Section 301
December 1976
Issue No. 3

CENTRAL OFFICE BUILDINGS

CONTENTS

1. GENERAL

1.1 This section provides REA borrowers, consulting engineers, contractors, and other interested parties with technical information for use in the location, design, construction and furnishings of REA-financed buildings provided to house unattended telephone central office equipment. Specifications for standard masonry type unattended central office buildings are included in REA Form 772.

1.2 This revision consolidates appropriate portions of three TE & CM Sections. Topics not discussed in previous issues are added including building pressurization, modern fire protection, and building and grounds surveillance. Some construction and electrical considerations thought to be unnecessarily restrictive in the past, are now included in this issue. Special emphasis is placed on making design, size, electrical, mechanical, fire and surveillance decisions after all central office equipment space and environment requirements are firm.

1.3 TE & CM Section 303, "Control of Maximum Temperatures in Unattended Dial Central Office Buildings" and TE & CM Section 310, "Heating, Ventilating and Humidity Control" are hereby eliminated. Appropriate information from these Sections (except text book data) has been retained.

2. SITE SELECTION

2.1 In connection with the selection of an appropriate site for an unattended telephone central office building, due consideration should be given to the following:

2.11 Locating the central office building at the wire center of the exchange area to be served is economically desirable. However, the wire center is seldom precisely known and not the only consideration when selecting a site. A reasonable approximation of the wire center for siting purposes may be obtained from the most recent area coverage survey and from local knowledge of residential and business growth trends.

2.12 Topography of the land in the general area chosen should not be subject to flooding. The Flood Disaster Protection Act of 1973 prohibits Federal financial assistance for acquisition or construction of buildings and equipment therein in areas identified by the Secretary of Housing and Urban Development as having special flood hazards unless the community in which such property is located is participating in the National Flood Insurance Program in accordance with HUD regulations and the property owner purchases flood insurance to the extent available under the Act. See REA Bulletin 414-1, and the "File with" dated January 29, 1975. Examples of flood hazard sites are river bottom land, or town sites that slope away from a street and down to an adjacent creek or river. Flood hazard boundary maps prepared by the Federal Insurance Administration are on file at most county court houses. The Federal Insurance Administration also publishes a more detailed map called a "Flood Insurance Rate Map." Questions about map details may be discussed with a Flood Insurance Specialist located in a Federal Regional Office. Severely sloping sites, swampy sites and rocky sites are usually considered to be last choice locations for building purposes. Nonetheless, do not rule out these sites for these reasons alone. Other costs and intangible considerations may offset the cost of "building" a good site.

2.13 Size of the building site should be as large as is consistent with future plans, costs and property restrictions. Purchasing additional land at a later date for a building extension, a microwave tower foundation or other building needs may be expensive when additional property could have been purchased during the initial purchase negotiations.

2.14 Zoning restrictions and environmental protection considerations will tend to limit choices of sites in some areas. Land covenants may also limit use and style of buildings to be erected thereon.

2.15 Building sites should be observed over a period of time to learn the degree of vibration caused by nearby highway traffic. Vibration felt when standing on a site indicates special foundation work will be required to make the site suitable for a telephone building. Dust from unpaved roads is a negative factor. Safe vehicle entry and exit should be considered. Sites <u>generally</u> requiring a left turn entry from a busy highway should be avoided for safety reasons.

2.16 Dust and corrosive material carried on prevailing winds may make some sites unacceptable. Refineries, fertilizer plants, chemical factories, smelters and wood products factories are examples of industries that produce atmospheric conditions which could be harmful to telephone apparatus.

2.17 Fire hazards may be avoided by observing existing use of property adjacent to a proposed site. Gasoline or other flammable liquid storage areas and lumber yards are examples of potential fire hazards that can disrupt telephone service when a central office is located next to them. Aerial, and even buried cables terminating at a central office adjacent to a fire hazard could be severely damaged by a fire even though the telephone building is saved.

2.18 Stable soil conditions are obviously important for a suitable building site. What is not so obvious is the subsurface cross section of dirt, rock, etc. Old and new mining activity has made otherwise desirable building sites unusable. Earth boring tests can reveal these conditions. When bore tests are conducted, the results can provide a foundation designer with necessary information to overcome unstable earth conditions. Large quantities of concrete often overcome unstable soil conditions. Rock blasting and site grading costs are additional considerations when selecting a building site.

