

## FACILITY ASSESSMENT AND MASTER PLANNING PROJECTS

As a part of ERA's regular consulting activities, the firm has taken on numerous facility assessment and master planning assignments. As is discussed below, many of these assessments were (an important) part of a larger task. A sampling of these assignments includes:

- **Foothill - De Anza Community College District HVAC Master Plan.** The District was planning to engage a performance contractor, and needed to identify the total HVAC infrastructure renewal needs for overall budgeting purposes. For both of these purposes, ERA was hired to prepare an HVAC Master plan, which included inventorying the HVAC systems and equipment, visually inspecting same, and identifying system deficiencies. In addition, the plan included an overall strategy for future HVAC systems, including the consolidation of refrigeration machinery on the De Anza campus by applying ERA's proprietary *Virtual Central Plant* technology (a melding of plant integration, automation and variable flow). In addition, a similar strategy was developed to add air conditioning to the Foothill campus. ERA ultimately identified a total budget need in excess of \$10,000,000, and managed the District's engagement of a performance contractor to implement a major portion of the needed work.
- **Santa Clara University Facility Condition Assessment.** Similar to Foothill - De Anza, the University was planning to engage a performance contractor, and needed to identify the total HVAC infrastructure renewal needs as well as begin the process of consolidating HVAC and electrical prime-mover (chillers, boilers and emergency generators) in lieu of stand-alone individual building systems which were exceeding the University's ability to keep up with their maintenance and repair. For these purposes, ERA was hired to prepare a Facility Condition Assessment, which included inventorying the HVAC systems and equipment, visually inspecting same, and identifying system restoration needs. This data was assembled into a comprehensive Microsoft ACCESS database (FCAD). In addition, ERA prepared a conceptual design for the first mini-utility plant. ERA ultimately identified a total budget need in excess of \$18,000,000, and managed the University's engagement of a performance contractor to implement a major portion of the needed work.
- **American President Lines Port of Oakland Terminal - HVAC System Evaluation.** Concerned about the condition of the HVAC systems in their various buildings at the terminal, APL engaged ERA to perform an assessment of the systems. This task included preparing single-line CADD floor plans for all the buildings with HVAC units and their identification number shown on the plans, a spreadsheet inventorying the equipment along with pertinent data, identification of system deficiencies and development of restoration budgets for each system.
- **Belmont Schools - Elementary School HVAC System Restoration Study.** The school district knew they had serious problems due to a growing backlog of deferred maintenance, but did not have a handle on the overall scope nor specific needs at each school site. ERA was hired to perform a study of the HVAC system restoration needs, school-by-school, and system-by-system. The result was a system restoration plan which included repairs to some systems and outright replacement and reconfiguration for others. ERA was further engaged to prepare construction documents and provide construction period services during the implementation of the project.

- **Northern California Presbyterian Homes - Mechanical, Electrical and Plumbing System Assessments.** Among their total inventory of facilities, NCPH owns three large retirement/nursing homes in the San Francisco Bay area. These facilities are all about 30 years old and have each begun to show serious deterioration of their HVAC, power distribution and plumbing systems. While each facility has a director of maintenance, it became apparent to corporate management that long term planning for the renewal of these infrastructure systems was beyond the capacity and mandate of the local maintenance staff. As a result, ERA was engaged to perform an assessment of these systems, including documenting the existing conditions (building plans, equipment inventories, photos, infrared testing, etc.), identification of system deficiencies, development of restoration plans, and programming the needed work over the ensuing decade. The results of this effort were assembled into neatly-crafted 3-ring binders for each facility, which will serve as a long term reference document for local and corporate staff for years to come - as well as provide documentary evidence to upper management of the facility restoration needs. Concurrently, due to the extreme deterioration of one facility's galvanized steel domestic water system, ERA performed an in-depth investigation of this system (including non-destructive and destructive testing of the system components such as internal inspection of large hot water storage tanks) and developed (and is now preparing construction documents for) a phased approach to system replacement that will put a new "core" system in place immediately and allow individual dwelling units to be "switched over" to the new system as they are remodelled or as necessitated by localized piping failures.
- **County of Sonoma Government Center - HVAC System Evaluation.** In the process of performing a conceptual design study for expansion and modernization of the Government Center's central cooling, thermal storage and heating plant, ERA determined that a serious need for restoration of air handling systems existed. Since correction of heating/cooling mixing, defunct economizers and failed control valves had an immediate capacity impact on the now-under-capacity central plant, the County engaged ERA to perform an evaluation of the nearly 100 air handling systems on the 600,000+ square foot, 14-building campus. This evaluation included development of a complete inventory of equipment with pertinent technical data, observation (and photographing) of each system, identification of system deficiencies, development of restoration and/or energy retrofit needs/opportunities, budget estimates and presentation of the information in a binder-format final report. ERA is proceeding with contract document preparation for urgent system repairs and improvements pending funding of the full \$3,000,000 plant modernization project.
- **County of Sonoma Government Center - Central Mechanical Plant Expansion Study.** Built in 1988, the Central Mechanical Plant serves the Administration Center, consisting of some 14 buildings encompassing over 720,00 square feet of space. Due to poor cooling performance of the plant and anticipated building expansion and new construction, ERA was engaged to investigate the plant and develop an expansion and modernization master plan.

