Fjardaal Smelter Project

Baseline Noise Survey

Report July 2004; revised August 2004
Supplemented June 2005 (frequency spectra)

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Report no.	P-60024-A-3Pdoc-03
Issue no.	1.2
Date of issue	June 28, 2005

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1 Preface

Prior to the construction phase and the later operation of the Fjardaal Smelter a baseline noise survey has been carried out. The baseline noise survey shows that the ambient noise level in the area is dominated by natural sounds from birds, running water in the glacial streams and by local road traffic.

The survey was carried out in week 24 in 2004 started on Tuesday 8 June 2004 and finished by the end of Friday 11 June 2004. The COWI employees Rasmus Krogh and Lars Find Larsen were responsible for the survey covering the noise impact at the future site area and the nearest surroundings in Reydarfjordur including Holmar and the Holmanes recreational area.

The first civil works (road construction) were started on the site before this survey was carried out, so special arrangements with the responsible contractor had to be made to stop these works during the noise measurements. No influence from the civil works was recorded during the measurements.

1.1 Noise Indicators and limits

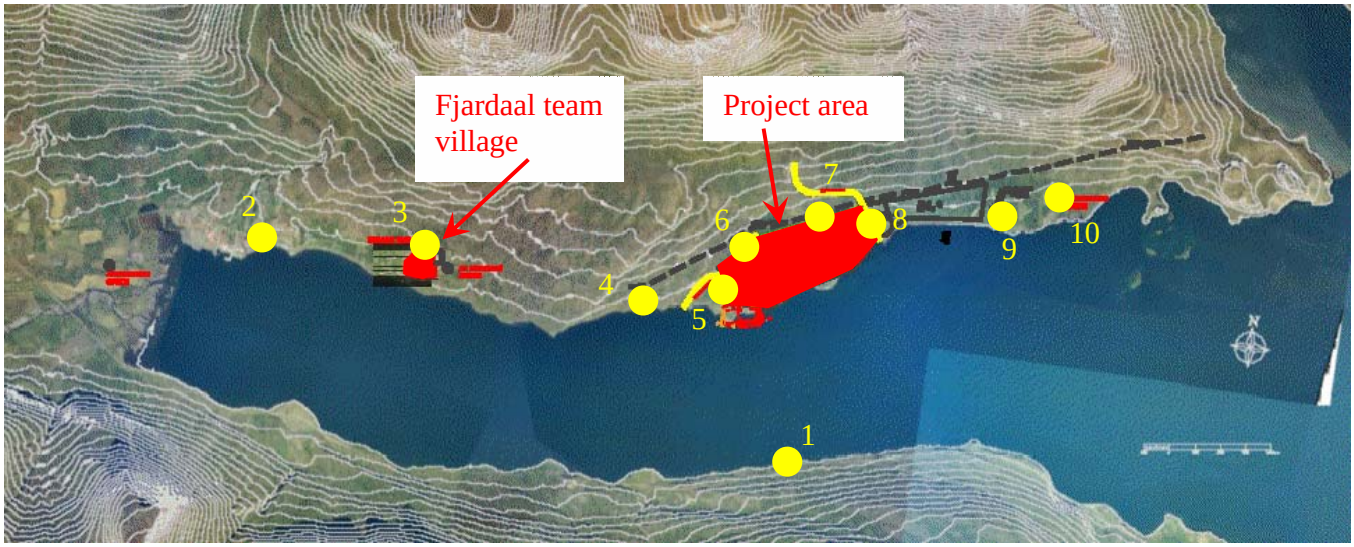
The recorded noise levels has been analysed to show the relevant noise indicators.

The Environmental Operating License No. 600100-2380 (EOL) for the Fjardaal Smelter set out that the smelter has to comply with the noise levels given in the Icelandic Regulation No. 933/1999. The noise limit at the boundary of the plant area according to the regulation No. 933/1999 and the EOL for the plant is 70 dB(A) during the day time, the evening and the night periods.

No limit values for the L_{Amax} level is part of the EOL. However to give an estimate of the peak values, especially during the night time, the analyses of the measurement results even show the L_{Amax} levels.

2 Measurement positions

The noise measurement was carried out in 10 positions shown on the map and described in the table below.



