STANFORD LINEAR ACCELERATOR CENTER

FY 2004 – FY2010 Comprehensive Energy Management Plan

Prepared by
Luda Fieguth, PE, CEM

Site Engineering and Maintenance Department

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Stanford Linear Accelerator Center

SLAC is one of the world 's leading research laboratories. Established in 1962, it is located at Stanford University in Menlo Park, CA. Our mission is to design, construct and operate state-of-the-art electron accelerators and related experimental facilities for use in high-energy physics and synchrotron radiation research.

- Recognized internationally with 3,000 visiting scientists from US universities, national laboratories, industrial concerns and foreign countries.
- Highly trained and award winning staff of physicists, engineers, computer scientists and other professionals.
- Work recognized with three Nobel Prizes in physics.

SLAC is operated by Stanford University for the US Department of Energy

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I. BACKGROUND INFORMATION

This document is a Comprehensive Energy Management Program and Plan (CEMP) for SLAC covering the period between FY 2004 and FY 2010. The purpose of this program is to provide a structure and schedule that meet all the applicable requirements listed in the DOE Order 430.2A, DEPARTMENTAL ENERGY AND UTILITIES MANAGEMENT and in accordance with a selected objectives, measures and expectations as developed by Federal Energy Management Program (FEMP). This plan will be incorporated into SLAC's performance-based agreement as appropriate for the mission of SLAC's site. The Comprehensive Energy Management Program and Plan will be updated annually to contain priority actions scheduled for implementation over the next year. SLAC will provide annual assessment of performance against this agreement using graded approach.

The Conventional and Experimental Facilities (CEF) Department of SLAC Director's Office is chartered with managing the Comprehensive Energy Management Program and Plan. SLAC Energy Manager is assigned to manage this program in accordance with established objectives and goals directly related to energy-efficient operations.

In the conduct of its research, SLAC spent $8.1 millions for 358.4 GWH of electricity and over $0.3 million for natural gas in FY 2004. To help manage these large expenditures SLAC's CEMP is directed to four major areas as follows:

- Meet DOE mandated goals;
- Meet performance-based contract objectives;
- Procure energy at the lowest cost for the required reliability;
- Improve efficiency of energy consuming systems in the most cost-effective manner.

In FY 2001 and FY 2003 SLAC achieved an "Outstanding" rating for implementation of these years energy management plans while in FY 2002 an FY 2004 SLAC achieved "Excellent" rating for the corresponding plans based on the gradients that were in force during these years.

The SLAC's FY 2005 Energy Management Plan is comprised of five (5) objectives that have been selected out of eight (8) objectives recommended by FEMP. We retained DOE FEMP objectives numbers rather than arranging them in a numerical order. As a result, the five objectives that SLAC undertook in FY2005 are: Objectives 1, 2, 3, 6 and 7. The "required" Objective 2 was not included in CEMP FY 2004 Specific Goals due to lack of comprehensive sub-metering throughout the site (see "Waver Justification for Measure 2 of Objective 2", Attachment 1 of CEMP). However, many FY 2004 specific goals are contributing to energy use and green house gas reductions upon completion of the projects.

II. FY 2005 SPECIFIC GOALS

In FY 2005 the SLAC Conventional and Experimental Facilities Department will be responsible for developing, reporting, and meeting specific energy management performance measures that are part of the Comprehensive Energy Management Program and Plan (CEMP) as follows:

OBJECTIVE 1: Energy Management initiatives are managed consistently with a Comprehensive Energy Management Program and Plan that includes the minimum requirements of Department of Energy (DOE) O 430.2A, Departmental Energy and Utilities Management.

