



U.S. Department of Energy
Office of Inspector General
Office of Audit Services

Audit Report

Management of the Department's Data Centers at Contractor Sites

DOE/IG-0803

October 2008




Department of Energy

Washington, DC 20585

October 30, 2008

MEMORANDUM FOR THE SECRETARY

FROM:


Gregory H. Friedman
Inspector General

SUBJECT:

INFORMATION: Audit Report on "Management of Data Centers at Contractor Sites"

BACKGROUND

The Department of Energy (Department) and its facility contractors maintain numerous data centers across the complex that varies in both size and complexity. These centers, which house data and voice hardware and software, and a variety of network equipment, typically require specialized security, power, and cooling capabilities. The centers provide common information technology (IT) services in support of the Department's most critical functions, including scientific research and national security activities. The cost to acquire data center space and the hardware, software and services necessary to sustain operations are significant – amounting to about \$331 million in Fiscal Year 2007.

Recent reviews by the Office of Inspector General (OIG) have identified a number of areas in which the Department could improve the efficiency of its vast IT efforts. For example, a series of reports revealed that significant operating savings were available by aggregating demand for IT goods and services. A number of Federal and private sector organizations have also realized meaningful savings by consolidating data centers, centralizing delivery of common services, and employing more efficient network and computing technologies. Based on these findings, we initiated this audit to determine whether the Department had effectively managed its data centers at contractor sites.

RESULTS OF AUDIT

The Department had not always taken advantage of opportunities to improve the efficiency of its contractor data centers. In particular, we evaluated operations at six data centers and concluded that:

- Despite opportunities to consolidate requirements and physical operations, the six sites maintained as many as 140 independent data centers. These data centers duplicated many of the functions or services provided by other co-located centers;
- In many instances, multiple data centers located at the same site separately provided common services such as email, data storage and libraries – services that were not unique and which appeared to readily lend themselves to consolidation; and,



- Four of six sites made only limited use of more efficient hardware technologies that conserve energy and reduce operational costs.

We found that neither the National Nuclear Security Administration (NNSA) nor the Department's program offices had required contractors to focus on reducing overall data center costs, including those related to energy use. Specifically, officials had not provided guidance or adequately communicated best practices to contractors and field sites regarding opportunities to consolidate data centers and improve the efficiency of IT hardware and services. Such operating enhancements would help to ensure that taxpayer-provided funds are used economically and efficiently.

As outlined in the body of the attached report, our audit disclosed a number of areas in which improvements are possible. To put this in some perspective, at just the six sites included in our review, we estimated that the Department could save over \$2.3 million annually through the use of more efficient hardware technologies that enable the consolidation of servers. Such actions would also make data centers more energy efficient, consistent with Departmental goals.

We noted, however, several signs of progress in this arena. For example, the Department's Office of Energy Efficiency and Renewable Energy (EERE) has partnered with industry and government agencies to improve energy efficiency in the nation's data centers. In an effort to reduce energy consumption in the Nation's data centers by 10 percent by 2011, EERE has developed assessment tools and provided information and training on data center energy efficiency to the Department, other Federal, and private sector organizations. Lawrence Berkeley National Laboratory has also undertaken efforts to improve the efficiency of data centers by designing systems to reduce energy consumption. At Headquarters, the Office of the Chief Information Officer has consolidated common services and implemented application hosting for most program elements and a similar initiative is being considered for Federal data centers across the complex. Further, several Department of Energy contractor-operated sites have taken steps to consolidate services, including e-mail. While these efforts are commendable, a number of opportunities remain to address redundant contractor data centers and services, and to consolidate activities. Accordingly, we have made recommendations designed to help the Department optimize the operation of its contractor-operated data centers across the complex.

MANAGEMENT REACTION

NNSA management concurred with our recommendations and agreed to take corrective action. Consolidated comments provided by other Department elements indicated that they also concurred with each of our recommendations and planned certain corrective actions. However, management expressed disagreement with several of our conclusions. Management's comments are discussed in greater detail in Appendix 3.