Measurement position	Coordinates		Description
	LON /Westing	LAT /Northing	
1	14°5"58,41'	65°0"55,224'	South side of the Fjord
2	14°11"42,276'	65°1"52,362'	Eastern part of the Reydarfjordur city
3	14°10"28,44'	65°1"51,336'	Fjardaal team village (mainly ref. point)
4	14°7"49,98'	65°1"45,594'	Framnes farm, ½ km west of the site
5	14°7"11,886'	65°1"49,512'	Western site boundary
6	14°6"56,712'	65°1"59,778'	Northern site boundary
7	14°6"11,208'	65°2"11,994'	Northern site boundary
8	14°5"38,148'	65°2"5,316'	Eastern site boundary
9	14°3"44,442'	65°2"20,802'	Holmar's farm, 1 km east of the site
10	14°2"49,95'	65°2"36,36'	Eastern boundary of the Holmar's farm, giving a representative position for the nature reserve area at Hólmanes

3 Sound propagation conditions

In this baseline noise survey the conditions of the sound propagation between the sound sources and the measurement positions are diverse. The main ground surface is grassland or rock bed. No greater mitigation measures or terrain edges influence the sound propagation.

4 Conditions during the measurement

The noise measurement periods were selected to assure the appropriate measurement conditions in compliance with the requirements in the Icelandic (and Nordic) standard.

4.1 Meteorological conditions

The meteorological conditions during each of the measurement are listed below. The cloudiness is defined as a fraction where 0/8 means clear sky and 8/8 means completely clouded over. The wind direction is given by direction of the compass i.e. ESE means east-south-east:

Meas. pos	Period	Cloudiness	Temperature	Wind speed	Wind direct.
1	Day	0/8	12 ºC	3 m/s	ESE
	Evening	8/8	9 ºC	2 m/s	ESE
	Night	8/8	9 ºC	< 1 m/s	ESE
2	Day	0/8	10 ºC	4 m/s	ESE
	Evening	4/8	6 ºC	< 1 m/s	ESE
	Night	8/8	2 ºC	< 1 m/s	ESE
3	Day	2/8	10 ºC	4 m/s	ESE
	Evening	0/8	6 ºC	< 1 m/s	ESE
	Night	0/8	2 ºC	< 1 m/s	ESE
4	Day	4/8	11 ºC	6 m/s	ESE
	Evening	0/8	6 ºC	2 m/s	ESE
	Night	8/8	10 ºC	< 1 m/s	ESE
5	Day	0/8	9 ºC	1 m/s	ESE
	Evening	0/8	10 ºC	4 m/s	ESE
	Night	8/8	6 ºC	2 m/s	ESE
6	Day	0/8	9 ºC	1 m/s	ESE
	Evening	0/8	11 ºC	4 m/s	ESE
	Night	0/8	4 ºC	< 1 m/s	ESE

7	Day	4/8	11 ºC	6 m/s	ESE
	Evening	4/8	7 ºC	2 m/s	ESE
	Night	4/8	4 ºC	< 1m/s	ESE
8	Day	6/8	10 ºC	6 m/s	ESE
	Evening	0/8	7 ºC	3 m/s	ESE
	Night	0/8	8 ºC	1 m/s	ESE
9	Day	4/8	10 ºC	4 m/s	ESE
	Evening	0/8	8 ºC	4 m/s	ESE
	Night	078	5 ºC	1 m/s	ESE
10	Day	0/8	12 ºC	2 m/s	ESE
	Evening	4/8	10 ºC	2 m/s	ESE
	Night	8/8	3 ºC	2<m/s	ESE

4.2 Background noise

The noise levels measured during the baseline noise survey shall not be adjusted for any influence from background noise.

4.3 Day and time of measurement

The noise measurements have been carried out in the period Tuesday 8 June to Friday 11 June 2004 covering the three time periods day, evening and night as defined in the EOL by the Icelandic Environment and Food Agency (EFA).

The traffic flow and the other noisy activities in the area and at the site during the measurements have been considered typical and representative.

5 Measurements and analyses

The measurements were carried out according to the procedures as described in the Nordic standard.