1. Enter all energy usage data as required into the EMS4 website not later than the submission due date.
2. Prepare and submit to DOE a FY2005 Assessment Report not later than the submission due date.
3. Provide potable water use data in the FY 2005 Annual Report not later than the submission due date.
4. Complete Conceptual Design of Combined Heat and Power (CHP) Plant for SLAC Computer Center (Building 50). When constructed this project will generate electricity and cooling for SLAC Computer Center by means of a gas-burning internal combustion engine and an absorption chiller.
5. Upon completion of goal #4 above, assess project financing alternatives and perform comparative life cycle cost analysis.
6. Implement feasibility study, conceptual design and life-cycle cost analysis of the "Collider Housing Lighting Upgrade" project. Submit a proposal for the project retrofit to DOE FEMP for funding consideration.
7. Design "Collider Housing Lighting Upgrade" project. The 1.8 miles North and South arc tunnels of the collider housing are being illuminated by means of 374, 88-watt mercury vapor lamps and of 122, 200-watt incandescent lamps located overhead at 20 feet intervals. The lights are ON 24/7, year round. Project design includes replacement of all the incandescent lamps with energy-efficient fluorescent lighting assemblies and installation of timers at all the lighting circuits of the collider housing.
8. Purchase three (3) additional Neighborhood Electrical Vehicles (NEV) in FY2005. (In FY2004 nine (9) additional NEVs have been purchased by SLAC, totaling it to 24 NEVs). The battery-operated NEVs allow SLAC to discontinue lease of some of GSA gasoline-powered vehicles.
9. Implement Title II design of "Underground Mechanical Utilities Replacement" project. This goal includes detail design and preparation of construction documents for underground piping replacement of natural gas, compressed air, cooling-tower water, chilled water and hot water systems. These systems

developed significant leaks over years that cause waste of energy and impose additional maintenance cost. The proposed work includes replacement of identified mains and branches known or suspected of leaking.

10. Develop scope of work and estimate cost of installation of electrical meters at substations and feeders as necessary for monitoring SLAC ordinary facilities electrical energy consumption separately from the experiment-related energy-intensive loads.

11. Evaluate a potential for implementing Energy Conservation Incentive Program (ECIP) at SLAC. Currently there are no economic incentives for divisions/ departments/building managers to conserve energy and to implement energy conservation projects. Evaluate for applicability recently implemented ECIP at Stanford University. This program transfers responsibility for paying for electricity use from Stanford Central Budget office to 20 units (schools) on campus.

12. Submit at least one article on the subject of energy management to Interaction Point, SLAC's publication.

13. Have SLAC Energy Manager to attend at least one energy management workshop, seminar or conference.

14. Continue participation in Environmental Management System (EMS) development representing energy management aspects of the system. Currently SLAC Energy Manager is a member of the Working Group for the EMS development.

15. Conduct a presentation on SLAC Energy Management Program for the Environmental Management System Working Group (see related goal #14).

16. Update Energy Management website at least twice during FY2005.

17. Distribute DOE energy-awareness posters and other outreach materials to SLAC building managers for displaying in public places.

18. To the extent that adequate funding is made available upgrade existing on-state gasoline fill up station to allow use of Voyager credit card for 211 GSA-owned vehicles. This will eliminate regular recurring off-site trips for gas fill up purposes for 211 vehicles. Saving on gasoline, employee's time and the vehicles insurance premiums will be significant.

19. Incorporate sustainable design principles into design of new lab/office building of Linac Coherent Light Source (LCLS) project. The project was granted additional funding to achieve Silver LEED certification.

<u>OBJECTIVE 2: Energy Use Reductions and Green House Gas Reductions show continuous improvement.</u>

20. Replace all existing obsolete fluorescent T12/electromagnetic-ballast lighting assemblies in buildings 040 and 084 with new T8/electronic ballasts, energy–efficient, assemblies. Total estimated cost of the project is $150K. The project's

construction bid package was prepared in FY 2004.

21. Implement the construction of "Collider Housing Lighting Upgrade" project. Total estimated cost of the project is $122K. This project is expected to result in annual electrical energy saving of 446 MWH with the projected payback period of 3.0 years (see related goal #6 and #7).

22. To the extent that adequate funding is made available, upgrade existing DDC Energy Management System's web control by installing central server that will consolidate current control functions and data. With the new control system many control functions will be improved and energy saving will be optimized. Total estimated cost of the project is $100K.

OBJECTIVE 3: Develop and Implement Water Efficiency Program and Plans.

