Audit Report

OFFICE OF THE INSPECTOR GENERAL

USE OF ENERGY CONSERVATION MEASURES IN THE DESIGN OF NEW MILITARY FACILITIES

Report No. 97-158

June 11, 1997

Department of Defense

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Acronyms

ETL	Engineering Technical Letter
KBTU	Thousand British Thermal Unit

INSPECTOR GENERAL
DEPARTMENT OF DEFENSE
400 ARMY NAVY DRIVE
ARLINGTON, VIRGINIA 22202-2884

June 11, 1997

MEMORANDUM FOR DEPUTY UNDER SECRETARY OF DEFENSE
(INDUSTRIAL AFFAIRS AND INSTALLATIONS)

SUBJECT: Audit Report on Use of Energy Conservation Measures in the Design of New Military Facilities (Report No. 97-158)

We are providing this audit report for review and comment. We conducted the audit in response to a request from your office and we considered your comments on a draft of this report and the results of a meeting with your staff when preparing the final report. Based on the meeting, we have changed our recommendation to reduce energy targets on new construction.

DoD Directive 7650.3 requires that all recommendations and potential monetary benefits be resolved promptly. Comments on the draft report were not fully responsive; however, we believe that the modified recommendation addresses your concerns. We request that you provide comments on the final report by August 11, 1997.

We appreciate the courtesies extended to the audit staff. Questions on the audit should be directed to Mr. Terry L. McKinney, Audit Program Director, at (703) 604-9288 (DSN 664-9288) or Mr. Bruce A. Burton, Audit Project Manager, at (703) 604-9282 (DSN 664-9282). See Appendix D for the report distribution. The audit team members are listed inside the back cover.

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Assistant Inspector General
for Auditing

Office of the Inspector General, DoD

Report No. 97-158
(Project No. 6CF-0062)

June 11, 1997

Use of Energy Conservation Measures in the Design of New Military Facilities

Executive Summary

Introduction. This audit was requested by the Office of the Assistant Secretary of Defense (Economic Security) to determine whether military construction projects were built giving consideration to current energy conservation guidelines. The Office of the Assistant Secretary of Defense (Economic Security) was disestablished, and its duties were incorporated into what is now the Office of the Deputy Under Secretary of Defense (Industrial Affairs and Installations).

The Federal Government is the largest energy consumer in the United States. DoD energy use represents approximately 70 percent of total Federal Government energy use. DoD energy consumption for buildings and facilities in FY 1995 was 248.5 trillion British thermal units at a cost of $2.6 billion. The Energy Policy Act of 1992 and Executive Order 12902 require a 30-percent reduction in energy consumption from 1985 levels by the year 2005. Energy use reduction is also a component of DoD efforts to reduce support costs significantly.

Audit Objectives. The overall audit objective was to determine whether military construction projects were designed and built giving consideration to current energy conservation guidelines. The audit also assessed the management control program as it applied to the design and construction of new facilities.

Audit Results. Military Departments were using inconsistent baselines for measuring progress in conserving energy in new buildings and were not aggressively reducing targets for energy use in new designs, even though these targets were not keeping pace with overall energy reductions mandated by Executive orders and the DoD has increased its emphasis on infrastructure cost reduction. Military Departments also did not implement other energy saving measures. As a result, new facilities were not designed to ensure maximum energy conservation and minimum utility costs.

For the Navy alone, as much as $27.3 million could be put to better use over the next 6 years by incorporating updated energy targets with current energy reduction goals in design decisions. The Army and Air Force were unable to provide us with sufficient data to reach conclusions about future monetary benefits. However, because current Army and Air Force target reductions have lagged behind the Navy, those Army and Air Force monetary benefits would likely be greater than those of the Navy.

Summary of Recommendations. We recommend that the Deputy Under Secretary of Defense (Industrial Affairs and Installations) revise energy conservation guidance to incorporate a 25 percent reduction in energy design targets from FY 1987 levels for mandatory use by all Military Departments. In addition, we recommend that the Deputy Under Secretary issue guidance to the Military Departments to emphasize the requirement to perform energy studies and life-cycle-cost analyses, and establish a system to validate the accuracy of design energy targets and calculated energy budgets for all new facility designs.

Management Comments. The Deputy Under Secretary of Defense (Industrial Affairs and Installations) provided comments that neither concurred nor nonconcurred with the recommendations or potential monetary benefits. The Deputy Under Secretary stated that the 30 percent energy reduction goal cited in the draft report applies to existing facilities and not to new design. The Under Secretary also stated that energy budgets should include all life-cycle cost effective measures, and that the Industrial Affairs and Installations Office was developing new DoD guidance on design. In a meeting on June 4, 1997, DoD energy staff acknowledged that energy targets were not consistent across Military Departments and were not keeping pace with energy goals. They suggested that the targets be reduced 25 percent from 1987 levels and be reevaluated annually. Although not required to comment, the Air Force agreed with the recommendations except for the recommendation to include energy goals in new energy targets. The Air Force, like the Deputy Under Secretary of Defense, stated that energy goals did not specifically apply to new construction.

Audit Response. The management comments on the draft report were not fully responsive, but we believe that any confusion over application of the 30 percent reduction goal has been eliminated in the final report. Because of the increased DoD emphasis on reducing support costs, the DoD facilities community faces greater overall cost reduction challenges and needs to take more aggressive action. Implementation of energy reduction measures across Military Departments is inconsistent in new construction, due in part to differences in energy targets. The Navy has voluntarily taken steps to update targets that incorporate energy reduction goals, while the other services have taken little action and their progress lags behind the Navy. Although many new energy conservation devices and measures have been developed, many energy targets have not been updated in 10 years. The Deputy Under Secretary needs to ensure consistency and aggressiveness in energy conservation implementation. We request that the Deputy Under Secretary provide comments that address all recommendations in our report by August 11, 1997.