Attachment

cc: Acting Deputy Secretary
Administrator, National Nuclear Security Administration
Under Secretary of Energy
Under Secretary for Science
Chief Information Officer
Chief of Staff

REPORT ON MANAGEMENT OF THE DEPARTMENT'S DATA CENTERS AT CONTRACTOR SITES

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Management of Contractor Data Centers

Contractor Data Centers

The Department of Energy (Department) had not always taken advantage of opportunities to improve the operational and energy efficiency of its data centers at contractor sites. Despite opportunities to consolidate requirements and physical operations, sites, and programs within sites, independently maintained numerous data centers that, in many respects, duplicated functions or services provided by other co-located centers. In many instances, multiple data centers located at the same site separately provided common services such as email, data storage and libraries – services that were not unique and which readily lend themselves to consolidation. Sites also made only limited use of more efficient hardware technologies that conserve energy and reduce operational costs, practices that could ultimately permit the consolidation of data centers.

Consolidation

Many of the entities at the six field sites we visited individually maintained data centers despite opportunities to consolidate and centrally manage these operations. At Argonne National Laboratory (Argonne) and Lawrence Livermore National Laboratory (Livermore), for example, several programs maintained their own center, with little or no coordination of data center services between the programs. Officials at Los Alamos National Laboratory (Los Alamos) informed us that there may be as many as 100 unclassified data centers on the site, most of which they believed could be consolidated. In addition, we identified almost 40 data centers at the other five sites we visited. Annual costs to operate and maintain just 14 of these data centers exceeded \$15 million. Officials told us that they did not maintain or have cognizance over costs for the other 100 plus data centers because the costs were either built into the overhead cost for the building or the site did not individually charge for each center. It should be noted that, subsequent to our review at Livermore, officials told us that Livermore has begun to actively pursue consolidating some of their institutional services into their new institutional data center.

Many of the sites we visited had also not taken action to utilize available excess data center space. Four of the data centers we visited had excess space and had offered the space to other organizations. However, organizations within those sites chose not to take advantage of the

opportunity for consolidation and continued to maintain their own functionally duplicate data center. An official at Argonne stated that each program maintained its own center because funding for the data centers is individually received by each program. Nonetheless, the official observed that there may be opportunities for consolidation.

Despite opportunities to combine services, sites operating multiple data centers often housed servers providing common services that lend themselves to consolidation. Many sites had consolidated enterprise, or corporate systems, such as payroll and other financial services within a single data center. However, many of these same sites were still operating separate common services, such as email, data storage, and data libraries at various other data centers on site. For example, Argonne had five scientific data centers that ran similar data storage and libraries for each center, services which may be capable of being consolidated and housed in a single center.

Application Hosting and Virtualization

Sites made only limited use of more efficient technologies, such as application hosting or virtualization environments. For example, only one site reviewed utilized an application hosting environment. Application hosting consists of a central or host organization providing full information technology (IT) services, including housing, securing, operating, and maintaining the servers or other devices for client organizations. This environment eliminates or decreases the need for each organization to individually operate and support its own servers, thereby reducing overall costs. We found that all six sites we visited made some use of a data center housing environment, in which multiple organizations individually operate and maintain their own servers and applications in a centralized environment. However, while this practice reduced the need for individual data centers, each organization still utilized its own resources to operate and maintain its equipment – an inefficient and at least partially duplicative support model.

Additionally, only three of the sites we visited, Los Alamos, Lawrence Berkeley Laboratory, and Sandia National Laboratory (Sandia), had taken limited advantage of existing technologies, such as virtualization, to consolidate their file servers. Virtualization allows

multiple operating systems to run concurrently on a single server, thus maximizing the use of the machine, minimizing the need for multiple servers for each operating system, and reducing energy consumption. At Los Alamos, even though virtualization was used only on a limited basis, officials estimated that their efforts would achieve annual savings of \$1.6 million. These same officials noted that significant underutilization of hardware existed prior to the move to virtualization. They also stated that virtualization is currently only being applied to business and institutional services; however, they hope to expand the process in the future and anticipate that they will be able to further reduce the number of physical servers by 50 percent. Officials at Sandia stated they had over 100 virtual machines, just a partial consolidation of the site's servers, resulting in annual savings of more than \$700,000.

