



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

Audit Report

Department of Energy Efforts to
Manage Information Technology
Resources in an Energy-Efficient
and Environmentally Responsible
Manner



OAS-RA-09-03

May 2009




Department of Energy

Washington, DC 20585

May 27, 2009

MEMORANDUM FOR THE SECRETARY

FROM:


Gregory H. Friedman
Inspector General

SUBJECT:

INFORMATION: Audit Report on "Department of Energy Efforts to Manage Information Technology Resources in an Energy-Efficient and Environmentally Responsible Manner"

BACKGROUND

The *American Recovery and Reinvestment Act of 2009* emphasizes energy efficiency and conservation as critical to the Nation's economic vitality; its goal of reducing dependence on foreign energy sources; and, related efforts to improve the environment. The Act highlights the significant use of various forms of energy in the Federal sector and promotes efforts to improve the energy efficiency of Federal operations. One specific area of interest is the increasing demand for Federal sector computing resources and the corresponding increase in energy use, with both cost and environmental implications. The U.S. Environmental Protection Agency reported that, without aggressive conservation measures, data center energy consumption alone is expected to double over the next five years. In our report on *Management of the Department's Data Centers at Contractor Sites* (DOE/IG-0803, October 2008) we concluded that the Department of Energy had not always improved the efficiency of its contractor data centers even when such modifications were possible and practical.

The Department of Energy and its facility contractors are major players in this process. U.S. taxpayers invest more than \$2 billion annually in Department information technology resources, including devices that consume significant amounts of electricity. The Energy Independence and Security Act of 2007, required the Department and all other Federal agencies to improve energy efficiency and to reduce energy costs and greenhouse gas emissions. In 2008, to help achieve these goals, the Department issued operating guidance requiring the adoption and implementation of a number of information technology-related environmental stewardship practices, including enabling power management features on computers and peripherals.

Because of significant cost, energy and environmental impacts, we initiated this audit to determine whether the Department managed information technology resources in an energy-efficient and environmentally responsible manner.

RESULTS OF AUDIT

Despite its recognized energy conservation leadership role, the Department had not always taken advantage of opportunities to reduce energy consumption associated with



its information technology resources. Nor, had it ensured that resources were managed in a way that minimized impact on the environment. In particular:

- The seven Federal and contractor sites included in our review had not fully reduced energy consumption through implementation of power management settings on their desktop and laptop computers; and, as a consequence, spent \$1.6 million more on energy costs than necessary in Fiscal Year 2008;
- None of the sites reviewed had taken advantage of opportunities to reduce energy consumption, enhance cyber security, and reduce costs available through the use of techniques, such as "thin-client computing" in their unclassified environments; and,
- Sites had not always taken the necessary steps to reduce energy consumption and resource usage of their data centers, such as identifying and monitoring the amount of energy used at their facilities.

We concluded that Headquarters programs offices (which are part of the Department of Energy's Common Operating Environment) as well as field sites had not developed and/or implemented policies and procedures necessary to ensure that information technology equipment and supporting infrastructure was operated in an energy-efficient manner and in a way that minimized impact on the environment. For example, although required by the Department, sites had not enabled computer equipment power management features designed to reduce energy consumption. In addition, officials within Headquarters programs and at the sites reviewed had not effectively monitored performance or taken steps to fully evaluate available reductions in energy usage at their facilities. Without improvements, the Department will not be able to take advantage of opportunities to reduce energy consumption and realize cost savings of nearly \$23 million over the next five years at just the seven sites reviewed. We noted that the potential for reduced energy consumption at these sites alone was equivalent to the annual power requirements of over 2,400 homes or, alternatively, removing about 3,000 cars from the road each year.

Many of the available energy reduction strategies, such as fully utilizing energy-efficient settings on the many computers used by the Department and its contractors, are "low hanging fruit" in that they will provide immediate tangible energy savings at little or no cost. Others, such as a shift to thin-client computing, an environment that transfers the processing capabilities from an individual's desk to a shared server environment, will require some level of investment which can, based on available literature, be successfully recovered through reduced acquisition and support costs. In our judgment, given its highly visible leadership in energy issues, aggressive action should be taken to make the Department's information technology operations as energy efficient as possible so that it can serve as a role model for both the Federal and private sector.

To its credit, the Department had increased the number of energy-efficient computers purchased in recent years. In addition, the Office of the Chief Information Officer implemented an automated computer shutdown program at Headquarters that was estimated to save up to nearly \$400,000 per year. Furthermore, we found that certain sites had initiated actions to review a potential transition to unclassified thin-client computing; however, implementation had not yet been completed. These are positive steps, but additional action is required, and our report contains several recommendations to this end.

MANAGEMENT REACTION

Management concurred with the report's recommendations and pledged to take needed corrective actions. In separate comments, the NNSA agreed with the information contained in the report and concurred with each of the recommendations. Management's comments are included in Appendix 4.

