-Audit performance test is to ensure that the application can handle the estimated usage without any significant performance degradation. The key metrics being reviewed will be:

1. **Individual page response time –** this will ensure that key functions perform well
2. **Concurrent sessions -** this will ensure that our environment settings will support our expected user base.
3. **Page views per hour –** The number of page requests that can be processed in an hour. For the eZ-Audit application, page requests equate to database transactions and need to be able to support the peak estimated page views per hour.

5.1. Detailed Goals per Cycle

This section will include detailed goals for each test cycle. The goals for each cycle are not static, consequently the proceedings of each test cycle are analyzed and a test cycle may be expanded into further cycles and vice versa. If issues are encountered on the scheduled performance test cycles that prevent completion thereof, the performance test cycles will need to be rescheduled. The application will be regression tested with real-time transactions with LoadRunner software.

5.2. Performance Test Cycles

5.2.1. Performance Test Cycle 1 – February 25, 2003

Detailed Goals for test Cycle 1:

- Run the following business processes to establish a baseline: Annual Submission, Create Users, Login / Institution home page.
- Target 150 concurrent user level

Exit Criteria:

- Baseline established for these scripts: Annual Submission, Create Users, Login / Institution home page.
- Script and environment issues identified, if any.
- 150 concurrent user target met.

5.2.2. Performance Test Cycle 2 – March 4, 2003

Detailed Goals for test Cycle 2:

- Run the following business processes to establish a baseline: Search, Create Users, Login / Co-Team home page, and either DDIF or ACD.
- Target 150 concurrent user level.

Exit Criteria:

- Baseline established for these scripts: Search, Create Users, Login / Co-Team home page, and either DDIF or ACD.
- Script and environment issues identified.
- Work towards resolving issue identified in previous cycle.

5.2.3. Performance Test Cycle 3 – March 6, 2003

Detailed Goals for test Cycle 3:

- Run the following business processes: Annual Submission, Create Users, Login / Institution home page.
- Run the following business processes: Search, Create Users, Login / Co-Team home page, and either DDIF or ACD.

Exit Criteria:

- The following scripts were tested during this cycle: Annual Submission, Search, Create Users, Login / Institution home page, Login / Co-Team home page, and either DDIF or ACD.
- Work towards resolving issue identified in previous cycles.
- 250 concurrent user level achieved.

5.2.4. Performance Test Cycle 4 – March 10, 2003

Detailed Goals for test Cycle 4:

- Run all business processes: Annual Submission, Search, Create Users, Login / Institution home page, Login / Co-Team home page, and either DDIF or ACD.

Exit Criteria:

- The following scripts were tested during this cycle: Annual Submission, Search, Create Users, Login / Institution home page, Login / Co-Team home page, and either DDIF or ACD.
- Work towards resolving issue identified in previous cycles.
- 250 concurrent user level achieved.

- Tune eZ-Audit application for optimal performance.

5.2.5. Performance Test Cycle 5 – March 13, 2003 - Optional

Detailed Goals for test Cycle 5:

- Run all business processes: Annual Submission, Search, Create Users, Login / Institution home page, Login / Co-Team home page, and either DDIF or ACD.

Exit Criteria:

- The following scripts were tested during this cycle: Annual Submission, Search, Create Users, Login / Institution home page, Login / Co-Team home page, and either DDIF or ACD.
- Work towards resolving issue identified in all previous cycles.
- Final, clean run of all scripts is achieved.
- 250 concurrent user level achieved.
- Tune eZ-Audit application for optimal performance.

6 Roles, Responsibilities, and Deliverables

This section outlines the roles and responsibilities of all parties involved in eZ-Audit Performance testing.

6.1. Performance Test Roles and Responsibilities

The following list outlines the roles and responsibilities of the eZ-Audit Performance Planning team.

Role	Assigned	Phone	Responsibility
Performance Test Lead	Roshani Bhatt	202 962-0740	Coordinate with all and resources to ensure that the capacity planning, performance test planning and performance test execution are completed on time. Facilitate weekly status meeting to discuss the performance test. Work with CSC to measure the performance of each component (CPU, Mem, IO, Network). Define the detailed goals for each Load Runner performance test cycle / test types – stress, stability, ssl, cache, db, and mainframe. Analyze the application functionality to plan the right mix of tests (submit, renew, correct). Define the expected concurrent users per server at optimized configuration. Determine the length of each run and starting / stopping points.
Performance Test Resource	Musab Alkateeb	202 962-0729	Coordinate test dates with all testing resources (ITA, eZ-Audit, CSC, Integration Partner). Work with all the teams to verify administrator contact information and attendance. Set up pre-test and test day conference calls.
ITA Load Runner SME	Chi-Yen Yang Musab Alkateeb	202 962 -0758 202 962-0729	Verify all test scripts and perform the calibration test. Fix the scripts after test cycle if necessary. Identify the bottleneck. Coordinate recording and testing of scripts. Document Executive Summary of the Load runner test cycle results. Use the test results to update the expected physical and logical configuration at peak.

