

GE EQUIPMENT CENTERS

APPLICATION CONSIDERATIONS

Introduction

For many years the petro/chemical industry has utilized equipment center's to house their electrical distribution equipment. Many industrials and utilities are now utilizing equipment center's for their equipment. The purpose of this paper is to define equipment center's and compare to present technology for outdoor electrical equipment.

Definition

An Equipment Center is a prefabricated, modular electrical/instrument enclosure. As a self-contained unit, it is a completely assembled building manufactured in a factory environment. Typical equipment enclosed by an equipment center is {low & medium voltage switchgear, motor controllers}, Relay Panels, RTU'S, instrument control panels, DCS systems, Heat Trace Panels, UPS systems, Battery Systems and SCADA systems. The equipment center can also serve as an outdoor enclosure for high voltage switchgear when Gas Insulated Switchgear (GIS) equipment is utilized.

An equipment center is designed and manufactured in accordance with a number of rigorous industry standards as outlined below. Additionally, an equipment center must comply with local building codes. The most common designs are self-framing interlocking wall and roof panels attached to structural steel base.

Table 1

ASCE 7-88	Minimum Design Loads for Buildings and Other Structures (ANSI A58.1)
NEC (NFPA-70)	National Electric Code
AWS D1.1	American Welding Society - Structural Welding Code
ASTM A-6	General Requirements for Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Support
ASTM A-36	Specification for Structural Steel
AISC	Manual of Steel Construction - Allowable Stress Design
UBC	Uniform Building Code

Wall System

Wall panels are typically 18 gauge painted galvanized steel that is formed to provide an interlocking system. Interlocking 3" exterior wall panels are typically on 16" centers and provide 100 MPH allowable wind loading. Higher wind load ratings are provided as required. Interior wall liners and insulation can also be provided.

Resistance to Environments

The interlocking panel design inherently provides a barrier against water entering the equipment Center by providing two 90' bends at seams between the exterior and interior of the equipment center. Additional weather-proofing is also provided to ensure enclosure integrity. After assembly of the wall system, all seams are sealed with industrial grade silicone sealant. Roof sealing putty is used at all wall-to-roof joints and at joints on peaked-roof enclosures. All roof panels are also individually sealed with silicone sealant.

The paint system consist of surface preparation, primer, underside coatings, finish paint and sealant. The finish coat is typically epoxy-based, to provide outstanding resistance to chemicals, moisture and abrasion; The flexible coating is highly resistant to the deteriorating effects of many acids, alkalis, solvents, greases, oils and other active chemicals.

The resulting enclosure can be designed for extreme ambient temperature and humidity environments, ranging from -40°C to +50°C, while allowing the use of lower cost indoor types of switchgear and electronic equipment. For special environments, the equipment center can also be fabricated from aluminum, stainless steel or fiber glass.

Grounding System

The equipment center is furnished complete with suitable factory installed grounding connections which bond all electrical equipment enclosure frames/ground buses to the building frame. Two (2) 4-hole ground pads are located at opposite corners of the exterior of the building. Separate "quiet" or isolated instrument ground bus can also be provided.

Other Construction Features

Typically, equipment center's are provided with interior and exterior lighting, heating, ventilation and duplex receptacles. An equipment center can also be provided with air conditioning, humidity control, and pressurization/purge systems (NFPA 496). Additionally, most features available in a site built building are available in an equipment center; including offices, bathrooms, communications room, battery rooms, etc.

Applications

Application of an Equipment Center is usually compared with conventional outdoor electrical/instrument enclosures such, as concrete block buildings and sheltered-aisle switchgear, Evaluation is centered around the issues of effectiveness for the application, initial installation costs, and total life cycle costs. Specific construction and procurement factors provide the basis for a more detailed technical and commercial comparison of alternatives.

Equipment Center vs. Conventional Building

Equipment Centers are primarily used in applications that have traditionally favored electrical rooms constructed at the site utilizing conventional construction techniques. The below table describes the advantages of an equipment center with the most common alternative, a concrete block building.

