A Case Study - Twenty Years Experience at the Smithsonian Institution: The Planning and Operation of a Cold Storage Facility for Photographs

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Abstract

Cold storage is the standard recommended method for prolonging the usable life of photographic materials. The use of cold storage facilities has been an important addition to the techniques and operating procedures of museums and other organizations charged with the long-term storage of photographs. While the value of cold storage is universally accepted, the techniques and pitfalls of operating a cold storage facility are less well known. Cold storage units are a complex assemblage of mechanical equipment to chill and dehumidify the air, while also removing harmful gases commonly found in an urban environment. The planning, funding, construction and operation of a large, walk-in cold storage unit requires both extensive time and detailed working knowledge by the staff assigned to the facility. The Smithsonian Institution's Office of Photographic Services has operated a photographic cold storage facility since 1982. This case study reviews the lessons learned in the construction and more than two decades of experience in the daily operation of this facility.

Introduction

Photographs, especially color photographs, fade when subjected to heat and humidity. For more than 20 years cold storage has been the recommended, standard method for prolonging the usable life of photographic materials. More recently, the importance of air filtration to eliminate oxidizing gasses, especially to protect hardcopy created by ink jet and other digital print technologies, has also been recognized. These recommendations have been refined and published in several International Standards Organization (ISO) documents. More recently, published standards recommend cold storage for extending the useful life of magnetic tape and optical disk media.

The introduction of cold storage facilities has been an important, if not mandatory, addition to the techniques and operating procedures of museums and other organizations charged with the long-term storage of photographs.

While the value of cold storage has been universally accepted, the techniques and pitfalls of operating a cold storage facility are less well known. Cold storage units are a complex assemblage of mechanical equipment, which chill and dehumidify the air while also removing harmful gases commonly found in an urban environment. The planning, funding, construction and operation of a large, walk-in cold storage unit requires both extensive time and detailed working knowledge by the staff assigned to the facility.

The Smithsonian Institution's Office of Photographic Services has operated a photographic cold storage facility since 1982, located in the Smithsonian's National Museum of American History in Washington, D.C. This cold room holds work dating to the late 1800s. This includes contemporary black & white and color films, as well as earlier photographic processes including glass plates.

In addition to photographs taken by Smithsonian staff photographers, the room holds numerous photographic collections that were acquired by or donated to the Smithsonian. These include the Juley Collection*, and the Bourges-Bruehl Collection†.

This paper reviews the lessons learned in the planning, construction and more than two decades of experience in the operation of this facility.

* The Peter A. Juley and Son Collection comprises 127,000 photographic negatives that document the works of approximately 11,000 American artists. The Juleys were preeminent New York City photographers, and the record of their work constitutes a mini-history of American art.

† From the mid 1930's through the early 1950's, the Bourges-Bruehl Studio produced more than 1,500 glass color separation negatives of paintings, drawings, and other works of art for Life magazine. Each set of separations consists of four 8" x 10" dry gelatin glass plates, corresponding to the yellow, magenta, cyan, and black inks used in the printing process.

Discussion

Cold storage rooms have long been used by many industries not associated with photographic preservation. These include the food, medical and transportation industries. Building an insulated room and making it cold is not the problem. Most fast-food restaurants in the United States have a walk-in cold room. Rather it is the control of Relative Humidity (RH), to precise low levels in a cold environment, which is unfamiliar to many architectural and engineering firms and contractors.

In most applications, such as household air conditioning, cooling the air also has the effect of reducing the humidity. However, at temperatures recommended for storing photographs, merely chilling the air still results in unacceptably high RH. Therefore, a desiccant dehumidify-cation system must also be installed.

Because photographic cold storage units are expected to operate to precise conditions for long periods of time without interruption, careful planning is the first step in designing and building a cold room. To be effective, planning should involve staff from multiple areas of the organization including the curatorial staff responsible for the collections, budget personnel, in-house maintenance staff, and others.

The first step is an analysis of the photographic materials that are to be stored. This will determine the ideal temperature/humidity specifications for the types of photographic materials involved, as well as the volume of material to be stored.

This is important because international standards recommend different temperature/humidity storage conditions for different materials. For instance, color film should be stored at colder temperatures than black and white. Glass plates must be stored within a precise RH range or there is a risk of delaminating the emulsion from the glass base.

