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Date : 24 August 2018

Subject : Background Environmental Noise Survey: Hologic,
Wythenshawe

Report No : R9129

1.0 Scope and objective

The Industrial Noise and Vibration Centre (INVC) was requested by Martina Antalova of Boulting Environmental Services Ltd to perform a background environmental survey at the Hologic site in Wythenshawe.

The objective was to measure the existing noise levels at key sensitive locations in order to set specifications for the noise that may be generated by the new/revised equipment to ensure there are no complaints.

The measurements included both continuous logging at a single position over a 24-hour period and spot measurements at 4 sensitive locations around the perimeter of the new facility.

The nearest residential property to the development is located to the north. In addition, there is also a community fishing pond located to the east. Both locations have been accounted for in the selection of the spot measurement positions.

This report provides details of the results of the site visit on 6 and 7 August 2018.

report

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2.0 Measurement procedure

The noise survey was performed between 6 and 7 August 2018. Daytime measurements were taken between 11:00 and 14:00 hours on 6 August, whilst the night-time measurements were performed between 21:00 and 00:00 hours on 6 August. The 24-hour continuous measurements ran from 11:00 hours on 6 August till 11:00 hours on 7 August.

Measurement locations were selected around the perimeter of the site to best assess the impact of the development at the most sensitive receptors. The locations are shown in Figure 1.

All levels measured were time averaged. Spot measurements were logged over a 15-minute period. The parameters recorded included L_{Aeq} and L_{A90} . In addition, calibrated digital recordings were also made. This allowed for post processing and detailed frequency analysis.

The continuous monitoring was set up to record both the L_{Aeq} and L_{A90} . These were logged over 5-minute periods and adjusted in post-processing to give both the 1-hour daytime and 15-minute night-time levels, respectively. The equipment was set up at location 2, this being the nearest residential property.



Figure 1 Measurement locations

3.0 Equipment

24-hour monitoring

Sound level meter calibrator RION NC-74: 34315114

Sound level meter RION NL-32: 00513543

Spot measurements

Sound level meter calibrator 4231: 2651819

Sound level meter B&K 2238: 2652322

4.0 Results and discussion

24-hour monitoring

Detailed results recorded during the 24-hour period can be found in Appendix 1.

From 08:30 hours on 7 August, the landscape team began work strimming and cutting the grass on the north-west side of the site. As a result, the levels measured during this period are likely to be higher than would be expected on a 'typical morning'. Therefore this period has not been included in the analysis.

From the levels measured, the following single value levels have been derived and best represent the current noise environment.

The daytime $L_{Aeq,1hour}$ ranged from 44 to 49 dB, with an average level of 48 dB. Whilst the daytime $L_{A90,1hour}$ ranged from 40 to 44 dB, with an average level of 43 dB.

The night-time $L_{Aeq,15min}$ ranged from 40 to 50 dB with an average level of 41 dB. Whilst the night-time $L_{A90,15min}$ ranged from 39 to 43 dB with an average level of 40 dB.

Spot Measurements

Position 1



Daytime

$L_{Aeq,15min} = 55 \text{ dB}$

$L_{A90,15min} = 48 \text{ dB}$

Night-time

$L_{Aeq,15min} = 50 \text{ dB}$

$L_{A90,15min} = 45 \text{ dB}$

Figure 2 Position 1

Comment

Noise levels measured at position 1 were dominated by road traffic noise. The noise from the large V-chillers located near the existing building (Figure 4) is also audible at this location. Figure 3 shows the associated frequency spectrum at position 1. The tones seen at 34 and 48.5 Hz and harmonics can be attributed to the V-chillers located close to the existing building.

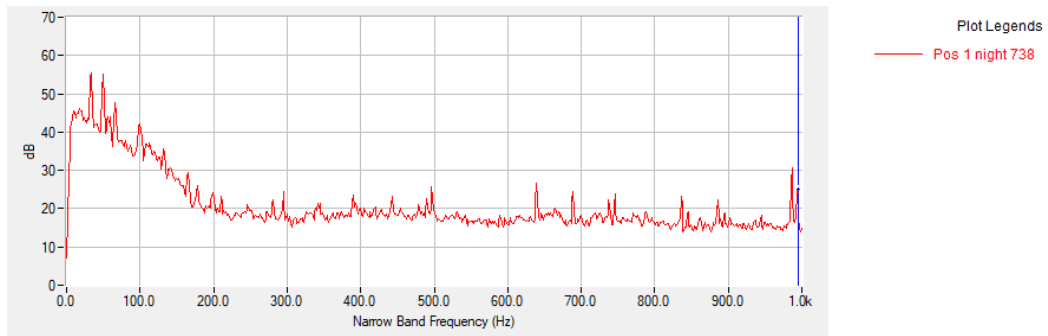


Figure 3 Measured frequency spectrum at position 1



Figure 4 V-chiller near existing building

INVC has developed a bespoke package of noise control options for similar chiller units to those seen in Figure 4:

<http://www.invc.com/noise/noise-control/fan-noise-reduction/#chiller>

Noise levels generated by the chiller units can be reduced by modification of the fan speed and mounting method together with the addition of close fitting acoustic screens and damping material to the unit casing.