2.19 The building location, construction plans and specifications should be reviewed by the state fire rating organization or a consultant for recommendations to obtain the most advantageous fire insurance rates.

2.2 A check list such as that shown in Exhibit A can be used effectively during site selection. Obviously, some weighting should be given to each item because costs of improving a site can be offset by savings in the purchase price, savings resulting from shorter cable runs, or savings resulting from other items shown on the check list.

3. BUILDING DESIGN

3.1 Building design should be based on the following considerations:

3.11 Designs should be limited to fire resistant materials such as concrete, brick, tile, plaster, etc. Metal buildings while fire resistant, generally have not had durability characteristics required to withstand damage from firearms, rust and wind.

3.12 Foundations and floor slabs are being subjected to greater loads resulting from new equipment designs. Therefore, construction details of types I and II shown in REA Form 772A must be followed closely. Thorough tamping of the earth beneath both types of floor slabs is a must.

3.13 Roof structures should not contain bar trusses. Failure of a single tack weld may destroy the integrity of this truss design. Existing buildings containing bar truss construction should be protected with a fire rated ceiling. Pre-stressed concrete, or large fire protected steel beams are more acceptable in wind and fire environments. Wood sheathing should not be used. Poured concrete or precast sections are recommended. A suitably designed pitched roof may be added above a flat concrete roof.

3.14 The cable entrance arrangment is assumed to be an underground tip cable entry. Cable vaults or floor cable slots beneath the main frame are to be the typical tip cable and entrance arrangement and should be developed in accordance with TE & CM 810, "Electrical Protection of Central Office Equipment." Where cables enter from a cable duct system, suitable gas venting should be provided adjacent to the exterior of the building foundation wall. Used and unused ducts should be sealed to prevent gas and water entry at the interior of the building foundation wall.

3.15 Ceiling heights must be determined after considering requirements of the switching equipment supplier. Some new equipment cabinet designs are less than 9' - 0" (2.7 meters) and include the cable rack arrangement as a part of the cabinet. A floor duct arrangement may be required by the switching equipment manufacturer. Floor ducts may not be suited for equipment changes. There appears to be a trend to eliminate the standard overhead cable tray.

3.16 Floor load design of buildings should range from 150 PSF (732kg/m^2) to 300 PSF (1465kg/m^2). These loads are developed when apparatus containing concentrated ferrite core circuits, minaturized integrated circuits and power plant apparatus are installed in a central office equipment building. Equipment suppliers will provide floor loading factors for their specific equipment.

3.17 Preparation of floors for employee comfort, appearance, ease of maintenance and minimum particle dispersion from the covering material is necessary. Carpeting does not satisfy all of these requirements. Commercial grade linoleum in a suitable color will provide resiliency, fire retardancy, long life, and minimal particle dispersion from the covering material. Second choice would be best quality composition tiles. Acceptable floor covering material should not contain asbestos. Buildings that have some amount of carpeting should be equipped with a central vacuum system.

3.18 Window openings should not be planned for telephone equipment spaces. These openings require maintenance, are subject to vandalism, and often cause erratic equipment performance due to concentrated sunlight exposure.

3.19 Earthquake resistant buildings and equipment racks seem desirable in parts of the United States such as the far west and southwest. Battery racks and equipment racks should be arranged to stand as a unit regardless of the movement of the walls of an equipment building. This means that cable racks or battery racks should not be fastened to two surfaces such as a wall and floor or wall and ceiling of a building.

3.2 Since many telephone central office buildings are enlarged at a later date, it seems prudent to contemplate this possibility in the original building design. Careful orientation of the original building will allow for the planned expansion. Designers of buildings need to think of ways to open an existing wall with the least possible harm to working equipment during construction of building additions.

3.3 Knowledge and application of Federal, State and local laws or building codes is expected of persons responsible for the design of Federally financed buildings. The Occupational Safety and Health Act is one of the more recent Federal Acts that is applicable to design of telephone equipment buildings.

4. BUILDING SIZE

4.1 The size of an unattended central office building should be determined after considering the following:

4.11 Present and ultimate switching equipment requirements. Rack space for transmission equipment must be allocated for at least twice as much transmission equipment as the five year plan requires. Carrier systems, VF repeaters, loop extenders, terminating sets, radio equipment, special service equipment and signaling sets are some of the transmission items that will be added in most offices.