23. Develop a Water Management Plan that includes at least four (4) BMPs.

24. Audit existing landscapes for irrigation efficiency. Propose operation and maintenance changes that will optimize performance of irrigation systems.

25. Implement life cycle cost analysis of installation no-flush urinals at five buildings.

26. Replace existing PH and/or conductivity sensors and Strantrol controllers with new sensors and PLC controllers at least two (2) out of four (4) cooling towers: 101, 1201, 1202 and 1701. The new control system will be connected to existing Honeywell Scan DCS (Distributed Control System). The system will allow remote monitoring and reset of the automatically controlled system's parameters therefore allowing optimizing the blow-down cycles.

27. Implement Title II design of campus cooling tower CT101 replacement project. The new cooling tower will be energy and water-efficient system with a sophisticated control to monitor the blow-down and make up cycles.

OBJECTIVE 6: Purchases of energy efficient technologies include low standby power devices.

28. Demonstrate by example the purchase of low standby power devices for 5 of the 10 device types.

OBJECTIVE 7: Control electric, gas, and water demand to control costs and mitigate supply disruptions.

29. Conduct site Assessment of Load and Energy Reduction Techniques (ALERT).

30. Develop work plans to implement Peak Load Management/Emergency Conservation Plans and Alert Assessments recommendations.

III. FY 2004 ENERGY MANAGEMENT PLAN PERFORMANCE ASSESSMENT

In FY 2004 the SLAC Site Engineering and Maintenance Department was responsible for developing, reporting, and meeting specific energy management performance objectives and measures that are part of SLAC's Comprehensive Energy Management Program and Plan.

OBJECTIVE 1: Energy Management initiatives are managed consistently with a Comprehensive Energy Management Program and Plan that includes the minimum requirements of Department of Energy (DOE) O 430.2A, Departmental Energy and Utilities Management.

31. Enter all energy usage data as required into the EMS4 website not later than the submission due date.

    FY 2003 energy usage data was entered into EMS4 before the submission due date following a request from DOE. Performance gradient: 1.

32. Prepare and submit to DOE a FY2004 Assessment Report not later than the submission due date.

    This document is the FY 2004 Assessment Report. Performance gradient: 1.

33. Implement Phase 2 of Feasibility Study for On-Site Combined Heat and Power (CHP) Plant project. When constructed, this project will generate electricity for SLAC Computer Center by means of an internal combustion engine. In FY2003 we completed Phase 1 of this study. During this phase, we compared the economics and reliability of 1.0 MW gas-burning internal combustion engine integrated with a 300-ton absorption chiller against a back-up diesel generator coupled with a dedicated electrical chiller for SLAC Computer Center operation. SLAC management evaluated and discussed the result of this study and concluded that it warrants further analysis with expanded scope of study. The Phase 2 of the study will include assessment of electrical power generation for miscellaneous critical operations of the entire site in addition to the critical loads of the Computer Center. Also, evaluation of the cost impact of the plant location will be included in this study. In addition, we plan to include search and solicitation of funding, grants and incentive/rebate programs available for this project.

    The study is in process at this time. A consulting firm (GE Solutions) has been hired to implement this study. A work plan for this project had been developed and available upon request. The target completion of the study is 11/12/2004. Currently, the scope of work is at ~50 % level of completion. Performance gradient: 0.5.

34. Replace all existing obsolete fluorescent T12/electromagnetic-ballast lighting assemblies in buildings 040 and 084 with new T8/electronic ballasts, energy–efficient, assemblies. Total estimated cost of the project is $150K.

The project implementation is in process at this time with bid package being finalized for upcoming construction bid. Project target completion is 12/17/2004. Performance gradient: 0.33.

35. Design "Accelerator Housing Lighting Control Upgrade" project. The accelerator housing (2-miles long underground structure that houses the linear accelerator beam) is being illuminated by means of 100-watt incandescent light bulbs located overhead at 10-feet intervals. During the machine operation the lights are in dim mode being controlled by resistors. The resistors reduce voltage output by wasting energy with heat. We plan to modify existing lighting control to allow all the lights in the tunnel turned off during No-Access state of operation. The managers of the operation require a pilot installation for a sector-pair of the tunnel prior to implementing the entire scope of work (see related goal #6).

