

# Meeting Power Plant Attenuating Challenges

*United Steel Structures conquers complicated acoustical regulations; and stringent structural requirements*

With noise control identified as a key permitting requirement for Keyspan Energy's Ravenswood Power Plant located in Queens, New York — proper noise abatement became an essential element in the design process of this new 250 MW power plant and gas compressor station. For permit compliance, the sound attenuation properties of the buildings and the building accessories were critical to the developer of this new installation that uses one GE 7FA turbine and one steam turbine with HRSG.

The structural design requirements of the project and the stringent noise control features mandated by the city and state of New York and more specifically the New York Power Authority (NYPA) Article X permit, proved to be an interesting design challenge for United Steel Structures Inc. (USSI), the Houston, Texas, U.S.A.-based acoustical building designer and supplier for the project.

"This project was a challenge for us because of the stringent structural and acoustic design criteria," said Robert Collum, business development manager, acoustics at United Steel Structures Inc. "In addition, it had to be a structure that was aesthetically pleasing."

Acoustically, NYPA's Article X permit requirements consisted of: the New York City Zoning Resolution limiting the noise level from any on-site activity to decibel levels according to octave bands; the New York City Noise Code that provides maximum noise levels based on "noise quality zones," which



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are derived from the various land use zones; the City Environmental Quality Review (CEQR) which is used to determine a proposed action's potential effects on sensitive noise receptors, including the effects on interior noise levels of residential, commercial and institutional uses; and the New York State Department of Public Service (NYSDPS) requirements, which uses the modified Composite Noise Rating Method (CNR) to assess potential noise impacts such as community attitude. Compliance is required for all dB(A), dB(C), and octave band components of

these four differing and sometimes contradictory statutes.

USSI focused significant attention on the noise levels below 100 Hz and specifically the impact of low frequency noise on the residential community located just 30 m from the property line and the local elementary school located less than half of a kilometer from the site as well. Compared with high frequency noise, low frequency noise is traditionally more difficult to suppress due to its propagation characteristics and the low-pass filtering effects of the building structure.

In the early design stage it became apparent that the 31.5 and 63 Hz octave band frequencies were the most significant noise components. It was further established that an effective acoustical balance between the walls, roof, walk doors, equipment doors and ventilation system would be necessary to comply with the 25 dB noise reduction for each of the two octave bands.

Five separate design and testing iterations of the proposed acoustical wall systems were conducted to fine tune the various acoustical parameters to achieve the 42 dB(A) and 26 dB(C) noise limits and the low frequency noise reduction criteria for NYPA's Article X compliance.

As part of the acoustic design process, USSI evaluated and addressed certain known acoustic anomalies inherent in the use of ribbed steel panels and the stiffness of the panel assembly itself. Under certain conditions acoustic energy can cause the exterior wall panel or panel assembly to vibrate, thereby re-radiating sound to the exterior. USSI designed and detailed the project to overcome this problem, yet still maintain easy construction methods.

One other acoustical design that raised concern was "flanking paths" of noise through openings, penetrations and exhaust stack breaching. Problems generally lie more with flanking than with the basic wall design in such large power plants, especially with elevations of 30 m or more. In the construction execution, it was necessary to control flanking of the walls if it was to be

expected to provide field isolation anywhere close to the laboratory data. Proper flashing materials and installation details are designed-in to prevent the escape of sound through openings, penetrations, exhaust stack breaches, etc. Since the walls are extremely critical to the overall acoustical success of this project, on-site inspection during construction was a must because no matter how the designs are drawn and how tight the specifications are written, the ultimate efficacy of the walls is, in large measure, provided by quality field workmanship to overcome such sound losses due to flanking paths.

The final construction for Ravenswood consisted of an assembly that is 355 mm thick and weighs approximately 68 kg/m<sup>2</sup>. The composite panel consists of various layers of mass septum barrier, multiple layers of high and low density acoustic fill materials, gasketing, connection details and vapor barrier positioned within the building structural wall cavity. A heavy gauge exterior pre-coated steel panel is provided for weather tightness and finished appearance and an interior perforated liner panel aids in absorption.

Upon completion of its final design, USSI conducted final acoustic testing in a NVLAP certified laboratory in accordance with ASTM E90-99 standards, resulting in a Sound Transmission Class (STC) rating of STC 58 and verifying appropriate octave band transmission loss characteristics for low frequency

attenuation. This tested assembly is exceeded by only one other previously constructed pipeline project in overall thickness, mass, STC rating and low frequency octave band performance. The project wall system is one of the most highly performing wall systems ever built on a power plant project of this type, according to USSI.

Structurally, the design of the siding material and the steel building system were required to withstand the high winds associated with a 30 m tall structure, the substantial loading imposed by the acoustic panel system, and the Building Code of the City of New York, including Earthquake Code 17/95.

USSI's history of acoustical projects similar to Ravenswood allowed it to effectively balance the highly acoustic needs of the project with a structural steel building system that would meet the project specifications, at the lowest practical cost. The goal was to provide a high performance yet economical acoustic building solution by utilizing carefully selected commercially available materials. The final challenge, then, was to integrate the acoustic wall system with the design, framing and structural detail of the selected structural system. The result is a high performance, load-bearing acoustical assembly that blends pre-engineered building technology with traditional steel design and fabrication, resulting in a very economical and easily constructible design for the client. 