4.12 Battery and frame room space. Approximately one third of the switching equipment space requirements should be added for battery and frame space. A partition is most desirable between this space and the switching and transmission equipment space--preferably a fire rated wall.

4.13 Toilet facilities, entrance foyer and work space. Electric and chemical toilets are available that can be installed without water and sewage disposal systems. Work space should be large enough for a full size file cabinet, a small desk and suitable chair. Office furniture should not be placed in the switching equipment space because office work activity can be harmful to switching and transmission systems.

5. ELECTRICAL SYSTEMS

5.1 Wiring for lighting, outlets, and power sources for chargers, etc. should conform to local and national electrical codes. Wiring and equipment should be protected as described in TE & CM 810, "Electrical Protection of Central Office Equipment." Wire sizes should not be compromised in any fashion. Aluminum feeder circuit and branch circuit wiring should be avoided. Service entrance conductors should be terminated at the service equipment in UL listed connectors that are suitable for either aluminum or copper conductors. Service entrance conductors may be aluminum or copper. These conductor connections must be installed according to the manufacturer's instructions. Special connector design and care are required in making connections with aluminum conductors because of "cold flow" considerations.

5.2 Outlets (115VAC) for test equipment, hand tools and trouble lamps should be within 6 feet of any equipment in the building. (This includes distributing frames). AC outlets have customarily been located at the bottom of equipment racks and other equally difficult places to reach. Crafts-people will appreciate the location of outlets placed three to four feet above the floor. This practice could substantially eliminate the need for extension cords and provide a safer work area. Outlet circuits should be designed for no less than 20 ampere service.

5.3 Grounding systems are necessary for lightning protection, for noise suppression in transmission and switching systems and for employee safety. A telephone central office grounding plan should be designed before construction is started because the plan may require imbedding conductors in the building's concrete floors. Single-point grounding is required for some electronic switching systems. All installations should be grounded in accordance with the switching equipment supplier's grounding plan. Exterior as well as interior grounding are discussed in TE & CM 810 mentioned above.

5.4 Lighting should provide an illumination of at least 70 foot-candles at a height of 30 inches above the floor. Lighting fixtures should be high enough to clear equipment racks and cabinets, but must be below cable racks or grids when used.

6. MECHANICAL

6.1 Mechanical furnishings in central office equipment buildings should be determined after considering the following:

6.11 Heating units, preferably electric, sized to provide no more than 80°F (27°C) temperature in any climate. It is most important to recognize that heat dissipated by electronic central office equipment will often provide room temperatures that are adequate for specified equipment performance. This means no less than 32°F (0°C) or as specified by equipment suppliers. Supplemental heat provided by electric heaters with fan circulation can be relied upon to raise temperatures to comfortable working conditions during the time craftspeople are in the building. Heat loss calculations plus equipment manufacturer's heat dissipation information form the basis for sizing the electric heaters to be installed.

6.12 Air conditioning may be necessary. In buildings where the inside temperature is expected to exceed switching, transmission and power equipment manufacturer's operating temperature requirements, there must be a means to lower the room temperature to the most critical temperature requirement. (See Paragraph 6.14 for humidity control.)

6.13 Air filtering systems are necessary. The wiping action of moving parts in electromechanical switching systems has partially offset the effects of dust and corrosion. However, in electronic switching systems there are few moving parts and large concentrations of electronic circuitry mounted on plug-in cards. Dust reduces the effectiveness of heat sinks designed to dissipate heat on these cards. Both dust and corrosion increase the probability of a poor connection at the multitude of plug-in card connectors in electronic systems.

6.131 Consideration must be given to the prevailing air quality. Atmospheric conditions can change seasonally. Good air filter selection must therefore consider the maximum conditions which may occur on an intermittent basis, such as, high winds, plowing of agricultural fields, cropdusting, atmospheric inversions, etc. Rural areas may present periodic conditions far more severe than highly industrialized areas.

6.132 The type of equipment intended for use in the central office should be evaluated to determine environmental requirements. Mechanical switching offices require protection from abrasive wear due to dust and dirt. Electronic switching offices require protection from excessive heat build up. Both types of equipment should be protected from corrosive atmospheres. Heat dissipation requires air movement. Fine dust particles carried in moving air are attracted to electronic components by electrostatic force. Over a period of time dust forms a thermal insulation around the components which reduces the effectiveness of a cooling air stream. Heat build up can shorten the life of electronic equipment.