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Part I - Audit Results

Audit Background

This audit was requested by the Office of the Assistant Secretary of Defense (Economic Security) in October 1995 to determine whether military construction projects were being built consistent with the current energy conservation guidelines. The Office of the Assistant Secretary of Defense (Economic Security) was replaced by the Office of the Deputy Under Secretary of Defense (Industrial Affairs and Installations).

DoD Energy Use. The Federal Government is the largest user of energy in the United States. DoD consumes approximately 70 percent of the energy used by Federal Government facilities. DoD energy consumption in buildings and facilities in FY 1995 was 248.5 trillion British thermal units at a cost of $2.6 billion. DoD reported 13.3 percent reduced energy consumption in buildings and facilities from 1985 through 1995. The Department had previously reported a 27.3 percent reduction from 1975 through 1985.

Energy Conservation Legislation. The President and Congress have addressed the issue of improving energy efficiency in facilities and operations several times since the mid-1970s. The most recent initiatives include the Energy Policy Act of 1992 and Executive Order 12902, signed on March 8, 1994, that set forth goals for energy conservation.

The Energy Policy Act of 1992. The Energy Policy Act of 1992 amended previous legislation by requiring energy consumption be reduced by 20 percent by the year 2000 from 1985 baseline levels on a British-thermal-unit-per-gross-square-foot basis. The Energy Policy Act of 1992 also requires that all projects with a payback of 10 years or fewer be identified and implemented in all U.S.-owned Federal buildings by the year 2005. Projects have a payback period of 10 years if cost savings from reduced energy consumption balance against the cost of implementing the project within a period of 10 years.

Executive Order 12902. Executive Order 12902 increased the energy reduction goal of the Energy Policy Act of 1992. Under the Executive Order, energy is to be cut 30 percent from 1985 levels by the year 2005.

Military Handbook 1190. Military Handbook 1190, dated September 1, 1987, was issued for all Military Departments to use as the energy conservation criteria for new construction; however, the Navy was the only Department using the guidance. The handbook requires use of energy conservation studies and life-cycle-cost analyses of different energy-conserving alternatives. Military Handbook 1190 includes" design energy targets" to establish energy usage limits to be used in designs for new construction projects.

Army and Air Force Guidance. The Army does not use Military Handbook 1190 for designing Army projects. It issued separate guidance dated March 13, 1987, "Architectural and Engineering Instructions," which has subsequently been updated. Air Force projects are designed according to the Army Architectural and Engineering Instructions along with engineering technical letters issued by the Air Force as supplemental guidance.

Audit Objectives

The original objectives of this audit were to determine whether military construction projects included the current energy conservation guidelines, and were built using the latest energy efficient design. Specific objectives included determining whether money set aside for design costs was used for the intended purposes, and whether worker productivity was considered in construction design.

The audit was later reannounced and retitled to focus the scope of the review on energy conservation measures. Two of the original objectives, determining whether money set aside for design costs was used for intended purposes and whether worker productivity was considered in construction design, were deleted. The overall objective, to determine whether current energy conservation goals and measures are included in the design of new military construction, remained unchanged. In addition, the audit examined the management control program at each Military Department as it applies to the objectives. Appendix A discusses the audit scope and methodology and the results of the review of the management control program. Appendix B is a summary of prior audits and other reviews.

Other Matters of Interest

Congress requires DoD to submit a report to the appropriate committees each year with respect to military construction activities and military family housing activities. The report includes information that allows committees to evaluate trends in contracting for architectural and engineering services as well as construction design. Contacts with Congressional staff indicated that Congress continues to emphasize the usefulness and necessity of this information.

At three of six Military design organizations visited, problems existed with accumulation and reporting of additional design costs (lost design) caused by changed requirements. Installation personnel were not fully documenting lost design costs in project files, nor was this information being included in the tracking system. Based on our limited samples, we believe the information forwarded to Congress may be inaccurate. The Military Departments need to evaluate and improve their procedures for accumulating and reporting this information.

Designing Energy Efficient Facilities

Military Departments were using inconsistent baselines for measuring progress in conserving energy in new buildings and were not aggressively reducing targets for energy use in new designs, even though, these targets were not keeping pace with overall energy reductions mandated by Executive Orders. In addition, the Military Departments were neither consistently implementing other energy measures, nor fulfilling the requirement to obtain waivers when the established energy target for a facility could not be achieved. Twenty four projects out of the 41 projects reviewed during the audit had no energy study or life-cycle-cost analysis performed, had energy budgets that exceeded the design energy target without the required waiver, or contained other energy-related inaccuracies.

These deficiencies occurred because effective oversight of the energy conservation program was lacking. DoD did not ensure that the latest energy conservation goals were considered in revising design energy targets. In addition, some design engineers either misinterpreted or had not received the latest guidance on energy conservation requirements.

As a result, new facilities were not designed to ensure maximum energy conservation and minimum utility cost. We calculated that for the Navy alone, as much as $27.3 million in cost savings could result over the next 6 years from including updated energy targets with current energy reduction goals in design decisions. The calculation includes only the Navy because the Army and Air Force were unable to provide sufficient data to reach conclusions about future cost savings. However, since current Army and Air Force target reductions have lagged behind the Navy's, their potential cost savings would likely be greater than those of the Navy.

Incorporating Energy Conservation Goals In New Facility Designs

The Military Departments did not consider the latest energy conservation goals in revising the energy targets used to establish energy usage limits in the design of new facilities. While these goals are not mandatory for new designs, the DoD should be making every effort to incorporate energy reductions consistent with these goals into new construction design. The Navy acknowledged the problem with outdated energy targets in written memoranda and was making commendable efforts to include more current goals into its design targets.