    This goal was implemented as stated. Performance gradient: 1.

36. To the extent that adequate funding is made available, implement lighting control modifications at a pilot sector-pair of the "Accelerator Housing Lighting Control Upgrade" project (see related goal #5).

    This goal was implemented as stated. The pilot project was successful. Performance gradient: 1.

37. To the extent that adequate funding is made available and provided that the installation at the pilot sector is successful, implement "Accelerator Housing Lighting Control Upgrade" project for the entire linear accelerator (see related goals #6 and #7).

    This project was implemented as stated, in schedule and within the budget of $77.3K. Performance gradient: 1.

38. Prepare a written response on DOE consultant's comments/questions for the previously submitted "Test Lab High-Bay Lighting Replacement" project proposal.

    This goal was implemented as stated. Performance gradient: 1.

39. Implement "Test Lab High-Bay Lighting Replacement" project. The scope of the project includes replacement of 80 energy-inefficient T12/magnetic ballast lighting fixtures with new, energy-efficient, T5/electronic ballast, assemblies. The total estimated cost of the project is $35.6K and the projected payback period is 2.9 years.

    This project was implemented as stated. Performance gradient: 1.

40. Decommission existing Low Conductivity Water (LCW) systems that service heat exchanging equipment of North and South Focusing Magnets of SLAC Linear Collider (SLC). The SLC operation has been discontinued. Expected saving on shutting down three (3) 100-amp LCW pumps is 199.5 kW or 1.7 GWH per year.

    This goal was implemented as stated. Performance gradient: 1.

41. Replace undersized and obsolete Variable Frequency Drives (VFDs) at 10 fan

motors of SLAC Computer Center (Building 050). The aggregate rated capacity of the motors is 170 HP.

This project was implemented as stated. Performance gradient: 1.

42. Replace two (2) existing floor standing air-handling units on the 2nd floor of the Computer Center (Building 050) with two (2) new, energy-efficient, units. Each unit capacity is 27 tons. The air handling units have already been purchased in FY 2003.

This project was implemented as stated. Performance gradient: 1.

43. Implement feasibility study, conceptual design and life-cycle cost analysis of "North and South Arc Tunnels Lighting Control" project.

The study is in process of development at this time with target completion of 10/22/2004. Performance gradient: 0.5.

44. Install Variable Frequency Drive (VFD) at 125 HP fan motor of CT 1701.

This project was implemented as stated. Performance gradient: 1.

45. Install a water meter at Central Plant hot water system make-up water pipe.

This project was implemented as stated. Performance gradient: 1.

46. Design replacement of all existing banks of cooling coils and seven (7) supply- and return-air fans of the central air conditioning system serving Computer Center of Building 050. The existing 30-years old, scaled and rusted energy-inefficient equipment will be replaced with new, energy-efficient, equipment. (The total estimate cost of the project is $461K and actual construction is planned to be implemented in FY2005.)

This goal was not implemented due to delay with funding approval. Performance gradient: 0.

47. Purchase six (6) additional Neighborhood Electrical Vehicles (NEV) in FY2004. (In FY2003 15 NEVs have been purchased by SLAC.) The battery-operated NEVs allow SLAC to discontinue lease of some of GSA gasoline-powered vehicles.

Nine (9) additional NEVs have been purchased by SLAC in FY2004. Performance gradient: 1.

48. Implement Title 1 design of "Underground Mechanical Utilities Replacement" project. This goal includes Title 1 design of underground piping replacement for natural gas, compressed air, cooling-tower water, chilled water and hot water systems. These systems developed significant leaks that cause waste of energy and impose additional maintenance cost. The proposed work includes replacement of identified mains and branches known or suspected of leaking. (Estimated cost of design and replacement of underground piping for these five (5) systems is $2,812,147. Title 2 Design and actual construction of the project is scheduled for implementation in FY2005/2006.)

This goal was implemented as stated. Performance gradient: 1.

