ExxonMobil

April 2022

Fife Ethylene Plant

Environmental Monitoring Programme

PPC/A/1013494 VN06/VAR01 Condition 6

This document assesses the impact of emissions (air, noise & vibration) from Fife Ethylene Plant on the local community and environment, with the aim of defining an appropriate forward monitoring plan for these emissions.

Revision	Date of Issue	Comments
1	28-Aug-19	First published
2	01-Apr-22	Updates made to reflect new information available since August 2019 and updated forward monitoring objectives per VAR01

Contents

1. Introduction

ExxonMobil Chemical Ltd (EMCL) Fife Ethylene Plant (FEP) undertakes environmental monitoring in order to;

- understand the scale of the risk to the environment and to human health and wellbeing so as to assess environmental risk and inform associated decision-making
- identify where mitigation measures are required and monitor the effectiveness of existing mitigations
- detect changes to environmental risk so as to allow effective intervention
- comply with legal obligations and international agreements

This Environmental Monitoring Programme focuses on FEP's emissions to air, and of noise and vibration during routine and process upset conditions. It aims to review existing monitoring data in order to assess the impacts of air, noise & vibration emissions on the environment and communities and define what environmental monitoring is required to effectively manage the impacts going forward.

2. Principles

Suitable environmental monitoring is that which is;

- Of a level and quality that is sufficient to assess the environmental risks posed by FEP
- A means to monitor the effectiveness of the controls used to mitigate environmental risks
- Clearly documented and performed to a recognised standard
- Commensurate with the level of environmental risk posed

3. Environmental Monitoring

3.1. Information Sources

There are several possible sources of information which inform environmental impact assessment;

1. Source data
    a. Sampling of emissions/throughput
    b. Continuous monitoring of emission/throughput
    c. Fence line monitoring
    d. Emissions calculation
    e. Inspection/audit of mitigations – can provide indication of the effectiveness of controls/mitigations put in place and indicate where they may be change
2. Receptor data
    a. Offsite monitoring (e.g. at sensitive receptors)
    b. Public observations - can provide a subjective interpretation on environmental impact, however the information may not be impartial and reports can be biased. This input is used primarily to provide consideration to monitoring techniques.
3. Modelled data

Each data source offers advantages, while also containing a level of uncertainty. It is advisable that the uncertainty of monitoring sources is taken into consideration when assessing monitoring data in order to ensure that it has been accounted for.

3.2. Available Data for Impact Assessment

FEP has undertaken environmental monitoring of its activities prior to its commissioning in 1986 and throughout the subsequent 36 years of operation. Over time, environmental understanding, associated monitoring methods and acceptable standards have improved and this is identifiable through the changes in monitoring seen at the site.

The following sections detail the current measurements and monitoring data that have, and are being undertaken currently to inform impact assessment.

3.2.1 Air Quality

There are 19 emission points at FEP which are listed in the sites environmental operating permit. They include the cracking furnaces, the boilers, the gas turbine, vents and flares (both FEP's elevated flare and any material FEP sends to the Shell FNGL ground flares). In addition to point source emissions, plant wide monitoring of emissions occurs to capture any potential leaks or releases.

A summary of the main existing air quality monitoring data that are used to assess and monitor FEP's impact on local air quality is below;

Type of Monitoring	Scope of Monitoring	Standard of Monitoring	Frequency of Monitoring
Source data: Continuous monitoring of emission/throughput	Furnaces: - smoke - O2 - CO - fuel composition - fuel rate	- BS2742:1969 Continuous online measurements	Continuous
	Gas Turbine: - O2 - fuel composition - fuel rate	Continuous online measurements	Continuous
	Boilers: - O2 - fuel composition - fuel rate	Continuous online measurements	Continuous
	Flare: - smoke - flow rate - composition - steam rate	- BS2742:1969 Continuous online measurements	Continuous
Source data: Sampling of emission/ throughput	Furnaces: - NOx - SOx	Direct measurement with Testoterm 350 flue gas analyser	Quarterly

