NOISE AND VIBRATION CONTROL FOR A NATURAL-GAS-FUELED ELECTRICAL COGENERATION SYSTEM LOCATED DIRECTLY ABOVE PENTHOUSE RESIDENTIAL SUITES IN A HIGH-RISE APARTMENT BUILDING

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INTRODUCTION

In some buildings it has become economical to provide continuously operating electrical power generators, driven by internal combustion engines fueled with natural gas, to reduce the demand for electrical power from hydro utilities. This paper describes the remedial work that was undertaken during commissioning of one such cogeneration system, located at the top of a residential apartment building, to reduce the transmitted noise to an acceptable level in the penthouse suites located directly below. The work consisted of retrofitting concrete inertia bases under the generator sets and supporting these bases on large open springs. Noise and vibration test data from measurements taken before and after completion of the remedial work are presented to document the success of the project.

SYSTEM DESCRIPTION

Two 65 kW cogeneration units operating at 1800 RPM were installed in a mechanical room at the top of an apartment building. Noise from the engines was clearly audible in two residential penthouse suites located directly below. A site inspection revealed that the the units had been provided with acoustic enclosures and the motor/generator assemblies were vibration-isolated from the base of the enclosure with housed-spring isolators having a nominal static deflection of 1 inch. There was no vibration-isolation between the base of the acoustic enclosure and the floor slab. The adjustable snubbers in the housed-spring isolators were snug and as a result the isolation effectiveness of the springs was reduced. The measured noise level in the bedroom of one of the penthouse suites, before any remedial work, is shown in Fig. 1. The maximum measured vibration level on the mechanical room floor near the units was -52 dBg at 60 Hz. The owner requested that the existing isolators be properly adjusted and that neporene isolation pads be inserted under the acoustic-enclosure base frames. The noise level was reduced noticeably in the penthouse suite after the isolators were adjusted but was still audible. There was no further improvement when the neoprene pads were inserted under the units.

DESCRIPTION OF REMEDIAL WORK

The remedial work consisted of raising each of the acoustic enclosures and installing large open springs under brackets fitted to the sides of the steel bases. To make the isolation efficiency of the modified system higher, each steel base was filled with concrete before being raised. The new spring isolators were selected for a nominal 3-inch static deflection under the actual load. Fig. 1 shows the results of the noise measurements taken after completion of the remedial work. The NC-30 noise criterion curve, which was used as the design goal for an acceptable noise level in the bedrooms, is also shown in Fig. 1. The vibration level on the mechanical room floor after the remedial work was -69 dBg at 60 Hz.

CONCLUSIONS

From the case study described in this paper, it can be concluded that cogeneration systems driven by internal combustion engines can be successfully installed above residential suites if the proper noise and vibration control methods are implemented.

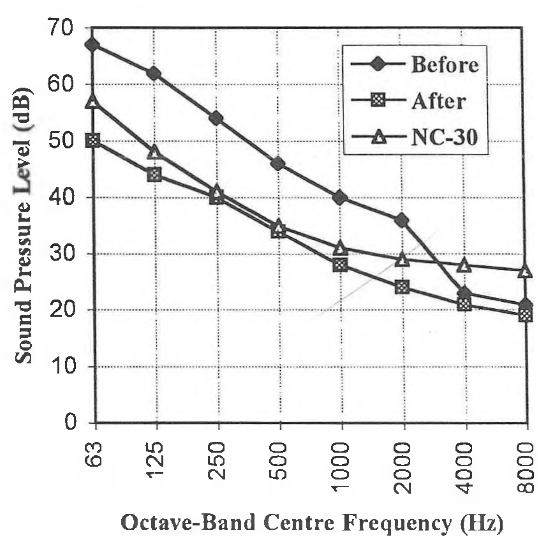

Fig. 1: Sound Measurements Taken Before And After Remedial Work.