Attachment

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

AUDIT REPORT ON DEPARTMENT OF ENERGY EFFORTS TO MANAGE INFORMATION TECHNOLOGY RESOURCES IN AN ENERGY-EFFICIENT AND ENVIRONMENTALLY RESPONSIBLE MANNER

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INFORMATION TECHNOLOGY MANAGEMENT

Information Technology Operations and Energy Consumption

Our review of seven Federal and contractor sites disclosed that the Department of Energy (Department) had not taken adequate steps to ensure that its information technology resources were managed in an energy-efficient manner and in a way that minimized impact on the environment. In particular, at each of the sites reviewed, we found that power management settings for desktops, laptops, and computer monitors were not enabled to the extent practical. In addition, none of the sites had implemented thin-client computing in their unclassified environments even though numerous industry best practices had identified such practice as a way to lower energy and acquisition costs, reduce disposal amounts, and enhance cyber security. The Department also had not always monitored the amount of energy used by its data centers, and therefore, could not justify the benefits of implementing more efficient technologies.

Power Management

The Department had not fully reduced energy consumed by its desktop and laptop computers through implementation of power management settings such as shutting down monitors, enabling computer standby, and placing a computer into hibernation when not in use. Although the Code of Federal Regulations and Executive Order 13423 – *Strengthening Federal Environment, Energy, and Transportation Management* – require Federal agencies to enable power management features on computers and monitors, we found that none of the seven sites reviewed had ensured that these settings were in place.

While the Environmental Protection Agency (EPA) noted that shutting down a computer monitor when not in use is one of the easiest things a user can do to save energy, we found that 54 of 116 (47 percent of computers sampled at 7 sites [4 Federal, 3 contractor]) failed to meet the EPA-recommended settings. For instance, each of the 20 computers reviewed at the National Energy Technology Laboratory (NETL) were set to never turn off the monitor after a period of non-use. At the Oak Ridge National Laboratory (ORNL), 8 of 18

computers were set to turn the monitor off after 48 hours, 144 times the recommended standard. Using EPA calculations, we determined that the sites reviewed could have saved over \$405,000 per year had they followed the EPA-recommended standard for monitor shutdown.

Placing a computer in standby mode after a specified period of non-use saves energy by cutting power to many of a computer's unused functions such as peripherals and hard drives. However, we found that none of the sites reviewed had uniformly implemented this setting consistent with EPA recommendations. For example, 23 of 24 computers evaluated at the Sandia National Laboratories (SNL) did not meet the EPA guidelines, including 22 computers that were configured to never go into standby mode.

In addition to standby, placing a computer into hibernation can provide additional energy savings. However, we found that nearly all of the computers reviewed did not have the hibernation feature enabled. Using EPA calculations, we determined that placing a computer into hibernation and standby mode could have saved on average \$25 per machine annually at the sites reviewed, or approximately \$1.2 million per year for the 46,435 machines reviewed. Although hibernation may not be practical for all scientific machines, the Department could realize energy cost savings for the vast majority of its computers used for non-scientific, non-technical purposes. To its credit, the Office of the Chief Information Officer (OCIO) recently implemented an automated computer shutdown program as part of its Department of Energy Common Operating Environment (DOECOE) at Headquarters that was estimated to save up to nearly \$400,000 per year.

Thin-Client Computing

The adoption of thin-client computing – a technology that depends primarily on central servers for processing activities rather than end-user desktops – can significantly reduce energy consumption. A thin-client device uses only a

fraction of the energy consumed by a standard desktop, results in acquisition and disposal savings, and enhances cyber security. However, despite successes realized in implementing thin-client computing in the classified environment, the Department had not taken action to use this technology in its unclassified environment, where appropriate.

Although thin-client computing can reduce end-user energy costs by up to 95 percent, none of the sites reviewed had implemented unclassified thin-clients. While we noted that thin-client computing would not be practical for everyone, based on estimates provided by Federal and contractor officials, we calculated that had the Department transitioned to this technology and replaced more than 10,300 desktops at the seven sites visited, energy savings of more than \$195,000 annually could have been realized. For instance, Headquarters could have replaced nearly 3,500 DOECO desktops with this platform, saving \$92,000 per year in energy costs alone. Similarly, had the Y-12 National Security Complex (Y-12) transitioned to thin-client computers, it could have reduced annual energy costs by \$18,061. While there may be some incremental increased energy usage and infrastructure costs to support a thin-client infrastructure, a Headquarters official informed us that a recent Departmental study concluded that overall energy consumption could be reduced by more than 55 percent.

At the seven sites reviewed, we determined that the Department paid \$1.2 million more than necessary in hardware acquisition costs in Fiscal Year (FY) 2008 by acquiring 2,063 desktops rather than thin-clients. In one case, Y-12 could have saved up to \$235,547 in FY 2008 by paying only about \$275 per thin-client rather than its average desktop cost of \$950. In another instance, SNL could have saved up to \$420,168 in hardware related costs over the same period by acquiring thin-clients instead of desktops. In addition, because thin-client machines generally have a life-cycle that is twice as long as a desktop and weigh only about one-fourth the

amount of a desktop, the sites reviewed may be able to avoid disposal of up to 77 tons of waste material annually.