Energy Targets. Military Departments developed energy targets in the mid 1980s to ensure that buildings were designed to a minimum level of energy consumption for different types of facilities in different weather regions. The targets were calculated in British thermal units per square foot per year, and

were developed to ensure that design engineers included energy conservation measures in building design that would result in calculated actual usage (energy budget) being less than the target values.

Energy Goals. Subsequent to the development of the energy targets, the Energy Policy Act of 1992 was enacted that required energy consumption per gross square foot be reduced by 20 percent by the year 2000 from the 1985 baseline levels. In March 1994, Executive Order 12902 was signed into effect, and increased the energy reduction goal of the Energy Policy Act of 1992, requiring that energy be cut 30 percent from 1985 levels by the year 2005. DoD did not formally implement Executive Order 12902 into the design process.

The Military Departments did not consider these energy reduction goals when revising their energy targets for new building design. Furthermore, the Army and Air Force developed separate energy targets; accordingly, the Military Departments were designing new buildings based on inconsistent standards. The Departments, with the exception of the Army, did make reductions in energy targets after the new energy reduction goals were established; but the reductions were minor and only the Navy was able to provide documentation that showed a commitment to incorporate these goals into new building design.

Military Department Actions. The Military Departments have not ensured that facility design targets kept pace with energy reduction goals. While the Navy still lags behind the goals, its efforts are better than the Army or Air Force efforts.

Target Adjustments. Each Military Department has independently issued energy targets for use in designing new facilities. The following table depicts a sample of differences in energy targets among the Military Departments.

Military Departments Design Energy Targets

Facility Type	Army*	Navy*	Air Force*
Office (A1)	40	36	40
Medical(B)	100	90	100
Clinics (D)	50	58.5	60
Institutional (I)	75	67.5	75
Housing (Q)	55	45	50
Research and Development (W)	60	54	65

*Values expressed in 1000 British Thermal Units for the same weather region

Oversight. Since 1992, when the Energy Policy Act was enacted, energy reductions within DoD have been disjointed and there has been minimal oversight. There was no consistency in emphasis, and progress was solely dependent upon the management commitment of the individual Departments.

Variances. The Navy has been aggressive reducing energy targets since recognizing the void in overall DoD guidance for energy reduction in facility design. In June 1995, the Navy implemented an across-the-board 10-percent reduction, and since 1987 has reduced the majority of its targets by almost 20 percent. The Army and Air Force have not initiated any across-the-board reductions. Since 1987 the Army has reduced the majority of its targets by a range of zero to 11 percent, with no adjustments since 1991. The Air Force has adjusted only 20 percent of its targets since 1987.

Other Energy Measures

Military installations were not consistently performing required energy studies and life-cycle-cost analyses for new facility designs to determine compliance with the design energy target requirements and to assure that the most energy efficient mechanical systems were being selected. There were also instances where the projected actual energy consumption (design energy budget) exceeded the minimum conservation requirement (design energy target) with no effort made to further reduce energy consumption through redesign or to obtain waivers when targets could not be achieved. When studies were performed they included overstated design energy targets resulting from using wrong weather regions and inaccurate facility category-type. Also, misinterpretation of energy conservation requirements resulted in understated energy budgets.

Energy Studies. Energy studies and life-cycle-cost analyses are required to be performed in the design of new military facilities to provide for the most energy-efficient and cost-effective design. Although the Military Departments have criteria requiring energy studies and life-cycle-cost analyses for all new facility designs, required studies and analyses were not always performed. All energy-conservation measures must be fully utilized in an effort to conserve energy and meet the latest mandated energy reduction goals. Of the 41 projects reviewed during the audit, 14 projects had no energy study performed. See Appendix C for a listing of these projects.

Life-Cycle-Cost Analyses. Life-cycle-cost analyses are required to compare alternative heating, ventilation, and air-conditioning systems to determine the most cost-effective system to incorporate into the new facility design. The selected system is then used in the energy study to determine compliance with the design energy target. This process enables the selection of the most cost-effective system that meets the energy-conservation requirements. For example, a life-cycle-cost analysis performed by the Naval Facilities Engineering Command, Southern Division, on the design of a new bachelor enlisted quarters at the Naval Air Station Jacksonville saved DoD approximately

$100,000. The analysis resulted in the alternative being selected for the system design that was almost $100,000 lower in total project and recurring costs than any of the other alternatives.

Of the 41 projects reviewed during the audit, 16 projects had no life cycle cost analysis performed. See Appendix C for a listing of these projects.

Energy Budgets in Excess of Energy Targets. Of the 41 projects reviewed during the audit, 8 projects had calculated energy budgets that exceeded the design energy target for the facility type and weather region. An additional 14 projects had no energy study performed and, therefore, no way to determine compliance with the energy target. In none of the instances where budgets exceed targets were any attempts made to improve energy efficiency through redesign effort, nor were required waivers requested and obtained. Army, Navy, and Air Force criteria all require that if the calculated energy budget exceeds the design energy target for the proposed facility, the design will be revised to incorporate any other economically justified energy conservation measures that may not have been considered. If, after making such effort, the recalculated energy budget still exceeds the design energy target, a waiver from this criteria must be requested and obtained from the appropriate office within the Military Department. In order to conserve energy and meet the mandated energy reduction goals, DoD must exert more effort to maximize energy efficiency and comply with the design energy targets whenever possible. The Military Departments should take steps to ensure compliance with redesign and waiver request requirements, including adequate documentation, when the energy budget exceeds the design energy target. Appendix C lists the eight projects with calculated energy budgets in excess of the design energy targets.

