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CONTROLLING NOISE AND VIBRATION FROM EMERGENCY GENERATORS

By Brad Pridham, Ph.D., Steve Meszaros, M.Sc., P.Eng., Darron Chin-Quee, M.B.A., P.Eng.

INTRODUCTION

Emergency generators ensure that critical building activities and life safety systems are not compromised in power outages. Increasingly, generators are also being used for peak shaving and grid voltage support to reduce utility costs. To maximize usable space, generators are being placed closer to noise and vibration sensitive spaces. Noise and vibration can be transmitted to these spaces through building partitions (walls and floors), the structural system and generator ventilation systems. If properly controlled through design, comfortable and functional indoor and outdoor noise and vibration environments can be achieved.

FACTORS AFFECTING CONTROL STRATEGIES

Figures 1 and 2 highlight generator noise and vibration control strategies. Notable factors to consider include:

The Size and Type of Generator: In general, larger units require more controls. Gas, diesel and bi-fuel generators each have different noise and vibration characteristics affecting the control requirements.

The Location of the Generator: Generator proximity to noise and vibration-sensitive uses increases the mitigation needed. Space and master planning are important considerations. Generators located on suspended floors often require more costly noise and vibration controls compared to slab-on-grade locations.

Emergency vs. Peak Shaving Usage: Higher levels of noise and vibration are tolerable in emergency situations, and impacts from regular testing can often be minimized through scheduling. However, peak shaving use requires that all comfort and environmental criteria are strictly met because the generator operation time and duration are unpredictable.

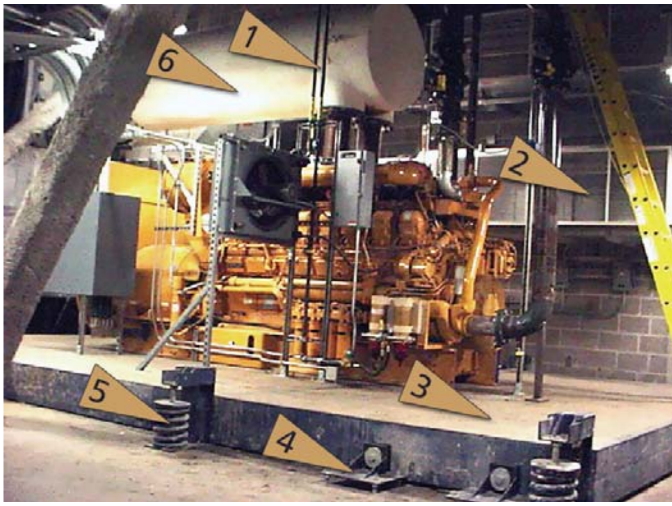

Figure 1: Some key elements of an emergency generator noise and vibration control system:

1. Isolation hangers for ductwork
2. Large fresh air silencers / ducts
3. Steel and concrete inertia base
4. Seismic snubber
5. Restrained spring isolators
6. Combustion exhaust muffler
7. Floating floor (not illustrated in photo)
8. Sound absorption (not illustrated in photo)

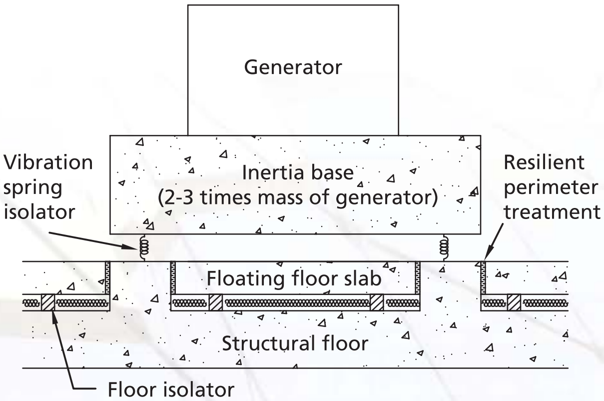

Figure 2: Example of a generator noise and vibration control strategy

DESIGN CONSIDERATIONS

The Architectural Design: The architectural design must include provisions for improved sound isolation between the generator room and adjacent noise-sensitive spaces plus accommodation for large mufflers and silencers. Space planning can reduce noise and vibration control requirements through buffering. For example, placing a transformer room below a generator as a buffer may eliminate the need for a floating floor or an upgraded ceiling in the space below the generator.

The Structural Design: A massive, stiff structure is required to support a generator, inertia base, and floating floor (potentially 15,000 + 40,000 + 20,000 = 75,000 lbs. total load). Floor deflections must be minimized to allow efficient operation of spring isolators. Seismic requirements must also be evaluated.

The Mechanical Design: Isolators and inertia bases are recommended in most applications. Cooling air systems may require 5 – 9 ft. long silencers, with large cross-sectional areas to meet insertion loss requirements and accommodate low-pressure drop tolerances typical of generator radiator fans. Combustion exhaust will often require hospital-grade silencers or better. Deep structural beams and sound isolation ceilings, that are resiliently hung, can also impact duct layouts in the ceiling space below a generator.

FACILITY-SPECIFIC REQUIREMENTS

Control requirements are facility specific and should be developed by the acoustical consultant and coordinated with members of the design team. "Cookie cutter" control strategies can result in unnecessary expenditure on materials and construction or inadequate acoustical performance.

BALANCING HOLISTIC DESIGN

Noise and vibration control strategies have to be well-coordinated with other design aspects, such as environmental noise and air quality. For example, generators located on grade are often preferred for noise and vibration control but may complicate issues related to exhaust re-entrainment where rooftop combustion exhaust locations are preferred.

It is important that the design addresses control strategies from all perspectives. A holistic design approach balances the different design elements related to generator control and can result in optimal facility performance.

Figure 3: Locating generators on rooftops can aid exhaust re-entrainment design considerations but can complicate vibration and noise control.

GENERATOR CONTROL: THINGS TO CONSIDER

- ☐ Inertia base (2-3 times mass of generator)
- ☐ Spring vibration isolators
- ☐ Vibration isolation hangers and flex connections for ductwork and piping
- ☐ Room exhaust and intake sound attenuators
- ☐ Engine muffler upgrade (e.g., hospital grade)
- ☐ Absorptive finishes in generator room
- ☐ Space contingency for large ductwork
- ☐ Space planning to create buffers
- ☐ Upgraded acoustical partitions / floor construction (e.g., cavity walls, floating floor, resiliently hung ceiling)

For more information see:

- RWDI AIR Technote Number 4: "Noise Impact Assessment and Certificates of Approval (AIR)"
- RWDI Technote Number 16: "Air Intake Placement for Laboratories – A General Overview"

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Rowan Williams Davies & Irwin Inc.
(519) 823-1311 www.rwdi.com

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