Table 2

	<u>Equipment Center</u>	<u>Conventional Building</u>
Major Electrical Equipment	No difference	No difference
Sourcing	One manufacture is responsible for all equipment purchasing	Separate solicitation, analysis (and often) sourcing of switchgear, building, battery systems, bus duct, etc.
Design Engineering	Complete package designed and engineered by one manufacturer	Purchaser must design and engineer
Construction	Variety of materials, depending on application environment and structural requirements including galvanized steel, stainless steel, and aluminum	Typically, concrete block
Foundation	Minimum foundation i.e., curb type or pier type	Requires full slab foundation with relatively large stem walls and footing
Base	Self-supporting, allowing all equipment to be factory leveled before shipment	Purchaser provides channel base and grouting for leveling all equipment
Internal wiring	Factory wired complete with wiring schematics	Job-site interconnection of control wiring as well as major equipment
Main bus interconnections	Coordinated by equipment center supplier.	Purchaser coordinates the match up of main buses for different types of equipment
Bus duct from transformers	Checked for ease of assembly	Purchaser coordinates and assembles bus to switchgear in field for first time
Grounding system	Integral to equipment center	Must be planned and built into foundation
	<u>Equipment Center</u>	<u>Conventional Building</u>

Testing	Customer can complete many pre energization tests before installation. Witness testing can be at one location.	Each type of equipment is tested at different factories. Witness testing requires more time and travel
Changes	Changes can be made after functional testing and inspection in controlled factory environment	
Receiving, Handling, & Storage	Arrives in single shipment, usually unloaded in one hour; can be stored indefinitely as integral unit, inherently protected against elements	Purchaser must provide for receiving and storing multiple units made at different times by different suppliers. Often involves redundant handling for storage, trucking to intermediate locations, and protection during storage from pilferage or other loss, or lost time due to weather
Installation	Involves minimum number of crafts	Requires many crafts; i.e., carpenters, ironworkers, cement finishers, brick layers, electricians-all with foremen and helpers
Expansion	Modular construction results in convenient expandability as system grows	Space for expansion must be included initial installation
Commercial Treatment	Taxed same as weatherproof equipment	Treated as real estate improvement necessitating higher tax schedule, building permits, progress inspections, bonding & insurance

Special Applications

equipment center's can be designed for high wind loading (up to 150 MPH), seismic Zone 4 applications, and high snow loading. Fire proofing can be installed on exterior walls to protect switchgear from transformer failures. Special exterior finishes can be provided to better integrate equipment center with surrounding environment. Offices, bathrooms, maintenance rooms, battery rooms, etc. can be added to equipment center to eliminate additional buildings at site.

Advantages:

One of the significant advantages of the equipment center alternative is minimal field erection and commissioning time and expense. All equipment is interconnected and tested before shipment from factory, including everything from switchgear systems to DCS systems, power panels, heat trace panels, lighting panels, HVAC systems and battery systems. In the case of conventional buildings, the purchaser or contractor must coordinate and provide field labor to install, interconnect, and test all equipment.

Equipment center utilization means, an order can be placed very early since a major part of the engineering, drafting, and coordination is transferred to the manufacturer. On the other hand, even a small control building has all the elements of a major project that requires project scheduling. A series of purchase orders is required. Requisitions may come from several sources. Meetings for evaluation, review and coordination are necessary, which in turn require added allocation of internal engineering manpower.

Shipping time differs for each type of electrical equipment. The total shipping time for equipment center's is only 3 to 4 weeks longer than for individually procured indoor equipment of the same type. Engineering and planning can proceed while waiting for equipment arrival at equipment center manufacturer's location. Experience has shown that up to four times the man-hours must be allotted for site equipment installation because of the additional work done in the field, while an equipment center arrives complete, pretested and ready for installation.

Commercial warranties may be affected by staggered lead times that do not run concurrently from the overall system commissioning dates. Finally, the sum of individual equipment prices are not as low as equipment purchased as a package from a single supplier.