Accuracy Of Energy Targets and Budgets

Military Departments used inaccurate energy targets in the design of new facilities. Four projects contained errors in design energy targets. Appendix C lists these projects. The errors were attributable to incorrect weather regions, or inaccurate facility types used in determining the targets. One project included an understated energy budget resulting from a misinterpretation of energy-conservation requirements. Following are projects exemplifying these errors.

Weather Region. The U.S. Army Corps of Engineers, Savannah District incorrectly identified a weather region for the flight simulation project at Dobbins Air Force Base, GA. They erroneously used the weather region for Robbins Air Force Base, GA which had a design energy target of 45 thousand British thermal units (KBTUs) per square foot. The correct weather region had a target of 35 KBTUs for a flight simulation facility. As a result of this error, the energy budget for the project exceeded the design energy target by 36 percent.

Facility Category Type. A U.S. Army Corps of Engineers, Fort Worth District project for two cold/dry storage warehouses at Fort Hood, Texas, included a design energy target of 75 KBTUs per square foot, which was the correct target for a cold storage facility. However, only 36 percent of the total facility square footage was for cold storage, the balance was for dry storage and administrative space, which had design energy targets of 30 KBTUs and 40 KBTUs per square foot, respectively. As a result, the correct design energy target, considering the different functions comprising the facility, should be 49 KBTUs per square foot. The calculated energy budgets for the two facilities were 66 KBTUs and 80 KBTUs per square foot, well above the corrected design energy target.

Interpretation of Energy Conservation Requirements. A Naval Facilities Engineering Command, Southern Division project for an administrative facility at the Naval Air Depot, Jacksonville, Florida included an understated energy budget resulting from a misinterpretation of energy conservation requirements by design personnel. Included in the building design was an avionics shop which has a different energy target than an administrative building. The Navy however, treated the facility strictly as an administrative facility in determining the design energy target of 40 KBTUs per square foot. The avionics shop however, amounted to approximately 20 percent of the facility and therefore should have been included in determining the design energy target. Including the avionics shop would have increased the target to 46 KBTUs.

The energy budget for the facility including the avionics shop was calculated to be 55 KBTUs per square foot, well above the design energy target. As a result, the Navy recalculated the energy budget excluding the avionics shop and treating the entire facility strictly as an administrative facility, thereby, decreasing the energy budget to 37 KBTUs per square foot, below the design energy target.

The Navy's justification for recalculating the energy budget was to make the comparison to the design energy target more meaningful, since the design energy target determined by the Navy was based solely on an administrative facility. The Navy justification was invalid, as the calculated energy budget should account for the energy consumption of the facility as it will actually be configured. As a result, the exclusion of the avionics shop from the energy budget calculations erroneously understated the energy budget, when in fact, the correct energy budget of 55 KBTUs per square foot exceeded the design energy target.

Oversight Of The Energy Conservation Program

The failure of facility designers to incorporate the latest energy conservation features into new facility designs is attributable to the lack of management emphasis and oversight in the energy conservation program both by OSD and the Military Departments.

Energy Conservation Criteria. Energy conservation guidance is not consistent within DoD. While the Military Handbook 1190 was developed as the criteria to be used by all the Military Departments, the Army chose not to use it and implemented its own criteria, "Architectural and Engineering Instructions." The Air Force also issued additional guidance, in the form of "Engineering Technical Letters," supplementing existing criteria. As a result, design guidance was divergent, and changes were not occurring consistently or at the same time.

Although similar, the Military Departments' guidance did not consistently incorporate energy conservation goals into the design of new facilities, and none of the criteria has incorporated the latest energy conservation goals into its design energy targets. The Military Departments lacked coordination in implementing and revising design energy targets, and as a result, were working towards achieving different energy goals.

OSD Oversight. The Military Departments issued their own energy conservation guidance and determined their own energy targets in the design of new facilities, with generally inadequate emphasis. Greater OSD oversight of the energy conservation program is necessary to ensure compliance with energy reduction goals. OSD needs to establish energy targets and other design energy guidance to be adhered to by all the Military Departments in design of new facilities. Budget reductions would be an effective enforcement measure.

In addition to the energy reduction goals, Executive Order 12902 directed an interagency energy management task force to determine applicable energy standards to be met or exceeded. The task force determined, based on the experience over the past 15 years, that it was not practical to develop generic energy targets for all agencies, building types and climatic regions, because even within building types different agencies might have very different requirements. The task force recommended that agencies develop their own targets, as long as they are validated to achieve better performance than the Code of Federal Regulations, part 10 standards. The task force addressed energy targets for all agencies as a whole, not individual agencies, therefore the task force findings did not address the specific requirements of DoD.

In view of the increased DoD emphasis on reducing support costs, it would be highly appropriate to apply more management oversight emphasis on energy cost reduction.

Commitment to Energy Conservation Program

Despite overall budget pressures, the Military Departments lacked sustained commitment to aggressive energy use reduction measures in new facility designs. Energy studies and life-cycle-cost analyses were not consistently performed on new facility designs, and the most energy efficient systems were

not always selected. In addition, design engineers at some of the Army installations visited were unaware of, or misinterpreted, the waiver requirements when the calculated energy budget exceeds the design energy target.

Performance of Energy Studies and Life-Cycle-Cost Analyses. Army Architectural and Engineering Instructions require that an energy study and life-cycle-cost analysis be performed for all new facility designs. However, the U.S. Army Corps of Engineers, Mobile District did not perform energy studies and life-cycle-cost analyses on all new facility designs. They were aware of the requirement to perform the studies and life-cycle-cost analyses, but stated that they do not always have the time to ensure that energy goals have been established and met, or that a life-cycle-cost analysis has been performed. Five of the six projects reviewed at the Mobile District did not have energy studies and life-cycle-cost analyses performed. The failure to perform required energy studies and life-cycle-cost analyses raises questions as to the Mobile District's commitment to the energy conservation program. By not performing these studies and analyses, the Army is not assured that the most energy-efficient and cost-effective systems are included in the design of new facilities.