Data Center Guidance and Management

Program officials and the National Nuclear Security Administration (NNSA) had not required contractors to focus on reducing data center costs and energy use. Also, best practices and opportunities to consolidate and improve the efficiency of IT hardware and services had not been communicated to contractors and field sites. Sites had not monitored server utilization to determine whether excess capacity existed or whether efficiencies could be achieved through virtualization of file servers.

Program Guidance

Despite Federal requirements that agencies maximize the value of their IT resources, NNSA and the Department's program offices had not provided guidance to contractors and field sites requiring them to examine opportunities for more cost-effective management of their data centers. Although the Department had been successful in consolidating operations and reducing data center costs in certain areas, officials had not taken action to require contractors to minimize costs. The Department had undertaken an effort to, among other things, consolidate its Federal data centers and reduce the number of file servers by creating a Federal application hosting environment as a part of the Department Common Operating Environment initiative at Headquarters. Officials from the Office of the Chief Information Officer estimated that these consolidation efforts would permit them to save or avoid costs of about \$15 million in just the first year. Also, both Federal and certain contractor

organizations have realized savings as a result of several relatively small, independent initiatives to reduce the number of servers through virtualization. Despite these successes, these best practices had not been communicated to contractors at field sites nor had the program offices directed them to determine whether they could achieve similar cost efficiencies through data center and file server consolidations.

Site officials we spoke with identified several reasons for not pursuing data center consolidation. Specifically, some sites indicated that their data centers had power and cooling problems, so they did not want to consolidate operations and possibly aggravate the situation. However, the use of more efficient information technologies, such as virtualization, can significantly reduce the number of servers necessary to run applications, resulting in corresponding savings in power and cooling. Some sites indicated that their funding was constrained and without specific direction, they wanted others to take the lead on using innovative approaches, such as virtualization. However, virtualization and application hosting are proven technologies that, as demonstrated by both Federal and private sector experience, result in near term savings.

Monitoring Server Utilization

Most of the sites we reviewed were not aware or were unable to quantify the benefits, including cost and energy savings, available from virtualization because they did not monitor server utilization. Even though they did not specifically monitor use of most systems, officials at Los Alamos told us that they believed that server hardware is underutilized, resulting in higher costs for data center maintenance and administration. Only one of the six sites visited, Livermore, monitored its server utilization at one of its data centers to ensure that excess capacity was not being acquired and existing computer resources were being maximized.

Opportunities for Savings

Consolidation of data centers through practices such as application hosting, virtualization and consolidation of common services could permit the Department's contractors to realize significant savings and achieve meaningful reductions in energy consumption.

Minimizing Costs

Without improvements in Department guidance and contractor monitoring of server utilization, contractors and field sites will continue to spend more than necessary on data center operations. Specifically, sites reported they had 2,433 enterprise servers¹ at five of the six sites we visited, many of which could be candidates for consolidation or virtualization. Two field sites reported they were able to eliminate, on average, 60 percent of the servers they targeted for virtualization. For example, the Pacific Northwest National Laboratory (PNNL) reported that it realized savings of approximately \$175,000 by consolidating only 113 servers. By extrapolating the savings that PNNL realized, which were the most conservative reported by various sites we polled, the Department may be able to realize savings of approximately \$2.3 million just through virtualization and consolidation of servers at just five of the six sites we visited.

Experience by Departmental organizations and results observed in industry also indicate that the projected savings by utilizing more efficient server technology are likely achievable. For example, Department organizations from which we obtained data indicated that their limited efforts in this area have already resulted in \$1 million in savings gained through consolidation efforts. A recent study on return on investments, conducted in July 2006 by industry experts, similarly reported that the Department saved over \$2.3 million by performing very limited virtualization of servers at just eight sites. These savings result from lower costs to acquire and maintain hardware, as many applications, common services and/or operating systems can run on the same server. Industry officials noted that virtualization typically reduces a system administrator's workload by 60 to 90 percent.

