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CHILEAN EXPERIENCE IN NOISE CONTROL ON GENSET BASED POWER PLANTS "ACÚSTICA 2012"

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Abstract
The energy supply deficit in Chile since late nineties has forced critical buildings and factories to support their self-energy supply by means of diesel or gas genset based power plants. Many of these plants are indoors, located near community or are movable type for rental, so the acoustic issues to meet legislation or comfort standards has been an important matter to solve. This has led to a great development of solutions and products for the professionals and companies dedicated to noise control in our country. From the early developments, based on empirical or trial and error solutions, the noise control industry has enhanced its tools and knowledge. This presentation shows our approach of the noise control solutions, using products developed by our company, and case studies of our experience in: hospitals (Hospital Militar de La Reina, located in Santiago, with two power rooms and eight 1000 KW gensets, acoustic performance of 78 dBA@3ft);, data centers (Data Center HP, located in Paine, with three enclosures for 2000 KW genset transported to site with the gensets inside, acoustic performance of 75 dBA@4 ft); and commercial constructions (Costanera Center, located in a commercial zone in Santiago, involved three towers, one of these 1000 ft high, and a shopping center, powered with eight genset 2400 KW each, acoustic performance of 50 dBA@166ft).

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1 Introduction

Chile has grown at a rate of 5.4% between 1986 and 2010. As our country grows, it demands more energy, revealing a natural linkage between economy and energy. The country currently has a total generating capacity of 16,970 MW, of which 73.6% is obtained from the Central Interconnected System (Sistema Interconectado Central, SIC), 25.6% from the Norte Grande Interconnected System (Sistema Interconectado del Norte Grande, SING) and 0.8% from the medium-sized systems in Aysén and Magallanes. The chilean electricity industry was a global pioneer in establishing competitive conditions in generating and selling electricity, maintaining the transmission and distribution segments under a system of financial regulation. In addition, private investment in generation, transmission and distribution assets led to significant expansion in the capacity of each one of our electricity systems, thus satisfying the maximum demand of the country. However, the regulatory framework of the industry has shown significant weaknesses, which have become clear when particular situations have needed to be addressed, such as the severe drought that resulted in electricity rationing in the late 1990s, the unexpected restrictions in the supply of natural gas from Argentina from 2004 onwards, and

the lower rainfall of recent years. In the face of these events, our country has undergone a transition to generation by power plants mainly based on coal and diesel and the companies and critical buildings have had to support its energy supply by means of diesel or gas gensets.

In the other hand, noise emissions in Chile are strongly regulated since 1997 by D.S. N°146/97 (Supreme Decree that regulates the noise emissions from stationary sources). This decree, limits the noise emission depending on the urban area which noise is being perceived. Table 1 shows the noise limits established by D.S. N°146/97

Table 1 – D.S. N°146/97 Noise limits.

Urban Area Type	Noise Limit (dBA)	
	7 to 21 h	21 to 9 h
Zone I (residential)	55	45
Zone II (residential and commerce)	60	50
Zone III (commerce and industry)	65	55
Zone IV (industry)	70	70

For rural areas the limit is 10 dBA over background noise.

Those two factors have allowed the development of noise control solutions, since in many cases the genset based power plants are located near residential or commercial areas.

The first solutions were made under a case by case development solution base, without having designed and proven products, so each component was designed particulary for each problem. Pressure loss issues were not well considered, so each solution had a significant uncertainty in solving operation issues. Since these early solutions, our company has been developing specific products for soundproofing genset rooms, some of them with government organizations fundings.

2 Noise Control in Genset Based Power Plants

2.1 Noise Sources

The main sources contributing to overall noise levels in power plants that can be identified are:

A. Radiation from engine casing
B. Air Intake
C. Exhaust
D. Radiator Fan
E. Generator

Noise from engine enclosure is the result of mechanical and structural propagation of radiated noise generated by the rapid cylinder pressure rise of the engine. The level of engine noise is most dependent on engine speed, since the speed is fixed in normal operation, the noise levels from engine casing is not dependent on electric load of genset. Air intake noise is generated by the interruption of airflow through the inlet passages by the opening and closing of the inlet valves. Inlet is load sensitive, increasing by 10 to 15 dB from no-load to full-load operation. Exhaust noise is produced by the periodic abrupt release of gas into the exhaust system as the exhaust valves open. The characteristic

frequency spectrum peaks at engine firing frequency. Exhaust noise typically increases 15 dB between no-load to full-load operation. Radiator Fan noise depends on the design of the system.