Energy Efficient Systems. The Naval Facilities Engineering Command, Southern Division allowed the Navy Exchange Service Command to dictate the heating, ventilation and air conditioning system to be included in the design of a new exchange recruit store at the Naval Training Center, Great Lakes, Illinois. Although three alternative systems were identified, no life-cycle-cost analysis was performed, and according to Navy design personnel, the selected system was not the most energy efficient. The system, selected by the Navy Exchange Service Command, was a roof top heating and cooling system selected because of its lower initial cost. Roof top systems have more costly maintenance, are susceptible to roof leakage problems, and are not the most energy efficient. Design personnel at the Naval Facilities Engineering Command, Southern Division, stated that projects sponsored by non-appropriated fund activities are not held to the same energy conservation requirements as other military construction projects. The sponsoring command can select the system to be included in the design, regardless of whether there are more energy-efficient systems available. Navy commitment to energy conservation should not be subject to limitations based on the sponsoring command, but should be consistent for all new facility designs since each Navy installation has to measure its progress against mandated reduction goals.

Awareness of Waiver Requirements. Design energy personnel at the U.S. Army Corps of Engineers, Savannah District were not aware of the waiver requirements for calculated energy budgets that exceeded the design energy target. For example, a flight simulation project had a calculated energy budget of 47.8 KBTUs per square foot exceeding the design energy target of 45 KBTUs per square foot. Design personnel were not aware that a waiver was required because of exceeding the energy target. They were unfamiliar with Army's Architectural and Engineering Instructions, which requires that a waiver be requested and obtained in such situations. After being informed of this requirement, they questioned whether it applied to the flight simulation project since the calculated energy budget only exceeded the energy target by 6 percent. The Army criteria as well as the criteria of the other Military Departments do

not limit the requirement for obtaining a waiver, but require that a waiver be obtained whenever the calculated energy budget exceeds the energy target. As it turned out, the design energy target was incorrect. The correct target was 35 KBTUs per square foot, which meant that the energy budget actually exceeded the energy target by 37 percent.

In addition, design energy personnel at the U.S. Army Corps of Engineers, Mobile District, did not obtain a waiver for the Large Engine Test Facility project at Arnold Air Force Base, TN. The project had a calculated energy budget of 55.5 KBTUs per square foot which exceeded the design energy target of 50 KBTUs per square foot by 11 percent. Their explanation for not having obtained a waiver was that Air Force criteria, Engineering Technical Letter (ETL) 87-4, March 1987, allows a 15 percent overage, and the calculated energy budget for the project was within 15 percent of the energy target. However, ETL 87-4 was revised in August 1994, with ETL 94-4. The revised criteria do not include any allowance for a 15 percent overage. Since the 30 percent concept design was submitted in November 1994, two months after ETL 94-4 was issued, ETL 94-4 was applicable to the project design.

Energy Benefits

The benefits derived from incorporating energy saving design into new buildings are far reaching. Many DoD buildings in use today were designed and built decades ago and have continued high energy costs through poor energy efficiency for, in some cases, more than 50 years. In contrast to those buildings, any energy efficiency built into new construction will provide benefits not just in the year of construction, but in each year that the building continues to be used. Energy savings mean cost avoidance, often with no offsetting costs, and this additional source of money can be used for other OSD and Military Departments' needs as the Defense budget continues to shrink.

Using information provided by the Navy on new construction for program years 1997 through 2003, we determined potential monetary benefits from incorporating the latest energy goals into new construction design. The Navy could reduce costs by as much as $27.3 million in the next 6 years by designing buildings that incorporate the energy reduction goals. The Army and Air Force were unable to provide the information necessary to determine potential savings on their new construction. However, if construction levels are similar to the Navy levels, savings for these two Departments would likely be higher because of their slower progress in incorporating energy goals into design targets.

In order to realize significant savings, aggressive energy targets should be uniformly used by all the Military Departments for the design of new facilities.

Conclusion

The Military Departments need to be more aggressive in driving down support costs through more emphasis on robust energy reduction goals for new facilities, although the Navy has made the most commendable effort.

Recommendations, Management Comments, and Audit Response

We recommend that the Deputy Under Secretary of Defense (Industrial Affairs and Installations):

1. Revise the Military Handbook 1190 to include revised design energy targets that incorporate a 25 percent reduction that considers the energy reduction goals of the Energy Policy Act of 1992 and Executive Order 12902 and instruct Military Departments that the Military Handbook is the primary source of design guidance for DoD.

2. Issue guidance to the Military Departments to:

a. Reiterate the requirement to perform an energy study and life-cycle-cost analysis on all new facility designs.

b. Perform additional design effort in an attempt to reduce the energy budget when it exceeds the target, and document such efforts.

c. Obtain a waiver when those efforts do not reduce the budget below the target.

d. Establish a system to validate the accuracy of design energy targets and calculated energy budgets for all new facility designs.

Deputy Under Secretary of Defense (Industrial Affairs and Installations) Comments on the Draft Report. The Deputy Under Secretary's comments neither concurred nor nonconcurred with the report recommendations and potential monetary benefits. The comments indicated that the 30 percent reduction did not apply to new design; instead construction should be designed to minimize life cycle costs. The Deputy Under Secretary indicated that energy targets should provide a reasonable intent to make new designs energy efficient and that his office was developing new guidance on design. In a subsequent meeting, Department officials agreed that energy targets had not kept pace with energy cost reduction goals or possibilities. These officials suggested the use of a 25 percent reduction of targets from 1987 levels with annual reevaluations.