In addition to energy and acquisition cost savings and reduced environmental impact, the use of thin-clients can significantly enhance the Department's ability to protect sensitive unclassified information by centralizing cyber security controls. Specifically, thin-clients would have permitted the Department to more effectively implement security vulnerability patches through consistent and timely patch management. In addition, user permissions, such as defining what types of devices (i.e., devices such as flash or portable hard drives) may be connected to the machine, could have been more easily controlled. Industry research has found that thin-client computing has many additional benefits, including more effective management of software licenses and increased reliability of hardware.

Data Center Energy Consumption

Although studies indicate that the amount of energy consumed by data centers is expected to nearly double in five years, the Department had not always taken the necessary steps to evaluate and reduce energy consumption and resource usage of their data centers. Numerous studies and independent articles have reported that resources used by data centers will continue to increase substantially as demand for data processing and storage increases. However, five of the field sites reviewed had not monitored the amount of energy used by their data centers and, therefore, could not justify the benefits of implementing more efficient technologies. For instance, data center officials at ORNL noted that they were unaware of the costs of operating the data center and had not coordinated with facilities personnel to monitor and reduce energy consumption. Our recent report on *Management of the Department's Data Centers at Contractor Sites* (DOE/IG-0803, October 2008) disclosed that implementing more efficient technologies, such as virtualization, could significantly reduce data center operating costs. In addition, as noted by a Department official, one of the first steps in

reducing energy consumption is to determine how much an entity is spending on energy usage in operating its data centers.

In addition, we found that even though the Department's Office of Energy Efficiency and Renewable Energy recently developed the Data Center Energy Profiler – an automated tool designed to identify numerous energy-saving opportunities within data centers – at a cost of \$465,000, none of the sites reviewed had utilized this tool. Furthermore, while NETL officials noted that they utilized cooling equipment that was energy-efficient when recently constructing a new data center facility, we found that additional energy reductions were possible had the site powered the equipment using direct current electricity, which was estimated to be up to 30 percent more efficient than what was utilized. One official estimated that even though the machine powered by direct current was more expensive, payback on this equipment could be achieved in less than two years through increased energy efficiencies and reduced maintenance costs. Notably, the Department had taken a number of actions in this area, including efforts to upgrade infrastructure of the Headquarters data center facility which will support the development of an energy improvement plan, and implementation of technologies such as virtualization at a number of field sites.

**Policies and Performance
Monitoring and Evaluation**

These problems occurred because Headquarters programs and field sites had not developed and/or implemented policies and procedures that addressed all relevant requirements for ensuring an energy-efficient information technology environment that minimized impact on the environment. In addition, a lack of adequate performance monitoring and program evaluations contributed to the Department's inability to ensure that information technology resources were managed in accordance with Federal requirements.

Policies and Procedures

Sites reviewed had not developed and/or implemented policies and procedures designed to

manage information technology equipment in an energy-efficient and environmentally sound manner. In particular, Department Order 450.1A – *Environmental Protection Program* – required programs and sites to enable power management capabilities on all computers, monitors, and other electronic equipment. However, none of the sites reviewed had developed policies and procedures to ensure that this requirement was implemented. In addition, Headquarters organizations had not developed policies requiring sites to increase the efficiency of information technology operations by minimizing data center energy usage and evaluating the use of thin-clients where possible. For instance, even though the Department recently completed a transition to classified thin-clients in which it realized enhanced cyber security and reduced costs, it had not issued guidance requiring evaluation and consideration of this infrastructure in an unclassified environment.

Performance Monitoring and Evaluation

Officials within Headquarters programs and at the sites reviewed had not effectively monitored performance to ensure that information technology resources were being managed in an energy-efficient manner and in a way that minimized impact to the environment. For instance, even though the sites reviewed operated more than 46,000 desktops and laptops, none of them had implemented a process to monitor that all power management settings were enabled to the extent practical to achieve maximum efficiencies. In most cases, power management settings were not utilized because sites permitted users to enable those functions as they deemed necessary. However, the EPA reported that enabling certain settings could save as much as \$25 to \$75 annually per machine. Similarly, our review found that annual savings of \$34 per machine could be realized at the seven sites reviewed through the implementation of commonly used power management settings.

Sites also had not taken steps to fully evaluate potential reductions in energy usage at their facilities. For instance, sites reviewed had not

obtained independent analyses of their data centers and other information technology operations to identify opportunities for efficiencies and related cost savings. Even when thin-clients were discussed, detailed project plans were not always completed or were not acted upon. For example, officials at Y-12 and ORNL stated that they had considered the prospects of implementing thin-clients, but had not completed a formal analysis to determine the benefits and, therefore, had not initiated action. Although the OCIO had evaluated different manufacturers' thin-client solutions, a formal study had not yet been conducted.