Often, exhaust and mechanical noise levels of gensets, which considers intake, and radiation from engine casing, are known from manufacturer data. When such data is not available, empirical procedure for estimating noise power levels can be used.

2.2 Room Ventilation

Noise is not the only factor to consider in genset noise control design. Proper room ventilation is of major importance to remove radiant heat from engine, generator, other driven equipment and other engine room component (cooling) and combustion air. Cooling and combustion air directly impact genset performance and dependable service life time. A properly designed genset room ventilation system will maintain room temperature within 15 and 22,5°F (8,5 to 12,5°C) above ambient room temperature, and not exceed 120°F (49°C). Many medium power genset have built-in radiators, selected for operating in specific environmental conditions.

2.3 Noise Control Measures

Noise control appliances for genset rooms tend to attenuate noise emission in room boundaries and in exhaust system using:

A. Isolating and sound absorbing walls.
B. Air inlet silencer.
C. Air outlet silencer.
D. Exhaust silencer.
E. Acoustic door.

In absence of accredited laboratories for acoustic testing in Chile, noise and pressure loss performance for silencers is being estimated with FEM analysis since 2007.

Figure 1 – a) Isolating and sound absorbing wall, b)Sound absorbing panels

Figure 2 – Inlet and outlet silencers. a) Acoustic louver b) rectangular silencer.

Figure 3 – Exhaust Silencers

3 Case Studies

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3.1 Hosptial Militar, La Reina (2006)

The Military Hospital of Santiago is the main clinical center of the chilean Army. This hospital consists of three buildings: Main Building (operating rooms, ICU, laboratories, radiology, etc…) is mounted on 163 seismic isolators; Hospital Building (305 beds); and Academic Building (classrooms, auditorium). For energy support this hospital has a power plant composed of two rooms: Room 1: Two CAT 3508B (800 KW each). Room 2: Six CAT 3412B (1088 KW each). Each room needed an acoustic performance of 78 dBA@3 ft, to meet D.S. N°146/97 (45 dBA in nearby community).

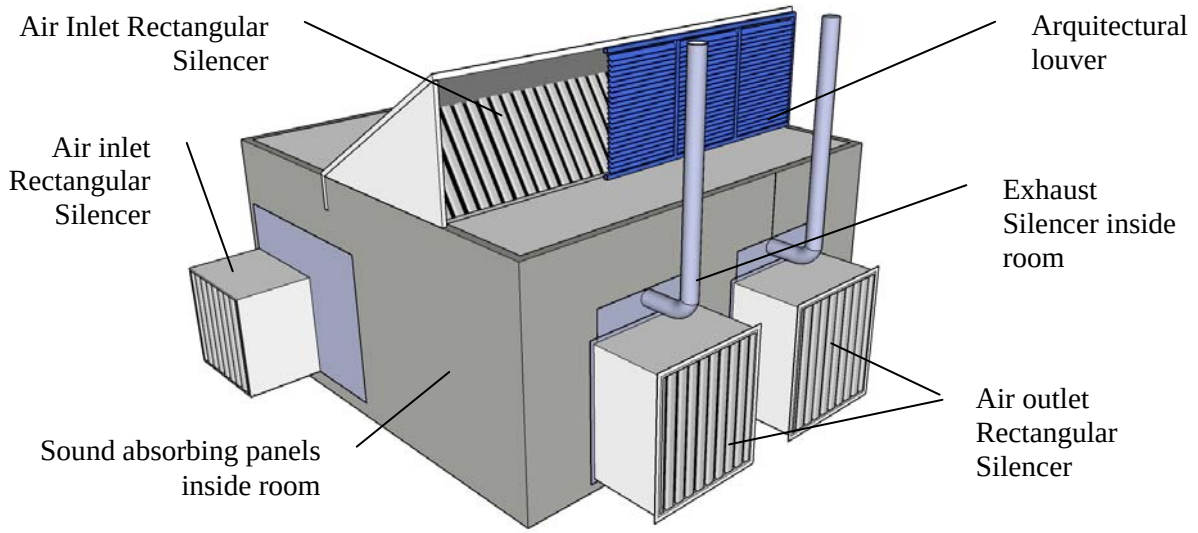


Figure 4 – Noise Control Measures in Room 1.