Position 2



Figure 5 Position 2

Daytime

$L_{Aeq,15min} = 48 \text{ dB}$

$L_{A90,15min} = 43 \text{ dB}$

Night-time

$L_{Aeq,15min} = 44 \text{ dB}$

$L_{A90,15min} = 39 \text{ dB}$

Comment

At position 2, the main contributors to the overall noise levels are road traffic and noise generated by the V-chillers located next to the existing building, (Figure 4).

Figure 6 shows the associated frequency spectrum at position 1. The tones seen at 34 and 48.5 Hz and harmonics can be attributed to the V-chillers located close to the existing building.

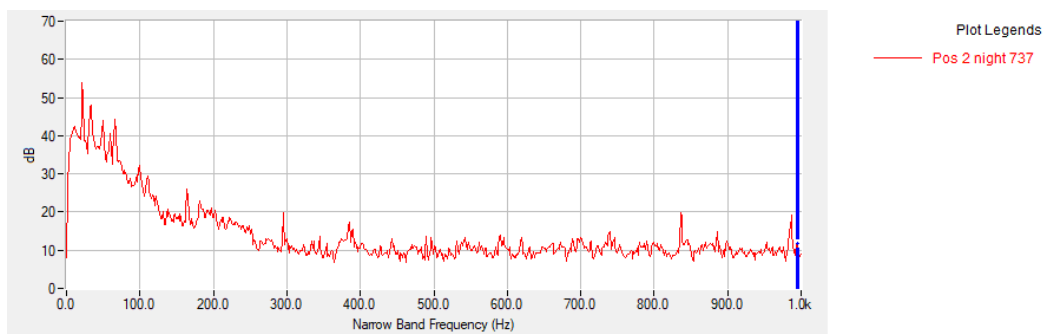


Figure 6 Measured frequency spectrum at position 2

Position 3



Daytime

$L_{Aeq,15min} = 45 \text{ dB}$

$L_{A90,15min} = 40 \text{ dB}$

Night-time

$L_{Aeq,15min} = 41 \text{ dB}$

$L_{A90,15min} = 33 \text{ dB}$

Figure 7 Position 3

Comment

At position 3, road traffic, train and aircraft noise contribute to the overall level. However, noise from the existing plant located at the rear of the new building is clearly audible. The level increases to 47.5 dB(A) when the chillers operate.

Figure 8 shows the measured frequency spectrum with no equipment running. Figure 9 shows the measured frequency spectrum when the dual fan Danfoss Optima Plus chiller unit was running.

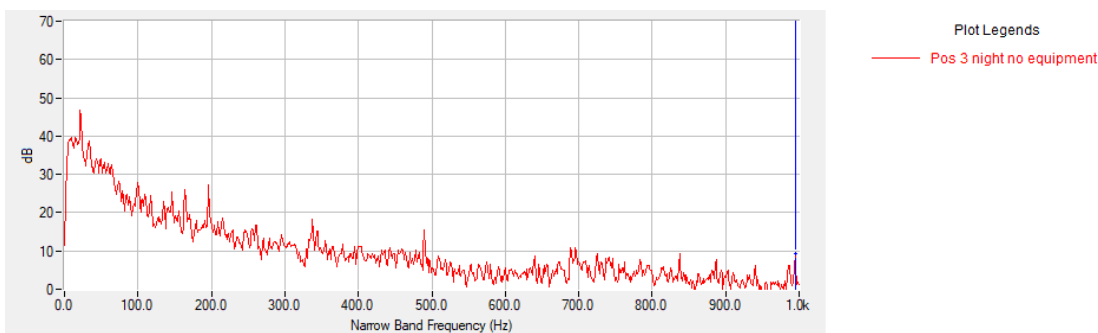


Figure 8 Measured frequency spectrum at position 3, no equipment

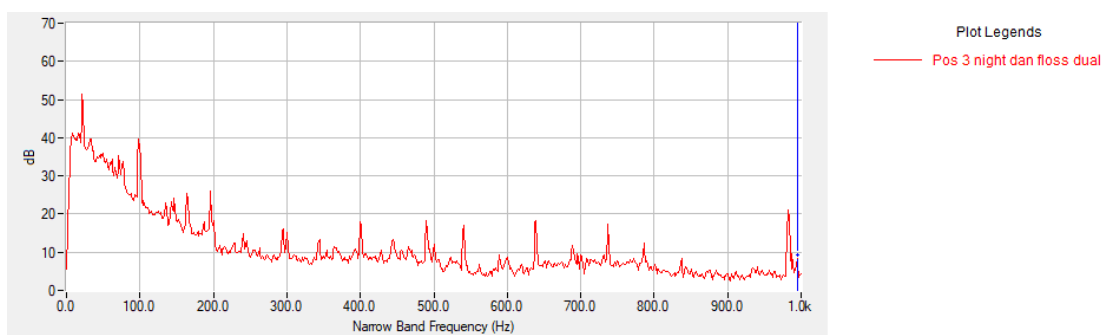


Figure 9 Measured frequency spectrum at position 3, dual fan Danfoss chiller

Air compressor

The air compressor is housed in a purpose-built enclosure. It is used intermittently, and varies depending on the demand for compressed air within the lab. The air compressor was artificially run to allow a short-term spot measurement to be performed at position 3.

