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VIKING UK GAS LTD
PROPOSED EBBERSTON MOOR-1 WELL SITE
ASSESSMENT OF ENVIRONMENTAL NOISE EMISSIONS

Prepared on the instructions of:
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1 INTRODUCTION

ACIA was commissioned to provide acoustic consultancy services in connection with Viking UK Gas Ltd's proposed well site on the Lockton prospect, at Ebberston Moor, North Yorkshire. The site is in a rural setting with a few residential properties nearby.

This report presents the results of a survey of ambient noise performed in the locality on the night of 1-2 December 2004. The results are reviewed in the light of official guidance and recent experience in the industry. An assessment is then made of the noise levels likely to result from the drilling programme, and from test flaring should gas be found.

2 NOISE SURVEYS

2.1 Date, times, surveyor

The survey of ambient noise levels in the vicinity of the proposed well site was made on Thursday 2 December 2004 between midnight and 04:00h. All measurements were taken by Ian Bennett, consulting engineer, ACIA.

2.2 Weather

The night was cloudy but dry with no significant wind. The air temperature was 3°C.

2.3 Instrumentation

A Bruel & Kjær 2260 precision integrating sound level meter was used for all noise measurements. The meter was fitted with type 4189 condenser microphone, mounted near-vertically 1.2m above ground level. A foam windshield was fitted for all measurements. The calibration of the measurement chain was checked before and after the series of measurements using a Bruel & Kjær type 4231 calibrator, and no drift was observed. The equipment is subject to a periodic laboratory calibration traceable to national standards.

2.4 Method

Ebberston Common Farm to the south-east, and South Moor Farm to the north-east of the proposed site were regarded as possible survey locations as these are the nearest residential properties with a clear view of the proposed site. Preliminary measurements before midnight revealed that there were no significant noise sources close to either location, or at the BG Transco compound next to the proposed well site. Moreover, there were no measurable differences between the ambient noise levels at any of these locations. The sound level meter was therefore set up at a single point, at the junction of the track leading to Ebberston Common Farm from Ebberston Common Lane. This convenient location was chosen as it would be readily identifiable in the future. Ebberston Common Farm is occupied by the landowner on whose land the proposed flare is to be located.

A sequence of five-minute measurements was conducted at the measurement location during the 'small hours' of the night. The overall L_{Aeq} and the usual statistical indices L_{A90}, L_{A50}, and L_{A10} were recorded by the instrument for each five-minute sample, and the results were downloaded to computer at the conclusion of the survey.

