Acoustic Breadth

Gas turbine electric generator for cogeneration has moderate noise level, and should be place outdoor when possible. City Hospital campus is located in a dense urban area. Due to limitation of available outdoor space and future construction above "roof" of P 1&2, location of CHP generator(s) are limited to the boiler room. Noise generated by gas turbine generator(s) may transmit to occupied spaces near the boiler room. Noise criteria are evaluated to ensure occupant comfort.

Sound level from each third (3^{rd}) bandwidth was obtain by measuring a 4.8 MW gas turbine generator set, similar to the one suggested for the alternate design, at Bucknell University. The gas turbine generator itself has an overall noise level of 96 dBA. However, the package included a weatherproof acoustic enclosure which reduced the overall noise level to 81 dBA. OSHA permits exposure up to 90 dBA for an (8) eight-hour work day without personal protection equipment. Optional equipments included inlet and exhaust silencers which reduced noise level below ambient outdoor noise level. Thus, sound created by the turbine generator would not be a concern at the property line.

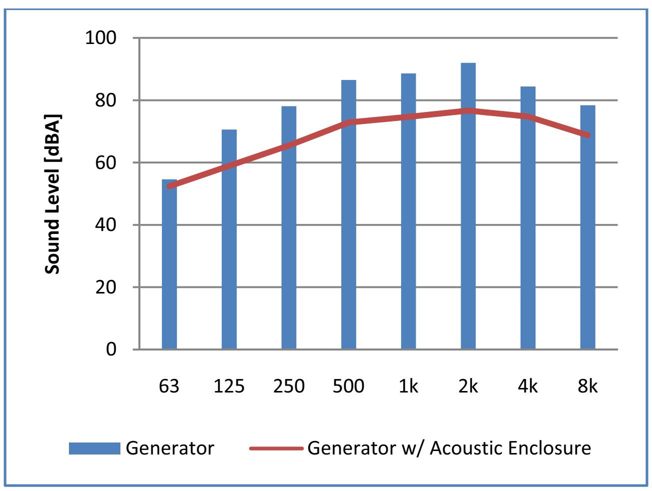

Figure 17: 4.8 MW Gas Turbine Generator Acoustic Properties

Designer of P1 CUP took acoustic design into consideration by placing equipments (chillers) with highest noise level farthest away from occupied area. P1 Boiler room, where the CHP for the alternate building system design is located, is surrounded by buffer zones. It is connected to the chiller room to the east, AHU room to the west, electrical room to the north separated by a corridor, and loading dock above.

(1) Vivarium
(2) AHU equipment room
(3) Boiler room
(4) Chiller room
(5) Electrical room