Within enclosure L_{Aeq} = 80 dB
At position 3 L_{Aeq} = 49 dB

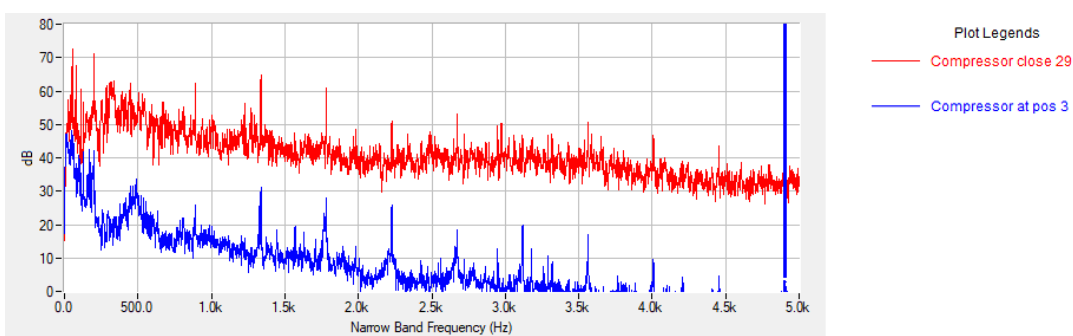


Figure 10 Measured frequency spectrum at position 3, air compressor running

Diesel engine

The back-up diesel generator is only run in emergency scenarios. It is, however, tested on a weekly basis. The backup generator was artificially run to allow a short-term spot measurement to be performed at position 3.

Close to generator L_{Aeq} = 78 dB
At position 3 L_{Aeq} = 56 dB

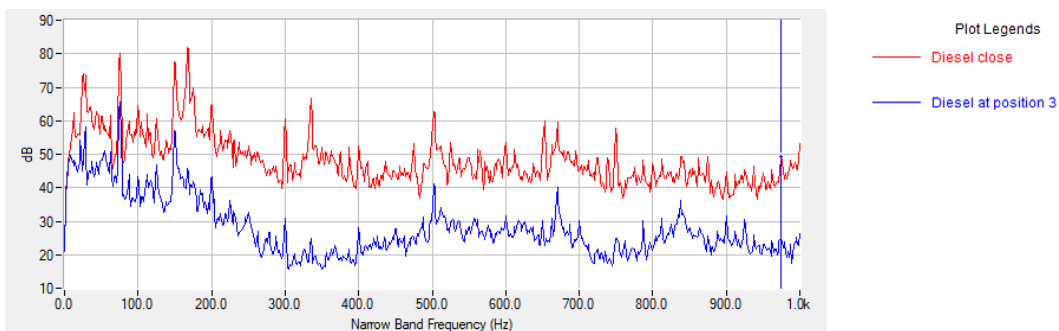


Figure 11 Measured frequency spectrum at position 3, emergency diesel generator running

Position 4



Daytime

$L_{Aeq,15min} = 56 \text{ dB}$

$L_{A90,15min} = 49 \text{ dB}$

Night-time

$L_{Aeq,15min} = 43 \text{ dB}$

$L_{A90,15min} = 41 \text{ dB}$

Figure 12 Position 4

Comment

At position 4, road traffic, train and aircraft noise contribute to the overall level. The large chillers located next to the main building are also audible at this location.

Figure 13 shows the frequency spectrum recorded at position 4. The tones seen at 34Hz can be attributed to the V-chillers located close to the existing building.

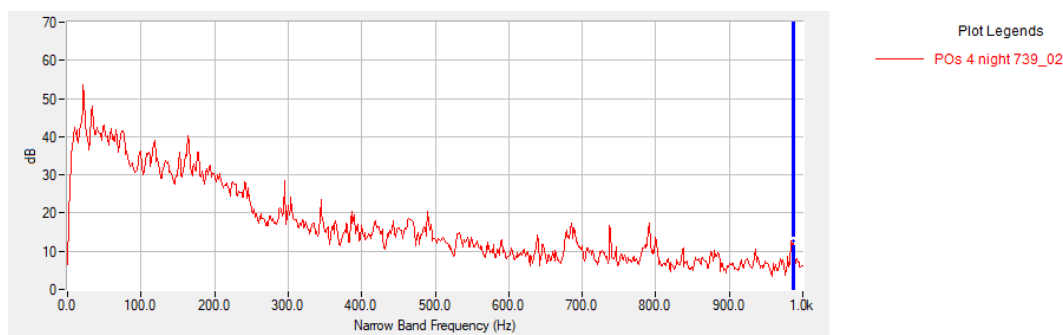


Figure 13 Measured frequency spectrum at position 4

5.0 Delivery noise prediction and assessment

During the survey there was minimal deliveries and no loading or unloading was witnessed. The impact of the new development and associated delivery activities has been predicted.



Figure 14 Distance to local sensitive receptors

INVC has previously undertaken noise measurements at a similar facility. The objective was to obtain typical noise levels from the loading and unloading of lorries. The 'A' weighted noise levels were measured at a height of approximately 1.5m above local ground level in free field conditions using calibrated instrumentation conforming to the Type 1 specification of BS 61672 - 1 - 2003. During the measurement period the weather was good with some cloud cover, dry and a wind speed of less than 2 m/s. The table below gives the noise levels for the loading and unloading activities

Table 1 Typical noise levels at 10m from lorry

Loading/unloading activity	L _{Aeq} dB
General loading activity at 10m	63
Reversing beepers at 10m	68

Referring to the distances shown on Figure 14 and the measured noise levels given in Table 1, the following assumptions and predictions have been made.

