HVAC SYSTEM EVALUATION AND REMEDIATION PROJECTS

As a part of ERA's regular consulting activities, the firm has made a special focus of troubleshooting and remediating HVAC systems which don't work (of which there is an abundance). A (very) brief sampling of these assignments includes:

- **Great Western Bank Building, HVAC System Investigation and Remediation Design.** Primarily a tenant occupied building, the Great Western Bank Building suffered, from "short-cut" design of the HVAC systems by the design-build contractor. The result was an HVAC system that could never provide adequate cooling, regardless of the season of the year. During the study phase it was determined that the original designer made some fundamental conceptual errors in determining the operating parameters of the air handling equipment - which effectively resulted in undersizing of both the airflow and the cooling coils. It appeared that replacement of the air handling units might be the only solution, since they were so severely undersized (the building was uncomfortably warm even during most of the winter months!).

  Because of the prohibitively high cost of replacing the air handling units in their interior location on each floor, ERA "re-engineered" the HVAC system from the inside out, assuming that the air handling units themselves could not be replaced, nor could their fan horsepower be increased (due to the limitations of the building's power distribution system). Grinding away with a computerized coil selection program, ERA determined that the air handling units could be made to perform by:
  - replacing the existing 4-row chilled water coils with 8-row coils of equal air pressure drop (examination of factory certified dimension drawings confirmed that they would fit in the air handling units)
  - increasing the chilled water flow through the coils (feasible with a much higher horsepower pump, and within the allowable flow rate for the chiller)
  - reducing the chilled water supply temperature (also with the allowable operating parameters for the chiller)
  - installing new air handling unit temperature controls (to reset the planned very-low supply air temperature upwards during cool weather)

  Upon completion of the study, ERA was engaged to prepare final installation documents. This work was performed in collaboration with the owner's selected contractor so as to achieve maximum integration of design concepts and the contractor's working knowledge of the building (the contractor had the service contract for the building). Final selection of equipment was made, simplified installation drawings were prepared and the project installed and put into operation over a 90 day period, including start-up. No tenant disruption was caused during the installation (which would have been the case had the conventional approach of replacing the air handling units been followed). Upon completion of the project, the building's HVAC systems provided comfort for the first time in the 15 year life of the building

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- **John Muir Medical Center (multiple projects).**

  Health Education Center Comfort Investigation and Correction. This HVAC system was ill conceived and utilized a mis-applied cooling-only HVAC system -- and allowed the outside air economizers for three air handling systems to attempt to share the same supply and exhaust ducting from the basement to the roof. ERA investigated this system and identified the fundamental problems involved. In early-2000 work commenced to implement the corrective work and included the installation of reheat coils for all VAV terminal boxes, new digital controls on the three air handling units, and new pneumatic controls for each VAV terminal box and zone. Given the modest size of the project and its "maintenance" nature, ERA prepared plans for use by a hand-picked contractor to install the reheat piping and coils. On its own, ERA installed, started up and calibrated all the controls work in-house. During the controls installation, ERA was able to identify specific, localized comfort problems and make on-the-spot balancing and control system calibration changes to meet the occupants' needs.

  Administrative Office Building, Building Pressurization Investigation and Remediation Design. This building was purchased by the hospital subsequent to the John Muir merging with Mount Diablo Hospital, and was remodeled to provide for a centralized administrative center. Unfortunately the remodel project overlooked some significant HVAC infrastructure problems, including inadequate return air pathways, inadequate building relief capability and inadequate cooling. ERA performed a detailed evaluation including direct building pressurization measurements and return air pathway identification and analysis and developed a remediation scheme which re-used much existing building equipment to correct the problems. This project is proceeding into design as of early-2000.

- **Alameda County Water District, Headquarters Building HVAC System Investigation and Remediation Plan.** This building suffered from an HVAC system which was built to a low budget and virtually all of the HVAC system components (chillers, boilers, air handling units, pumps, comntrols, etc.) were suffering from pre-mature ageing, and the inherent flaws in the original design. The result was poor comfort in most parts of the building, high maintenance costs from constant repairs and high energy bills as well. In addition, the facility is facing a significant expansion in the not-too-distant future.

  ERA conducted a detailed investigation which included examination of all the system components and operational testing of selected equipment. Out of this investigation, ERA developed a remediation program for which ERS prepared the construction documents, and which is proceeding into construction in late 2002. The remediation program will include new chillers and boilers, new air handling units (the original rootop units were made for indoor use and have suffered the ravages of weather), the addition of reheat coils to all VAV terminal boxes, special sound attenuation treatment for the chiller yard, new digital controls for the plant, air handling systems and zone controls as well. The existing low voltage lighting control system will also be enhanced by interfacing it to the new digital control system.

- **General Cinema Theatre, Building Pressurization Investigation and Remediation Design.** An 8 cinema theatre, the Fremont Hub General Cinema's HVAC systems were constructed in a design-build fashion. Unfortunately the result of the process was a building that very frequently

experienced such severe pressurization that extra employees had to be hired to close exit doors following each show - otherwise they would stand open, allowing unpaid entrance to the theatre. Finally, additional problems existed with the HVAC systems being noisy, both in the lobby (quite severe) and in the cinemas (not as severe, but critical to the theatre retaining it's LucasFilms "THX" certification). ERA performed a thorough survey of the building's HVAC systems, including a whole building test, placing all ten HVAC systems alternately into full return air mode and then full outside air mode of operation. Full spectrum sound power tests were also performed at this time to determine whether the cinemas met the THX sound power criteria (NC-30) in each mode of operation. As a result of the investigation, a remediation scheme was developed which included modifications to enlarge the return air pathways (a noise source in full return air mode), addition of powered exhaust fans for full outside air operation, and careful balancing of the supply and exhaust air fans under full outside air operation. Once this scheme was implemented, the cinemas so modified were brought into perfectly neutral air pressure balance. This also solved the noise problems which resulted from a misguided attempt to solve the pressure problem by dampering supply air flows.

- **Joseph P. Bort MetroCenter (BART), Building Comfort Investigation and Remediation.** This building suffered from poor comfort almost any time of the year and high energy bills as well. ERA conducted a detailed investigation which included testing and calibration of zone pneumatic controls and observation of the operation of the pneumatic controls for the air handling and central heating/cooling plant. ERA subsequently developed a remediation scheme which is proceeding into design in early-2000 to add digital controls to the plant and air handling systems and completely rehabilitate and recalibrate the pneumatic zone controls. Contrary to the Owner's initial fears, wholesale replacement and/or reconfiguration of the HVAC central air handling systems was determined not at all to be necessary to provide superior comfort in this building.

- **Sierra Nevada Memorial Hospital - Central Cooling Plant Study and Implementation of Critical-area Chilled Water System.** In 1992, ERA was engaged to perform a conceptual design study for the expansion and modernization of the building's central cooling equipment. In addition to the needed central plant work, 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.

- **U.C. Davis Medical Center - Chilled Water Distribution System Study and Remediation.** 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 (including surgery recovery rooms!) temperatures regularly exceeding 80°F in the summer months (and frequently approaching 90°F for days at a time)! 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 instead of cold supply water to their cooling coils. ERA developed a $1,400,000 remediation plan which consisted of conversion of the entire system to variable flow, elimination of all 53 booster pumps and the installation of digital controls for the new 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 then be focused on and resolved.