**Cost Savings and
Environmental Stewardship**

Without improvements, the Department will not be able to realize cost savings of nearly \$23 million over the next five years at just the seven sites reviewed, will continue to use more energy than necessary, and may not be able to take advantage of opportunities to help reduce harmful emissions. As noted in a recent study, Dell Computer Company expects to realize annual savings of \$1.8 million by implementing power management functions on 50,000 desktop and laptop computers. Based on our audit work, we determined that the seven sites reviewed could potentially realize similar savings of about \$7.8 million over the next five years by implementing recommended power management settings. Enabling these features complex-wide could result in significant additional savings.

The Department could also realize hardware acquisition savings of up to \$6 million over the next five years through adoption of thin-client computing at the seven sites reviewed. A transition to thin-client computing could also result in at least \$149,000 of energy-related savings, including avoiding the use of 1.9 million kilowatt hours over five years. Furthermore, based on industry data, we estimated that the sites visited could save an additional \$1.8 million per year through reduced support services costs associated with thin-client technology. Details of our cost savings calculations are included in Appendix 2.

The energy savings realized by adopting power management settings throughout the Department could reduce electricity usage by over 27 million kilowatt hours per year, or enough to power 2,453 homes. Alternatively, it could also reduce the amount of carbon-dioxide emissions created by producing the electricity necessary to power computers by 16,000 tons – equivalent to taking 2,980 cars off of the road each year. Transitioning to thin-client technology for unclassified computing could provide additional environmental benefits because these machines have double the life-cycle and weigh only about one-fourth the amount of a desktop, enabling the Department to avoid disposal of up to 77 tons of waste material annually. Furthermore, adequate analysis of energy usage in its data centers may also enable the Department to take advantage of opportunities to reduce energy consumption and realize significant cost and environmental benefits.

RECOMMENDATIONS

To address the issues identified in this report, we recommend that the Administrator, National Nuclear Security Administration, the Under Secretary of Energy, and the Under Secretary for Science, in coordination with the Department and National Nuclear Security Administration Chief Information Officers:

1. Develop and implement policies and procedures for ensuring that power management settings are enabled on all computing resources, as appropriate;
2. Analyze the costs and benefits of utilizing thin-client computing in an unclassified environment and implement the results to the extent practical; and,
3. Identify and implement mechanisms to reduce data center energy consumption, including but not limited to conducting energy usage assessments and implementing the use of existing Department automated tools.

**MANAGEMENT
REACTION**

Management generally concurred with the report's findings and recommendations. While management believed that existing policy relating to implementing power management features was sufficient, it indicated that steps will be taken to ensure that power management settings are enabled where possible. In addition, management stated that thin-client technology is not acceptable for all computer users, but noted that it will continue to evaluate the costs and benefits of implementing thin-clients throughout the Department. Furthermore, management commented that it had already initiated action to address energy consumption in its data centers as a result of our prior report on Management of the Department's Data Centers at Contractor Sites. However, National Energy Technology Laboratory officials disagreed with our observation that they could have utilized more energy-efficient cooling equipment when constructing their data center. In its comments, management also disclosed that it was concerned that our estimated cost savings may be overstated.

In separate comments, the NNSA agreed with the information contained in the report and concurred with each of the specific recommendations. The NNSA disclosed that except for a small configuration used to support mission applications, the information technology services utilized by its Federal workforce are the responsibility of the Department's OCIO. In addition, the NNSA noted that there are numerous technological and funding aspects that must be considered when implementing thin-client technology. Furthermore, management stated that it had taken action during the course of our review to promote energy efficiencies in its data centers. NNSA management indicated that it will work to implement the recommendations contained in the report.

**AUDITOR
COMMENTS**

Management's comments were responsive to our recommendations. Where appropriate, we made changes to the body of our report to address management's comments. Although we agree that the existing Departmental policy contained a requirement to implement power management

settings, we found that none of the programs or field sites reviewed had developed supporting policies and procedures relevant to specific power management settings, such as required timeframes for enabling system standby, shutdown, and hibernation. Furthermore, as noted in our report, we agree that thin-client technology is not suitable for all users, but should be evaluated and implemented where appropriate. In addition, while we agree that NETL made incremental improvement when constructing their data center, we believe based on discussions with a Department official and industry research that additional efficiencies were possible had the site utilized direct current to power its cooling equipment. Regarding our estimated cost savings, as noted in Appendix 2, we utilized conservative information when performing our calculations to help ensure that we were not overstating potential benefits. Management's comments are included in their entirety in Appendix 4.

Appendix 1

OBJECTIVE

To determine whether the Department of Energy (Department) managed information technology resources in an energy-efficient and environmentally responsible manner.