As determined during the study, the cooling portion of this plant suffers from a number of problems, including:

- inadequate capacity

- a number of fundamental design flaws that hamper charging of the chilled water storage tank
- an unfortunate condenser heat recovery scheme that forces the chillers to operate at elevated condenser water temperatures and prevents proper heating of the buildings
- an inferior plant control system
- inadequate heat rejection system, limiting the number of chillers that can be operated simultaneously (only three of the four 250 ton chillers can presently be operated)

ERA developed a multiphase plan totaling some \$3,500,000 to modernize and expand the plant, including:

- Phase One (\$1,600,000):
  - condenser water upgrade (more heat rejection capacity) and removal of the heat recovery system
  - repiping of the chilled water system within the plant to greatly simplify the plant and its operation and eliminate the hydronic system flaws which hamper tank charging
  - abate CFC by converting all existing chillers to R-134a
  - upgrading and expansion of the digital control system and revamping of the control sequence and operating parameters of the plant
- Phase Two (\$1,900,000):
  - expand the plant building
  - install a new 500 ton chiller
  - install a new 500,000 gallon chilled water storage tank

As part of the study a simulation model of the plant was built using EPRI's "Cool Aid" program, which demonstrated that the the Phase One work will restore comfort while simultaneously reducing operating costs by approximately 20%. The model also demonstrated that the Phase Two work while providing an additional 900 tons of capacity, will still operate at approximately 10% less cost than the present malfunctioning plant.

In an effort to expedite immediate improvements to the plant operations, ERA was engaged immediately upon completion of the study to implement removal of the heat recovery system (complete) and expansion of the heat rejection system (underway in early 1998).

In the process of performing the expansion and modernization study of the plant, ERA determined that a serious need for restoration of air handling systems also existed. Since correction of heating/cooling mixing, defunct economizers and failed control valves had an immediate capacity impact on the now-under-capacity central plant, the County engaged ERA to perform an evaluation of the nearly 100 air handling systems on the 14-building campus.

This evaluation included development of a complete inventory of equipment with pertinent technical data, observation (and photographing) of each system, identification of system deficiencies, development of restoration and/or energy retrofit needs/opportunities, budget estimates and presentation of the information in a binder-format final report. ERA is proceeding with contract document preparation for urgent system repairs and improvements pending funding of the full \$3,500,000 plant modernization project.