Type of Monitoring	Scope of Monitoring	Standard of Monitoring	Frequency of Monitoring
	- CO2 - O2 - CO		
	Gas Turbine: - NOx - SOx - CO2 - O2 - CO	Direct measurement with Testoterm 350 flue gas analyser	Quarterly
	Boilers: - NOx - SOx - PM - O2 - CO	- BS EN 14792 - BS EN 14791 - BS EN 13284-1 - BS EN 14789 - BS EN 15058	6-monthly
	Vents: - H2S	- Drager tube	Weekly
	Plant wide: - VOC - Mercury	Health & Safety Standards per COSHH RA	Annually
Source data: Calculation	Furnaces: - NOx (mass) - CO2 (mass)	As agreed in writing with SEPA	Annually
	Gas Turbine: - SOx (mass) - CO2 (mass) - TOC (mass)	As agreed in writing with SEPA	Annually
	Boilers: - NOx (mass) - SOx (mass) - PM (mass) - CO2 (mass) - VOC (mass) - CO (mass)	As agreed in writing with SEPA	Annually
	Flares: - NOx (mass) - CO2 (mass) - TOC (mass) - VOC (mass)	As agreed in writing with SEPA	Annually
	Vents: - CO2 (mass) - H2S (mass) - TOC (mass)	As agreed in writing with SEPA	Annually
Receptor data: offsite monitoring	8 Locations (3 community, 4 fenceline, 1 offsite); - VOC's - PM	Undertaken by the National Physics Laboratory - EN ISO 16017-1 - EN ISO 16017-2	21-Aug to 1-Oct 2008

Type of Monitoring	Scope of Monitoring	Standard of Monitoring	Frequency of Monitoring
		- Partisol Plus Model 2025 Sequential Air Samplers (QPAS/B/546) - UKAS ISO 17025	
Modelling Data	2009: • Impact assessment during normal operation • Assessment under flaring scenario 2019: • Impact assessment during normal operation • Assessment under assumed 'worst-case' scenario (365 days, 300T/H, black smoke)	ADMS Dispersion model EU, UK Legislative Assessment Criteria WHO Guidelines	2009, 2019

In addition to monitoring undertaken by FEP, a system of Local Air Quality Management (LAQM) has been in place in the UK since 1997. The role of the LAQM review and assessment process is to review local air quality and identify all relevant locations where the air quality objectives are being or are likely to be exceeded. Where an area of exceedance is identified, the local authority is required to declare an Air Quality Management Area (AQMA) and implement an Air Quality Action Plan to improve air quality within the areas.

Fife Council has examined the results from monitoring in the Fife Council area and concluded that concentrations of all Air Quality Standard pollutants (outside identified Air Quality Management Areas) are below the objectives at all relevant locations, therefore there is no need to undertake further detailed assessment (1). A report is published annually by Fife Council which incorporates monitoring data from 4 automatic monitoring sites, 40 diffusion tubes, coastline sampling and data from the Grangemouth petrochemical sites (which are within an identified Air Quality Management Area). The report also discusses the Regional Air Model which is used to predict and monitor air quality throughout Fife.

The following table summarises additional sources of data used to assess and monitor FEP's impact on local air quality;

Additional sources of baseline information and trends (2)	
Key facts regarding air quality together with datasets and interactive maps.	www.scottishairquality.co.uk/
State and trend information and key messages.	www.environment.gov.scot/our-environment/air/

The Scottish Pollutant Release Inventory (SPRI) – The database and map of annual mass releases of specified pollutants to air, water and land from certain SEPA-regulated industrial sites.	www.sepa.org.uk/environment/environmental-data/spri/
The Air Quality in Scotland website provides access to technical reports, including the Scottish Air Quality Database Annual Report which provides a summary of air quality monitoring carried out on behalf of Government and local authorities and summarises trends in air quality monitoring for certain pollutants.	http://www.scottishairquality.scot/news/
Maps and datasets for Air Quality Management Areas and LAQM tools and guidance.	www.scottishairquality.co.uk/laqm/
Air quality data from the present day back to 1986 from sites monitoring at hourly and less frequent intervals.	www.scottishairquality.co.uk/data/
Air quality information produced by individual local authorities – each local authority is required to review and assess air quality in their area annually (this process identifies where an AQMA may be required).	www.scottishairquality.co.uk/news/reports?view=laqm

Data from FEP, Fife Council and Shell FNGL is also provided to the Independent Air Quality Management Review Group who provide advice and recommendations to Fife Council regarding the monitoring of air emissions arising from the operations at the Mossmorran plants and the Braefoot Bay terminal facilities. They do this by independently reviewing the air quality data as well as considering the potential impact that any major plant changes could have on air quality. They produce annual reports to present their findings of the review and any recommendations they may have.