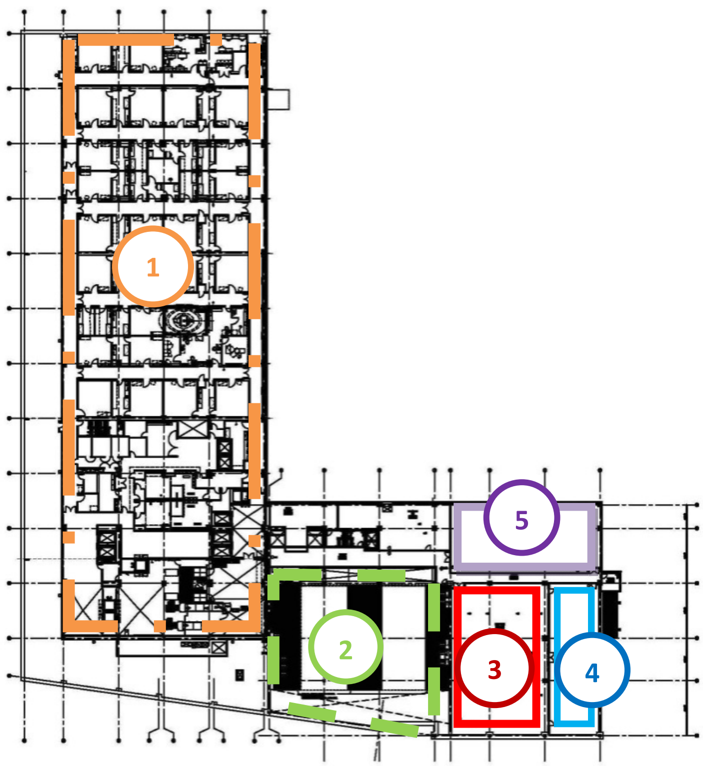

Figure 18: P1 Level C Plan

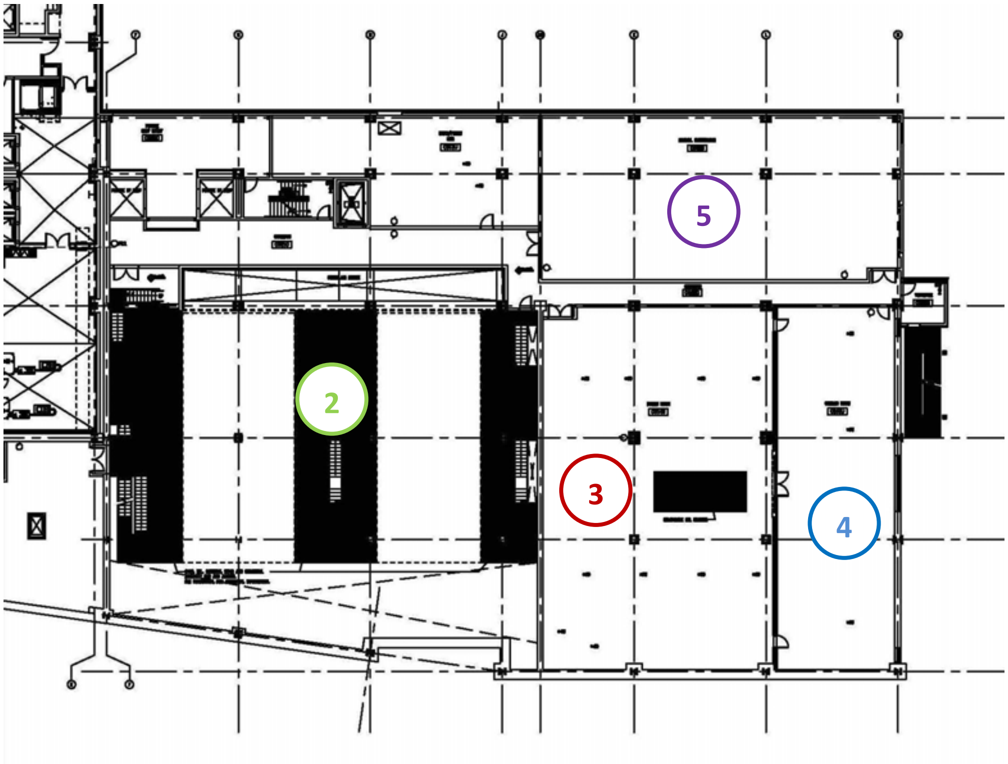

Figure 19: P1 CUP Plan

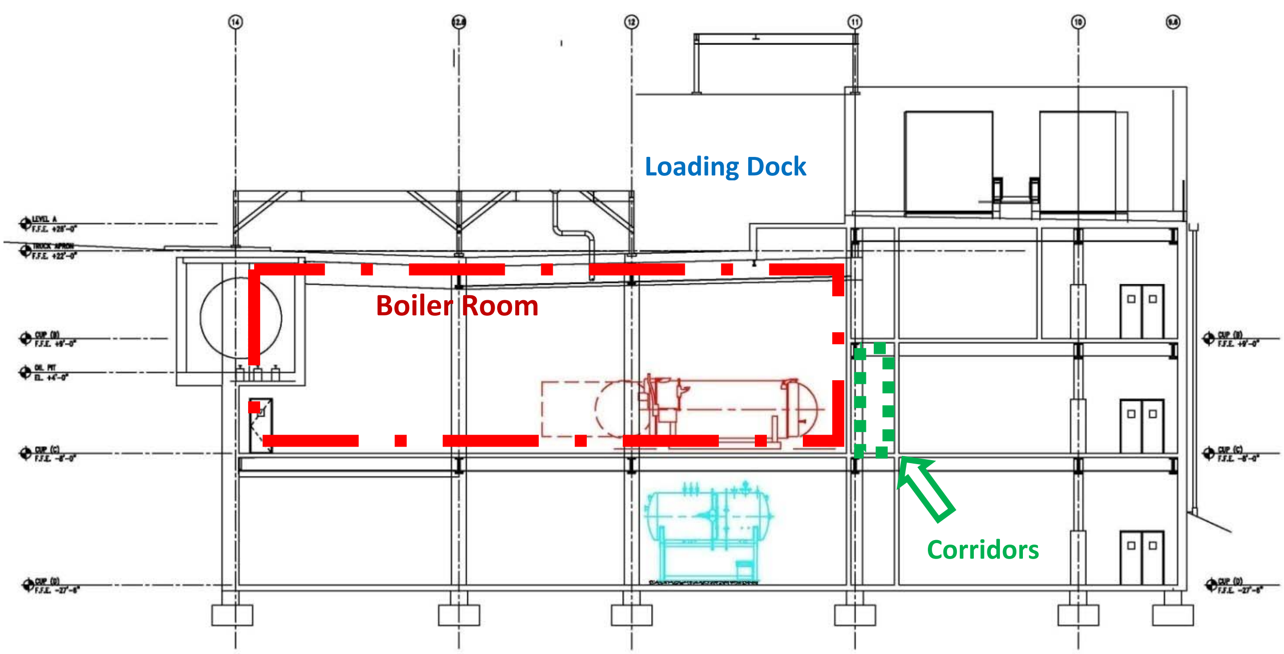

Figure 20: CUP Section Looking West

The AHU room is separated from the boiler room by an eighteen (18) inches thick concrete shear wall. Sound transmission through this wall would be minimal. The corridor is focus of the sound transmission analysis because it is connected to other spaces on the floor.

The corridor is separated from the boiler by an eight (8) inch concrete masonry unit (CMU) partition with a six (6) by seven (7) hollow core metal door. Three (3) equations are used to calculate sound transmission through the assembly:

Equation 1: $$TL_{ov} = 10\log\frac{\sum A}{\sum {A_i}^{-0.1TL_i}}$$

A_i = Area of an element
TL_i = Transmission loss of an element

Equation 2: $$NR = TL + 10log\frac{\sum A}{S}$$

A = Total absorption in the receiving room
S = Surface area of the barrier

Equation 3: $L_2 = L_1 - NR$

L_1 = Noise level of source
L_2 = Noise level of receiver room

Noise reduction (NR) of this partition assembly calculated to be 34 dBA, and the noise level in the corridor would be 47 dBA (*Appendix iv*). It would not be a source disturbance even if the corridor is connected to a laboratory space that has a recommended noise criteria (NC) level of 45 -55 (53 – 58 dBA).

Structural Assessment

To evaluate whether the alternate mechanical system can be support by the existing structural system of P1 CUP, a simple comparison method is used. The existing structural system is designed to support 800 bhp which weighs 75,150 lbm with water over a foot print of 110 square feet, or 685lbm/ft^2. The 3.5 MW generator has an approximate weight of 57,350 lbm over 256 square feet (225 lbm/ft^2). The generatorexert one third (1/3) the pressure of the 800 bhp boiler on the boiler room floor. Therefore, the existing floor system can support the alternate building system design.