6.133 Some air handling systems are designed to maintain a positive pressure inside the central office. This is to assure that all outside air is introduced through the filtering system, not through cracks and crevices around doors and other openings. This can be accomplished by introducing a controlled amount of outside air into the air handling system. The pressure difference between the inside and outside of an equipment room should be about .1 inch (.25 CM) on a water gage sensor. This amount of pressure difference will apply about 11 pounds (5 KGS.) on the inside surface of a 3 foot (.91 Meter) by 7 foot (2.1 Meters) door. Greater pressure differences can make it difficult to close a door. And, in extreme cases, can move the weakest wall of an equipment room.

6.134 Outside air requirements would be determined by the amount of air being lost due to vents or other air leaks. As an example, a system utilizing 1,000 CFM and losing 50 CFM through vents, doors, etc., would require 15 percent outside air (.15 x 1,000) to maintain a 10 percent (.1 x 1,000) outside air surplus for pressurization. Pressure controlled venting may be required to make the system reach equilibrium at the desired pressure differential with respect to outside atmospheric pressure.

6.135 Particles suspended in an environment are made up of particle sizes and weights having a variety of stratification values. Return air ducts should be split returning half from the upper levels and half from the floor levels. This procedure would insure getting most of the internally generated particles back to the air filter system for removal.

6.136 Air supplies should be located in such a manner as to encourage migration of internally generated particles back to the return air grills without short cycling the conditioned air.

6.137 Air filter systems should be capable of accommodating various filter efficiencies, as dictated by the changing environment, without altering the basic system design. These efficiencies should range from 30%, 50%, 80% and 90% when tested according to the American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE) standard 52-68 on atmospheric dust spot efficiency. Spun glass filters should not be used because they release particles of glass which is an abrasive material.

6.138 The air filter system should incorporate the capability of adding activated carbon for control of corrosive atmospheric gases when and if atmospheric changes occur or equipment sensitivity requires such control. The activated carbon filter should remove 95% of all adsorbable gases, odors, vapors and fumes.

6.139 When an electrostatic dust precipitator is used, an activated carbon filter placed downstream of the precipitator may be specified, if warranted for the particular application to effectively adsorb ozone generated by the precipitator. All applications of carbon filters require an additional high efficiency filter to control carbon particle blow off. Electrostatic precipitators should be equipped with indicators to show presence of high voltage on the collector plates and ionizer wires.

6.1310 Humidifiers and/or dehumidifiers should be located upstream of the highest efficiency particulate filter to eliminate residue bleed off from these devices.

6.1311 Blower characteristics should be designed to maintain building pressure and dissipate heat at the highest possible resistance when the total system is utilizing prefilters, activated carbon filters, and 95% final filters. This resistance would range from 1.50" (3.81cm) water gauge clean to 2" (5.08cm) water gauge final resistance exclusive of all other system components.

6.1312 A pressure differential warning device should be located in the building to indicate loss of positive pressure. Filters should be changed when positive pressure cannot be maintained above .01" (.02cm) water gauge. This assumes no air leaks have developed after the air handling system is placed in service.

6.1313 Air balance of the total system should be accomplished to maintain a higher positive pressure in critical switching areas over areas containing batteries, standby generators, the main frame and other spaces that require less air quality control.

6.1314 Batteries, standby power generators, etc., should be located outside of the switching area so that these areas can receive the tail end of the conditioned air by circulation into these rooms or enclosures through barometric dampers. Barometric dampers prevent a reverse air flow from the contaminated area into the switching equipment room.

6.14 Humidity control became more important when it was learned that values above 20% tend to reduce the possibility of generating static electricity. Degraded performance of some types of electronic equipment has been shown to be caused by static electricity. Also, the comfort of employees working in the building should be considered. Where climatic conditions cause humidity in the building to be less than 20 percent, a humidifier should be considered. When humidity exceeds 60 percent a dehumidifier should be considered. Many air conditioning systems extract enough moisture from the air to keep the humidity below 60 percent. In all applications the central office equipment manufacturer's humidity requirements should prevail.