SCOPE

This audit was performed between July 2008 and April 2009 at Department Headquarters in Washington, DC, and Germantown, Maryland; the National Energy Technology Laboratory, Pittsburgh, Pennsylvania, and Morgantown, West Virginia; the Oak Ridge Office, Oak Ridge National Laboratory, and Y-12 National Security Complex, Oak Ridge, Tennessee; and, the Sandia National Laboratories and National Nuclear Security Administration (NNSA) Service Center, Albuquerque, New Mexico.

METHODOLOGY

To accomplish the audit objective, we:

- Reviewed Federal regulations and Departmental directives and guidance pertaining to management of information technology resources;
- Reviewed prior reports issued by the Office of Inspector General;
- Reviewed numerous energy consumption related documents pertaining to the Department's management of information technology resources;
- Held discussions with officials from the Environmental Protection Agency and program officials and personnel from Department Headquarters and field sites reviewed, including representatives from the Offices of the Chief Information Officer, Health, Safety and Security, Science, Fossil Energy, and the NNSA; and,
- Performed physical observations of data centers and end-user computing environments and calculated potential cost savings based on our observations and relevant supporting documentation.

We conducted this performance audit in accordance with generally accepted Government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives. The audit included tests of internal controls and compliance with laws and regulations to the extent necessary to satisfy the audit objective. Because our review was limited, it would not necessarily have disclosed all internal control deficiencies that may have existed at the time of our audit. We also assessed performance measures in accordance with the *Government Performance and Results Act of 1993* relevant to security over information systems. We found that none of the seven sites reviewed had developed measures related to our audit. We did not rely on computer-processed data to satisfy our audit objective. Management waived an exit conference.

POTENTIAL SAVINGS

To determine potential savings associated with implementing power management functions, we obtained information from each of the seven sites reviewed relevant to the number of desktop and laptop computers in use. We also utilized information regarding energy usage assumptions included in an Office of the Chief Information Officer (OCIO) study, as well as information specific to each of the other sites visited and our own physical observations. Using this information, we entered the data into an Environmental Protection Agency (EPA) calculator designed to identify potential cost savings associated with enabling power management functions. Based on the data input into the EPA tool, we determined that the seven sites reviewed could save up to \$7.8 million over the next five years by enabling EPA recommended power management settings on 46,345 desktop and laptop computers.

In addition, we calculated potential savings that could be realized by implementing thin-client technology in an unclassified environment, including costs associated with hardware acquisition, support services, and reduced energy consumption. However, our analysis did not include examination of all infrastructure support costs associated with thin-client computing, such as the potential need for more data and application servers, since these requirements will vary by site. To calculate hardware savings, we obtained information from each of the seven sites reviewed pertaining to the number and cost of machines purchased over the past two years. We also obtained estimates from site officials regarding the percentage of unclassified desktops that could be converted to thin-clients, which ranged from 20 to 50 percent. Using actual purchase data and the officials' estimates noted above, we calculated the average price paid for a desktop in fiscal year 2008. To ensure our savings were conservative, we used the corresponding percentage of the least expensive computers at each site as our baseline in calculating the average price of a desktop computer. We then compared this result to the cost of acquiring an equivalent number of thin-clients using a phased approach, including additional hardware and licenses. Based on our review, we determined that the sites reviewed could save up to \$6 million in hardware costs over the next five years.

To calculate potential support services cost savings associated with the operation of thin-clients, we utilized a third-party calculator. We input the number of potential desktops that could be converted to thin-clients, multiplied by the lowest end of the support services cost range to be conservative and determined that \$8.8 million could be saved over the next five years at the sites reviewed. In addition, energy savings associated with thin-client usage was calculated by comparing the average amount of power used by a desktop compared to a thin-client. This difference was then multiplied by the number of hours used per year (as disclosed in an OCIO study) and the cost of a kilowatt hour at each of the sites visited. Based on this calculation, we determined that \$149,785 in energy savings could be realized over the next five years.

The table shown on the next page details the possible savings the Department could realize over the next five years.

Appendix 2 (Continued)

Site ¹	Power Management Savings	Thin-Client Savings			Total
		Energy	Acquisition	Support	
NETL	\$42,383	\$944	\$150,226	\$86,700	\$280,253
ORNL	\$407,053	\$5,011	\$255,982	\$364,933	\$1,032,979
SNL	\$614,815	\$5,188	\$420,168	\$490,450	\$1,530,621
Y-12	\$252,364	\$3,057	\$235,547	\$294,808	\$785,776
NNSA Service Center	\$41,370	\$126	\$7,617	\$11,900	\$61,013
Headquarters	\$95,432	\$15,409	\$128,240	\$495,125	\$734,206
ORO	\$110,360	\$222	\$8,425	\$9,775	\$128,782
Annual Savings	\$1,563,777	\$29,957	\$1,206,205	\$1,753,691	\$4,553,630
Five-Year Savings	\$7,818,885	\$149,785	\$6,031,025	\$8,768,455	\$22,768,150

* Reflects only potential savings at a limited number of sites. We were unable to calculate Department-wide savings.