- The 5-min L_{Aeq} of activity for the loading the lorry = 63 dB L_{Aeq} at 10m
- Therefore at 50m this equates to $20 \cdot \log(10/50) = -14$ dB
- The result of a 5-min L_{Aeq} of activity for loading the lorry = 49 dB L_{Aeq} at 50m
- Similarly, for the reversing lorry = 68 dB L_{Aeq} at 10m
- Therefore at 50m this equates to $20 \cdot \log(10/50) = -14$ dB
- This results in a 5-min L_{Aeq} of activity for the reversing lorry = 54 dB L_{Aeq} at 50m

Table 2 Summary of predicted levels due to delivery bay

Equipment	Distance (m)	Position	1-hour L _{Aeq} dB	L _{A90} 1hr day dB	L _{A90} 15min night dB
1 lorry unloading/loading	50	Property 2	49	43	40
1 lorry unloading/loading	125	Property 1	44*	48	45
1 lorry unloading/loading	125	Fishing pond	41	40	33

*3 dB has been added to account for the reflection created by the building wall.

The predicted noise levels could increase by up to 3dB if two lorries are loaded simultaneously.

The predicted level at property 1 during loading/unloading activities is 44 dB(A). This can be compared to the background level measured at position 1. At night, the L_{A90} was 45 dB, it can be seen that the predicted level is 1 dB below the current night-time background level.

The predicted level at property 2 during loading/unloading activities is 49 dB(A). At night the background L_{A90} was 40 dB, this being 9 dB below the predicted level. During the day the L_{A90} was measured as 43, this being 6 dB below the predicted level.

The predicted level at the fishing pond during loading/unloading activities is 41 dB(A). This can be compared to the background level measured at position 3. At night the L_{A90} was 33 dB(A), this being 8 dB below the predicted level. The prediction however takes no account of screening. It is likely that the existing building will provide approximately 10 dB reduction in the level. Thus, the level generated at the fish pond during deliveries is likely to be similar to the existing background level.

6.0 Noise control recommendations

According to the criteria set out in BS 4142, the predicted levels during loading/unloading at property 1 and the fishing pond are unlikely to cause any adverse impact to the local community and as such complaints are not likely. The predicted level at property 2 indicates that there may be some adverse impact during loading/unloading. To minimise the impact of the new delivery bay it is recommended that:

- additional bespoke acoustic screening and absorptive cladding should be included in the designed to reduce the level generated during loading/unloading activities.
- when the lorries are being loaded or are parked engines should be switched off
- any refrigeration units on the vehicles should be run on electrical hook-up
- 'white noise' reversing beepers are installed on trucks and forklifts that are used on the site.

The survey and resultant measured levels have shown that the existing HVAC equipment and future equipment have negligible impact at positions 1,2 and 4. The measured levels at position 3 have shown that the existing equipment is the main contributor to the noise. Additional equipment is likely to have a similar effect when running. It is therefore recommended that:

- Source noise control is retro-fitted to the existing chillers
- Bespoke close fitting acoustic screens and absorptive cladding
- The wooden compressor enclosure is updated to a permanent acoustic enclosure
- Design noise control audit of new equipment

The combination of retro-fitted noise control to existing HVAC equipment, to reduce the current levels, and application of noise control to new equipment will ensure that the increase in noise levels due to the new HVAC equipment will be minimised.

7.0 Summary

A background noise survey has been performed to assess the current noise levels around the proposed extension.

24-hour monitoring was performed at the closest residential property. In addition short term spot measurements were also performed at multiple locations around the development. The measurements indicate that the daytime and night-time background levels are:

Daytime $L_{Aeq,1hour}$ of 48 dB and $L_{A90,1hour}$ of 43 dB.

Night-time $L_{Aeq,15min}$ of 41 dB and $L_{A90,15min}$ of 40 dB.

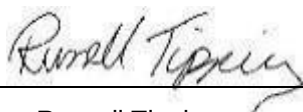
At positions 1, 2 and 4 the spot measurements indicated that road traffic noise and the large V-chillers associated with the existing building are the main contributors to the noise level.

At position 3 the spot measurements indicate that the current noise levels are impacted by the existing equipment located at the rear of the new building. When no equipment is running the noise levels here fall to an L_{Aeq} of 45 dB during the day and an L_{Aeq} of 41 dB at night. The chillers located at the rear of the new building run intermittently and when operating increase the level at position 3 to an L_{Aeq} of 47.5 dB. Both the existing equipment and proposed new equipment are also tonal in character, which can increase the likelihood of complaints.

Noise levels generated by the weekly testing of the emergency diesel generator and intermittent use of the air compressor have also been included in the assessment and the level at position 3 increases to an L_{Aeq} of 56 dB and 49 dB respectively.

Currently, it is understood that complaints have been received from users of the fishing pond located in the direction of position 3. If the main environmental requirement is to minimise the impact at the fishing pond, it is likely that noise control will need to be applied to both the existing equipment and proposed new equipment. **INVC** can provide support and recommendations to minimise the impact at all locations.