Consolidation and Reduced Energy Consumption

While investment in server and data center consolidation may initially exceed normal operating costs, industry experts and contractor officials with successful consolidation experience agree that the payback period is

¹ An enterprise server is defined as a computer system which performs an essential service for the organization, such as file servers, email servers, print servers, and web servers. It does not include research and development and other scientific computers.

generally short and return on overall investment is substantial. Reductions in data center space can, in many instances, result in corresponding decreases in data center lease and maintenance costs, which are typically 10 to 100 percent more expensive than normal office space. For example, the Defense Contract Management Agency recently consolidated 18 data centers into 2 through a virtualization process, reportedly saving the organization hundreds of thousands of dollars a year.

Additional savings can also be achieved through reduced energy consumption through server and data center consolidation. For example, an August 2007 study by the Environmental Protection Agency, relying on data provided by Hewlett Packard, determined that data center managers could cut energy consumption by as much as 40 percent if they adopted the most efficient technologies available. The study concluded that the government could save over \$959 million in five years just in reduced energy costs by adopting technologies to consolidate servers and enhance their efficiency. Reducing energy consumption through server and data center consolidation will also help achieve the President's Order calling for executive agencies to improve energy efficiencies and reduce carbon emissions by three percent annually.

RECOMMENDATIONS

To help improve the efficiency of contractor-operated data centers, we recommend that the Administrator, NNSA, and the Under Secretaries of Energy and for Science, in coordination with the Department and NNSA's Chief Information Officers:

1. Share best practices and provide guidance and direction regarding data center consolidation through application hosting and server consolidation;

We further recommend that the Administrator, NNSA, and the Under Secretaries of Energy and for Science:

2. Require contractors and field sites to actively monitor server utilization and take action to more fully utilize existing server capacity; and,

-
3. Require contractors and field sites to consolidate servers, data centers, and common services, where appropriate.

MANAGEMENT REACTION

NNSA management concurred with our recommendations and noted that after considering any unique mission needs and best business practices, they will provide best practice information, guidance, or direction related to consolidation; monitor utilization; and encourage the appropriate consolidation of services. Department management generally concurred with the recommendations in the report and indicated that it supports the report's goal of improving data center efficiency and reducing the impact on the environment. The Department indicated that it planned to continue to share best practices through existing forums and would publish additional guidance if necessary, but contemplated no additional action at this time. Although it did not detail specific actions to be taken, management indicated that it would take steps to require laboratories and sites to monitor and more fully utilize existing servers, and where appropriate, consolidate servers, data centers and common services.

Department management, however, questioned the accuracy of some portions of the report. While management agreed there will be cost savings from data center consolidation opportunities, they felt the savings would be significantly less than those stated in the report. They believed the calculation used in the report includes servers that do not easily lend themselves to virtualization. They also believed the calculation included estimated savings from early stage virtualization efforts, where advantage can be taken of the systems easiest to virtualize and may not be representative of virtualization savings at later stages of the effort.

Department management also noted that multiple services at a certain site can not always be consolidated. They stated that providing a few systems with the same services may be more appropriate, in some cases, because of user needs and efficiency. In addition, management believed the report advocates consolidating all servers and scientific computing into one physical location. They stated that this scenario is not always cost-effective, there are continuity of operation issues involved with such consolidations, and physical security requirements must be considered.

**AUDITOR
COMMENTS**

NNSA management concurred with our recommendations and agreed to take corrective actions that are responsive to our recommendations.

While other Department elements concurred with each of the recommendations, action proposed to address recommendation one was not fully responsive. In particular, management planned to take no additional action to share best practices and provide guidance and direction regarding data center consolidation. As noted in our report, action beyond that currently being taken by program officials is necessary to ensure that contractors focus on reducing data center costs and energy use. While management indicated that it would take action to address recommendations two and three, it did not provide specifics as to how the corrective actions would be accomplished.

Based on management's comments on our draft report, we asked field sites to correct and provide updated information regarding servers. This new data specifically excluded research and development and other scientific servers. Based on this data, we re-calculated the savings available from server virtualization alone and believe that they could amount to as much as \$2.3 million per year. These potential savings are, in our opinion, very conservative in that they only include savings available through virtualization at five of the Department's sites and do not include other savings typically available through consolidation. Specifically, cost efficiencies related to data center consolidation and reduced lease and maintenance, labor, and energy costs were not included in the projected savings.