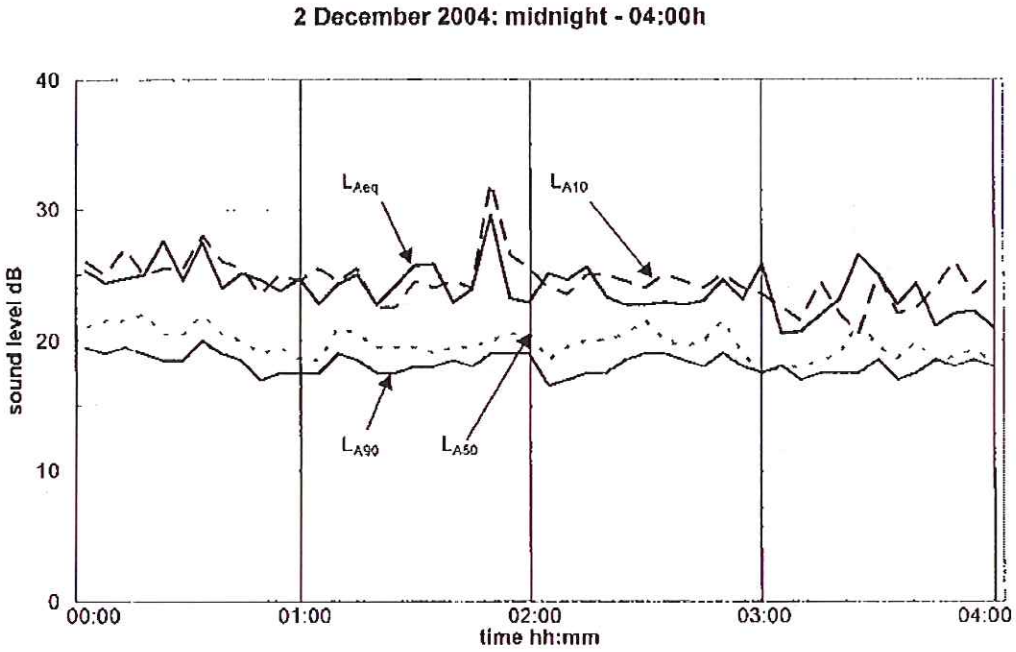
3 RESULTS

TABLE 1: Results of ambient noise survey, dB, 2 December 2004

start time	end time	L_{Aeq}	L_{A90}	L_{A50}	L_{A10}
00:00	00:05	25.3	19.5	21.0	26.0
00:05	00:10	24.4	19.0	21.5	25.0
00:10	00:15	24.7	19.5	21.5	27.0
00:15	00:20	25.0	19.0	22.0	25.0
00:20	00:25	27.6	18.5	20.5	25.5
00:25	00:30	24.6	18.5	20.5	25.5
00:30	00:35	27.5	20.0	22.0	28.0
00:35	00:40	24.0	19.0	20.5	26.0
00:40	00:45	25.1	18.5	20.0	25.5
00:45	00:50	24.6	17.0	19.0	23.5
00:50	00:55	23.8	17.5	19.5	25.0
00:55	01:00	24.7	17.5	18.5	24.5
01:00	01:05	22.8	17.5	18.5	25.5
01:05	01:10	24.3	19.0	21.0	24.5
01:10	01:15	25.0	18.5	20.5	25.5
01:15	01:20	22.7	17.5	19.5	22.5
01:20	01:25	24.2	17.5	19.5	22.5
01:25	01:30	25.7	18.0	19.5	24.5
01:30	01:35	25.8	18.0	19.0	24.0
01:35	01:40	22.9	18.5	19.5	24.5
01:40	01:45	23.9	18.0	19.5	24.0
01:45	01:50	29.5	19.0	20.0	32.0
01:50	01:55	23.2	19.0	20.5	26.5
01:55	02:00	22.9	19.0	20.5	25.5
02:00	02:05	25.1	16.5	18.5	24.0
02:05	02:10	24.6	17.0	19.5	23.5
02:10	02:15	25.6	17.5	20.0	25.0
02:15	02:20	23.3	17.5	20.0	25.0
02:20	02:25	22.7	18.5	20.5	24.5
02:25	02:30	22.7	19.0	21.5	24.0
02:30	02:35	22.9	19.0	20.0	25.0
02:35	02:40	22.7	18.5	19.5	24.5
02:40	02:45	23.0	18.0	20.0	24.0
02:45	02:50	24.6	19.0	21.5	25.0
02:50	02:55	23.1	18.0	19.0	24.0
02:55	03:00	25.8	17.5	17.4	23.5
03:00	03:05	20.5	18.0	17.9	22.5
03:05	03:10	20.7	17.0	18.0	21.5
03:10	03:15	21.9	17.5	18.4	24.5
03:15	03:20	23.1	17.5	19.0	22.0
03:20	03:25	26.5	17.5	21.4	20.5
03:25	03:30	25.0	18.5	19.5	25.0
03:30	03:35	22.7	17.0	18.6	22.0
03:35	03:40	24.3	17.5	19.9	22.5
03:40	03:45	21.1	18.5	18.2	24.0
03:45	03:50	22.0	18.0	18.8	26.0
03:50	03:55	22.2	18.5	19.2	23.5
03:55	04:00	21.0	18.0	18.4	25.0

The results show that on a calm night the ambient noise levels in the vicinity of the proposed well site barely reach 20dB L_{A90}. This is not surprising, as the nearest industrial noise source is several miles away, and the nearest major roads are about 10km distant. At the time of year when the survey was conducted, there were very few remaining leaves on trees, and the only variation in noise levels was the result of the movements of domestic and wild animals.

A time history of the measured levels is presented below.



4 NOISE CRITERIA

4.1 Definitions

It is appropriate at this stage to define some of the terms used in the measurement and specification of noise levels in the environment.

A-weighting

The A-weighted sound pressure level results from filtering a signal by an "A" filter (BS.4197) whereby both low-frequency and high-frequency components have been attenuated without affecting the components near 1000Hz.