5.1 Equipment and software

Instrument	Type	Serial number
Integrating Sound Level Meter	01dB - SdB01+	10129
Integrating Sound Level Meter	Brüel & Kjær - 2231	1437085
Sound Level Calibrator	01dB - Cal21	1120153
Sound Level Calibrator	Brüel & Kjær - 4230	1440808
DAT recorder	HHB - Portadat PDR1000	11637
Tape recorder	Sony TC-D5M	47270
Anemometer	Skywatch Eole	-
GPS	Pocket PC with GPS	6Z2BKVL2503T
Analysis software	DELTA - NoiseLab ver. 1.1b	-

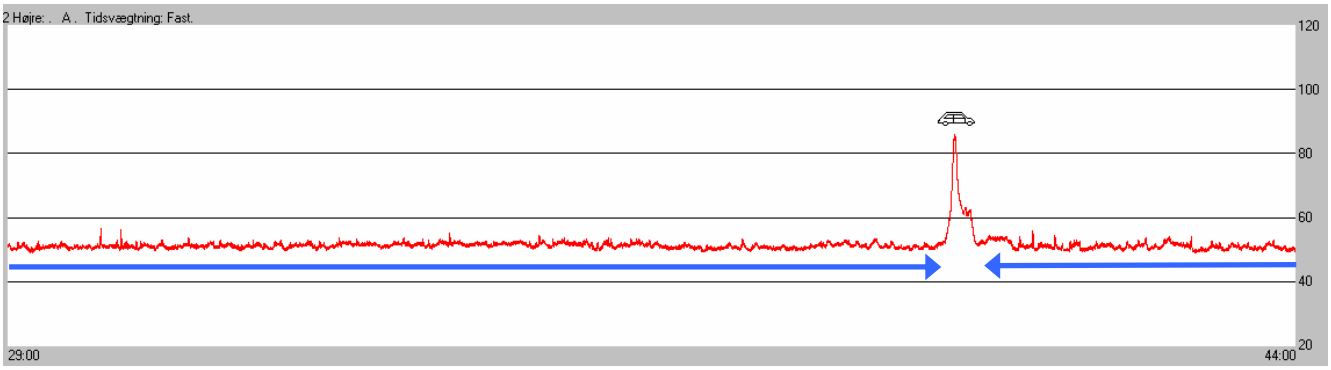
5.2 Procedure of the measurement and analyses

The measurements were carried out as supervised, manned measurements. The measurements were taken during a selected number of representative periods of ½ hour in all three time periods. All measurements was recorded on DAT-recorder and afterwards analysed in our sound laboratory. The analyses give $L_{Aeq,\ 30min}$, L_{10}, L_{50}, L_{90} and L_{Amax}. L_{10}, L_{50} and L_{90} show the noise level that is exceeded in 10%, 50% and 90% of the measurement time. L_{90} may be considered as the average minimum noise level (often considered as the true background level).

The measurement positions 2, 6 and 7 are located quite close to the road side.

At all locations the analyses show both the overall noise levels and the levels obtained, when extraneous events have been excluded, like vehicles passing

very close by the measurement position, birds circling around the position complaining due to the presence of the noise survey team. These few seconds of the recording have been excluded. The example below shows the noise peak from a car passing by.



The blue lines indicate the part of the measurement that has been used to estimate the noise level. The exclusion of these short measurement times has in general reduced the results by 1 dB.

The same analyses and exclusion of extraneous event will be made in the future noise surveys.

6 Results

6.1 Equivalent noise and fractiles

The results of the analyses are stated in the table below.