49. Submit at least one article on the subject of energy management to Interaction Point, SLAC's publication.

An article "Site Lighting Upgrade Program" has been published in May 7, 2004 in the "Interaction Point" newspaper. Performance gradient: 1.

50. SLAC Energy Manager to attend at least one energy management workshop, seminar or conference.

SLAC Energy Manager attended a few workshops provided locally by PG&E and the "Energy 2004" conference in Rochester, NY. Performance gradient: 1.

51. Continue improving/upgrading the Energy Management website.

The "Energy Management" website has been updated twice during FY2004. Performance gradient: 1.

52. Distribute DOE energy-awareness posters and other outreach materials to SLAC building managers for displaying in public places.

New posters have been distributed. Performance gradient: 1.

53. Procure of microcomputers and peripheral equipment through Basic Ordering Agreements (BOAs) negotiated by DOE ICPT (Integrated Contractor Purchasing Team) in compliance with Energy Star criteria.

This is an on-going, multi-year, program that is being implemented as stated. Performance gradient: 1.

54. Continue providing information and assistance in the forming of ride-sharing pools as well as information regarding mass transit and bicycle path through the SLAC Transportation Coordinator. Where operations permit, allow flexible work hours for participation in ride-sharing programs.

This is an on-going, multi-year, program that is being implemented as stated. Performance gradient: 1.

55. Continue providing bus service to and from Cal-Train station in Palo Alto in accordance with schedule that allow employees to commute on public transportation.

This is an on-going, multi-year, program that is being implemented as stated. Performance gradient: 1.

56. Update laboratory's CEMP by March 31, 2004.

SLAC's CEMP has been updated before March 31, 2004. The CEMP is available upon request. Performance gradient: 1.

OBJECTIVE 3: Develop and Implement Water Efficiency Program and Plans.

57. Provide potable water use data in the FY 2004 Annual Report.

Potable water use data for FY 2003 Annual Energy Management Report was submitted in October of 2004 following a request from DOE. A formal request for FY 2004 Annual Energy Management Report has not been put forward at this time. Performance gradient: 1

58. Complete "Waste Water Recycling" project. This project includes installation of new 12,000 gal holding tank for storage of collected waste water as an addition to the existing mobile water treatment unit. The waste water is being delivered by a vacuum truck that collects waste water from different sources such as transformers' secondary containments, underground vaults, etc. The recycled water will be used for cooling tower 1701 water make up.

This project was implemented as stated. Performance gradient: 1.

59. Replace existing PH and/or conductivity sensors and Strantrol controllers with new sensors and PLC controllers at least three (3) out of six (6) cooling towers: 101, 1200, 1201, 1202, 1701 and 404. The new control system will be connected to existing Honeywell Scan DCS (Distributed Control System). The system will allow remote monitoring and reset of the automatically controlled system's parameters therefore allowing to optimize the blow-down cycles.

The PH control components were replaced on cooling towers 1200 and 404. Performance gradient: 0.67.

60. Develop a Water Management Plan that includes at least four (4) BMPs; implement elected BMPs.

Implementation of this goal has been postponed until FY 2005. Performance gradient: 0.

OBJECTIVE 6: Purchases of energy efficient technologies include low standby power devices.

61. Modify acquisition systems to facilitate the purchase of low standby power devices.

This goal is in process of implementation. SLAC procurement department has revised Laboratory's General Terms & Conditions for Fixed Price Construction Contracts; a new article on purchasing of Energy Efficient Standby Power Devices has been incorporated into this document. In addition, a questionnaire on purchasing of low standby power devices will be incorporated into the Laboratory's on-line purchase requisitioning system in FY 2005. Performance gradient: 0.5.

OBJECTIVE 7: Control electric, gas, and water demand to control costs and mitigate supply disruptions.

62. Conduct an Assessment of Load and Energy Reduction Techniques (ALERT) at site.

Implementation of this goal is postponed until 2nd quarter of FY 2005 due to shortage of man-power. Performance gradient: 0.

