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Designing Control Rooms For Reliable Operation

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Modern process control equipment requires stringent protection from pulp and paper mill environments in order to maintain reliability and maximum useful equipment life. State of the art installations will typically require an operator control room and a process computer room. The operator control room will contain CRT-based consoles, printers, video copiers, annunciator panels, recorders and possible backup panels. Backup panels are at the point of being eliminated in some current installations with the growth of confidence in digital control systems and ability to build in redundancy.

All equipment required for operator interface with the process is contained in the operator control room. The process computer room will contain input/output devices, microprocessor-based control devices, multiplexers, computers and mass storage devices. These will usually be separate but contiguous to the operator control room.

Both the operator control room and computer room require appropriate design and construction features to protect the equipment against environmental and process hazards.

Electrical control rooms which contain controls for electrically driven equipment should be constructed in a similar manner. Depending on the equipment to be housed in the room and ambient air conditions, air purification requirements similar to those for operator control rooms and computer rooms are required.

Recommendations

Access to computer rooms and operator control rooms must be regulated. Only people with a legitimate need to be there should be permitted in these rooms. These rooms should be marked clearly as “Restricted” or “Authorized Personnel Only.”

All doorways used regularly by personnel must be provided with air locks to prevent infiltration of contaminants.

Computer and operator control rooms should be located and constructed in such a manner that equipment is protected from exposure to operating hazards, excessive ambient air conditions and excessive vibration. Close access to the process is often of secondary importance to the security of control equipment and comfort.

Operator control rooms should have a noise level below 60 decibels. Construction materials are available to achieve this level.

Fluorescent lighting is preferred because it generates less heat than incandescent fixtures and illuminates the work area more evenly. Light fixtures that minimize glare should be used to

reduce the problem of operator fatigue. Also, it is important to prevent the light source from being reflected from the surfaces of control displays into the operator's eyes.

Sectional lighting control can be used to appropriately zone the individual lighting requirements within the control room. To further reduce eye strain and fatigue, lighting level controls are an effective means of allowing the operator to adjust the lighting level.

Critical control rooms should be supplied from more than one lighting circuit-breaker to reduce the possibility of a blackout. Emergency lighting for passageways and panel illumination for continued operation should always be provided.

Operator control rooms usually require raised floors under which wiring and cables are run for interconnection of the electronic equipment. All conduit and cable entries into operator control rooms should be routed below the raised floor. This requirement also applies to computer rooms which have raised floors. Entries should be through the sub-floor or the wall into the space between the raised floor and the sub-floor.

All conduit and cable entries must be tightly sealed to preserve the integrity of pressurized rooms. In all sealing methods, the principal concerns are fire rating, moisture, chemical resistance and the effectiveness of seals. Fire-resistant foam sealant is one of the preferred sealing methods. The sealant must surround every cable within a penetration to ensure the best possible seal.

The complete structure must be designed as a fire-resistant building. Fire protection is necessary and can be best provided by the installation of a Halon Automatic Fire Protection System. Air conditioning ducts should be equipped with automatic fire dampers.

Smoke alarms with audible warning systems are recommended. Alarms should sound in the control rooms and vicinity and also at designated remote stations. Fire detection and alarm systems are particularly important in process computer rooms which are not normally occupied.

Air conditioning systems selected for operator control rooms and computer rooms should be installed so that there is no possibility of water entering the operator control room or computer room. Since total loss of air conditioning must be avoided, two half-size units are recommended as a minimum requirement. Window-type air conditioning units are not recommended.

Temperature and humidity should be controlled within the appropriate limits in order to minimize corrosion, condensation, prevent problems from static electricity and provide for operator comfort. Dry bulb temperature should be contained within a range of 68ºF to 78ºF.

Relative humidity should be controlled within a range of 35 percent to 50 percent. 35 percent RH is a minimum for operator comfort and for minimizing static electricity. 50 percent RH is a maximum for minimizing corrosion.

Both temperature and relative humidity should be regulated at a reasonably constant level. +/-3ºF and +/- 5 percent RH is suggested.

A pressurizing air system supplying purified air which can sustain 0.08-inch H2O pressure inside the control/computer rooms is recommended. This system should be capable of supplying two volume changes per hour for well-sealed rooms. Tightly sealed rooms are of paramount importance to avoid excessive air changes and the intrusion of corrosive gases.

A deep-bed activated carbon filter system is recommended to remove corrosive contaminants from the makeup pressurization air supply. The complete system should consist of particulate filtering elements, blower, ducting, and a deep bed of activated carbon capable of removing significant amounts of hydrogen sulfide, sulfur dioxide, and chlorine gases. Concentrations of all corrosive gases in the makeup air should be reduced as much as possible, preferably below a target of 5 ppb. The carbon bed should have a service life in excess of one

year, although the actual service life will depend on ambient concentrations of contaminant gases which are adsorbed.

A room static differential pressure detector and low differential pressure alarm are desirable to indicate loss of adequate room pressure. The alarm would have a time-delay feature to prevent accidental triggering if both air-lock doors are open simultaneously for a short time period.

Operator control rooms and computer rooms must be carefully constructed. No holes or openings should be left in any room surfaces where contaminants, rain or leaks of any liquid can enter the room. When electronic equipment is present in the room before construction is completed, all entrances or holes through walls or floors must be shelter-protected and temporarily sealed.

All openings must be permanently grouted, sealed and flashed before job completion. All penetrations of pipelines used for water, steam, and process fluids must be avoided. Care must be taken to minimize the possibility of spills or pipeline failures infiltrating these control room areas.

To the extent possible, location of overhead piping or equipment which can leak or spray their contents onto the room should be avoided. Special attention needs to be given to the sealing of wall to roof deck, wall to ceiling slab, door and window perimeters and air conditioning ducts or other penetrations through walls and hung ceilings to assure as few opportunities of air leakage as possible.

A cast-in-place concrete slab is the preferred type of roof construction because it renders the best watertight and impact-resistant roof.

On top of the concrete roof deck, a built-up roofing system over rigid insulation with a vapor barrier should be installed. As an alternate to the conventional built-up roofing, an approved single-ply roofing system may be used.

Ceiling slabs used as a floor should have a cast-in-place concrete slab using shrinkage-compensating Portland Cement. On top of the structural roof slab, a layer of 0.070-inch thick membrane waterproofing should be installed to prevent moisture penetration. The membrane should be topped with a minimum of 3 inches of protective shrinkage-compensating concrete. The concrete floor which serves as the ceiling should be pitched towards floor drains located away from control room area.

Walls obviously must be constructed to be air-tight. Masonry walls serve this requirement well in many instances. Other types of wall construction can be used provided construction details keep air leakage to a minimum.

The elevation of the finished concrete floor in relation to adjacent floors should be a minimum of 4 inches to provide protection from possible flooding.

Raised computer floor systems should be a conventional rigid grid support system provided with suitable pedestal height for access to wiring. Floor finish should be static-inhibiting. Treatment of concrete sub-floors to prevent dusting is recommended.

A typical construction for ceilings within the operator control area is a suspended T-bar type with acoustical panels. Sufficient space should be allowed above the suspended ceiling to install HVAC ducts and lighting fixtures.

The interior of an operator control room should be aesthetically pleasing in terms of color choices and lighting. The use of appropriate colors can improve operator alertness and minimize glare. This is a very subjective matter and the advice of a knowledgeable consultant is recommended.

In summary, the design of process control rooms need not be difficult, just carefully done. As long as electronic process control equipment is protected from environmental and process hazards, the control room is at least adequately designed. But to really protect valuable electronic and analog equipment, a control room designed with the above specifications in mid is necessary.

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