Both PNNL and Los Alamos reported that they expect to be able to eliminate 60 percent of the total servers at their respective sites through virtualization. PNNL and other laboratories' savings were determined from early stage virtualization. For that reason, we used the most conservative of all projected savings (reported savings ranged from \$1,550 to \$8,000 per server) in our projected savings calculation.

Contrary to management's comments, we do not believe that one all-purpose system is always the most efficient and that there are instances where consolidation may not be appropriate. Because of continuity of operations issues, we do not advocate consolidating all servers and scientific

computing into one physical location, except where appropriate. As we noted in the Methodology section of this report, we also recognized that there are data centers and servers that can not be consolidated or moved from their current location for legitimate business and scientific purposes or security considerations. Nonetheless, we observed numerous opportunities for consolidating duplicative services, such as file servers, email, data storage, and data libraries, services that can, and have been, consolidated at some Department sites.

Appendix 1

OBJECTIVE

To determine whether the Department of Energy (Department) had effectively managed its data center and application hosting environments at contractor sites.

SCOPE

The audit was performed between September 2006 and December 2007 at Departmental Headquarters in Washington, DC, and Germantown, MD, Argonne National Laboratory in Argonne, IL; Fermi National Accelerator Laboratory in Batavia, IL; Lawrence Berkeley Laboratory in Berkeley, CA; Lawrence Livermore National Laboratory in Livermore, CA; Sandia National Laboratory in Albuquerque, NM; and Los Alamos National Laboratory in Los Alamos, NM. We also obtained information from Pacific Northwest National Laboratory (PNNL) in Richland, WA.

For our review, we defined a data center as a room or facility used to house computer systems and associated components that required special environmental controls, such as extra power and cooling. We did not include rooms and servers that could not be removed from their current location for legitimate business and scientific purposes. We also did not include supercomputer rooms, as those do not readily lend themselves to consolidation.

METHODOLOGY

To accomplish our objective, we:

- Reviewed applicable laws and directives pertaining to information technology management, including the Clinger-Cohen Act of 1996 and DOE Order 200.1;
- Reviewed applicable standards and requirements issued by the National Institute of Standards and Technology;
- Inquired about any data center or application hosting guidance and practices throughout the organization;
- Held discussions with field site officials and officials from various Departmental offices; and,
- Reviewed reports by the Office of Inspector General and the General Accounting Office.

To calculate potential savings that could be achieved by virtualization of servers, we first examined the savings reported

Appendix 1 (continued)

by four Department entities that had eliminated servers through virtualization. The savings identified ranged from approximately \$1,550 to \$8,000 per server. We chose to use as our base the most conservative savings, which were reported by PNNL. PNNL reported overall savings of \$175,000 by consolidating 136 servers onto 23 physical hosts, thus saving approximately \$1,550 per server eliminated. Two field sites reported they were able to eliminate, on average, 60 percent of the servers through virtualization. Therefore, we calculated our savings by first multiplying the 2,433 enterprise servers reported by five of the six sites we visited by 60 percent. These server counts did not include research and development and other scientific computers. The resulting number of 1,460 servers represents the number of enterprise servers that can potentially be eliminated through virtualization at the 5 sites. Next, we multiplied the 1,460 servers that could be eliminated by \$1,550 and determined that the Department could achieve savings of approximately \$2.3 million at just 5 of the 6 sites we reviewed.

The evaluation was conducted in accordance with generally accepted Government auditing standards for performance audits and included tests of internal controls and compliance with laws and regulations to the extent necessary to satisfy our objective. Accordingly, we assessed internal controls regarding data centers and application hosting environments. Because our review was limited, it would not necessarily have disclosed all internal control deficiencies that may have existed at the time of our evaluation. We also evaluated the Department's implementation of the *Government Performance and Results Act* and determined that it had not established performance measures for data centers and applications hosting environments. We relied on computer processed data and validated that data to the extent necessary to satisfy our audit objective.