Air Force Comments on the Draft Report. Although not required, the Air Force provided comments on the draft of this report. The Air Force agreed

with report recommendations except for Recommendation 1. The Air Force, like the Deputy Under Secretary of Defense, did not agree that the energy goals should be applied to new construction.

Audit Response. The management comments were not fully responsive. The lack of DoD policy has resulted in Military Departments establishing their own baselines for progress which has led to inconsistent implementation across DoD. We were aware that the energy goals do not specifically apply to new construction. However, we believe that the current baselines for measuring progress of energy conservation in new construction are outdated and inconsistent. The Navy has taken steps to update targets to incorporate energy reduction goals while the other services lag behind. The mixed success of energy reduction measures across Military Departments is due in part to differences in energy targets. Although new energy conservation devices and measures are being developed, a large number of energy targets have not been updated in 10 years. We believe the Deputy Under Secretary should aggressively push energy conservation as well as recommending the incorporation of life-cycle cost effective measures to ensure consistency in energy conservation. The Military Departments could still use waivers on a case by case basis when meeting these goals is not feasible. We request that the Deputy Under Secretary provide revised comments that incorporate the suggested 25 percent reduction and address other recommendations in our report.

Part II - Additional Information

Appendix A. Scope and Methodology

Scope of the Audit

Projects Reviewed. We reviewed documentation from FYs 1991 through 1996 related to 41 military construction projects. Specifically, we examined energy conservation studies, energy use budgets and energy targets. We also interviewed project managers and design personnel.

Audit Period, Standards, and Locations. We performed this economy and efficiency audit from June 1996 through December 1996 in accordance with auditing standards issued by the Comptroller General of the United States as implemented by the Inspector General, DoD. We included tests of management controls considered necessary. We did not use computer-processed data or statistical sampling for this audit. We visited or contacted individuals and organizations within DoD. Further details are available upon request.

Management Control Program

DoD Directive 5010.38, "Management Control Program," August 26, 1996, requires DoD organizations to implement a comprehensive system of management controls that provides reasonable assurance that programs are operating as intended and to evaluate the adequacy of the controls.

Scope of Review of the Management Control Program. We reviewed management control procedures regarding construction and design activities at various installations. We also reviewed management's self evaluation of those management controls.

Adequacy of Management Controls. We identified material management control weaknesses as defined by DoD Directive 5010.38. The Department of Defense failed to ensure compliance with energy conservation laws and regulations and to reduce support costs as much as possible. If management implements the recommendations to standardize the criteria and implement the energy goals in new construction design, the management controls would be strengthened.

Adequacy of Management's Self Evaluation. The Military Departments did not identify energy conservation as an assessable unit and did not conduct management control reviews of energy validation under any assessable units. The Deputy Under Secretary of Defense also did not conduct reviews of Military Department implementation of energy conservation and therefore, did not identify the material management control weakness.

Appendix B. Summary of Prior Audits and Other Reviews

During the past 5 years, three audits have discussed energy conservation and the Energy Policy Act of 1992.

Inspector General, DoD

Inspector General, DoD, Report No. 97-070, "Use of Energy Conservation Funds," January 15, 1997, states that the Military Departments used energy funds for energy purposes; however, the commitment of DoD and the Military Departments to energy conservation was questionable. Specifically, DoD has no assurance that funds were used as effectively as possible in achieving program objectives and goals. The Office of the Secretary of Defense concurred with our recommendations

Inspector General, DoD, Report No. 93-055, "Implementation of the Energy Policy Act of 1992," February 18, 1993, stated that the DoD implementation of energy initiatives was commendable. DoD reported reduced energy consumption of 27.3 percent from FYs 1975 through 1985; however, DoD needed improvements to better implement energy conservation policies at selected Military Department and Defense Logistics Agency installations. This audit primarily addressed whether DoD had developed a system to determine if energy initiatives were being implemented. The audit did not evaluate the accuracy of reported energy reductions and addressed periods prior to the timeframes addressed by this audit.

The report recommended that the Military Departments update energy management plans annually and that the Marine Corps establish an energy management plan. It also recommended that the Defense Logistics Agency establish procedures to verify that field installations maintain awareness of and implement energy management plans.

The Military Departments and the Defense Logistics Agency concurred with the recommendations.

Air Force Audit Agency

Air Force Audit Agency Report No. 95052012, "Management of Energy Costs," was issued August 29, 1996. The report concluded that the overall management of the base program could be improved. Although the energy conservation program was effectively achieving its goal, the bases reviewed did

not properly identify or bill all utility costs nor correctly compute utility rates. Also, bases did not properly manage energy reduction projects. Air Force management concurred with the recommendations and agreed to take corrective actions.

Appendix C. Summary of Projects With Energy Design Issues

Project Description	Project Number	No Life Cycle Cost Analysis	No Energy Study	Overstated Design Energy Target	Energy Budget Exceeds Energy Target
U.S. Army Corps of Engineers Mobile District					
Bachelor Enlisted Quarters	EEPZ963001	X	X		
Aircraft Maintenance Hangar	93218	X	X		
Large Engine Test Facility	159000				X
Helicopter Hangar	FTEV963006	X	X		
Family Housing		X	X		
Administrative Building		X	X		
U.S. Army Corps of Engineers Fort Worth District					
Bachelor Enlisted Quarters	0360990	X	X		
Vehicle Maintenance	0022550	X	X		
Equipment Shop	0033981	X	X		
Cold/Dry Storage Warehouse	229760			X	X
Bachelor Enlisted Quarters	022612				
Replace Family Housing	0371500	X			
Vehicle Maintenance	0371480				
U.S. Army Corps of Engineers Savannah District					
Flight Simulator	949010			X	X
Vehicle Maintenance Complex	017310	X	X		X
Hospital Replacement	0287450				
Elementary School	40383				
Enlisted Barracks w/o Dinning Hall	034551				
Command and Control Building	93079.50				