3.2.2. Noise & Vibration

FEP has conducted a baseline assessment of noise sources on site, this is documented in site noise maps. Where equipment or circumstances change noise is assessed and appropriate (short term and long term) control measures in line with the Control of Noise at Work regulations are implemented to maintain personnel protection. Any change to the plant that may affect the resulting noise profile must also be assessed.

Beyond the site boundary extensive community noise monitoring has been conducted to assess the impact of the plant on the receiving environment and communities. Appendix 2 Summary of Noise Monitoring & Key Findings, summarises the monitoring completed to date including the outcomes that have been used to assess the impact of noise and vibration on communities and influence monitoring scope.

Following the June 2017 flaring events, a discrepancy between the results of a BS4142 Noise Impact Assessment and the feedback from local community indicated there was reason to further investigate noise from flaring. The potential source of vibration mentioned by communities during the event was likely the presence of low frequency noise (ground borne vibration was demonstrated to be technically unfeasible due the distances involved and above ground operational presence). On this basis it was considered that more thorough acoustic assessment may assist in confirming the low frequency noise hypothesis.

Robin Mackenzie Partnership (RMP Acoustics), a specialised acoustic consultancy division of Edinburgh Napier University, was engaged by FEP in late 2017 to investigate noise associated with flaring to pinpoint variables affecting noise generation and support identification of effective noise mitigations. Such assessment could only occur during flaring events and as such RMP were retained on-call to respond should any events occur. Both flaring events in 2018 (March and May) were assessed in extensive detail (full frequency data).

In June 2018 SEPA varied the FEP permit to include a requirement that '..all appropriate preventative measures are taken against noise and vibration emissions through the application of BAT and ensure that no significant pollution is caused'. Alongside this SEPA included a new permit condition which required FEP to undertake an evaluation of Best Available Techniques (BAT) to prevent and, where that is not practicable, to reduce emissions of noise, vibration and smoke associated with flaring, by 30-Apr-19.

Significant work was undertaken to complete a comprehensive assessment of Best Available Techniques for flaring. As is confirmed in SEPA's subsequently published guidance on Noise and Vibration Management (Jul-21) 'all measures necessary' and 'Best Available Techniques' are interchangeable terms.

In July 2018 the presence of low frequency noise vibration from flaring was confirmed and this information initiated further investigation into the source of the low frequency noise. While a correlation with elevated flare rate was found at 200Hz, contribution from other sources including steam flow and ground flare rate could not be quantified. In addition, no correlation was found between any aspect of flaring and the 20Hz frequency. Without a better understanding of the source of the low frequency noise engineering solutions could not be targeted to ensure reduction or elimination of the noise. Further data was required, however opportunities to monitor during flaring were limited as no planned flaring events were scheduled in the near future, and unplanned flaring is not predictable. RMP Acoustics were maintained to respond as soon as possible if and when an opportunity for monitoring occurred.

No further flaring events occurred over the course of 2018 so further acoustic analysis was not able to be completed. Based on the acoustic data for flaring that was available from March 2018 and May 2018, RMP Acoustics were requested by FEP to undertake comprehensive data analysis comparison to identify possible correlations in order to identify the root cause of the noise. Their report was issued in March 2019 and while not conclusive, the analysis pointed to several priority areas to focus future monitoring including steam rates to elevated flare, flow rate to ground flares and elevated flare and varied weather conditions.

The Flaring BAT Evaluation was submitted to SEPA on 30th April 2019. It concluded that 'acceptable' noise levels are not clearly defined or quantifiable but an approach is needed to demonstrate future compliance. This meant that it was not possible to define what rate of flaring, if exceeded, caused noise impact in communities and likewise, what controls associated with flaring reduced associated noise as far as practicable.