Equivalent continuous noise level (L_{Aeq})

This is the A-weighted noise level which if present for the entire measurement period would produce the same sound energy to be received as was actually received as a result of a signal which varied with time. It is normally abbreviated to "L_{eq}" or "L_{Aeq}", and is often followed by a specification of the time period (such as 1 hour, or 5 minutes) indicating the period of time to which the measured value has been normalised; for example, "$L_{Aeq,1hr}$".

L_n index

The L_n resulting from an environmental noise measurement is the level which was exceeded for *n* percent of the measurement period. Thus, an L_{A90} of 35dB represents the A-weighted sound pressure level which was exceeded at the microphone for 90% of the measurement period. Any value of *n* between 0 and 100 is meaningful, but the indices in general use in the UK are L_{A90}, L_{A50} and L_{A10}. The L_{A90} index is generally taken to be representative of the steady background noise level. The L_{A50} is the arithmetic average of all the instantaneous values during the measurement period. The principal use of L_{A10} is in the assessment of road traffic noise.

4.2 Acceptable noise emissions from drilling

4.2.1 BS.4142: 1997

The acceptability of environmental noise is usually assessed with reference to this latest revision of an old-established standard. It recommends that a "new" industrial noise be compared with the pre-existing background level. Corrections can be made for the additional effects of tonal or impulsive noise, and the likelihood of complaints from the local community determined.

The use of these methods when considering noise emissions from onshore drilling operations has several shortcomings. A major problem arises from the fact that a drilling rig cannot be considered a fixed installation, and therefore falls outside the scope of the standard. An onshore rig is seldom on location for more than a few weeks: noise emissions that would clearly constitute a nuisance if they continued for several months may be perfectly acceptable in the short term.

BS.4142 also states that it should not be used where the ambient noise level is below 30dB(A). Clearly, this is the case at the site under consideration, so it follows that any analysis of the acceptability or unacceptability of the proposed exploration drilling must be based on the absolute levels of noise the process creates, rather than the excess over background noise, which will be considerable. Even using the best available noise control technology it can be difficult to select a site from which to explore a particular prospect that is far enough away for residential property to ensure that operations are inaudible at all residential locations all the time.

4.2.2 *Other guidance*

These points were addressed in the Department of the Environment's *Report of the Noise Review Working Party 1990*, wherein the transitory nature of noise from onshore oil and gas exploration sites was discussed. The point was made that noise from such sites may be better controlled by use of Section 60 of the Control of Pollution Act, in conjunction with a specific Code of Practice for such sites.

In a report by the ISVR, Southampton University, for Hampshire County Council, a noise limit of 35dB L_{A90} was recommended for a long-term oilfield development in a rural area with nearby housing. For the short-term drilling expected at the Ebberston Moor-1 site, the ISVR determined that noise levels up to 5dB noisier than the long-term criterion would probably not cause significant nuisance, so values of 40dB L_{A90} were therefore acceptable. It is a characteristic of conventional rotary drilling that for the typical rig the L_{Aeq} emitted is generally 3 to 4 dB numerically higher than the L_{A90}. Thus, making an appropriate adjustment, it follows that the environmental noise limit for noise levels during drilling would be in the range 43 to 44 dB L_{Aeq} at the nearest properties at night.

4.2.3 *MPG 11*

The Department of the Environment Minerals Planning Guidance MPG11, "*The control of noise at surface mineral workings*" reinforces the views expressed above. It states at paragraph 34 that the night-time noise limit at noise-sensitive dwellings should be 42dB L_{Aeq}. This limit is based on the assumption of permanent night-time working,

whereas the present case is a temporary one, drilling an exploratory well over a period of a few weeks. It may be considered appropriate to allow up to 5dB above this level in view of the transient nature of the work, but 45dB L_{Aeq} at night would be an acceptable limit.

Daytime noise limits can often be considerably more relaxed, partly because residents are not sleeping and are going about their business, but mainly because the levels of background noise during the day are considerably higher than at night. MPG11 states at paragraph 34 that the daytime noise limit should normally be 55dB $L_{Aeq,1hr}$, a value that follows the recommendations of the World Health Organisation in their publication "Environmental Health Criteria 12 - Noise".

