## Current Control Houses

<table>
<thead>
<tr>
<th>dB</th>
<th>Type</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Transparent</td>
<td>Wood</td>
</tr>
<tr>
<td>5</td>
<td>Poor</td>
<td>Masonry</td>
</tr>
<tr>
<td>10</td>
<td>Moderate</td>
<td>Concrete</td>
</tr>
<tr>
<td>20</td>
<td>Good</td>
<td>Metal Siding</td>
</tr>
<tr>
<td>30</td>
<td>Metal</td>
<td>All-Metal</td>
</tr>
</tbody>
</table>

*Source: Meta-R-389, Preliminary Appraisal of HEMP Effects on Electrical Substations by Dr. Edward B. Savage and Dr. William A. Radasky, Metatech, page 5*
Current Control Houses

Points of Entry
• **Electrical Systems:** Dual fed (A&B) with two unprotected systems. Some have provisions for roll-up emergency generators.
• **HVAC Systems:** Typically thru-wall air conditioners mounted in the side walls of the building and heating is supplied by electric heaters.
• **Plumbing Systems:** Some have bathroom and/or sink facilities.
• **Data & Communication Systems:** Typically, data and communications through copper Telephone/SCADA lines.
• **Fire Detection/Protection Systems:** Typically heat/smoke detectors that transmit their alarm signals through the phone/SCADA lines. Local fire extinguishers.
• **Security Systems:** Controlled through card/badge readers, key pads and video analytics.
• **Trenches/Cables:** Multiple access points from yard, separate the “A” system cables from the “B” system cables, shielded/non-shielded cables and trench covers.
Future Control Houses

Pre-manufactured Modular Steel Buildings:

- Meet and exceed Mil STD 188-125-1 and 2. Their rugged construction is wind and ballistic resistant and low maintenance. Delivered with components installed.
- Modular, scalable design allows almost unlimited custom sizes, superior to shelters manufactured from shipping containers.

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Conductive Shotcrete Structures:

- An independent team has been developing conductive shotcrete for EMP Mil Std 188-125-1 protection through a Research Agreement with the University of Nebraska-Lincoln.
- The special concrete mixture has bits of carbon and metal added to it to absorb energy. A key ingredient is magnetite, a mineral and iron ore with magnetic properties. (all points of entry through grounded steel plates)
EMP Shielding Within a Conventional Structure:

• Can be constructed within a commonly built structure such as a “Metal Frame /Metal Siding” or “Pre-manufactured Concrete” building. Widely used modular panel system of galvanized steel laminated to a 3/4-inch, high-density particle and/or plywood board core. Joined together with an extruded “hat and flat” and “cove” clamping system.
Some Companies have begun to modify their construction materials and methods to create Metal Buildings to Meet 30 to 40 dB attenuation at 1GHz in anticipation of the new DHS guidance.
Points of Entry

- **Electrical Systems**: Dual fed (A&B) with two unprotected systems. Some have provisions for roll-up emergency generators. Fitted with HCI certified filters.
- **HVAC Systems**: Typically thru-wall air conditioners, Class 1 Division 1 Motors, heating is supplied by electric heaters. Fitted with waveguide vents and HCI certified power filters.
- **Plumbing Systems**: Some have bathroom and/or sink facilities. Fitted with waveguide beyond cut-off penetrations.
- **Data & Communication Systems**: Typically, data and communications through copper Telephone/SCADA lines. Changed to fiber optic systems.
- **Fire Detection/Protection Systems**: Typically heat/smoke detectors through the phone/SCADA lines. Local fire extinguishers. Changed to fiber optic systems.
- **Security Systems**: Controlled through card/badge readers, key pads and video analytics. Changed to fiber optic systems.
- **Trenches/Cables**: Multiple access points from yard, separate the “A” & B system. Shielded cables, shielded marshalling cabinets, shielded cables grounded, conductive trench covers.
PROTECTION LEVEL 1 (Survival of Data and Equipment)

EMP Protected Environment

• With EMP protected enclosures and treated points of entry, your data and processing equipment will survive. Although the power, cooling, and utilities in an unprotected host facility may not be immediately available, your equipment will remain safe. When power, cooling and utilities and communications are restored, your data equipment will be fully operable.
PROTECTION LEVEL 2  (Survival & Continuous Operations of Data & Equipment)

Independent Power and Utilities

• If an EMP event occurs, your data and processing equipment will **continuously operate** with a fully independent and protected power and utility source. This unit may be located inside your suite or outside the existing data center facility. Your data processing and communication will not be interrupted.

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System Design

Welded  Shielded Enclosure Types
ETS-Lindgren Inc.

Modular

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Mechanical Room Hybrid System

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Modular/Welded Interface

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System Hangers from Parent Building

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Before and After

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Service Entrance Power Line Filters

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EMP Shielded Doors

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EMP Shielded Doors

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EMP Protected Floor Drain

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EMP Generator Exhaust

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LCT Shielded Substation Control Cable

- Copper conductor
- PE/PVC insulation
- Helical copper tape shield
- PVC jacket

Applications
Predominantly used in utility substations. Can be installed indoors or outdoors, in cable trays, conduit, underground duct, or direct buried in wet or dry locations. Conductor operating temperatures are not to exceed 90°C wet or dry. Rated 600 Volts.
The Roxtec EMC cable seal

- Acts as an integrated part of the shield surrounding the equipment.
- The shield represents a barrier to incoming or outgoing electromagnetic energy, whether it is transmitted as radio frequency waves or via cable screens.
Use the “fully conductive” Trench Cover that uses a metalized fiber within the molding process to achieve electrical continuity across the entire surface of the cover. In lieu of metal diamond plate or High Density Polymer Concrete trench covers

Trench Covers

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The Little Mountain Test Facility is a state-of-the-art test facility, Air Force Materiel Command laboratory dedicated to simulation testing of nuclear hardness, survivability, reliability and electromagnetic compatibility of defense systems.
System Verification

FIGURE A-2. Sample test area assignments.

Source: MIL STD 188-125 1
System Verification

Step 1 - Reference

Step 2 - Measurement

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System Verification

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Conclusions

- Federal legislation has been enacted to require all Critical Infrastructure Segments to address EMP.
- Of the 16 Critical Infrastructure Segments, The Electrical Utility segment of the Energy Sector is getting the most attention.
- The current design of control houses offer very little to no resiliency to EMP.
- Commercially available systems exist to address EMP protection for Substation Control Houses.
- EMP Protection requires addressing not only the Control House structure but all Points of Entry.
- EMP Protection components should be certified Hardness Critical Item (HCI).

Michael A. Caruso