On 23rd May 2019 in response to the Flaring BAT Evaluation, SEPA varied FEP's permit to require submission of an Environmental Monitoring Plan by 23rd August 2019. The concept of a monitoring plan had been discussed with SEPA previously as a means of communicating FEP's approach to understanding and responding to emissions during flaring. It allowed FEP to explain and justify approach to monitoring (data driven approach).

FEP continued to engage RMP to respond and analyse any flaring events, with process upsets occurring in April, June, July and August of 2019 adding further data and understanding to the flaring noise evaluation. The Environmental Monitoring Plan was submitted on 23 August 2019 and it proposed a continuation of the targeted acoustic studies to;

- Better understand the relationships between noise and vibration associated with flaring and flow rates, wind direction, wind speed and low frequency noise
- Confirm the source(s) of flaring noise and variables affecting the flare noise profile
- Confirm the effectiveness of associated mitigative measures
- Establish levels of elevated flaring below which noise impacts are not anticipated to occur

From April 2020 three permanent monitoring stations were installed and operational at the North Access Road, Lochgelly and Dorloch Cottage. These were used to further acoustic studies of baseline noise and enable better information gathering during flaring events.

All four flaring events which occurred in 2020, including the planned plant start-up in February 2020, were monitored and assessed. The data has identified correlations between low frequency noise at the noise sensitive receivers and elevated flow rates which aligns with the operational focus to preferentially maximise the use of the ground flares wherever possible.

In February 2021 an additional two monitoring stations (bringing total to 5) were installed at Little Raith Farm (East) and Mossbank Poultry Farm (West) by RMP Acoustics in order to provide monitoring at the closest noise sensitive property in each direction and to allow for assessment under different wind directions.

Noise monitoring and assessment continued throughout 2021, with planned plant shutdown and startup enabling data analysis. Focus was placed on quantifying the benefit achieved from replacement of the elevated flare tip. There were no significant unplanned elevated flaring events during the year. One report was completed in February relating to a process upset which resulted in less than 80min of elevated flaring, averaging 16T/H and assessment confirmed this did not cause impact to nearby receptors.

A full summary of noise monitoring undertaken and key findings is included in Appendix 2 Summary of Noise Monitoring & Key Findings.

4. Assessment of Impact

An assessment of environmental impact considers both the consequences of emissions as well as the probability, or likelihood that the emission may occur and at what levels. The scenario that is assessed can be acute (failure of abatement equipment), or chronic (persistent exceedance of acceptable emission levels) as applicable. When assessing the impact of emissions, the following dimensions are considered;

- Vulnerability of the receiving environment and reversibility of impacts
- Contributory sources of emissions (beyond the plant boundary)
- Source, duration, size/scale and intensity of the emission
- Effectiveness of mitigative measures on the emission
- Acceptability criteria for the emission (if defined)
- Actual or perceived effect upon the environment (incl. human health)

The availability of high-quality data to support the assessment often varies, however it should be proportionate to the nature and scale of the emission. In instances where data may be unavailable, conservative assumptions can be made in order to determine whether further data is necessary to assess the impact. For example, if a conservative, 'worst-case' assumption on an emission source is made and the outcome of the assessment indicates that the impact is acceptable, further data is not required as it will only confirm that the impact is acceptable. However, if a conservative assumption identifies that there is potential for an unacceptable impact, additional data serves to quantify and/or qualify the impact. If, following further analysis, the impact is still deemed unacceptable, mitigations are then reviewed to manage the emission impacts to demonstrate BAT.

An overview of the data that has been used in the assessment of impact is provided in Section 3.2. Available Data for Impact Assessment. The following sections discuss the impact assessment for air quality, noise & vibration.

4.1. Air Quality

4.1.1. Receiving Environment & Contributory Sources

FEP is located approximately 3km south-east of the town of Cowdenbeath in Fife. The area surrounding the plant is predominantly farmland, with small populations totalling approximately 155,000 surrounding the plant within a 10km radius (refer Figure 1: Radial 5km and 10km demarcation from FEP).

Air quality is classified as 'good' in the areas surrounding Mossmorran (4) . The review of all other local developments did not identify any locations where there may be a risk of the air quality objectives being exceeded and so no additional air quality assessment was recommended (1).