Project Description	Project Number	No Life Cycle Cost Analysis	No Energy Study	Overstated Design Energy Target	Energy Budget Exceeds Energy Target
U.S. Army Corps of Engineers Savannah District (cont'd)					
Medical/Dental Clinic	016580				
Joint Stars Dormitory	953015				X
Naval Facilities Engineering Command Southwest Division					
Controlled Industrial Facility	P-701	X	X		
In-Service Engineering Laboratory	P-121S	X	X		X
Enlisted Barracks With Physical Fitness Center	P-028T				X
Bachelor Enlisted Quarters	P-889T				
Oil Treatment Facility	P-186	X	X		
Maintenance Facility	P-031T				
Maintenance Facility	P-010T				
Naval Facilities Engineering Command South Division					
Bachelor Enlisted Quarters	P-673T				
Consolidated Training Center	P-656T				
Administrative Building	P-220T				X
Naval Exchange Command		X	X		
Bachelor Enlisted Quarters	P-467				
Bachelor Enlisted Quarters	P-212S				
F-18 Facilities	P-394			X	
Medical/Dental Clinic	P-850				
Naval Facilities Engineering Command Atlantic Division					
Bachelor Enlisted Quarters	P-995T	X	X		
Ship Self Defense Facility	P-338				
Explosive Ordinance Disposal Operations Facility	P-461	X			
Bachelor Enlisted Quarters	P-708				
Oily Waste Collection System	P-898			X	
Total		**16**	**14**	**4**	**8**

Appendix D. Report Distribution

Office of the Secretary of Defense

Under Secretary of Defense for Acquisition and Technology
  Deputy Under Secretary of Defense (Environmental Security)
  Deputy Under Secretary of Defense (Industrial Affairs and Installations)
  Director, Defense Logistics Studies Information Exchange
Under Secretary of Defense (Comptroller)
  Deputy Chief Financial Officer
  Deputy Comptroller (Program/Budget)
Assistant Secretary of Defense (Public Affairs)

Department of the Army

Assistant Secretary of the Army (Financial Management and Comptroller)
Auditor General, Department of the Army
Commander, Army Corps of Engineers

Department of the Navy

Assistant Secretary of the Navy (Financial Management)
Commander, Naval Facilities Engineering Command
Auditor General, Department of the Navy

Department of the Air Force

Assistant Secretary of the Air Force (Financial Management and Comptroller)
Auditor General, Department of the Air Force

Other Defense Organizations

Director, Defense Contract Audit Agency
Director, Defense Logistics Agency
Director, National Security Agency
  Inspector General National Security Agency
Inspector General, Defense Intelligence Agency

Non-Defense Federal Organizations and Individuals

Office of Management and Budget
Technical Information Center, National Security and International Affairs Division, General Accounting Office

Non-Defense Federal Organizations and Individuals (cont'd)

Chairman and ranking minority member of each of the following congressional committees and subcommittees:

Senate Committee on Appropriations
Senate Subcommittee on Defense, Committee on Appropriations
Senate Committee on Armed Services
Senate Committee on Governmental Affairs
House Committee on Appropriations
House Subcommittee on National Security, Committee on Appropriations
House Committee on Government Reform and Oversight
House Subcommittee on Government Management, Information Technology, Committee on Government Reform and Oversight
House Subcommittee on National Security, International Affairs, and Criminal Justice, Committee on Government Reform and Oversight
House Committee on National Security

Part III - Management Comments

Office of the Under Secretary of Defense Comments

OFFICE OF THE UNDER SECRETARY OF DEFENSE

3000 DEFENSE PENTAGON
WASHINGTON, DC 20301-3000

ACQUISITION AND TECHNOLOGY

March 28, 1997

MEMORANDUM FOR DIRECTOR, CONTRACT MANAGEMENT DIRECTORATE, DOD INSPECTOR GENERAL

SUBJECT: Draft Audit Report on the Use of Energy Conservation Measures in the Design of New Military Facilities (Project No. 6CF-0062)

I appreciate your work on the subject audit and the opportunity to comment. I am concerned by your finding that designs were not supported by energy studies or life-cycle cost studies. I have asked the Services to explain and will provide further comment later.

I would like to clear up the confusion over energy conservation goals and their applicability to new construction. The Energy Policy Act and Executive Order 12902 do require a 30 percent reduction in our consumption of energy per square feet of building space by the year 2005. However, that goal applies to our existing inventory of facilities, not new design. The Act and Executive Order require us to design new facilities that minimize the life cycle cost. New facilities must perform better than existing facilities to bring our average down by 30 percent.

Energy budgets, in terms of energy use per square foot during a standard year, are design targets that, if met, indicate reasonable compliance with our intent to make new designs energy efficient. Your recommendation should require these energy budgets to incorporate all life cycle cost effective measures versus a 30 percent reduction goal. We are currently developing a new DoD Directive on design, and will include such guidance.

John B. Goodman
Deputy Under Secretary
(Industrial Affairs and Installations)

Department of the Air Force Comments

DEPARTMENT OF THE AIR FORCE
WASHINGTON, DC

24 APR 1997

MEMORANDUM FOR DIRECTOR, CONTRACT MANAGEMENT DIRECTORATE
INSPECTOR GENERAL, DEPARTMENT OF DEFENSE

FROM: HQ USAF/ILEC
1260 Air Force Pentagon
Washington, DC 20330-1260

SUBJECT: Draft Audit Report on the Use of Energy Conservation Measures in the Design of New Military Facilities (Project No. 6CF-0062) (SAF/MI memo to DUSD (IA&I), 21 Apr 97)

As indicated in the referenced memo, the Air Force is forwarding the attached specific detailed comments on the subject report. While concurring with most of the report's recommendations, Air Force energy managers believe the auditor did not correctly apply the 30 percent energy reduction goal as defined in Executive Order 12902.