Equipment Center vs. NEMA 3R Shelter Aisle Enclosure

Most major switchgear suppliers offer a line of sheltered aisle in single-row or double row arrangements that typically comply with NEMA 3R requirements for outdoor installation. Single-row installations consist of a line-up of outdoor switchgear adjacent to a weatherproof walk-in aisle. The overall design provides weather protection and good economy of space, but is limited in application flexibility and room of auxiliary equipment. The below table provides a more detailed comparison of equipment center construction and application as an alternative to NEMA 3R Sheltered Aisle Switchgear enclosures.

Table 3

	<u>Equipment Center</u>	<u>Sheltered Aisle Switchgear</u>
Major electrical Equipment	No Difference	No Difference
Sourcing	One Manufacturer is responsible; enclosure is flexible and can accommodate various equipment	Separate enclosure must be sourced for each type of electrical equipment
Design and Engineering	Complete package designed and engineered by one manufacturer	Purchaser must design and engineer
Foundation	Minimum foundation, i.e., curb type or pier type	Usually requires full slab foundation with relatively large stem walls and footings
Base	Self-supporting, allowing all equipment to be factory leveled before shipment	Purchaser provides channel base and grouting for leveling all equipment
Internal wiring	Factory wired complete with wiring schematics	Job-site interconnection of control wiring as well as major equipment
External connections	Easily adaptable to overhead or underground conduit systems	Slab floor mandates detailed and exact conduit location; changes are difficult
Testing	Unit is completely factory tested; customer can complete many pre-energization tests before installation	
Receiving, Handling & Storage	Arrives in single shipment, usually unloaded in one hour; can be stored indefinitely as integral unit, inherently	Purchaser must provide for receiving and storage multiple units made at different times by different suppliers.
	Equipment Center	Sheltered Aisle Switchgear
Receiving, Handling and Storage (Cont.)		Often times involves redundant handling for storage, trucking to

intermediate locations and protection during storage from pilferage or other loss or time due to weather.

Installation

Involves minimum number of crafts.

NEMA 3R construction must be field assembled.

Advantages

A key advantage of the equipment center is the flexibility to provide a variety of equipment (switchgear, motor controllers, relay panels, RTU, supervisory control and battery systems, data logging, event recorders, etc.) installed and interconnected in the same enclosure. Additionally, an equipment center provides superior weather protection and can be insulated and air conditioned to protect sensitive electronic equipment. Sheltered aisle switchgear is limited to the type of non-switchgear equipment that can be housed in the enclosure.

Equipment Center and High Voltage Switchgear

Through the use of SF6 gas-insulated switchgear, equipment centers can also be used for housing high side (Transmission and substation) switchgear up to 170kv. A double feed station, or H configuration with five circuits can be housed in a single 40' equipment center. This configuration provides enormous space savings, higher reliability and less maintenance than typical air insulated substation. All the advantages of an equipment center (single point engineer, procurement, fabrications and testing) are applicable to High Voltage Switchgear. In combination with low side switchgear equipment center, an entire substation could consist of two equipment centers and transformers.

Summary

An equipment center provides the end user with a self contained, pre engineered, prefabricated solution to housing switchgear, auxiliary electrical equipment, instrument/control panels, DCS systems, heat trace panels, UPS, etc. Of particular significance is (1) the ability to provide rugged, reliable enclosure construction in accordance with established standards, (2) the ability to acquire the complete outdoor electric/instrument equipment package, from a single supplier with design and engineering responsibility, and (3) the ability to provide complete pre delivery interconnection and testing, to include switchgear control wiring, lighting transformers, power panels, lighting panels, lighting fixtures, receptacles, exterior lighting, batteries and chargers, Modular construction from interlocking materials contributes to flexibility as well as cost-effectiveness. The equipment center will reduce engineering, procurement and field cost over the other switchgear enclosure technologies, without an impact on reliability, maintainability or performance.

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