Under ideal circumstances several rooms should be built within an overall facility to accommodate these various needs. Most cultural facilities cannot afford this luxury. Therefore, it may be necessary to choose a temperature/humidity specification that comes closest to meeting all these needs.

For this reason, budget development is also one of the first factors to be considered. Cold storage facilities can be expensive, but need not be prohibitively so. However, cost projections are usually the limiting factor in making many subsequent planning decisions.

In addition to initial construction costs, budget projections must also include day-to-day operating expenses, routine maintenance and long-term, life-cycle projections for scheduled equipment replacement.

In determining the types of mechanical equipment needed, planning should include research on the long-term accuracy and dependability of the equipment to be used. It is important that architects and engineers understand the importance that normal daily temperature/humidity operating conditions don't "max out" the capabilities of the equipment. Rather, equipment should have the capability of operating to a wider range of conditions than those used on a daily basis.

The selected location of the cold storage facility within the building should first take into account safety of the collection. Basements can be prone to flooding. The room should not be located directly under water or sewer pipes that might leak. Room location should also address personnel use issues including handicapped access, the Americans with Disabilities Act (ADA) requirements, and the need for a separate exit door in the event of fire or other emergency. Also to be considered is how heat and water vapor generated by the room's operating equipment will be eliminated. Discussions concerning location should consider the probability of needing to expand the facility at a later date.

It is also important to include a staging area, where photographs being removed from cold storage can acclimate to the outside ambient room conditions. Otherwise, when cold film is met by warmer, moister air, water vapor will condense on the surface like "sweat" on a can of soft drink being removed from a refrigerator.

There are important issues regarding the physical layout of equipment inside the room. Because there will be extreme differences in RH inside and outside the room, it must be realized that there is a high probability of having water condensation around holes anywhere the walls or ceiling of the room are penetrated. For instance, connections to light fixtures on the ceiling can develop condensation drips if the electrical wiring is fed directly to the fixture through the ceiling. Electrical wiring should enter the room through a sidewall and then be routed through conduits inside the room.

Careful consideration must be given to meeting local fire codes that may require a sprinkler system in the room. To prevent accidental water discharge, a dry pipe system should be used, which will charge with water upon smoke detector activation. The sprinkler heads themselves should only spray water in the presence of heat, and then shut off automatically when the fire is extinguished.

Air filtration equipment will also be required to eliminate dust and oxidizing gasses within the room. The system should include air filters capable of removing dust and dirt particles 0.3 mm and larger. Electro-static air filtration should not be used because it produces ozone. Photographs tarnish or fade in the presence of oxidizing gasses such as ozone, sulfur dioxide and nitrous oxide.

These gasses are typically found in most urban environments and must be filtered from the cold room. This has become increasingly important due to the susceptibility of ink jet and other digitally produced prints to fading when exposed to these gasses. Filtration using activated charcoal is typically used.

All of this equipment should be monitored and controlled from at least one central location located in or near the room. If the facility is in a remote location, redundant controls should also be installed where the organization's staff normally works.

During construction of the facility, the installation of the room panels and all equipment should be monitored, photographed, and documented, preferably by a member of the staff who will assume operating control when

construction is complete. This is especially important because of the long-term nature of the facility. Present and future maintenance and operating staffs must know where everything is located, how equipment is interconnected, and "what's behind the walls".

Planning should also include a break-in period once installation is completed and prior to placing the collection in the room. The break-in period is necessary for training, and to allow staff to develop workflow plans and become familiar with operating the facility. This time can also be used to familiarize other staff in the organization with the new facility. This would include staff not involved in the day-to-day operations of the unit, but whose collections might be stored there.

By utilizing a break-in period, experience can be gained without putting the collection at possible risk. Attention should be paid to recognizing routine sounds from the equipment, checking for strange odors, and determining initial temperature and humidity variances. This period will also allow new equipment and storage cabinets to "age", and dissipate any harmful out-gassing. It is important that the paint on equipment and cabinets be fully cured, and not give off any odor.

There are a number of considerations that should be taken into account to accommodate staff that will work in the room. First all personnel assigned to work in the cold room should be provided with cold weather clothing. The clothing selection should, within reason be left to the individual. Some people will be comfortable with only insulated vests, while others will want full coats. In the summer, when staff may wear shorts, skirts, or sandals, those working in the room may need insulated pants, and footwear. There should be windows equipped with heating units in all doors. Being able to look into, or out of the room, without opening the door can be essential. A telephone, building fire alarms, and speakers from building PA systems should be installed in the room.