- **John Muir Medical Center - Emergency Power Master Plan.** Having been built in three major phases over a 35 year period, John Muir Medical Center has found itself with aging and un-integrated utility systems in their 400,000 square foot main hospital building. While ERA had already implemented upgrades and integration of the cooling and building automation systems, the Director of Plant Services was still concerned about the overall reliability and longevity of the hospital's emergency power systems. Accordingly ERA was asked to prepare a master plan for the long term management of these systems. This task included documenting the existing conditions (including a hospital-wide department survey and preparation of CADD single-line power distribution diagrams), identification of system deficiencies and development and budgeting of three alternative plans for system restoration and modernization. Funding of this project is currently programmed for around the year 2000.
- **National Medical Enterprises - Evaluation of Corporate-Wide Building Automation and Energy Management.** While Corporate management had funded the installation of numerous building automation systems over the years, uncertainty existed as to whether the projects had been universally successful and whether other strategies and/or opportunities were being overlooked. As a result, ERA was hired to evaluate the overall energy efficiency of NME's inventory of facilities (totalling some 75+ acute care hospitals nationwide) and the efficacy of the building automation systems that had been installed. This task included reviewing energy use data for all facilities, interviewing corporate staff, performing site inspection visits for selected sites and preparing a strategic report for the corporation. This report revealed significant success with the program, along with significant organizational infrastructure problems and significant untapped energy efficiency opportunities. Follow-on assignments included the development of a corporate-wide performance contracting program, currently being implemented.
- **U.C. Davis Medical Center - Investigation of Chilled Water Distribution System.** Practically since it was first built, this 500,000+ square foot acute care hospital suffered from inadequate cooling in the summer months, with patient room temperatures exceeding 80°F in the summer months. In the early 1990's, a large project was commissioned to correct this problem, but resulted in making the situation worse, rather than better. In 1996 ERA was engaged to perform a thorough investigation of the system. This task included preparing floor plans, isometrics and a schematic diagram for the entire chilled water distribution piping system encompassing all of the piping work performed over more than 50 construction projects over the years. These drawings were then verified/corrected in the field with the assistance of the operations and maintenance staff. Next a computer model of the piping system was prepared and this analysis clearly revealed that the use of a constant flow system with booster pumps at each air handling unit was over-pumping the water and actually causing water to flow backwards through significant portions of the piping system. The result, which explained the building's poor cooling performance, was that many air handling units were receiving warm return water flow backwards through their coils. ERA developed a \$1,400,000 remediation plan which consisted of conversion of the entire system to variable flow, elimination of all booster pumps and the installation of digital controls for the variable speed main chilled water pumps. This project was implemented in early 1997, with the result that the entire building was comfortable for the first time in 25 years! In addition, the few small areas in the hospital that suffered from cooling problems not related to the flow problems (inadequate airflow, undersized controls, etc.) could be focused on and resolved.

## **Sierra Nevada Memorial Hospital - Central Cooling Plant Expansion and Modernization.**

In 1992, ERA was engaged to perform a conceptual design study for the expansion and modernization of the building's central cooling equipment. Typical of most hospitals, building expansion design teams had bypassed the integration of utility systems as being beyond the scope of their purview and designed new, stand-alone, central cooling plants for each wing.

With the new wing under design, the Hospital would have had a total of three plants. As suggested to the Hospital, ERA undertook to investigate how the existing plants could be restored and simultaneously expanded, both to renew the failing old equipment and provide additional capacity for the new wing. The resulting study identified a plant that could be built within the confines of the existing building, would integrate all cooling operations, provide chiller redundancy for greater reliability and would convert the entire plant to variable flow operation for improved energy efficiency. In addition, the study identified a serious system deficiency wherein small, critical HVAC systems had been added to the chilled water system without the incorporation of outside air economizers - resulting in the central plant having to run 24 hours per day, 365 days per year. A dedicated, compact chilled water system (with its own water-side economizer) was incorporated into the project to take this burden off the central plant.

ERA was subsequently engaged to perform final design on this project in a phased fashion, the first phase of which (the dedicated critical-HVAC chilled water system) was completed during early 1993 and interestingly included pre-purchasing of the chiller and it's temporary installation to support surgery (which was in desperate need of cooling due to the deterioration of the existing main plant) during the summer of 1992. ERA provided critical commissioning services for this small system, which had to be brought on line smoothly so as to prevent disruption of Cat Scan operations.

The main chilled water plant expansion and modernization phase (the bulk of the work) has was completed over the winter of 1993/94. This project included interconnection to the new building automation system and incorporated oversized heat rejection equipment to maximize available PG&E rebates. In addition, the key equipment (chillers and cooling towers) were pre-purchased by the Owner, primarily to optimize their selection under the complete control of the Owner, separate from the construction bidding process.

As a "side-effect" of the energy retrofit and chilled water plant projects completed by ERA, ERA was also asked to evaluate digital zone controls as an option for the new wing HVAC systems. While this was determined to be attractive (since the marginal cost was small for new construction), in the process of the analysis, it was discovered that the out-of-state HVAC design engineers had configured the new wing air handling systems without outside air economizers, which would have put the central cooling plant back into 24 hour, 365 day operation! This oversight was brought to the attention of the Director of Plant Operations and immediately corrected through directed re-design of the systems.

Additional work at this facility has included design of an extension of the critical HVAC chiller system to the new outpatient wing, conceptual design of a new clinical laboratory, design of the Second Floor Nursing Consolidation project, investigation and planning of isolation room upgrade work, and investigation of indoor air quality concerns.