Application Contact	Frank Southfield / Andrew Smalera	202-962-0790 202-962-0744	Responsible for application changes and recommendations. Monitor application performance at each test cycle. Coordinate script execution with ITA.
Websphere Administrator	Roshani Bhatt /Bob Wehrle	202 962-0740 202 962-0760	WAS configuration changes and updates. Monitor key areas and deliver summary results.
IHS Administrator	Roshani Bhatt / Bob Wehrle	202 962-0740 202 962-0760	IHS configuration changes and updates. Monitor key areas and deliver summary results.
eNetwork Dispatcher Administrator	Roshani Bhatt / Bob Wehrle	202 962-0740 202 962-0760	Load Balancer configuration changes and updates. Monitor key areas and deliver summary results.
Solaris System Administrator	Gary Thomas/ Joe Hala	804 733-2440 ext 242 860 513-5708	Monitor hardware to ensure optimal configuration. Monitor CPU, Mem, IO, capacity levels. Record hardware capacity levels at different intervals throughout the test cycle. Coordinate dates with ITA to upgrade Solaris.
Oracle Administrator	Rich Ryan	860 701-1209	Monitor Oracle Database to ensure the optimal configuration. Monitor the Oracle Database performance throughout the test cycle. Make recommendations on ways to improve Oracle performance.
Network Administrator	Joe Lipsky/ Chad Simmons	203 317-5131 203 317-5048	Monitor Network to ensure optimal configuration. Monitor capacity levels at different intervals throughout the test cycle.
Windows Administrator	Craig Gates	203 317-5174	Monitor the Load Generator boxes (CPU) during the performance test. Troubleshoot the issues that arise with Load Generator boxes.

6.2. Documentation

The following documents will be submitted to the eZ-Audit project team within the dates specified. Table 7.1 provides a guide as to the data that needs to be captured and presented to the team at the conclusion of each test cycle.

6.2.1. ITA Analysis

ITA will deliver a LoadRunner document that will summarize the test, problematic areas, and recommendations. The ITA team will also be expected to monitor and document the areas outlined in Table 7.1. ITA is expected to deliver this analysis within 3 days after each test cycle.

6.2.2. CSC Capacity Analysis

CSC will complete a spreadsheet, which captures information on current capacity percentages. This information will be used to better plan the performance tests and for capacity planning at the conclusion of all the test cycles.

6.2.3. CSC Performance Test Data

The Performance Monitoring Areas, found in Table 7.1, provide a guide as to the type of data that will need to be collected. CSC should decide on the best format for providing this data and summary of test results. The data should be collected at a five minute sampling points, unless otherwise suggested during the test. CSC is expected to deliver this data and summary of test results within 2 days after each test cycle.

6.2.4. CSC Performance Test Summary Analysis

At the conclusion of the performance tests, CSC will provide a document containing general comments, summary of capacity issues, and effective capacity.