An exit conference was held with Department officials on October 28, 2008.

PRIOR REPORTS

Office of Inspector General Reports

- *Special Report on Management Challenges at the Department of Energy* (DOE/IG-0782, December 2007). This annual special report details the Office of Inspector General's (OIG) overall concerns. The management challenges identified in this report include contract management, cyber security, environmental cleanup, human capital management, project management, safeguards and security, and stockpile stewardship. In addition, the OIG identified a watch list of areas that are of a concern but do not amount to a management challenge. The watch list items are infrastructure modernization and worker and community safety. Furthermore, the OIG identified a national trend concerning energy consumption.
- *Facility Contractor Acquisition and Management of Information Technology Hardware* (DOE/IG-0768, June 2007). Over the past three years, the Department of Energy (Department) has spent over \$400 million on information technology (IT) hardware; however, problems have been noted in its ability to effectively manage its acquisition and control of IT hardware. The audit noted that five of seven sites reviewed had not developed or fully implemented hardware specifications and brand standards for computers and related peripherals, causing at least \$4.7 million in unnecessary expenditures over the three-year period. The report concluded that the Department could potentially realize savings of about \$16.6 million over five years at the sites reviewed by better controlling hardware costs and implementing standards for certain equipment.
- *The Department's Efforts to Implement Common Information Technology Services at Headquarters* (DOE/IG-0763, March 2007). The OIG found that although some progress had been made at Headquarters, five major organizations, accounting for 40 percent of the total potential user population, were not migrated to the common operating environment within the first year as planned, thus preventing the realization of the full \$15 million in expected first year cost savings. The OIG recommended that completion of Headquarters' migration to the Department Common Operating Environment be accomplished prior to implementation at field sites. Additionally, formalization of migration plans, requirements analyses, and cost-benefit analyses should be accomplished.
- *Information Technology Support Services at the Department's Operating Contractors*, (DOE/IG-0725, April 2006). The Department continues to face a number of challenges related to contractor procured or furnished IT support services, including contractors that did not aggregate demand to leverage or reduce costs; per user costs that varied substantially between sites; costs for co-located contractors that varied by as much as 50 percent per user; and many contractors that did not actively capture or track costs in a manner that facilitated Federal oversight. This occurred because the Department had

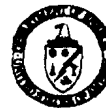
Appendix 2 (continued)

not established a corporate-wide approach to providing and managing IT support services that included contractor-managed sites. In addition, Federal officials charged with monitoring contractor performance did not always employ contracting incentives to help reduce costs. As a result, there is the potential for significant cost savings at contractor-managed sites. For example, we identified the potential for reducing IT support costs by over \$14 million for just the contractor-managed sites co-located at the Hanford complex.

- *Management of the Department's Desktop Computer Software Enterprise License Agreements* (DOE/IG-0718, January 2006). This audit was conducted to determine whether the Department was effectively managing the acquisition and maintenance of desktop software across the agency. Seven of sixteen organizations reviewed were found to have acquired software through locally established agreements or contracts at prices that were as much as 300 percent higher than those available through the Department-level agreements. Although significant savings were possible, enterprise-wide agreements for common tools such as security and anti-virus software had not been established. Additionally, various locations and organizations acquired 14,000 encryption software licenses, paid the required annual maintenance fees for a number of years; however, never used the licenses.

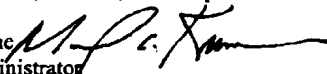


Department of Energy
National Nuclear Security Administration
Washington, DC 20585



JUL 22 2008

MEMORANDUM FOR Rickey R. Hass
Assistant Inspector General
for Environment, Science, and Corporate Audits

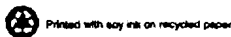
FROM: Michael C. Kane 
Associate Administrator
for Management and Administration

SUBJECT: Comments to Draft Report on Management of Data
Centers; A06TG038; IDRMS No. 2006-29792

The National Nuclear Security Administration (NNSA) appreciates the opportunity to review the Inspector General's (IG) draft report, "Management of Data Centers at Contractor Sites." We understand that, based on the potential to reduce costs, the IG initiated this audit to determine whether the Department/NNSA is effectively managing its data centers at its contractor sites.