The primary contributors to air quality impacts in Fife are from transport (1) (4). There are several key transport motorways transgressing the area including the M90, A92 and A91, as well as busy residential areas that may experience congestion or high variation in traffic flows. Other industrial contributors include the dockyards (Rosyth), Arms Firm (Glenrothes), waste incineration (Dundee), opencast mining (Kelty, Crossgates) and the Grangemouth Complex comprising of refining, chemical, pharmaceutical , cement and wood treatment facilities. Other

contributory sources include flights, railways, ports, poultry farms, commercial sources (e.g. biomass combustion, solid fuel burning), domestic (heating, burning etc.) and fugitive sources such as construction and agricultural emissions.

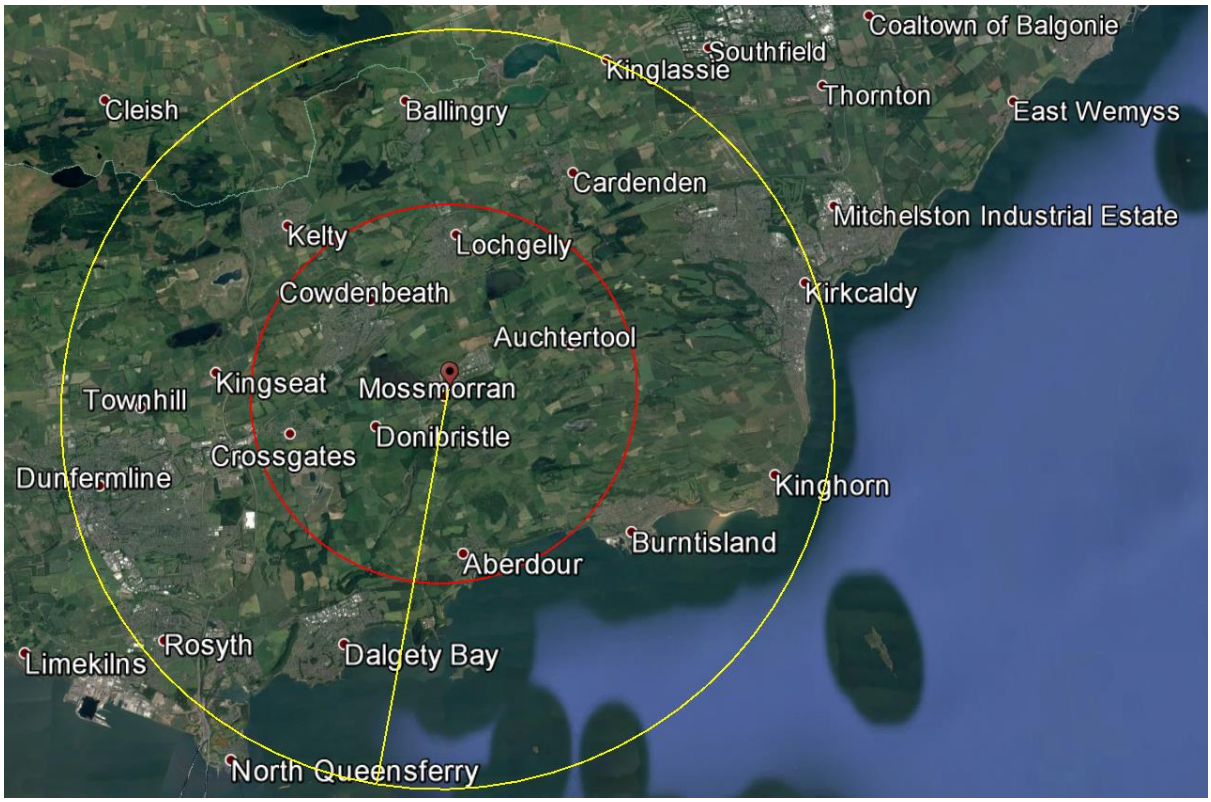

Figure 1: Radial 5km and 10km demarcation from FEP

4.1.2. Sources of emission from FEP

There are 19 emission points at FEP which are listed in the site's environmental operating permit. They include the cracking furnaces, the boilers, the gas turbine, vents and flares (both FEP's elevated flare and any material FEP sends to the Shell FNGL ground flares).

