

White Paper Report

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WHITE PAPER

Grant Number: PF-50036-10

Title: Planning for an Energy Efficient and Sustainable HVAC System at the Archives
Research Center

Project Director: Jennifer Hain Teper (258714)

Grantee Institution: University of Illinois, Urbana

Report Date: June 29, 2012

INTRODUCTION

Overview

The University of Illinois Library and Archives in partnership with the University of Illinois Facilities and Services Engineering Services Engineering Design (ESED) Sustainability Coordinator were awarded \$13,720 through a *Sustaining Cultural Heritage Collections* planning grant to analyze the existing climate control system for the Archives Research Center (ARC), as well as evaluate the performance characteristics of the storage vault area to develop a plan for improved operation, effectiveness and energy efficiency. Planning for the installation of a fire suppression system was also included in the planning project. This planning grant has been a critical step towards improving the preservation of one of the most valuable and unique collections held by the University of Illinois Libraries, which is currently stored in a less-than-ideal environment with no available fire suppression.

The vault storage areas within the ARC (a three floor/11,314 sq. ft. space constructed in 1921 for use in research on fruits and vegetable crops, insecticides and fungicides were originally designed to maintain consistent temperatures of 0, -20, and -40°F. In the mid-1990s, as part of a facility retrofit in preparation for the ARC, the original ammonia gas refrigeration system was removed from the cold room/vault areas and replaced with a residential quality HVAC system that has proven to be incapable of providing a preservation quality storage environment for the collections.

Background

Since 2006, the Library's Preservation Unit has been actively tracking environmental conditions within the ARC collection storage areas including the monitoring of temperature and percent relative humidity as well as integrated pest management (IPM) activities. At least one PEM2 digital datalogger is located within each storage area and the data, collected monthly, is processed with the new *e-climatenotebook* software (<https://www.eclimatenotebook.com/>) developed by the Image Permanence Institute.

The temperature variation (see figure one) from the current HVAC unit is reasonable (with annual variations between 65 and 73 degrees F, barring a few spikes due to environmental system failures), however the system is incapable of operating efficiently or sustainably at the cooler temperatures suggested for long-term paper storage (60-65 degrees F). The relative humidity (RH) control, or lack thereof, is an even more significant problem, with annual fluctuations between 14% to 95% RH (see figure two). While some gradual annual shifts of relative humidity are acceptable for paper storage, the extremely low RH during the winter months, with the system's inability to humidify the air, is extremely damaging to paper collections over time. Additionally, the extreme

annual shifts, even if gradual, of over 80% RH annually, have also put physical stress on paper and other materials.

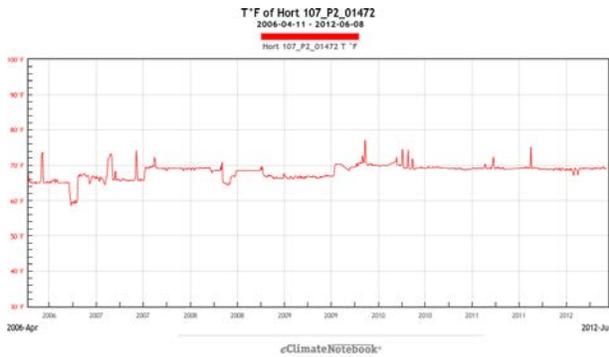


Figure One:

Temperature measurements from 2006-2012

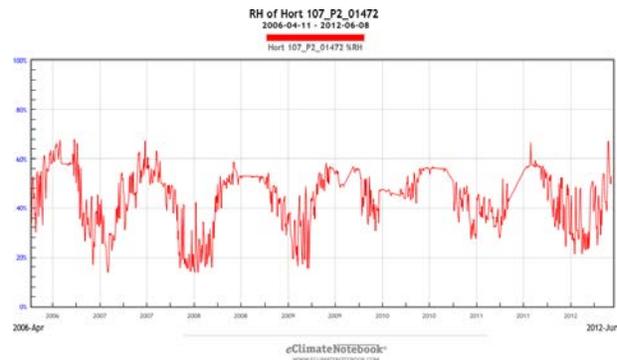


Figure Two:

Relative humidity measurements from 2006-2012

NARRATIVE

Project Activities

This planning project sought to assemble all key players necessary to evaluate and appropriately plan for an improved and energy efficient HVAC replacement within the vault of the ARC; investigate the creation of an appropriate musical instrument storage environment within a peripheral space to the vault in the ARC; and plan for the installation of a pre-action wet-pipe fire suppression system in these collection areas.

