The ultimate solution for maintaining your nationwide generator network

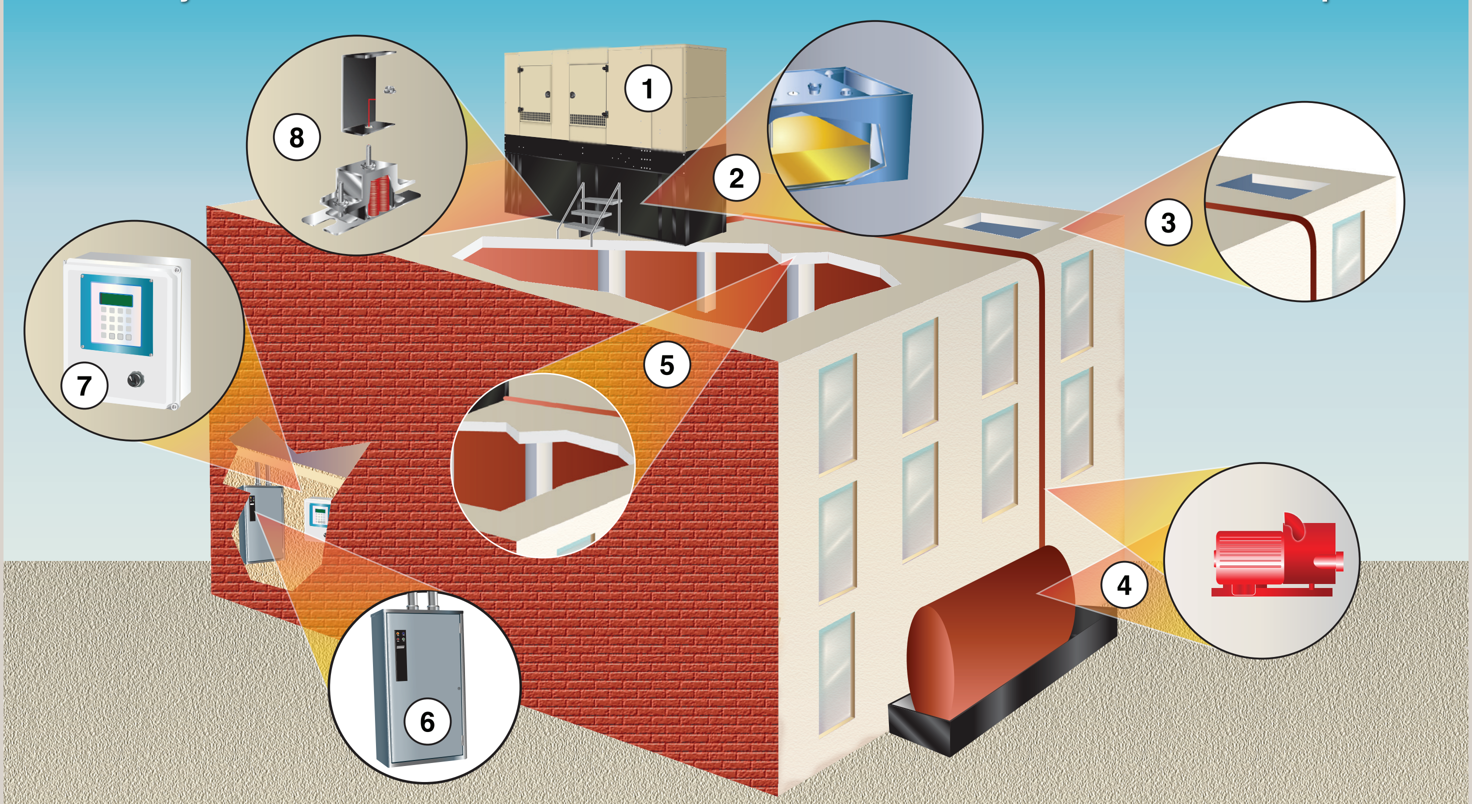
Generator Set Systems Installed On Top of Tall Buildings

1.0 Introduction:

Failure of standby units installed at ground level and in basements, during Super Storm Sandy and Hurricane Katrina, increased interest in installing emergency generator sets on rooftops of tall buildings. The Federal Emergency Management Agency (FEMA) has published Advisory RA3, March 2013, following Hurricane Sandy that details their recommendations to reduce flood risk for mid- to high-rise buildings. However, as there are several reasons to install generating sets on the top of tall buildings it is already a common practice with the techniques for successful installation already tested and in use.

This Information Sheet discusses the issues that have to be considered for installations of emergency generator sets on the roofs of tall buildings, construction requirements, and codes covering this type of installation:

Key Installation Considerations When a Generator is Installed on a Roof Top



Key issues to be considered for roof top generator installations (Consult all local electrical and building codes)

Item	Details	Item	Details
1	Enclosed set for weather protection, ability to withstand strong winds and silencer that meets local noise ordnance.	5	A qualified structural engineer should confirm the roof and building supports can bear the weight of the complete generator system.
2	If the fuel is diesel there should be a daily service tank fed from a ground located bulk tank. Tank should have spillage containment.	6	The transfer switch is installed adjacent to the building's main power distribution location with generator power fed from the roof.
3	For routine service there should be a convenient roof top access sized for service entry and regular maintenance components.	7	Often the generator control panel is on the lower floor adjacent to the transfer switch with wires routed to the generator terminal block.
4	Generator fuel tank is usually supplied by a transfer pump from a ground based bulk storage tank, with a float switch operation.	8	Additional vibration isolators (such as spring type indicated) will have to be used to isolate generator vibration to other parts of the building.

