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DESIGN PROCEDURE FOR NOISE CONTROL AT PRESSURE REDUCTION STATIONS

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1. INTRODUCTION

Natural gas comes ashore at the east coast reception terminals at Bacton, Theddlethorpe, Easington and St Fergus, and is then pumped to most parts of the UK through 4000 km of high pressure pipeline at 69 bar using compressor stations where necessary. This high pressure is used to maximise energy transmission through and storage in the system.

As the pipeline approaches densely populated areas the line pressure is reduced; this is the job that pressure reduction stations perform, providing an interface between the transmission system and the regional distribution system where the pressure is further reduced for final distribution.

2. OPERATION OF PRESSURE REDUCTION STATIONS

A typical pressure reduction station is shown schematically in Figure 1. Gas taken from the high pressure line is filtered to remove rust, scale etc. accumulated in the gas and then metered, after which the gas is heated in a water bath heater to compensate for the temperature reduction it undergoes during decompression. The pressure is then reduced and the gas fed into the regional system for distribution. Pressure reduction can take place in stages, the first stage cutting to a fixed intermediate pressure at the inlet to the volumetric regulator, which then makes the final pressure cut down to the regional pressure. Typical pressures are shown on Figure 1.

3. NOISE SOURCES

3.1 Water Bath Heaters

A bath heater is a large (up to 4.5 MW) gas fired indirect heat exchanger in which water heated by large atmospheric burners preheats gas passing through a secondary heat exchanger in the main water bath. Noise from the heaters has three components:

(i) low frequency combustion "roar" from the flame

(ii) low frequency resonances of the smoke tube/exhaust stack driven by the combustion processes

(iii) high frequency "hiss" from the high pressure gas injectors on the burners.

Typical noise levels are 72 dB(A) at 15 m for a 3 MW heater.

3.2 Regulators

Regulators control the flow through the station by varying the restriction to flow in the line, noise being generated by the high velocity gas stream constrained within the regulator body and downstream pipework from which it subsequently radiates. Noise spectra normally peak in the 2 and 4 kHz octave bands. Performance figures for a typical 300 mm regulator are:

Flow: 400 tonnes/h

Pressure cut: 69 to 10 bar

Mechanical power dissipated: 9 MW

Noise level: 115 dB(A) at 1 m

Figure 2 shows typical spectra for bath heaters and regulators.

4. DESIGN PROCEDURES

The procedure evolved to ensure that noise from pressure reduction stations does not annoy our neighbours is shown schematically in Figure 3. The main points are:

(a) Pre-construction background survey

This is carried out to strict standards by experienced staff using precision equipment. Minimum octave band noise levels (L_{90}) are measured in the locality of all existing dwellings within a 500 m radius of the site centre. Measurements are made between midnight and 0400 hours during periods of settled weather, with due allowances being made for extraneous noise.

(b) Criterion

Having established the background noise level for the area, we have then to place limits on noise levels for the station when fully operational. This may be agreed with the local authority but, if not, we impose our own limits in order to avoid nuisance to our neighbours.

(c) Prediction of noise levels

(i) Water bath heaters - empirical relationships.

(ii) Regulators - manufacturers' data (Ref 1) modified to include our own field results.

(d) Noise reduction methods

By comparing predicted levels with the site criterion we obtain noise reduction requirements for the equipment. Wherever possible, commercially available noise control methods are used but, where not, "specials" have to be developed; these measures are then incorporated into the final site design.

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(e) Performance check

When the site is operational, return visits are paid to the site to check:

(i) that the criterion has been satisfied

(ii) the accuracy of the prediction methods

(iii) the quality of the noise control measures included on site.

This method is being refined continually.

ACKNOWLEDGEMENTS

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REFERENCE

1. E E ALLEN. 1970. Fisher Controls Co, Publication TM-24. Noise control in valves and regulators.

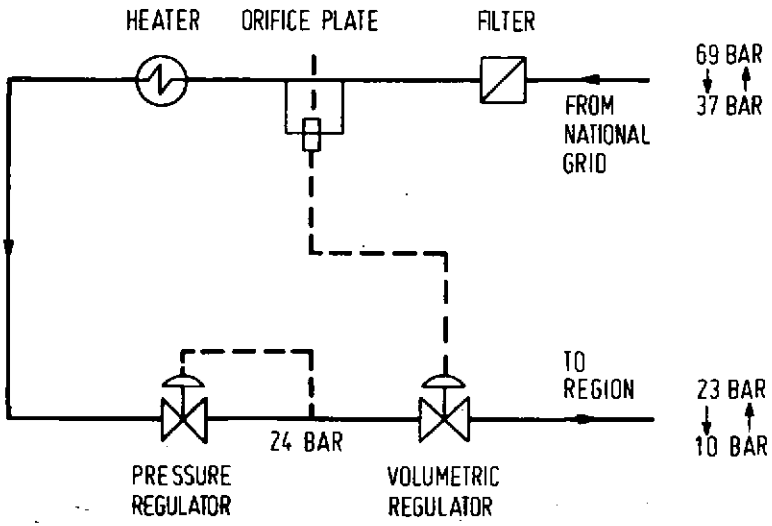

FIGURE 1 Typical pressure reduction station

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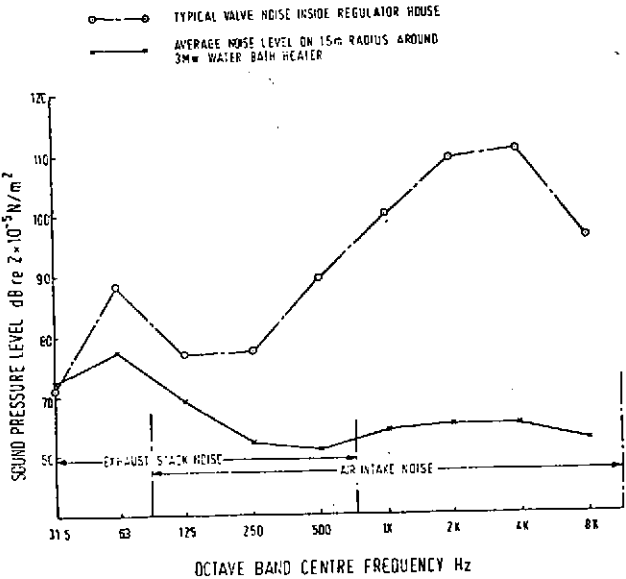

FIGURE 2
Typical spectra for bath heaters and regulators.

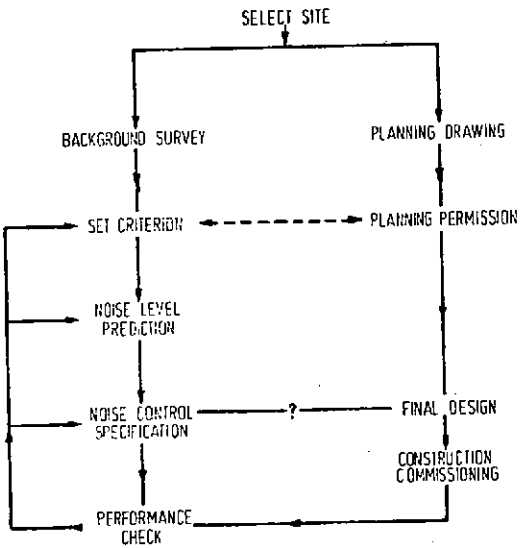

FIGURE 3
Noise control procedures.