We acknowledge the fact that we have not always taken advantage of opportunities to improve operational efficiencies. Based on your work, NNSA acknowledges the need for the recommendations contained in the draft report. After considering any unique mission needs and best business practices, NNSA will provide best practice information, guidance, or direction related to consolidation; monitor utilization; and, encourage the appropriate consolidation of services.

It is important to note that the reference to Lawrence Livermore having programs maintain their own centers with little or no coordination of data center services is not completely accurate. Over the past year, Lawrence Livermore has built and moved into a new institutional business data center and now has the capacity to co-locate more of its institutional applications. There are discussions with program entities (National Ignition Facility and the National Atmospheric Release Advisory Center, to name two) to explore opportunities to move assets to the new data center. Since the data center has only recently opened, not all of the overhead funded servers have been co-located and consolidated. The second half of the data center requires increased cooling capacity which is planned for Fiscal Year 2009. Lawrence Livermore will consider, at that time, the movement of some of the unclassified servers and will consider more consolidation. With any consolidation, programmatic need-to-know considerations are driving factors in whether servers may be consolidated with other servers. Lawrence Livermore is



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Appendix 3 (continued)

actively pursuing consolidation; therefore the comment that there is little or no coordination of data center services between programs is not accurate.

Should you have any questions about this response, please contact Richard Speidel, Director, Policy and Internal Controls Management.

cc: Linda Wilbanks, Chief Information Officer
Camille Yuan Soo-Hoo, Manager, Livermore Site Office
David Boyd, Senior Procurement Executive
Karen Boardman, Director, Service Center

Appendix 3 (continued)



Department of Energy
Washington, DC 20585

August 1, 2008

MEMORANDUM FOR RICKEY R. HASS
ASSISTANT INSPECTOR GENERAL
FOR ENVIRONMENT, SCIENCE,
AND CORPORATE AUDITS
OFFICE OF INSPECTOR GENERAL

FROM: GEORGE J. MALOSH
DEPUTY DIRECTOR FOR FIELD OPERATIONS
OFFICE OF SCIENCE

SUBJECT: Response to Inspector General (IG) Draft Report,
"Management of Data Centers at Contractor Sites"

Thank you for the opportunity to review and comment on the draft report, "Management of Data Centers at Contractor Sites." The following is a Departmental consolidated response, which considers comments from the Office of the Chief Information Officer (OCIO), the Under Secretary of Energy, and the Office of Science (SC).

DOE strongly supports the goal of the IG to improve data center efficiency and reduce the impact on the environment. However, DOE believes this report misrepresents the potential cost savings, the management approaches, and the day to day operations of DOE laboratory and site systems. It may not be appropriate to simply apply models from industries that are not involved in scientific research and engineering to the DOE laboratories and sites.

The statement that "Without improvements in Department guidance and contractor monitoring of server utilization, contractors and field sites will continue to spend more than necessary on data center operations." may not be entirely accurate. The laboratories and sites are always looking for ways to minimize costs, such as those related to data center operations, so that they can maximize the funding available to perform their mission work for DOE.

There will be cost savings from some opportunities for further data center consolidation and server virtualization and the labs/sites are aggressively pursuing these savings. However the cost savings will be significantly less than stated.



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Appendix 3 (continued)

The projected cost savings in the report is calculated as follows: $\$7.3 \text{ M} = 0.6$ (elimination efficiency) X 7,835 (estimated number of servers to be consolidated) / 113 (number of servers at PNNL used in the example) X \$175K (claimed savings for PNNL).

The issue for the above calculation is the 7,835 servers as being indicative for the four labs referenced. PNNL would only have 300-400 as their total base number of servers that would likely benefit from virtualization. The only way to get to 7,835 servers for four labs is to have included scientific servers. Running virtualization software for business process servers such as email, calendaring, payroll, web servers, etc. is usually very effective. Running virtualization software on scientific and engineering applications in most cases will actually lower the performance of the server as measured by scientific or engineering output. Consequently, the 7,835 estimate is probably wrong by a factor of 5 to 10 and the real cost savings is a factor of 5 to 10 less than estimated.