4.3 North Yorkshire County Council policy

Planning consent is sought from the North York Moors National Park Authority, and it is established that such consent would not be withheld provided that the environmental impact of the development can be controlled to the extent appropriate for a national park. ACIA has been unable to discover any specific noise guidance policy adopted by the authority, but the Local Plan requires that noise from minerals extraction should be mitigated to the greatest extent possible, or eliminated altogether.

However, North Yorkshire County Council's planning guidance covers the exploration and development of hydrocarbons. The *North Yorkshire Minerals Local Plan* adopted in 1997 recognises the existence of gas deposits beneath the county, and was published with due regard to the council's experience with the Vale of Pickering gas field. Section 7 of the plan deals specifically with oil and gas exploration. The recommended noise limits are reproduced below.

> *'Noise limits will be imposed on planning permissions for the drilling of exploration and appraisal boreholes and production wells. The free field measurement of noise at the nearest noise-sensitive property should not exceed the following levels:*
>
> > *07:00 - 19:00 Background levels plus 10dB up to a maximum of 50dB $L_{Aeq,1hr}$*
> >
> > *19:00 - 07:00 Background levels plus 10dB up to a maximum of 42dB $L_{Aeq,1hr}$*
>
> *In certain specific cases lower levels may be set relative to quiet rural areas or to dawn, summer evening or weekend periods.'*

4.4 Acceptable noise emissions from flaring

Should gas be found in quantity, it may be necessary to implement a test programme over several days. The gas produced during the programme would flow to the surface and be flared off in a controlled manner using the Mardair four-burner unit previously used by Perenco UK Ltd. This approach was used on gas finds in the North Yorkshire area, and there is inevitably some noise associated with the process.

The concept of Speech Interference Level (SIL) has been found to give a reasonable indication of the residents' response to daytime flaring noise at other North Yorkshire sites. The SIL is the arithmetic average of the sound pressure levels centred on the octave band centre frequencies 500Hz, 1kHz and 2kHz. SIL values up to 60dB have previously been regarded as acceptable, provided that local residents are fully informed that flaring noise is temporary and very short-term in nature.

However, it may be more appropriate for a location within a national park to adopt similar noise limits to those for drilling. Daytime noise levels up to 50dB L_{Aeq} would therefore be acceptable. Flaring would not be undertaken between the hours of 19:00h and 07:00h.

5 PREDICTED NOISE LEVELS

5.1 Prediction locations

The predicted noise levels from the site were calculated for the noise-sensitive locations shown in Table 2. All the noise sources on site were assumed to be lumped together at the centre of the site. The Ordnance Survey grid references were obtained from a GPS system on site, with an assumed accuracy of ±5m.

TABLE 2: OS coordinates of noise prediction locations

location	E	N
R1: Ebberston Common Farm	490198	489413
R2: South Moor Farm	490569	490305
R3: Jingleby Thorn	489347	489559
R4: Broad Head Farm	490205	488156
centre of proposed well site	490016	489631

5.2 Drilling noise

5.2.1 *Basis of predictions*

It is Viking UK Gas Ltd's intention to use a truck-mounted rotary drilling rig. The typical sound pressure levels emitted by such rigs under steady drilling conditions have been measured by ACIA and by others on several occasions over the past ten years, and the typical overall sound power level L_{wA} is 106dB. In the worst case this means that the typical equivalent continuous noise level L_{Aeq} at a distance of 100m is 58dB. However, most rigs have quite pronounced directional characteristics so the actual value measured at a particular point will vary according to the actual rig used, and its orientation. The resultant sound levels are also subject to additional atmospheric, ground and barrier attenuation.

The orientation of the rig on this particular site is likely to be with the pipe racks towards the north-east. On that basis the calculated resultant noise levels to the north-east may be regarded as the maximum likely. The rig orientation may, however, be subject to change according to the operational considerations of the drilling contractor appointed.

5.2.2 *Calculated noise levels*

Noise levels (L_{Aeq}) at the noise-sensitive properties nearest to the proposed sites were calculated using the octave band sound power levels in Table 3. The actual levels experienced would vary slightly

depending on weather and wind direction, but the calculated values may be taken as typical for drilling ahead in calm weather.