6.15 Air handling units should be applied in strict accordance with each manufacturer's instructions. Where products of several manufacturers are combined in an air handling system, it is desirable to study the total system to detect detrimental interaction between units.

7. FIRE

7.1 Fire protection is considered to be necessary, not only from a property damage standpoint but more importantly from a service interruption standpoint.

7.11 Fire prevention begins by eliminating as many flammable building construction materials and furnishings, as are reasonably possible.

This includes wood, plastics and textiles. Consideration of explosive fumes is another important fire prevention item. Batteries give off hydrogen when being over-charged. Motor generators may also introduce explosive atmospheres (fuel and exhaust) in an equipment room. Hence, adequate ventilation of the battery and generator areas must be provided. A ceiling vent above the battery rack will suffice in the immediate overhead at the battery rack. Sizing this vent requires some knowledge of the rate of hydrogen gas released per cell during full charge. About .016 cubic foot per hour per cell at 1 ampere is a good approximation. Information for calculating vent size may be obtained from battery manufacturers.

7.12 The possibility of a fire or explosion is increased when an auxiliary power plant is located in the same building with the central office equipment. New thinking is to place it to one side of the building or on the roof. Since these units are noisy, a roof mount helps to reduce this noise source. Roof mounts introduce other problems that may offset its advantages. Outside locations provide adequate ventilation to these units and thereby reduce the possibility of explosive conditions. Flooding of basement locations may cause loss of power when most needed. Therefore, basement locations are not recommended for power equipment. (See TE & CM Section 320, "Emergency Generating and Charging Systems").

7.13 Fire detection is inexpensive (less than $100 per detector) and very effective when ionization smoke detectors and heat detectors are coupled in an integrated detection and protection system. Local distributors of these devices can provide engineering assistance and installation as needed.

7.14 Fire protection may be provided by hand carried extinguishers, but the latest thinking is to equip an office with a fire extinguishing gas discharge system. When the smoke (products of combustion) detector operates it can sound an alarm and set a timing chain into motion to release the extinguishing agent--or hold release until a heat detector is operated. Since these gases are expensive (about 5 dollars per pound) there may be some advantage to an arrangement to allow a reasonable time for persons who may be at the scene to use a portable extinguisher to extinguish the fire. However arranged, a halogenated gas or CO_2 system provides fast extinguishing action with practically no residue. Corrosion resulting from decomposition products of fire extinguishing gases are significantly less than corrosion resulting from water applied to burning wire insulation. Speed of detection discharge and extinguishment minimizes decomposition of gases used to suppress fires. Toxicity of gases is low. However, prolonged human exposure is not recommended. Since the amount of gas in a system is calculated to quickly mix with the air volume in an equipment room, any open windows or doors will tend to make a gas less effective. As in other systems, accidental discharge is expensive. Air intake and discharge systems must be interfaced with a gas system to prevent air circulation when the fire suppression system is activated.

An arrangement may be made with local fire marshals to gain entry to an unattended c.o. to determine a course of fire fighting action when a smoke alarm is received.

8. SURVEILLANCE

8.1 Surveillance of grounds and building contents is becoming increasingly important. Tower lighting, building entry, unfavorable room environment, malfunctioning equipment etc., should be monitored at a continuously manned center. Several low cost alarm systems are available to satisfy this requirement. When control functions are necessary, these same alarm systems can be equipped to provide control for remote switching of spare units and bilateral switching of automatic transfer circuits. Receipt of an alarm from a smoke detector can alert maintenance people to call a local fire station in the vicinity of the unattended office to search out the smoke source. Central office status and control systems cost a very small percent of the real estate and contents of an unattended office. Increasing regard for quality of telephone service makes status and control systems an essential requirement of today's central office operations people.

SITE CHECK LIST

Exchange ______________ Site Identification →

Information shown is for first site considered for this exchange. Information for alternate sites should be inserted in remaining columns.

	rte. 5 & Cedar			
COST ESTIMATES ($)				
LAND	2500			
EXCAVATING	4000			
BLASTING	None			
GRADING	1000			
LANDSCAPING	None			
SPECIAL FOUNDATION	None			
INSURANCE	Normal			
OTHER				
INTANGIBLES (Yes, No)				
FIRE HAZARDS	No			
FLOODING	No			
ZONING OR BUILDING COVENANTS	None			
DUST AND CORROSION	None			

EXHIBIT A