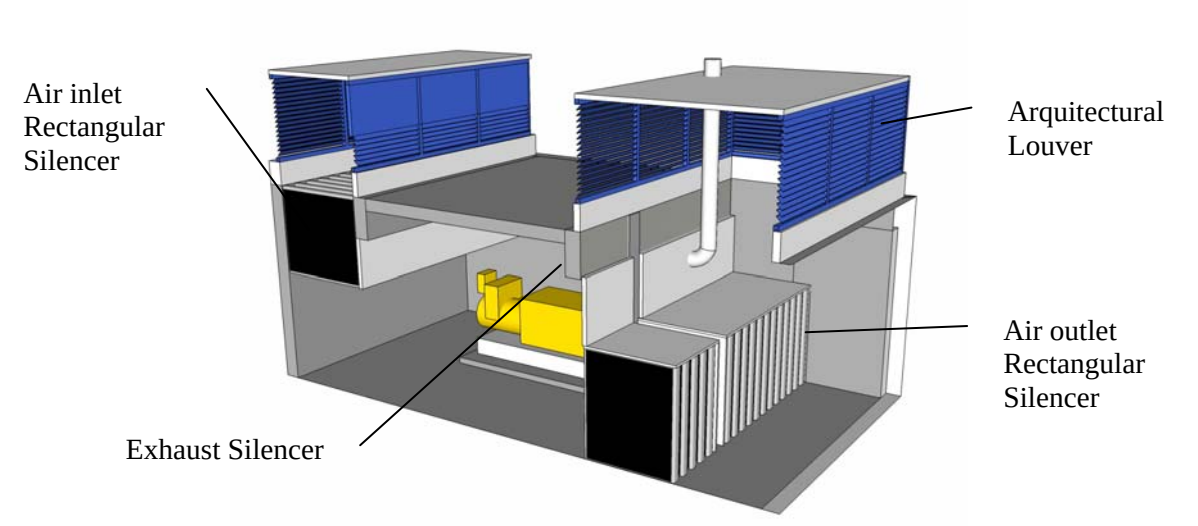
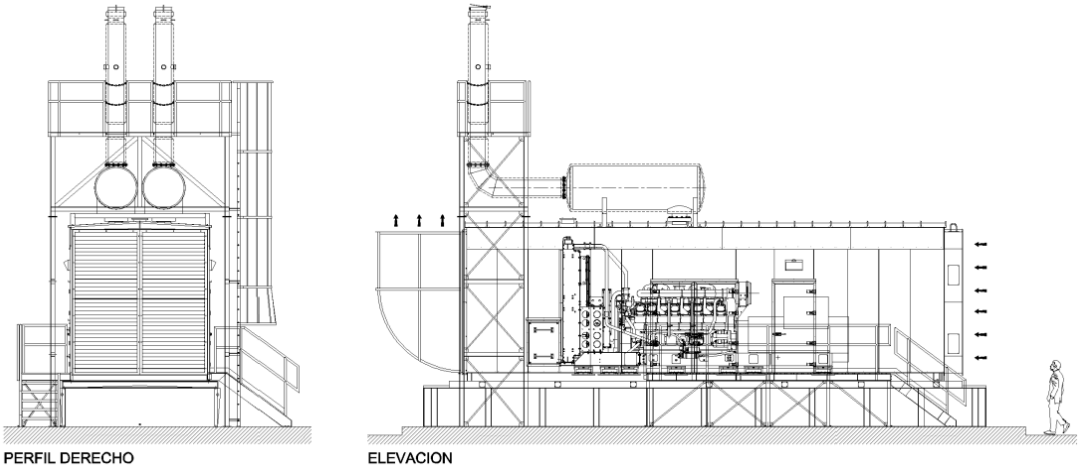


Figure 5 – Noise Control Measures in Room 2.

3.2 HP Data Center (21010)

For backup power purposes HP Data Center, located in Paine, a village near Santiago, installed three container type enclosures for CAT 3516B, 2000 KW each. Specification stated noise performance of 75 dBA@3 ft with all equipment operating simultaneously, equipment should arrive at the site inside the enclosures and mounted over fuel tanks. To ensure compliance with specifications, laboratory acoustic testing was necessary.



Frontal View Side View

Figure 6 – HP Data Center Enclosure.a) Plans.

Figure 7 – HP Data Center Enclosure. b) enclosure being installed, c) enclosure finisshed.

3.3 Costanera Center (2012)

Costanera Center is an ongoing construction of four skyscrapers being built at the financial district of Santiago. The tallest of four building is 1000 ft high and was designed by Cesar Pelli. Mechanical room is above shopping center located at the center of the four buildings and has a power room for co-generation with 8 Cummins DQLB (2400 KW each). Acoustic performance should allow 50 dBA@166 ft and comfortable environment inside building complex.