The project team was composed of people with three areas of expertise: library/archives experts, campus planning experts, and contracted engineers and project planners. Library/archives experts addressed preservation, access and library-specific facilities issues. Overarching preservation needs were addressed by the Head of Preservation and Conservation. Specific preservation and access needs for paper and instrument collections were addressed by the respective archivists, and library specific facilities issues were addressed by the Assistant Dean of Libraries for Facilities. The campus planning experts were members of the campus' Facilities and Services (F&S) Department, who oversee and manage all facilities construction and renovation projects. In addition, F&S contracted engineering services included the campus sustainability coordinator to effect as much energy conservation in the project as possible while still maintaining an ideal environment. The project was designed with all necessary campus members to ensure satisfactory production of project drawings and specifications completed through the schematic design phase. The production of this end product was monitored, analyzed and confirmed with the project team throughout the timeframe of

the grant to ensure a high-quality outcome that met the needs of long-term archival storage as well as considered long-term energy efficiency and sustainability.

Accomplishments

The planning grant involved five steps to arrive at a successful, final schematic design. These steps were:

- 1) Preparation for project (months 1-3 , August – October 2010)
- 2) Kick-off meeting (month 4 – November 2010)
- 3) Development of schematic design (months 4-7, December 2010-March 2011)
- 4) Approval of schematic design (month 8, April 2011)
- 5) Incorporation of any changes to schematic design, as needed (month 8, April 2011)

Overall, each of these steps were completed successfully, though step 3, Development of the schematic design, took longer than expected (until July 2011) and required a no-cost extension of the grant.

The University of Illinois Library worked with Affiliated Engineers, Incorporated (AEI), an engineering firm based in Madison, WI with branch offices in Chicago and Champaign, during the grant period. The full and final schematic design project manual was submitted to the Library on October 6, 2011.

Working with the environmental guidelines provided by the University of Illinois Library's preservation staff and curators, AEI delivered a base bid for two new DX cooling systems (one for the vault and one for the historical instrument storage area) with three alternatives providing increased energy efficiency: 1) Chilled water cooling; 2) Heat recovery coil; and 3) Geothermal cooling. Any combination of this base bid and alternatives would be able to provide the environmental conditions set forth at greater energy efficiency and reliability than the current system. The additional installation of an enthalpy wheel, energy recovery ventilator, and pumped heat recovery coil were proposed to help recover otherwise lost energy, resulting in long-term efficiency and energy sustainability. The enthalpy wheel will recover temperature (sensible heat) and moisture (latent heat), resulting in a recovery of 87% of the total energy in the exhaust air in the summer and 91% in the winter months. The energy recovery ventilator (used in the instrument storage system) will be used in place of the enthalpy wheel for this small space as a more economical means of heat recovery. Lastly, the inclusion of Option 2) a heat recovery coil will result in additional water heat from the relief air being used to offset facility reheat loads during dehumidification cycles, thus saving additional energy over time.

Audiences

Since this was a planning grant, the public impact of the planning stage of this project is relatively minimal. Audiences for this project would include institutions holding collections of cultural significance in less than ideal, older structures with existing but inadequate HVAC systems. Should installation of this system commence, the project could serve as an example of reasonably low-impact renovations which create high-impact improvements in preservation storage environment and energy savings.

Evaluation

As part of the project plan, a full evaluation of the submitted schematic design documents by the project team was completed. This review resulting in several changes and clarifications in the final project documentation.

In review of the planning grant project as a whole, there were no significant weaknesses in the project design except for not allowing enough time for slippage of the project timeline by the contracted engineering firm. The resulting design successfully met the desires of the project team, fulfilling desires of the collection managers, facilities staff, and preservation staff. Again, due to the nature of this project being a planning grant, no public response was solicited.

Continuation of Project

The results of the planning grant were submitted in November 2011 in an NEH Sustaining Culture Heritage Implementation Grant. Award announcements are pending, and due out in the fall of 2012. If not grant is awarded, the University of Illinois will investigate internal and state funding sources to see this project to completion.

Long Term Impact

As a planning grant, the long-term impact of this grant project is reasonably minimal without the desired implementation. Upon implementation, this project could serve as an example of utilizing existing structures creatively for collection storage. It will also result in a dramatically improved storage environment for collections housed in the ARC, resulting in better stewardship for the present and future collections housed therein.

Grant Products

The planning grant resulted in the production of the *Horticulture Field Lab Archive Storage HVAC Upgrades Project Manual (through Schematic Design)*, submitted October 6, 2011 by Affiliated Engineers, Inc. This document is on file with the Facilities and Services Offices within the University of Illinois.