The cost savings estimates from PNNL and other laboratories were determined from relatively early stages virtualization efforts where advantage can be taken of the systems easiest to virtualize. It may be more appropriate to use a methodology that recognizes this factor with a virtualization maturity model.

At multiple times, the report implies that because there are multiple instances of certain services at a single laboratory, there are necessarily consolidation opportunities. This is not necessarily always true. The laboratories and sites, with the exceptions of some limited administrative systems, are not comparable to large corporations or government agencies. It is not always the case that providing one all-purpose system is actually more efficient than providing a few limited purpose systems because the need to provide all possible features and platforms actually trades off with efficiency.

This report may be misleading in how it defines a "data center." It appears to be claiming that consolidating all servers and scientific computing in one physical place is clearly the most cost effective. The laboratories and sites attempt to consolidate data centers whenever possible. In many cases the up-front costs of space, fiber network distribution, power distribution and cooling systems are the driving factors rather than the costs of computing and networking systems themselves. To be cost effective, this situation must be analyzed location by location so that advantages can be taken for site specific resources and mission requirements. Most laboratories and sites run several physical locations as a virtual data center or centers as this sometimes provides the most cost effective operational solution when all costs are included. In addition, continuity of operations considerations usually require at least two or more physical locations be used.

The physical security requirements for providing appropriate cyber security must also be taken into consideration. Specifically, the physical locations and separations required to meet certain cyber security requirements must be taken into account in any concept of data center consolidation.

Appendix 3 (continued)

Recommendation 1: To help improve the efficiency of contractor-operated data centers, share best practices and provide guidance and direction regarding data center consolidation through application hosting and server consolidation.

Management Response:

DOE concurs with sharing best practices and providing guidance and direction regarding data center consolidation through application hosting and server consolidation.

On sharing best practices, the DOE National Laboratories CIOs (NLCIO) meet three or four times a year and Energy, National Nuclear Security Administration, SC, and DOE OCIO staffs are frequently present. Roughly half of the meeting time is devoted to sharing IT best practices. Data center consolidation and server virtualization projects have been subjects of this IT best practices sharing multiple times over the past several years.

DOE already performs numerous reviews on achieving mission program goals and laboratory and site operating efficiencies which includes the IT programs and activities at the laboratories and sites. As warranted by the results of these reviews in the IT area, DOE will provide appropriate guidance and direction regarding data center consolidation through application hosting and server consolidation.

Action Plan:

The existing NLCIO, DOE program offices and OCIO meetings are already providing a forum for sharing best practices for data center consolidation and deployment of server virtualization technologies.

Estimated Completion Date:

Completed. No new action is required at this time, but guidance and direction will be issued as needed per the discussion above.

Recommendation 2: Require contractors and field sites to actively monitor server utilization and take action to more fully utilize existing server capacity.

Management Response:

DOE concurs with this recommendation and will verify that the laboratories and sites are appropriately consolidating data centers and deploying server virtualization technologies including its utilization that optimize the cost efficiencies in this area for achieving their DOE mission.

Appendix 3 (continued)

Action Plan:

DOE will have all of its laboratories and sites validate they are optimizing the consolidation of their data centers and deployment of server virtualization technologies including utilization monitoring.

Estimated Completion Date:

All DOE laboratories and sites will provide the validation by no later than March 31, 2009, to their responsible DOE field/site office.

Recommendation 3: Require contractors and field sites to consolidate servers, data centers, and common services, where appropriate.

Management Response:

DOE concurs with this recommendation and will verify that the laboratories and sites are appropriately consolidating data centers and deploying server virtualization technologies including its utilization that optimize the cost efficiencies in this area for achieving their DOE mission.

Action Plan:

DOE will have all of its laboratories and sites validate they are optimizing the consolidation of their data centers and deployment of server virtualization technologies including utilization monitoring.

Estimated Completion Date: All DOE laboratories and sites will provide the validation by no later than March 31, 2009, to their responsible DOE field/site office.

If you have any questions related to this response, please contact Devon Streit at 202-586-9129.

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