The emissions are consistent with those associated with combustion equipment and include;

- Sulphur dioxide (below the UK Pollutant Reporting Inventory threshold for emissions)
- Carbon Dioxide
- Nitrogen Dioxide
- Volatile Organic Compounds (below the UK Pollutant Reporting Inventory threshold for emissions)
- Carbon Monoxide
- Particulate Matter (below the UK Pollutant Reporting Inventory threshold for emissions)

All emissions occur within permitted rates/levels which have been established based on Best Available Techniques and consideration of surrounding contributory sources.

Other emissions (such as H2S) are monitored primarily from an operational perspective to ensure ongoing safety of site workers.

During flaring, additional combustion occurs at either the Shell FNGL ground flares and/or the elevated flare. Emissions from flaring are consistent with typical combustion as detailed above. The material sent to flare is of known composition (gas chromatograph analyser in situ). During exceptional circumstances (such as loss of steam), smoke (or soot) may be emitted from the flare. This is not considered a frequent or regular emission, occuring;

- once in 2009
- once in 2012
- for 27 minutes in 2017
- for 110 minutes in 2019
- for 19 minutes in 2020
- for 47 minutes in 2021 (as agreed with SEPA)

In addition to point source emissions, there are minor diffuse emissions including those from transport vehicles at the site, flange or valve fugitives, tank breathing etc.

4.1.3. Acceptable Air Quality Levels

Extensive legislation exists defining acceptable levels of emissions throughout Europe and the UK. These are summarised below;

- Directive 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe
    - Sets limit values, or target levels for selected pollutants that are to be achieved by Member States
- The Air Quality Standards (Scotland) Regulations 2010
    - Transpose Directive 2008/50/EC into UK legislation and sets legally binding Air Quality Standards (AQS)
- The Air Quality (Scotland) Regulations 2000 as amended and the Air Quality (Scotland) Amendment Regulations 2016
    - Provide health-based criteria and derives Air Quality Objectives (AQO) policy targets
- The Environment Act
    - Part IV requires Local Authorities to periodically review air quality through the Local Air Quality Management process

In addition to statutory standards there are also multiple sources of applicable air quality guideline for example;

- Air Quality Guidelines for Europe, the World Health Organisation (WHO)
- Environment Assessment Levels

4.1.4. Mitigating Measures

Mitigative measures that eliminate, or where that is not practicable, reduce emissions from activities at FEP are clearly defined in European Best Practice Reference Documents which are legally binding in the UK.

Fit-for-purpose monitoring (as described in Section 3.2.1 Air Quality) enables the effectiveness of mitigative measures to be assessed and any changes assessed timely. An overview of the existing measures utilised to eliminate, reduce and/or control emissions are included below;

- Sulphur dioxide
    - Fuel selection, monitoring
- Carbon Dioxide
    - Maximising energy efficiency/monitoring key energy variables, control systems, fuel selection, recovery and reuse of hydrogen, heat recovery
- Nitrogen Dioxide
    - Burner steam control, use of spent air, control systems, monitoring, fuel selection, combustion optimisation
- Volatile Organic Compounds
    - LDAR programs, closed loop vapour return, No Oil To Sewer policies, combustion optimisation, control systems
- Carbon Monoxide
    - Combustion optimisation, optimisation of thermal decoking
- Particulate Matter
    - Combustion optimisation, optimisation of thermal decoking

4.1.5. Actual or Perceived effect on the Environment

Extensive and detailed air quality modelling has been undertaken by a specialist consultant (Wood PLC) to determine the actual effects of emissions on local air quality. Modelling is a globally accepted standard in which to undertake air quality impact assessment as it allows;

- A picture of the air quality in a zone may be obtained - in contrast to the limitations in the spatial coverage of air quality measurements.
- The relation between air concentrations and the emissions causing these can be made explicitly and quantitatively by modelling, which is most important for supporting air quality management.
- Models are the only available tool if the impact on air quality of possible future sources or of alternative future emission scenarios is to be investigated.