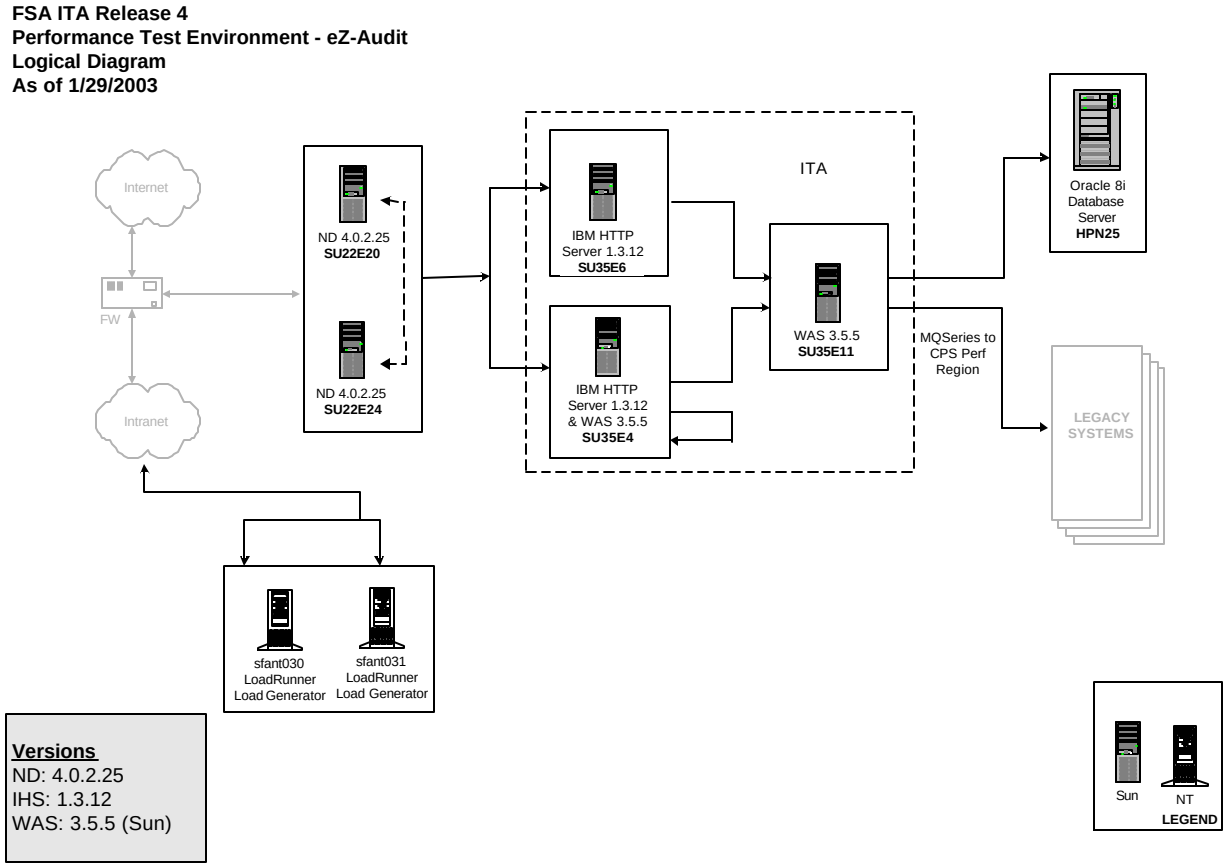
6.2.5. eZ-Audit Development Team Test Summary Analysis

At the conclusion of the performance tests, the development team will provide a document containing a list of any recommended application changes and overall application performance comments.

7 Technical Infrastructure

7.1. eZ-Audit Performance Test Environment

eZ-Audit Performance Test Environment Diagram



7.1.1. Performance Test Environment Requirements

- This environment mirrors the proposed production environment as closely as possible.
- Oracle Test Server should be configured to handle peak session usage.

- eNetwork Dispatcher Load Balancing will handle 250 concurrent users.

7.1.2. Configurations

- Network Dispatchers: SUE220 / 1 CPU / 1 GB RAM: SU22E20 Primary, SU22E24 Secondary. OS: Solaris 2.8 and Network Dispatcher 4.0
- Web Servers: SU35E4 (4 CPUs and 2 GB Memory), SU35E6 (4 CPUs and 2GB Memory). OS: Solaris 2.6 and IBM HTTP Server
- App Server: SU35E11 (4 CPUs and 2 GB Memory). OS: Solaris 2.6 and WAS 3.5.5

8 Performance Monitoring

8.1. Performance Monitoring Table

The table lists each performance area, it's associated performance monitoring points, a general description of the performance area, and the group responsible to monitor the area. This document will be supplied to those monitoring the test. It will ensure that all required areas would be monitored.

Performance Areas	Performance Monitoring Point	Description	Monitored By:
Run Time	• Total memory available for the JVM • Amount of free memory for the JVM	Application server - Memory used by a process as reported by the JVM.	ITA
Database connection pools	• Average size of the connection pool (number of connections) • Average number of threads waiting for a connection • Average wait time in milliseconds for a connection to be granted • Average time the connection was in use	Application server - Reports usage information about connection pools for a database.	ITA
Servlet engines	• Average number of concurrent requests for a servlet • Amount of time it takes for a servlet to perform a request • Average number of concurrently active HTTP sessions.	Application server - Reports usage information for Web applications, servlets, Java Server Pages (JSPs), and HTTP sessions.	ITA
Network Dispatcher	• Completed number of connections per web server • Number of connection errors per web server • Active number of connections to the web servers	eNetwork Dispatcher is an IBM load-balancing tool. It balances http requests between web servers.	ITA