Predictions have also been performed to estimate the impact of loading and unloading at the new delivery bay. Figure 14 shows the locations of the sensitive receptors considered and the distances from the delivery bay. The predictions have shown that the impact of the new delivery bay will be minimal at property 1 and at the fishing pond. However, due to the proximity, the levels at property 2 may cause adverse effects. It is recommended that additional noise reduction measures, as described in section 6 are included in the design.

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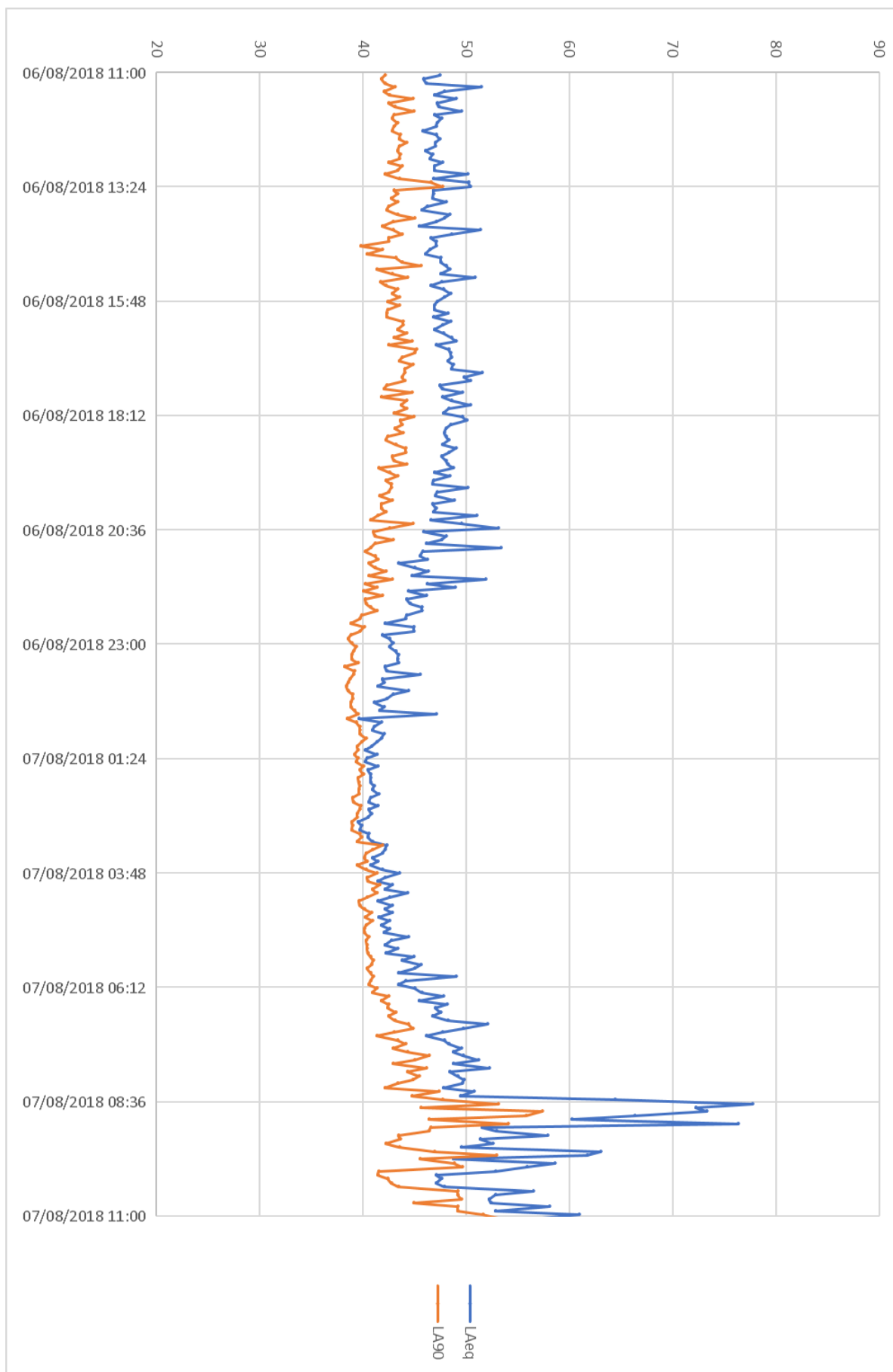
Appendix 1 – 24-hour monitoring results