These items are more important than they may seem at first glance. Staff working in a closed, cold, noisy room must be able to feel that they are maintaining contact with the "outside world" while they are there.

Once placed in full operation, a list of personnel authorized to enter the facility should be developed. Copies of this list, complete with emergency contact information, should be provided to building security staff.

During normal operations it is also critical that operating staff standardize normal day-to-day operating procedures. A standard routine should be developed for filing and retrieving photographs from the cold room.

An example would be that requests for photographs to be pulled are grouped and placed in order according to the filing system in the room. Staff might generally enter the room at the same time each day. When negatives or prints are pulled a sign-out card would be left in its place. This card would list the file number of the photograph, why it was pulled and the date it was pulled.

Photographs leaving the room would then be placed in the staging area to acclimate before going into the outside environment. The photographs might first be put into a plastic bag to insure greater safety during the acclimation process. A chart should be posted in the staging area specifying the amount of time photographs should be staged before being taken into a normal office environment.

Photographs returning to cold storage might also be assembled and re-filed at the same time. In this way, entry to the room can be limited to specific times. Of course, any plan should have contingencies for rush deadline projects.

The facility should be monitored daily to assure that specified conditions are being maintained. A routine tracking program must be developed. Temperature and humidity reading should be automatically recorded, or taken daily by staff.

A routine maintenance program must be established. Decisions must be made regarding in-house or contract maintenance. The room should be kept clean, but cleaning chemicals such as ammonia are harmful to photographs and should not be used.

A complete set of operating instructions, schematics, and blue prints should be kept for reference near the room. In addition a supply of spare parts, preferably recommended by the equipment manufacturers, should be maintained, both to facilitate routine maintenance and meet unexpected emergencies without excessive down time. If the purchase of spare parts requires special approvals or processing through procurement offices, efforts should be made to have approvals done is advance rather than under emergency circumstances.

As with other building operations decisions should be made as to whether routine maintenance will be done under contract or by in-house staff. There are usually advantages and disadvantages to each approach. They should be carefully weighed and key decisions made early. The goal is to insure a smooth, continuous operation of the cold room at prescribed temperatures and humidity, with a minimum or down time. As experience is gained in the daily operation of the facility, variances in temperature and humidity can often foreshadow the need for non-scheduled maintenance.

Other emergency preparations should include operational contingencies for fires, floods, and loss of power. Maintenance plans should also specify time frames for normal life-cycle replacement of equipment.

Because some of the equipment may have a life cycle of ten years or more, it is also critical that advance year budget planning be incorporated, not only into the operating unit's administration, but also into the long-term budgeting of the parent organization itself. These considerations should be reviewed at all levels annually.

Conclusion

Cold storage is the recommended standard method for prolonging the usable life of photographic materials. While the value of cold storage has been universally accepted, the techniques and pitfalls of operating a cold storage facility are less well known. Cold storage units are a complex assemblage of mechanical equipment, which chill and

dehumidify the air while also removing harmful gases commonly found in an urban environment. The planning, funding, construction and operation of a large, walk-in cold storage unit requires both extensive time and detailed working knowledge by the staff assigned to the facility.

References

1. ISO 18911:2000 *Processed Safety Photographic Films – Storage Practices*
2. ISO 18920:2000 - *Processed Reflection Prints – Storage Practices*
3. ISO 18934 - (Currently Under Development) - *Extended Term Storage Environment for Multiple Media Archives*
4. ISO 18925:2002 - *Optical Disk Media – Storage*

Biography

Jim Wallace received his B.A. degree in journalism from the University of North Carolina at Chapel Hill. He served as Director/Curator Imaging & Photographic Services, Smithsonian Institution from 1977-2003. The Office provided photography for the Smithsonian's major museums on the Mall, adding 16,000-20,000 new images each year to long-term storage files that contain approximately 3.5 million images, and date to the late 1860's. In 1982, he established one of the Institution's first cold storage facilities for the long-term preservation of photographs. He is a member of the ISO TC42, Working Group 5 –Image Permanence.