Measurement position	Period	$L_{Aeq,30min}$ [dB(A)]	L_{10} [dB(A)]	L_{50} [dB(A)]	L_{90} [dB(A)]	L_{Amax} [dB(A)]	Remark
1	Day	35	36	35	34	44	-
	Evening	32	33	32	31	40	-
	Night	31	32	31	30	37	-
2	Day	36	40	34	29	46	-
	Evening	38	40	38	36	45	Constr. noise - tunnel project
	Night	41	43	40	38	54	Constr. noise - tunnel project
3	Day	41	43	40	38	51	Constr. noise - tunnel project
	Evening	41	42	37	36	59	Birds
	Night	39	41	37	36	55	Birds
4	Day	41	43	40	38	49	-
	Evening	37	38	35	34	52	Birds
	Night	35	36	35	34	48	-
5	Day	37	38	36	35	49	Traffic
	Evening	40	41	38	37	54	Birds
	Night	36	38	36	35	43	-
6	Day	35	37	36	33	46	-
	Evening	39	40	38	36	53	-
	Night	39	42	37	35	52	Birds
7	Day	45	47	45	42	53	Wind + Traffic
	Evening	44	45	44	43	47	Glacial stream
	Night	42	43	41	40	54	-
8	Day	42	45	39	38	54	Wind
	Evening	33	34	33	32	40	-
	Night	40	41	40	38	50	Traffic
9	Day	35	37	34	33	45	Wind
	Evening	38	41	37	35	46	Birds
	Night	37	39	36	35	46	Birds
10	Day	37	39	36	35	44	Traffic
	Evening	37	38	37	35	45	Glacial stream
	Night	37	39	37	36	44	Glacial stream

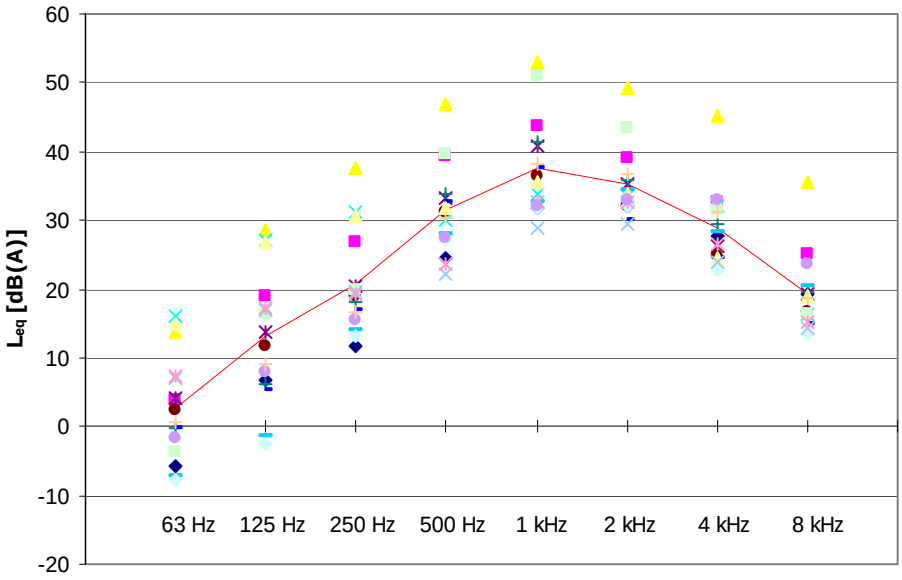
The remark column gives information about some of the important noise sources that have given a significant contribution to the resulting noise level in the measurement positions.

6.2 Accuracy

The accuracy of the analysed noise levels as presented in section 6.1 is depending on both the accuracy of the measuring chain (+/- 2 dB) and the fluctuation in the measuring conditions (traffic, natural animal life and meteorology). We estimate the overall accuracy of the results is better than ±4 dB.

6.3 Frequency Analysis

1/1-octave frequency analyses have even been carried out. At each of the selected 10 measurement positions the recorded measurement were analysed to give 1/1-octave A-weighted frequency spectra as shown below. Each colour and marker shows the frequency spectrum measured at each measurement position. On the y-axis is the recorded sound pressure level in dB(A) and on the x-axis the 1/1-octave bands 63 Hz to 8 KHz.



The chart shows the characteristic distribution of the frequencies within the spectrums from 63 Hz to 8 kHz for each measurement position and the recorded sound pressure level. As seen the frequencies around 500 - 1 kHz are dominating.

The full-drawn line shows the average frequency curve normalised to the same L_{Aeq} level. This curve gives a good picture of the frequency spectrum to represent a relative 1/1-octave frequency spectrum independent of the actual noise level. This curve is given in figures below.

63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
-38	-28	-20	-9	-3	-5	-12	-21

The frequency analysis is based on daytime recordings, as this period has the highest ambient noise level from the various numbers of sources.