TABLE 3: Sound power levels emitted by a typical drilling rig

Hz	63	125	250	500	1k	2k	4k	8k	A-wtd
dB	113	112	109	104	99	94	89	82	106

Table 4 shows the predicted level, L_{Aeq} produced by the rig itself (in the absence of background noise) at each of the properties. It should be noted that the levels indicated take account of the soft ground attenuation between noise source and receiver. Some additional attenuation has been assumed, where applicable, to allow for the depth of woodland between the site and the receivers.

TABLE 4: Predicted noise levels resulting from steady drilling

location	m from well	L_{Aeq} dB
Ebberston Common Farm	284	42
South Moor Farm	872	25
Jingleby Thorn	673	21
Broad Head Farm	1487	11

5.2.3 *Noise from drilling activities*

Since drilling continues 24 hours a day, seven days a week, noise problems are most likely to occur at night. As can be seen from the results the predicted level at night, L_{Aeq}, from the rig alone is 42dB at Ebberston Common Farm. More significantly, at South Moor Farm and Jingleby Thorn the levels are less than 10dB above the minimum conceivable night-time background level of 18dB L_{A90}.

The effects of the weather on noise emissions sometimes give cause for concern, especially at properties perceived to be downwind of the noise source. It is ACIA's experience with drilling sites, however, that the increase in background noise because of the wind rustling through vegetation is more than sufficient to mask the increased noise resulting from downwind enhancement. This will certainly be so near this site, where the background noise in any significant wind is confidently expected to increase by 10 to 20 dB.

In general, "tripping" the type of drilling rig contemplated for this site is no noisier in terms of the $L_{Aeq,1hr}$ than drilling ahead. It would be quite usual for there to be occasional impact sounds or increases in noise during the tripping-out and tripping-in operations, or when additional stands of pipe are added to the drill string, but these would not affect the equivalent continuous sound level measured at a location remote from the rig.

5.3 Flaring noise

If hydrocarbons were to be found, gas would flow to the surface and would be flared off with a Mardair 4-burner unit. The maximum rate of gas flow would be 10mmscfd, although for most of the time the flow rate would be considerably less. The noise levels emitted by the Mardair four-burner unit at the maximum flow rate have previously been measured on several occasions, and are shown in Table 5. The flare head consists of four burners arranged in a square formation, and does not have any significant directional noise characteristics.

TABLE 5: Sound power levels emitted by Mardair four-burner flare

Hz	63	125	250	500	1k	2k	4k	8k	A-wtd
dB	114	109	102	101	97	93	90	94	103

The noise levels resulting from flaring at 10mmscfd are shown in Table 6. In the same manner as the drilling noise calculations described above, the levels take account of the soft ground attenuation between noise source and receiver, and additional attenuation has been assumed, where applicable, to allow for the depth of woodland between the flare and the receivers.

TABLE 4: Predicted noise levels resulting from steady drilling

location	m from well	L_{Aeq} dB
Ebberston Common Farm	284	40
South Moor Farm	872	23
Jingleby Thorn	673	19
Broad Head Farm	1487	8

Depending on the layout of the temporary equipment required for flaring purposes on site, there may be additional screening of the flare burner from the point of view of the nearest noise-sensitive properties. However, no allowance has been made for this additional noise mitigation.

It may be safely deduced that if any flaring were to take place, it would not cause significant disturbance to the local residents.

6 CONCLUSIONS

The study of environmental noise levels shows that noise limits of 50dB $L_{Aeq,1hr}$ during the daytime and 42dB, $L_{Aeq,1h}$ at night are entirely appropriate for this development in view of the intermittent and short-term nature of operations. Even on the quietest of nights, the requirement that noise at the nearest noise-sensitive property should not exceed the background level by more than 10dB can be met. For these purposes Ebberston Common Farm, being the home of an interested landowner, is not regarded as noise-sensitive.

The same noise limits can be met using the proposed four-burner flare unit even when gas is flowing at the maximum anticipated flow rate. For much of the time during the reservoir appraisal exercise, the gas flow, and thus the noise emitted, would be considerably lower.

It is concluded that the proposed gas exploration well would not be a source of noise nuisance.

APPENDIX: map showing noise measurement and prediction locations