63. Update a Site Specific Peak Load Management/Emergency Conservation Plan by June 30, 2004.

This goal was implemented as stated. Performance gradient: 1.

64. Develop work plans to implement Peak Load Management/ Emergency Conservation Plans and Alert Assessments recommendations.

Implementation of this goal is postponed until 2nd quarter of FY 2005 due to shortage of man-power. Performance gradient: 0.

Performance Gradient: The summation of the performance gradients for the 34 goals is 27.5. This represents weighted average of 0.81 (27.5/34) or "Excellent" performance level.

IV. EXEMPTION JUSTIFICATION FOR MEASURE 2 of OBJECTIVE 2

Objective title: Energy Use Reductions and Green House Gas Reductions show continuous improvement and are on target toward meeting DOE energy efficiency leadership goals consistent with DOE O 430.2A.

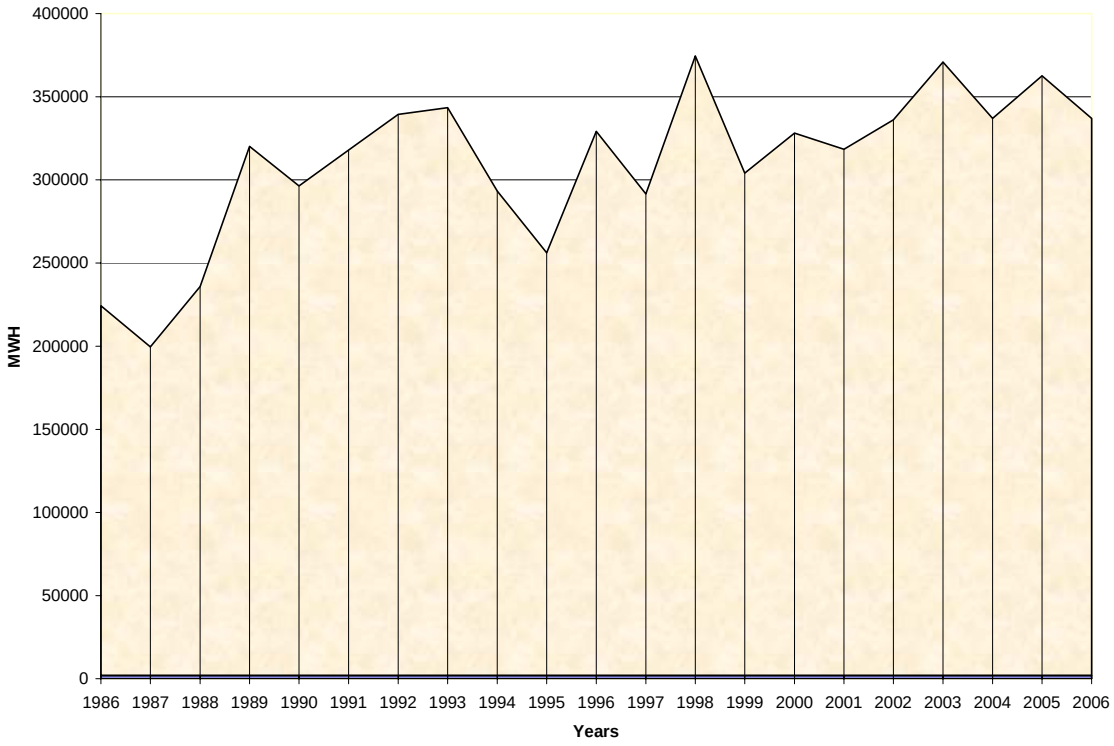
MEASURE 2
((PY - CY) / PY) x 100 = percent reduction
where PY = previous year energy use per gross square foot and CY = current year energy use per gross square foot as reported in DOE's Energy Management System 4.