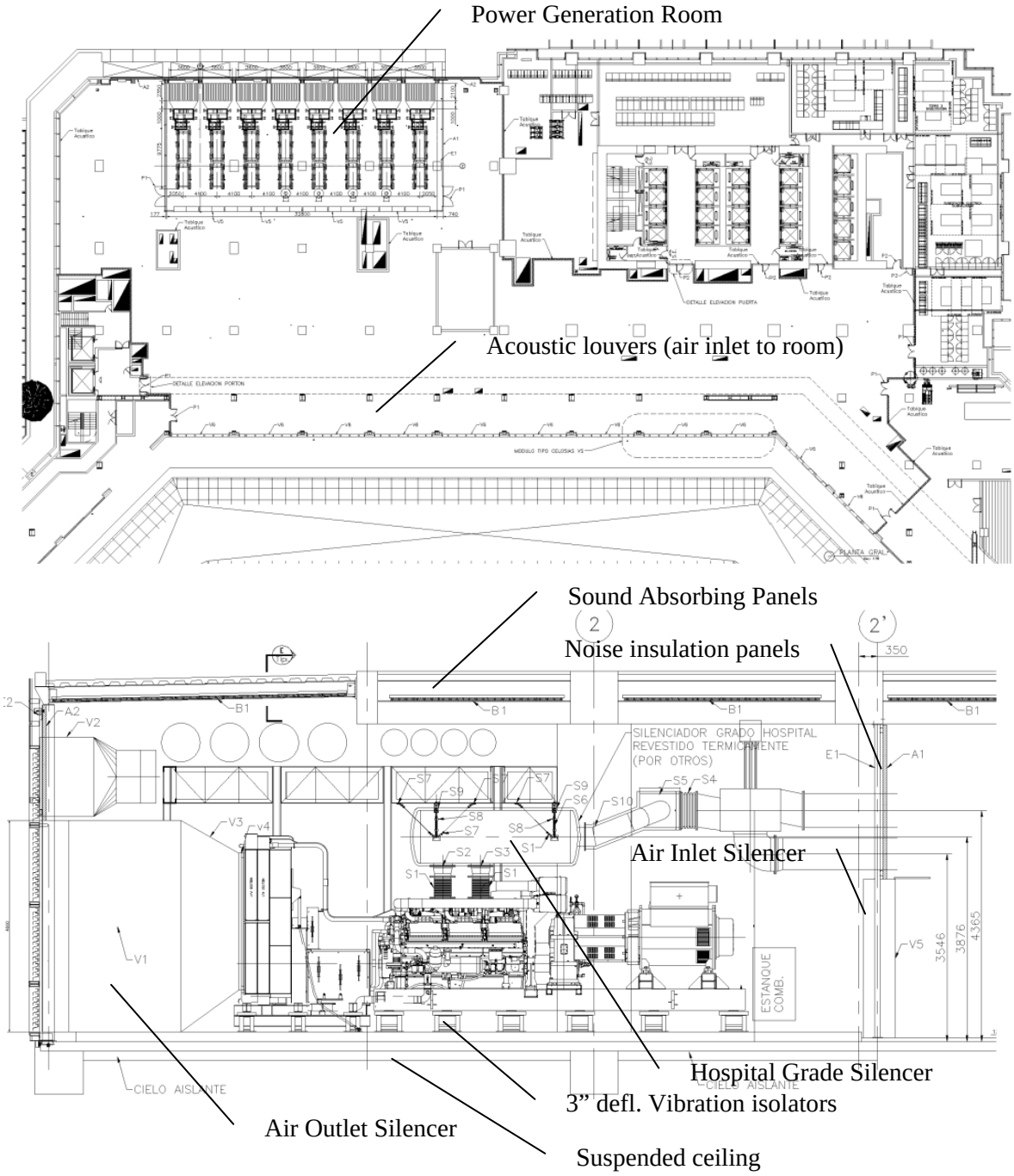


Figure 8 – Center Mechanical room, a) Plan view, b) Section view.


a)

b)

Figure 9 – Costanera Center Mechanical room, a) Power Generation room, b) acoustic louvers.

4 Conclusions

The requirements of power supply and backup power in Chile through diesel generators has allowed us to develop noise control solutions and products. This development has led us to constant improvement of the solutions we can offer to the industry in terms of manufacturing processes and assurance of results taking into account both acoustical and ventilation requeriments. It has also allowed both architects and engineers, get to know the importance of this issue and enable us to collaborate in the success of the project required spaces for noise control systems, understanding the possible limitations and, most importantly, trust in the efficiency of technical solutions.

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