¹ The Department is currently transitioning the NNSA Service Center to the Department of Energy's Common Operating Environment (DOECOE), which will become the responsibility of the Office of the Chief Information Officer. In addition, potential savings calculated for Headquarters are based only on a review of DOECOE machines.

PRIOR OFFICE OF INSPECTOR GENERAL REPORTS

- *Management of the Department's Data Centers at Contractor Sites* (DOE/IG-0803, October 2008). The Department of Energy (Department) had not always taken advantage of opportunities to improve the efficiency of its data centers. In particular, as many as 140 data centers were found at the six sites reviewed that duplicated common services such as e-mail, data storage, and libraries. Furthermore, four of the six sites made only limited use of more efficient hardware technologies that conserve energy and reduce operational costs. The Office of Inspector General (OIG) estimated that \$2.3 million per year for these six sites could be saved through the use of more efficient hardware technologies allowing for the consolidation of servers and be more energy-efficient.
- *Facility Contractor Acquisition and Management of Information Technology Hardware* (DOE/IG-0768, June 2007). Over the past three years, the Department has spent over \$400 million on information technology hardware; however, problems have been noted in its ability to effectively manage its acquisition and control of such 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 a 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's 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.



Department of Energy
Washington, DC 20585

May 7, 2009

MEMORANDUM FOR RICKEY R. HASS, DEPUTY INSPECTOR GENERAL
OFFICE OF AUDIT SERVICES
OFFICE OF THE INSPECTOR GENERAL

FROM:

THOMAS N. PYKE, JR. 
CHIEF INFORMATION OFFICER

SUBJECT:

Department of Energy Report on "The Department's Efforts to
Manage information Technology Resources in an Energy-Efficient
and Environmentally Responsible Manner"

The Office of the Chief Information Officer (OCIO) appreciates the opportunity to provide comments to the Office of Inspector General's April 3, 2009 draft report on managing information technology resources. The OCIO and the Department fully support the efforts to reduce the nation's energy consumption and acknowledge the benefits of improving the energy efficiency of Federal operations across the DOE Complex.

To answer the recommendations in the report, the Department's Chief Financial Officer requested that the OCIO consolidate its comments with those from the various Departmental Program offices, and, as such, comments have been received from the Office of Science, the Office of Fossil Energy, and the National Energy Technology Laboratory. The National Nuclear Security Administration indicated that they would provide comments under a separate cover.

Comments to address the specific recommendations are outlined below while technical comments to the body of the report are included as an attachment.

Recommendation 1

Develop and implement policies and procedures for ensuring that power management settings are enabled on all computing resources, as appropriate.

The Department concurs with the intent of the recommendation – to help ensure power settings are enabled across the DOE Complex, as appropriate – but disagrees that additional policy is needed. Departmental policy already exists in the form of DOE O 450.1A, Environmental Protection Program, which specifies that federal and contractor sites are required to "enable Energy Star® features (e.g. power management capabilities) on all computers, monitors, printers, copiers, and other electronic equipment, or to the maximum degree based on mission needs."

In addition, the current DOE COE desktop computer that is delivered and maintained by the OCIO for the majority of Headquarters organizations and some field sites already possesses numerous energy saving controls. In early 2008, the OCIO worked closely with the provider



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of the DOE COE patch management software to include a power management capability. Through this joint effort, extensive power management capabilities were added and implemented to the DOE COE Windows XP standard image. These power management features include the ability to force the desktop computer to be powered off at night. Patch management is now staggered during periods of non-activity during the normal duty hours which removes the requirement to leave the computers on at night to receive patches.

Program and field locations included in the audit have indicated that they would take additional steps to enable power management settings where possible. In particular, the Office of Science stated that they would “provide additional direction to their federal and contractor personnel to implement power management settings as directed in DOE O 450.1A.” The National Energy Technology Laboratory confirmed that they were “moving forward to regulate power management settings for all desktop and laptop computers through the execution of scripts to automatically change power management settings on NETL desktops and laptops in accordance with the EPA recommendations to turn off monitors after 20 minutes of inactivity.” They added that they will be initiating a pilot to determine the impact of placing systems into standby after 60 minutes of inactivity although their past experience of placing systems into standby or hibernation mode has not been positive as such actions have caused systems to lose connection to servers or to network disk drives.

Recommendation 2

Analyze the costs and benefits of utilizing thin-client computing in an unclassified environment and implement the results to the extent practical.

The OCIO concurs with the recommendation. During FY08, the OCIO began a multi-vendor prototype testing activity and evaluated six different thin client product offerings. In addition, live testing of the technology continued at the OCIO March 2009 Information Management Conference in New Orleans and agreement was reached to begin a pilot project for further evaluation at a DOE field site.