CPU utilization	• Network Dispatcher Server (SU22E20 and SU22E24) • 2 web servers (SU35E4 and SU34E6) • 2 application servers (SU35E4 and SU35E11) • Database server (HPN25) • Database (EZTST)	Depicts the utilization of the CPU. High CPU utilization can be an indicator of a CPU bottleneck. CPU bottlenecks may occur when Global CPU utilization exceeds 75%. However, some workloads can operate with very high CPU utilization with the CPU becoming a bottleneck.	CSC
Memory utilization	• Network Dispatcher Server (SU22E20 and SU22E24) • 2 web servers (SU35E4 and SU34E6) • 2 application servers (SU35E4 and SU35E11) • Database server (HPN25) • Database (EZTST)	Indicates the utilization of memory. If memory utilization is below 95%, it is not a bottleneck. Memory can reach 100% utilization without necessarily being a bottleneck. The combination of high memory utilization and Virtual Memory reads & writes indicates that memory is a bottleneck.	CSC
Disk I/O	• Network Dispatcher Server (SU22E20 and SU22E24) • 2 web servers (SU35E4 and SU34E6) • 2 application servers (SU35E4 and SU35E11) • Database server (HPN25) • Database (EZTST)	Illustrates the percentage of time that a disk I/O is pending on a disk device. High disk utilization can be an indicator of a disk bottleneck. Disk utilization greater than 50% may indicate a disk bottleneck. The service times, not charted, will determine if the I/O subsystem is performing poorly.	CSC
Network Utilization	• Connections from firewall to eNetwork Dispatcher • eNetwork Dispatcher to Web Servers • Web servers to Application servers • App Servers to Oracle database servers • App servers to CPS mainframe	The bandwidth required to support an application. It can refer to the application traffic in and out of a data center, or between servers.	CSC

Throughput	• Bytes per second	Volume processed in a specified period by the system or system component	ITA
Hits Per Second	• Hits per second	The number of hits per second on the application.	ITA
User Response Times	• Average, minimum, and maximum times for SSL pages • Average, minimum, and maximum times for non-SSL pages	Elapsed time between two events measured at specific points	ITA
Servlet Performance	• Servlet and JSP performance	The performance of each of the servlets and JSPs as they are accessed by the test script.	ITA
Database Optimization	• Database performance • Tables and Indexes • Database calls	The database performance should be monitored. Oracle database should be optimized.	CSC
Application Performance	• Application Code	eZ-Audit will monitor the application log file(s). Monitor and optimized the application code.	eZ-Audit Team

Appendix A – School Volume Estimate

The table below uses the assumptions in section 4 to formulate volume estimates for school users.

School Annual Submission Estimate	
# of submissions using eZ-Audit	4500
Peak Submissions / month	1000
Avg work days per month	20
Avg hours / day system is in use	10
Avg time / submission(in hours)	1
Avg pages for submission including Login and additional reviews	15
System Hours / Month	200
Sessions / hour average	5
50% of submissions in a month are in 1 week	500
Peak Hour in peak week is 5 times avg hour	50
20% contingency	10
Total Concurrent Users	**60**
Time between pages(in hours)	0.066667
Page Views per hour	**900**
Page views per minute	15
Page views per second	0.25

Appendix B – Additional School Requests Estimate

The tables below estimate additional school requests of the eZ-Audit system for status checks and additional submissions. These estimate use the assumptions in section 4.

School Status Check Estimates	
Number of Submissions	4500
Number of times per year they will check status	5
Time required to check status(in hours) = 2 minutes	0.033333
Total system time required per year(in hours)	750
Total system hours per year	2400
Total status checks per day	93.75
Peak Day multiplier	5
Peak hour multiplier	5
Total status checks in peak hour	**234.375**
Avg Concurrent Status checks	**7.8125**

Additional School Submissions / Use Estimate	
Total Schools	4500
% who have other requests	25%
Blended time for other requests(in hours)	0.5
System hours per year	562.5
Average Status Checks per day	4.6875
Peak day multiplier	3
Peak hour multiplier	3
Peak Other submissions per hour	**4.21875**
Total peak concurrent users	**2.109375**

User Administration	
# of submissions using eZ-Audit	4500
Peak Submissions / month	1000
Avg work days per month	20
Avg hours / day system is in use	10
Avg time / submission(in hours)	0.08
Avg pages for user creation	3
% of users created in peak week	20%
Avg Users Created per Institution	5
Total Users Create in peak week	1000
System Hours / Month	200
Time between pages(in hours)	0.028
Total Page Views in peak week	3000
Page Views per hour	**300**
Page views per minute	5
Page views per second	0.083

Appendix C – FSA Usage Estimate

The table below is the eZ-Audit estimate for FSA concurrent sessions and page views using the assumptions in section 1.4.3.

FSA Concurrent User Estimate	
FSA Users	300
% Users Logged in at peak(i.e. not at lunch, in a meeting, etc.)	45%
% of logged in users actively using the system(i.e. not reviewing printouts, on phone, or using another application such as PEPS)	15%
Peak users logged in	135
Peak users active	**20.25**
Average time per page(in hours)	0.083333
Pages per hour per user viewed	12
Total Page views per hour	**243**
Total Page views per minute	4.05
Total Page views per second	0.0675