Time	Measurement Time (h:mm:ss)	L _{Aeq} dB	L _{A90} dB
06/08/2018 11:03	0:05:00	47	42
06/08/2018 11:08	0:05:00	46	42
06/08/2018 11:13	0:05:00	46	42
06/08/2018 11:18	0:05:00	51	43
06/08/2018 11:23	0:05:00	48	42
06/08/2018 11:28	0:05:00	47	43
06/08/2018 11:33	0:05:00	49	45
06/08/2018 11:38	0:05:00	47	43
06/08/2018 11:43	0:05:00	47	43
06/08/2018 11:48	0:05:00	50	45
06/08/2018 11:53	0:05:00	47	43
06/08/2018 11:58	0:05:00	48	43
06/08/2018 12:03	0:05:00	47	43
06/08/2018 12:08	0:05:00	47	43
06/08/2018 12:13	0:05:00	46	43
06/08/2018 12:18	0:05:00	47	44
06/08/2018 12:23	0:05:00	47	44
06/08/2018 12:28	0:05:00	47	44
06/08/2018 12:33	0:05:00	47	44
06/08/2018 12:38	0:05:00	46	43
06/08/2018 12:43	0:05:00	47	44
06/08/2018 12:48	0:05:00	47	44
06/08/2018 12:53	0:05:00	48	43
06/08/2018 12:58	0:05:00	47	44
06/08/2018 13:03	0:05:00	47	43
06/08/2018 13:08	0:05:00	50	42
06/08/2018 13:13	0:05:00	47	44
06/08/2018 13:18	0:05:00	50	47
06/08/2018 13:23	0:05:00	50	48
06/08/2018 13:28	0:05:00	47	43
06/08/2018 13:33	0:05:00	47	43
06/08/2018 13:38	0:05:00	47	43
06/08/2018 13:43	0:05:00	48	43
06/08/2018 13:48	0:05:00	46	43
06/08/2018 13:53	0:05:00	46	42
06/08/2018 13:58	0:05:00	48	43
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06/08/2018 14:23	0:05:00	49	44
06/08/2018 14:28	0:05:00	47	43
06/08/2018 14:33	0:05:00	47	43
06/08/2018 14:38	0:05:00	47	40
06/08/2018 14:43	0:05:00	47	42
06/08/2018 14:48	0:05:00	46	40
06/08/2018 14:53	0:05:00	48	43

Time	Measurement Time (h:mm:ss)	L _{Aeq} dB	L _{A90} dB
06/08/2018 14:58	0:05:00	48	44
06/08/2018 15:03	0:05:00	48	46
06/08/2018 15:08	0:05:00	48	41
06/08/2018 15:13	0:05:00	48	43
06/08/2018 15:18	0:05:00	51	44
06/08/2018 15:23	0:05:00	48	42
06/08/2018 15:28	0:05:00	47	42
06/08/2018 15:33	0:05:00	48	43
06/08/2018 15:38	0:05:00	49	43
06/08/2018 15:43	0:05:00	48	44
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06/08/2018 18:33	0:05:00	48	44
06/08/2018 18:38	0:05:00	48	42
06/08/2018 18:43	0:05:00	48	42
06/08/2018 18:48	0:05:00	48	43
06/08/2018 18:53	0:05:00	49	44
06/08/2018 18:58	0:05:00	48	44

Time	Measurement Time (h:mm:ss)	L _{Aeq} dB	L _{A90} dB
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06/08/2018 19:08	0:05:00	48	43
06/08/2018 19:13	0:05:00	48	44
06/08/2018 19:18	0:05:00	49	42
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06/08/2018 21:33	0:05:00	45	41
06/08/2018 21:38	0:05:00	52	43
06/08/2018 21:43	0:05:00	46	40
06/08/2018 21:48	0:05:00	49	41
06/08/2018 21:53	0:05:00	44	40
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06/08/2018 22:23	0:05:00	44	40
06/08/2018 22:28	0:05:00	44	40
06/08/2018 22:33	0:05:00	42	39
06/08/2018 22:38	0:05:00	45	40
06/08/2018 22:43	0:05:00	45	40
06/08/2018 22:48	0:05:00	42	39
06/08/2018 22:53	0:05:00	43	39
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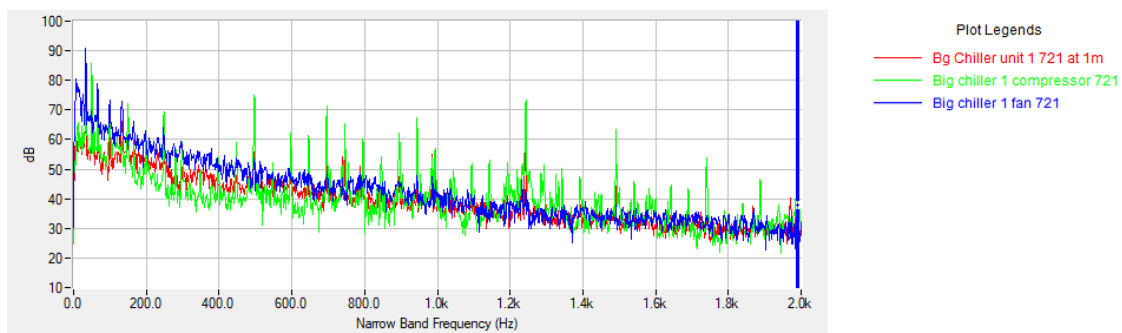
Time	Measurement Time (h:mm:ss)	L _{Aeq} dB	L _{A90} dB
07/08/2018 07:08	0:05:00	48	43
07/08/2018 07:13	0:05:00	46	41
07/08/2018 07:18	0:05:00	48	43
07/08/2018 07:23	0:05:00	48	44
07/08/2018 07:28	0:05:00	50	43
07/08/2018 07:33	0:05:00	49	44
07/08/2018 07:38	0:05:00	50	46
07/08/2018 07:43	0:05:00	51	45
07/08/2018 07:48	0:05:00	49	43
07/08/2018 07:53	0:05:00	52	46
07/08/2018 07:58	0:05:00	48	44
07/08/2018 08:03	0:05:00	49	45
07/08/2018 08:08	0:05:00	50	45
07/08/2018 08:13	0:05:00	50	43
07/08/2018 08:18	0:05:00	48	42
07/08/2018 08:23	0:05:00	51	47
07/08/2018 08:28	0:05:00	49	45
07/08/2018 08:33	0:05:00	64	48
07/08/2018 08:38	0:05:00	78	53
07/08/2018 08:43	0:05:00	72	46
07/08/2018 08:48	0:05:00	73	57
07/08/2018 08:53	0:05:00	66	56
07/08/2018 08:58	0:05:00	60	46
07/08/2018 09:03	0:05:00	76	54
07/08/2018 09:08	0:05:00	52	47
07/08/2018 09:13	0:05:00	53	46
07/08/2018 09:18	0:05:00	58	43
07/08/2018 09:23	0:05:00	51	44
07/08/2018 09:28	0:05:00	53	42
07/08/2018 09:33	0:05:00	50	44
07/08/2018 09:38	0:05:00	63	47
07/08/2018 09:43	0:05:00	62	53
07/08/2018 09:48	0:05:00	49	46
07/08/2018 09:53	0:05:00	59	49
07/08/2018 09:58	0:05:00	56	50
07/08/2018 10:03	0:05:00	53	42
07/08/2018 10:08	0:05:00	47	41
07/08/2018 10:13	0:05:00	48	42
07/08/2018 10:18	0:05:00	47	43
07/08/2018 10:23	0:05:00	48	43
07/08/2018 10:28	0:05:00	57	49
07/08/2018 10:33	0:05:00	53	49
07/08/2018 10:38	0:05:00	52	50
07/08/2018 10:43	0:05:00	52	45
07/08/2018 10:48	0:05:00	58	49
07/08/2018 10:53	0:05:00	53	49
07/08/2018 10:58	0:05:00	61	52
07/08/2018 11:03	0:00:03	56	54