If your staff has questions regarding these comments, please have them contact Major Mark Tissi, (703) 695-8195.

KARSTEN H. ROTHENBERG, Colonel, USAF
Chief, Engineering Division
DCS/Installations & Logistics

Attachment:
Comments

Final Report Reference

AIR FORCE COMMENTS
DOD IG DRAFT FINAL REPORT
USE OF ENERGY CONSERVATION MEASURES IN THE DESIGN OF NEW MILITARY FACILITIES

COMMENTS ON REPORT:

1. GENERAL: We believe the auditor is not correctly applying the 30 percent energy reduction goal as expressed and defined in Executive Order 12902. The 30 percent energy reduction goal is not to be applied to new facility design as the auditor is trying to do. The goal applies to the energy consumed in the total inventory of buildings owned or leased by the military department in 2005 compared to the base year 1985. This inventory consists of less energy-efficient older facilities as well as newer, more energy-efficient facilities. Building new energy-efficient facilities is only one factor contributing to meeting the energy reduction goal.

This 30 percent reduction goal has limited direct relevance to the design of new facilities and is not addressed in Section 306 (a) "New Federal Facility Construction" of Executive Order 12902. Design energy targets were established to ensure that new facilities were energy efficient and complied with 10 CFR 435. The design energy targets are in the range of 40 to 60 KBTUs (1,000 British Thermal Units = 1 KBTU) per square foot for facilities commonly constructed by the Air Force. When compared to the average of 112 KBTUs per square foot for Air Force buildings in FY85, these new buildings reduce the energy consumed per square foot by over 50 percent when compared to similar existing buildings.

The Federal Energy Management Improvement Act (1988) made DOE's "Energy Conservation Voluntary Performance Standards for Commercial and Multi-Family High Rise Residential Buildings" mandatory for Federal agencies. The Air Force, Army, and Navy worked together, using the Army's Huntsville Division, to identify and update their specifications and documents to incorporate these new requirements. The design energy targets in Military Handbook 1190 were reviewed and updated at that time.

Page 6

2. Page 7, Progress: *The chart showing the Air Force, Army, and Navy progress is not supported or logical. All military departments had the same design energy targets in 1991.* Only minor changes were made to these numbers until the Navy encouraged their designers to reduce their energy use targets by 10 percent in June 1995. The Air Force implemented the design energy targets in Military Handbook 1190A (unpublished update) in it's Engineering Technical Letter (ETL) 94-4, Energy Usage Criteria for Facilities in the Military Construction Program in 1994. These were coordinated with the Army and Navy. It was our intent that these targets match those issued by the other services. The Air Force depends on the Army and Navy, as our design agents, to implement our ETLs for new construction. Our design energy targets are basically the same as the Army's and Navy's.

Page 8

3. Page 9, Weather Regions: This paragraph indicates that the Robins AFB GA weather region was used for a Dobbins AFB GA project resulting in the energy use target being too high. These

bases are in the same weather region.

4. Appendix C of the draft audit report: We are unable to determine which projects, if any, are Air Force, since only Army and Navy design locations are shown.

RECOMMENDATIONS:

1. Revise the Military Handbook 1190 to include design energy targets that incorporate the 30 percent energy reduction goals of the Energy Policy Act of 1992 and Executive Order 12902 and instruct Military Departments that the Military Handbook is the primary source of design guidance for DoD.

Nonconcur. The 30 percent energy reduction goal applies to the energy consumption of the total inventory of buildings owned or leased by the military department and has only limited relevance to new construction. It certainly is not applicable to the design energy targets that presently result in facilities that consume far less than 50 percent of that used by the total building inventory. By direction of the Office of the Assistant Secretary of Defense, Economic Security, the military departments are currently developing a Department of Defense Instruction (DoDI) to replace Military Handbook 1190. The DoDI will provide policy, responsibilities and procedures for the planning, engineering, design, construction, operations, and maintenance of military installations and facilities in accordance with appropriate Public Laws and Executive Orders. The DoDI will direct the Secretaries of the Military Departments or their designated DoD construction agent to supplement this instruction with specific technical criteria as may be required to meet their mission requirements. Realistic and achievable energy budgets, as well as other requirements to ensure the continued design and construction of energy efficient facilities, will be an integral part of these technical criteria.

2a. Reiterate the requirement to perform an energy study and life-cycle-cost analysis on all new facility designs.

Concur. However, studies should not be required for features where the potential savings are less than the cost of performing the study. The option of using previous studies and analysis, either directly or with necessary revisions and updates, that are applicable to the project should be encouraged. This will reduce redundancy and allow very limited design resources to focus on those efforts and innovative technologies, including energy and water conservation, that will provide the biggest return. Providing proper documentation in the project files for design decisions must be reiterated.

2b. Perform additional design effort in an attempt to reduce the energy budget when it exceeds the target, and document such efforts.

Concur.

2c. Obtain a waiver when those efforts do not reduce the budget below the target.

Concur.

2d. Establish a system to validate the accuracy of design energy targets and calculated energy budgets for all new facility designs.

Concur. A simplified document/check list directed at explaining how energy efficiency in new buildings is to be determined needs to be developed. A new Defense Energy Program Policy Memorandum (DEPPM) dedicated to energy conservation and design energy target compliance may be the document/check list needed.

Audit Team Members

This report was prepared by the Contract Management Directorate, Office of the Assistant Inspector General for Auditing, DoD.

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