However, our analysis to date indicates that, while thin client product offerings should suffice for many DOE federal employees and their direct support contractors, this technology is not an acceptable substitute for all computer users. One example of an area that may be challenging for thin client usage is in the delivery of video streams and applications that rely on high end graphics. Therefore, we anticipate DOE will require a mixed environment of thin-client architectures and PC technology. OCIO commits to continue to evaluate user needs and their applications in assessing all costs/benefits and potential impacts of implementing thin-clients throughout DOE.

The Office of Science (SC) stated that they believe sufficient cost/benefit data is already available to them and their sites for decision-making purposes. SC plans to allow their individual sites to evaluate and implement the technologies that represent the best use of their management attention and resources.

NETL agreed to review the results of the OCIO’s current and future analyses and identify a subsequent path forward.

Recommendation 3

Identify and implement mechanisms to reduce data center energy consumption, including, but not limited to, conducting energy usage assessments and implementing the use of existing Department automated tools.

The comments made by the Department as part of the report on *Management of the Department's Data Centers at Contractor Sites* (DOE/IG-0803, October 2008), as well as the action plans associated with the recommendations made in that report, already address this recommendation.

The Office of Science noted that the IG did not provide data showing that no work was ongoing in this area, just that sites were not making use of the particular tool the OIG encountered. The National Energy Technology Laboratory disagreed with the conclusion that their data center was not energy efficient stating, "The data center HVAC system utilizes chilled water data center units. They are very reliable and as energy efficient as anything on the market. Chilled water units were chosen for various reasons: 1) since the building's HVAC system operates on an independent chilled water system, the building's system could be used as the redundant backup system should one of the data center's chilled water generators fail; 2) the data center's heat load can allow the building's chilled water generators to operate more efficiently during transitional ambient temperatures; and, 3) the chilled water generators provide free cooling during cold ambient temperatures greatly enhancing system efficiency."

As cited in the prior report, the OCIO has already consolidated the common services and implemented application hosting for most of the Headquarters program elements and, in response to the prior report, agreed to share best practices associated with that consolidation as requested. In addition, the OCIO – in partnership with the Federal Energy Management Program in the Office of Energy Efficiency and Renewable Energy, the Office of Management, and the Lawrence Berkeley National Laboratory (LBNL) – will be installing power, cooling, and data center environmental metering systems for the Germantown and Forrestal data centers. Due to the age and configuration of these data centers, there is no effective method to isolate the data center power and cooling consumption from the rest of the building. The assessment effort proposes to install power and cooling meters to baseline energy use and support the development of an energy improvement plan. The metering system is expected to be installed by the end of May.



Department of Energy
National Nuclear Security Administration
Washington, DC 20585




May 1, 2009

MEMORANDUM FOR

Rickey R. Hass
Deputy Inspector General
for Audit Services

FROM:

Michael C. Kane 
Associate Administrator
for Management and Administration

SUBJECT:

Comments to the IG's Draft Report on IT Energy
Efficient Resources, Project No. A08TG064; IDRMS
No. 2008-02008

The National Nuclear Security Administration (NNSA) appreciates the opportunity to review the Inspector General's (IG) draft report, *The Department's Efforts to Manage Information Technology Resources in an Energy-Efficient and Environmentally Responsible Manner*. We understand that this audit was conducted to determine whether the Department is managing the life-cycle of information technology equipment in an energy-efficient and environmentally responsible manner.

NNSA generally agrees with the report and recommendations. However, it is important to note that the NNSA Federal computing resources (e.g., desktops, peripherals) are managed by DOE through Energy Information Technology Services (EITS) as part of the DOE Common Operating Environment (DOE COE). Consequently, EITS the Department's Chief Information Officer (DOE CIO) manages all power settings for NNSA Federal staff desktops and peripherals. Any changes to the DOE COE configuration and image that maximizes power efficiency are the responsibility of EITS.

Recommendation 1: Develop and implement policies and procedures for ensuring that power management settings are enabled on all computing resources, as appropriate.

Even though the NNSA concurs with the recommendation, we do not directly control Federal computing resources except for a very small configuration that NNSA maintains to support mission applications. The NNSA's Chief Information Officer (NNSA CIO) is prepared to work closely with the DOE CIO and EITS in defining the appropriate power management settings and implementing these through the customer service and service level agreements established between the two parties.

Management and Operating (M&O) computing resources: The M&O contractors directly control their computing resources and have the responsibility for managing the power settings on their computing resources. As part of its IT oversight responsibilities, the NNSA CIO will work closely with the Contracting Officers and M&O contractor staffs to identify and implement energy efficient power settings. The following table outlines the actions that the NNSA CIO plans to undertake:

Action	Completed By
<ul style="list-style-type: none"> • Develop a policy to minimize computing resources power consumption <ul style="list-style-type: none"> ○ Establish policy formulation team ○ Identify appropriate power settings ○ Develop draft policy ○ Assess impact ○ Have policy approved 	4 Q – FY 2010
<ul style="list-style-type: none"> • Modify contracts <ul style="list-style-type: none"> ○ Prepare Contract Requirements Document (CRD) ○ Modify contracts as necessary 	2 Q – FY 2011
<ul style="list-style-type: none"> • Monitor and Report 	180 days after CRD is implemented and on an annual basis to ensure continued compliance

Recommendation 2: Analyze the costs and benefits of utilizing thin-client computing in an unclassified environment and implement the results to the extent practical.