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2.0 Advantages and Disadvantages of a Roof Top Installation:

Advantages:

- **Above Flood Levels:** Avoids flooding during adverse weather
- **Security:** The roof can be secure and away from vandalism found at street level
- **Real Estate Availability:** In densely populated cities land is at a premium and the roof area is easier to utilize

Disadvantages:

- **Moving Equipment to Roof:** Installation costs can be more expensive when cranage is required
- **Fuel Storage & Delivery:** Storage of flammable fuel on top of building, and piping fuel to higher location

3.0 Roof Installation of Generator on Existing Building:

A feasibility study will have to be undertaken into the practicalities of installing a generator set on the roof of an existing building. This study will involve several considerations including:

- **Architect/Structural Engineer:** They will have to verify that the building structure and roof are able to support the additional weight of the generator system, to what degree will vibration have to isolated, and is there sufficient space
- **Building and City Codes:** There will be local codes specifying fuel storage, location of equipment on roofs, and sound attenuation to protect surrounding buildings
- **Electrical Engineer:** They will advise what is required to route the power from the bottom to the top of the building, the location of the Automatic Transfer Switch, and wiring sizes for long runs found on tall buildings
- **Building Contractor:** They will access how much of the equipment can be carried up and when cranage is required. Some very tall buildings have used helicopters to lift generators to the top of a roof. They will access if it is more practical to have a self contained already enclosed generator set put on the roof, instead of building a separate generator enclosure

4.0 Roof Installation of Generator on a New Building:

The same codes will apply to those specified on an existing building, but on a new building the architects will consult with the electrical contractors and the generator supplier regarding all the loads and generator system requirements that have to be incorporated into their architectural designs.

5.0 Fuel Selection:

In past weather events, standby generators have failed to start or could not continue to run due to fuel contamination and/or re-supply issues. In selecting a fuel the following should be considered.

- **Natural gas (NG):** Under normal conditions natural gas is supplied without interruption. However, some NG utilities will shut off their pipeline when faced with a pending natural disaster to avoid the dangers of fire or gas escaping from a ruptured pipeline, particularly in seismic zones. Before selecting NG verify with the utility company their policy on continued supply
- **Diesel-fuel:** Diesel powered systems can include a self-contained fuel supply in a sub-base fuel tank with sufficient to operate for 12- to 48-hours. During a weather event or natural disaster 'pre-disaster' supply contracts should have delivery priority
- **Diesel Storage:** A bulk storage tank would add considerable load to a roof, particularly an existing roof not designed to carry such a load. It is a better practice to fit a rooftop, double-wall, day tank at generator site that is fed by adequately sized fuel transfer pumps from the bulk storage tanks mounted at ground level or in the basement, below the Design Flood Elevation (DFE). Fire codes could also restrict the bulk storage of diesel on the roof

6.0 Specifications for Roof Top Installations:

Most distributors of major generator set manufacturers have experience in roof top installation of generator systems, especially those serving markets that include cities with many tall buildings. Your generator distributor can advise on the correct generator specification. Specification considerations include:

- **Wind:** High buildings can have wind factors up to 150 mph, enclosure specification should take account of wind force
- **Lower Temperature:** Consider all cold starting aids to allow for the lower air temperatures atop of tall buildings
- **Snow/Ice Accumulation:** Louvres should be specified that can manage snow in certain locations
- **Sound attenuation:** This is to isolate surrounding buildings and the floors below. A sound attenuated enclosure with high-grade exhaust silencer may be preferable
- **Vibration:** The unit should be fitted with vibration isolators to stop vibration into the building structure
- **Spill Containment:** Containment under generator sized to capture a leakage of all fluids including fuel
- **Generator Controls:** Generator controls may have to be duplicated and available in the building's control room which could be located at ground or basement level. Remote annunciation to monitor roof top installation may be preferable
- **Built in load bank and/or connections at ground level:** To resolve any compliance with periodic system testing
- **Automatic Transfer Switch:** On a tall building location on ground level adjacent to the utility supply may be preferable

7.0 Access to a Roof Top Installations:

A heavy-duty trade/service elevator should be incorporated to allow any heavy components and/or service items such as lube oil, coolant, etc. to be taken up to the rooftop-mounted generator. A local derrick or A-frame crane may be needed to lift such items as cylinder heads, etc. during any regular maintenance or repair work. Sufficient space between any structures must be provided so as to permit ready access of service technicians. Radiator exhaust should be away from critical sound areas and building ventilation or exhaust hoods.

8.0 Planned Maintenance Considerations for Roof Top Installations:

For critical standby generator systems to be in compliance with NFPA 110 they should be exercised with load weekly. This goes a long way to ensuring the unit will perform during a power outage. In addition to loading the set, filter and oil changes should be made per manufacturer's instructions or whenever needed, paying particular importance to the batteries and their charging system.

It is useful to specify a ground level electrical connection point (such as a 3R three-way manual switch) so that a load bank can be connected to the rooftop generator periodically to comply with full load performance testing. It would also allow for the connection of a temporary generator to be brought to building as an emergency power source while the rooftop standby generator is out-of-service due to maintenance work.

9.0 Further Reading:

Attachment of rooftop equipment:
http://www.fema.gov/media-library-data/20130726-1605-20490-8163/fema549_apndx_e_ra6.pdf

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