Appendix 2 – Source measurements

V-chiller 1

Noise level close to equipment : 72 dB(A)

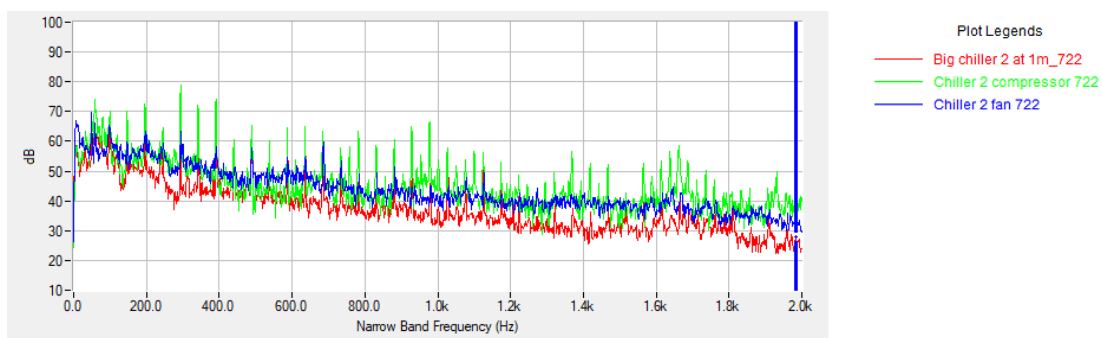


Compressor generates tones at 48 Hz and harmonics

Fan generates tones at 34 Hz and harmonics

V-chiller 2

Noise level close to equipment : 72 dB(A)

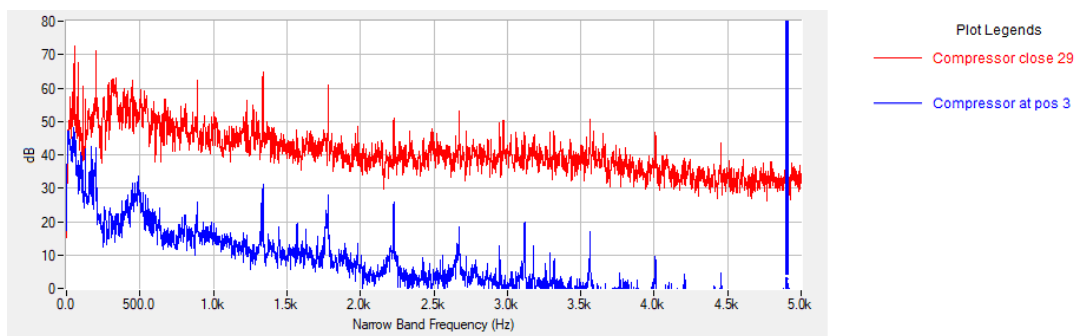


Compressor generates tones at 48 Hz and harmonics
Fan generates tones at 59 Hz and harmonics