The NNSA in theory agrees with the recommendation. Below are identified impacts, as well as a series of actions to address the recommendations. *These actions are dependent on the funding that is required to plan, design, acquire, and implement a thin-client architecture for the NNSA unclassified systems.*

It is important to note that putting in place a thin-client desktop is only one of the actions and cost items for implementing a thin-client architecture. A thin-client architecture will impact:

- NNSA networks – acquiring the bandwidth and circuits/switches necessary to support greatly increased transmission loads while maintaining performance and reliability requirements.
- NNSA infrastructure – acquiring the thin-client devices that support unclassified computing applications and peripherals. Also acquiring and configuring the server and storage networks necessary to support thin-client computing.
- NNSA business applications and databases – defining, planning, modifying, and testing changes to NNSA business applications and data bases to work on a thin-client architecture.

- NNSA cyber security policies – defining, planning, implementing, and testing cyber security standards, configurations, and settings to support a thin-client architecture.

The following outlines the actions that the NNSA CIO proposes to undertake related to analyzing the costs and benefits of and implementing a thin-client architecture to the extent practical.

Action	Completed By
<ul style="list-style-type: none"> • Conduct a study on the costs, benefits, and impacts of moving to a thin-client architecture for NNSA’s unclassified systems. <ul style="list-style-type: none"> ○ Define objectives, scope, key actions and deliverables ○ Select contractor ○ Undertake study ○ Assess impact, costs and benefits 	2 nd Q – FY 2012
<ul style="list-style-type: none"> • Phased implementation of a thin-client architecture for unclassified systems that support Federal sites and staff 	TBD (Dependent upon funding availability and results of the study)
<ul style="list-style-type: none"> • Phased implementation of a thin-client architecture for unclassified systems that support M&O contractor sites and staff 	TBD (Dependent upon funding availability and results of the study)

Recommendation 3: Identify and implement mechanisms to reduce data center energy consumption including but not limited to conducting energy usage assessments and implementing the use of existing Department automated tools.

Even though the NNSA concurs with the recommendation, we do not directly control Federal computing resources except for a very small configuration that NNSA maintains to support mission applications. The NNSA CIO will undertake a series of actions to address the recommendations.

Federal data centers: In early FY 2009, the NNSA CIO identified the serious energy consumption, maintainability, scalability, and performance issues with its current Headquarters configuration and initiated actions to replace it. NNSA is promoting the acquisition of a “blade” architecture using a virtual operating system (VMware), an enhanced storage network using advance NAS technology, and a new back-up technology. This configuration would significantly reduce NNSA’s “foot print” and power consumption.

Action	Completed By
<ul style="list-style-type: none"> • Replace NNSA’s mission support infrastructure 	1 st Q – FY 2010

M&O computing resources: The M&O contractors directly control their computing resources and have the responsibility for monitoring and managing the power utilization on their computing resources. Several M&O's (Pantex, Livermore, Los Alamos) have initiated, and in some cases completed projects to virtualize their unclassified environments, which have resulted in significant reductions in physical servers and the related power consumptions. The NNSA CIO has strongly supported these efforts. As part of its IT oversight responsibilities, the NNSA CIO will work closely with the Contracting Officers and M&O contractor staffs to further reduce energy consumption, implement energy usage assessments, and implement the appropriate tools. The following table outlines the actions that the NNSA CIO plans to undertake:

Action	Completed By
<ul style="list-style-type: none"> • Develop a program to conduct periodic energy usage assessments at the sites 	4 Q – FY 2009
<ul style="list-style-type: none"> • Monitor and report energy usage 	On an annual basis
<ul style="list-style-type: none"> • Analyze existing DOE automated tools for identifying data center power saving opportunities and determine if complex-wide use is possible 	1 Q – FY 2010
<ul style="list-style-type: none"> • Determine applicability of tools for use by sites 	1Q – FY 2010
<ul style="list-style-type: none"> • Develop and implement a program to inform IT staff at M&O's on how to identify power saving opportunities 	2 Q – FY 2010
<ul style="list-style-type: none"> • Monitor developments in mechanisms and tools for reducing data center energy consumption and inform IT staff at the M&O's about appropriate mechanisms and tools 	On-going

Should you have any questions about this response, please contact Cathy Tullis, Acting Director, Policy and Internal Controls Management, at 202-586-3857.

cc: Linda Wilbanks, Chief Information Officer
 David Boyd, Senior Procurement Executive
 Karen Boardman, Director, Service Center

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