This objective is not a part of FY2004 Energy Management Plan due to the following:

A. In FY 2002 DOE FEMP made a decision to migrate the entire site into the "Industrial and Laboratory" category. About 80% of total site electrical power consumption is related to experiment-dedicated loads for the high energy physics and synchrotron radiation experimental research facilities. The facilities that contain the experiment-dedicated equipment fit the definition of "Exempt" category. The energy requirements and operation schedules of SLAC experiments vary from year to year (see graph below); therefore, the reduction of energy consumption by SLAC, compared with a base (or any

year), cannot be attributed to energy conservation alone. The remaining facilities fit the definition of "Standard Buildings". The mission-driven process energy use, such as that consumed by SLAC's accelerators and beam lines, cannot be separated from the household loads with the existing metering capability. SLAC does not have accurate data for 1990 (or any other year) as the base year because of the lack of comprehensive sub-metering throughout the site.

SLAC Electricity Usage



(Note: Usage in years 2005 and 2006 are projections)

B. In 2001 SLAC offered a sophisticated proxy measure to report the energy consumption in the "Standard Building" and "Exempt" categories, but it was not accepted by FEMP because it would not have been sufficiently accurate.

C. Since 1992 SLAC implemented many energy conservation projects and has achieved significant reduction in energy consumption. The estimated total cost of these projects is more than $9 millions.

V. LONG TERM GOALS

To ensure that there are adequate systems in place to meet the goals defined in the DOE ORDER 430.2A DEPARTMENTAL ENERGY AND UTILITIES MANAGEMENT, long term goals have been defined for the applicable requirements of the DOE Order 430.2A as follows:

1. Implement life cycle cost-effective improvements, as identified during facility energy audits on an annual basis as funding is made available.

2. Implement water management through water efficiency program in accordance with Objective 3 of Section II - Develop and Implement Water Efficiency Program and Plans.

3. Demonstrate annual progress toward completing energy and water audits of all non-experiment-dedicated facilities.

4. Apply sustainable design principles to new buildings. Comply with 10 CFR 434, Energy Conservation Voluntary Performance Standards for New Buildings; Mandatory for Federal Buildings, from conceptual design through commissioning. Although not mandatory, energy efficiency and sustainable design principles will be considered when designing building alterations for the benefit of reduced life cycle costs and enhanced occupant satisfaction.

5. Evaluate designating SLAC Visitor Center as Showcase Facilities to highlight renewable energy improvements.

6. Continue using existing acquisition system that promotes selection of DOE/EPA Energy Star products. This system was set up in FY 2003. It includes a questionnaire on Energy Star labeled products incorporated in the Laboratory's on-line purchase requisitioning system and addition of Article 62: "Energy-Efficient Products" into the Laboratory's General Terms & Conditions for Fixed Price Construction Contracts.

7. Implement Objective 6 - Purchases of energy efficient technologies include low standby power devices.

8. Continue procurement of microcomputers and peripheral equipment through Basic Ordering Agreements (BOAs) negotiated by DOE ICPT (Integrated Contractor Purchasing Team) in compliance with Energy Star criteria.

9. Continue implementing existing Preventive Maintenance Program that includes identification and correction of energy conservation operational and maintenance deficiencies that are correctable at low cost.

10. Increase use of alternative funding mechanisms in lieu of direct appropriations for energy efficiency improvements consistent with good business practices.

11. Increase number of trained energy managers as needed to ensure effective implementation of DOE orders requirements.

12. Implement feasibility studies that include off-grid generation systems. Implement the projects that demonstrate that such systems are life-cycle cost effective and offer other benefits.

13. Control electric, gas, and water loads to minimize utilities costs and mitigate the impact of sudden disruptions in the supply of energy in accordance with Objective 7 - Control electric, gas, and water demand to control costs and mitigate supply disruptions.

14. Continue annual performance evaluations of SLAC Energy Manager to assess energy management activities and ability of the laboratory to meet provisions of DOE Order 430. 2A.

15. Develop and implement outreach programs to motivate employees to modify behavior to become more efficient in their use of energy and water and to minimize waste.

16. Continue providing information and assistance in the forming of ride-sharing pools as well as information regarding mass transit and bicycle path through the SLAC Transportation Coordinator. Where operations permit, allow flexible work hours for participation in ride-sharing programs.

17. Continue providing bus service to and from Cal-Train station in Palo Alto in accordance with schedule that allow employees to commute on public transportation.