Air compressor



Within enclosure $L_{Aeq} = 80$ dB

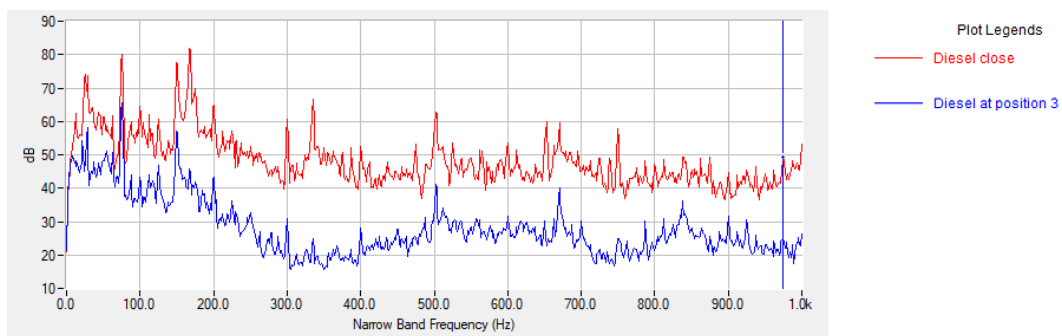


445 Hz + harmonics

Diesel engine



Close to generator $L_{Aeq} = 78$ dB



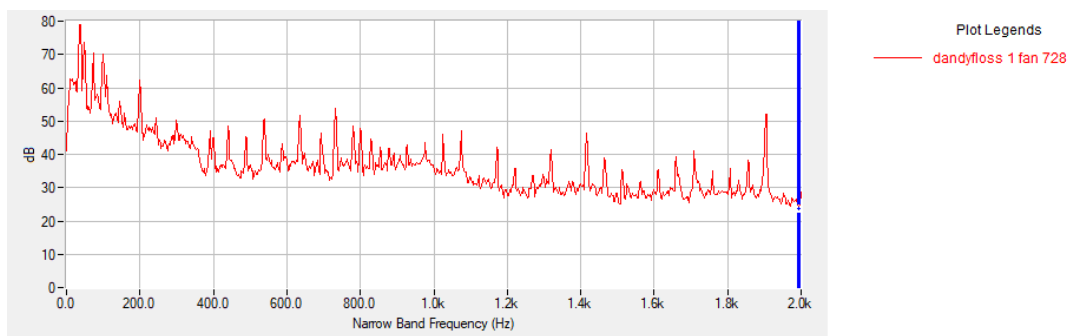
75 Hz and harmonics
167 Hz and harmonics

Chiller units behind new building



Single fan Danfoss Optima Plus (3 blades)

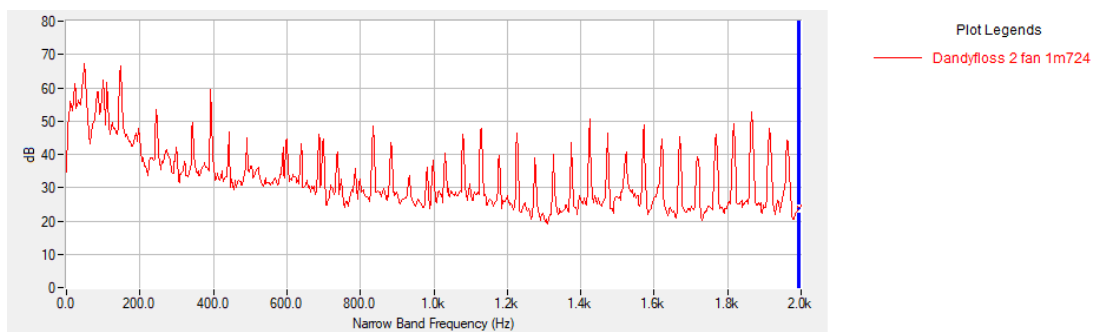
Close to unit $L_{Aeq} = 64$ dB



36 Hz and harmonics
48 Hz and harmonics
100 Hz and harmonics

Dual fan Danfoss Optima Plus (5 blades)

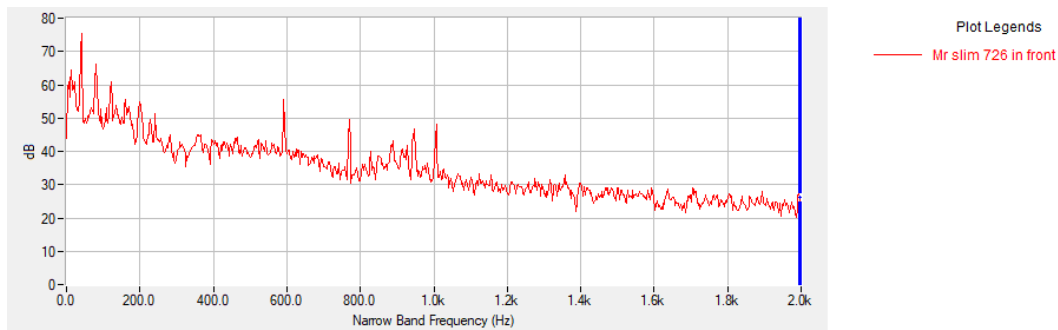
Close to unit $L_{Aeq} = 70$ dB



49 Hz and harmonics
100 Hz and harmonics
109 Hz

Mitsubishi Mr Slim (3 blades)

Close to unit $L_{Aeq} = 65$ dB



40 Hz and harmonics

592 Hz and 769Hz, 829, 888, 947 and 1007 Hz (60Hz toothcomb pattern)