The principal conclusion of the Wood PLC 2019 assessment is that, as there are no predicted exceedances of any acceptable Air Quality Standard, Air Quality Objective or Environmental Assessment Levels during normal operation of FEP and during flare event scenarios, the risk of adverse impacts on human health due to activities (including flaring) at FEP are negligible. This conclusion is entirely consistent with the conclusion of the 2009 modelling study.

Smoky flaring instances, while uncommon, have also been considered in the model. Inverse modelling demonstrates that, for flaring emissions to exceed an acceptable standard, particulate emissions (soot) from the elevated flare would need to be at a level that would account for approximately 84% of the total UK emissions of PM2.5. Such an outcome is implausible, even at 365 days of continuous smoky flaring.

Feedback from communities on the perception of air quality varies and tends to correlate with frequency and magnitude of flaring events, particularly if the flare has been smoky. Reviews of social media indicate concern from a limited audience (<50), particularly during flaring events, of the impact of associated air emissions (in particular smoke which is an uncommon occurrence).

There is sufficient available monitoring in place to confirm the effectiveness of existing mitigative measures and monitor emissions for any substantial change. There is sufficient

monitoring available to confirm compliance with all emission limits set in the environmental permit.

Highly detailed modelling confirms that the actual risk of adverse impacts on human health due to activities (including flaring) at FEP are negligible. This includes consideration of an unrealistic extended duration, heavy smoking flaring scenario.

The perceived impact of emissions on air quality vary, however stakeholder engagement has indicated high receptiveness from the community to existing data which has assisted in addressing concerns to a level that required no additional follow-up.

No air quality impacts are considered to require monitoring in addition to that currently undertaken, based on modelling, analysis and risk. In 2019 the Environmental Monitoring Plan concluded that the variations in the perception of air quality impacts from the facility are best addressed through improved communication of the substantial existing datasets which are not currently well understood.

4.2. Noise & Vibration

4.2.1. Receiving Environment & Contributory Sources

The most immediate noise sensitive receivers are personnel working on the plant, while the area immediately surrounding the Ethylene Plant is predominantly farmland. The nearest offsite noise sensitive receiver is Dorloch Cottage located approximately 1500m to the South East. Other offsite noise sensitive receivers include housing adjacent to a Poultry Farm 1600m to the South West; Cowdenbeath 2000m to the North West, Little Raith Farm 2500m to the North East and Lochgelly 3000m to the North North East. Cowdenbeath and Lochgelly (see Appendix 4 Noise Monitoring Plan (Flaring) which contains a map of noise sensitive receptors at which monitoring is undertaken).

Figure 2: Radial 5km delineation from the plant

The noise environment around the plant, excluding any contribution from the flares, is dominated by road traffic noise on the surrounding minor roads and A92 to the north. Other plant activities may be audible at Dorloch Cottage and Little Raith Farm under certain meteorological conditions.

The noise environment at the Poultry Farm is dominated by road traffic noise from the B295 and distant A92. At Cowdenbeath and Lochgelly the noise environment is dominated by road traffic from the A92. (5)

Baseline noise monitoring undertaken in 2016 and again in 2020 during normal operating conditions concluded that;
'The results show that the site noise during normal operations, has no impact during the day or night periods at any of the NSRs identified. This is partially due to high traffic flows on nearby roads.'

This was further reinforced when continuous monitoring was undertaken from August to September 2018 in Lochgelly during normal operating conditions where it was found that; *'The spectral nature of the background noise at the measurement location has been assessed and it was found that road traffic noise is dominant above 400Hz.'*

Other contributing noise sources in the area include;

- Goathill rock quarry in Donibristle undertakes surface extraction activities, including blasting and stone crushing, with associated heavy vehicle haulage
- Surrounding agricultural farming activities and vehicles (tractors, combines)
- Air traffic travelling to/from Edinburgh Airport
- The trainline and associated use through Crossgates/Cowdenbeath
- Windfarms and associated weather (high winds)
- Construction (e.g. new build domestic/commercial facilities)

During flaring activities up to the date of this report, noise from the ground flares has been demonstrated to have minimal effect on offsite receptors, however elevated flare noise has been clearly audible at Dorloch Cottage, Little Raith Farm and the Poultry farm. These three receptors are the closest to the Mossmorran complex and to the south of the A92 motorway. Data shows that the intensity of the elevated flare noise at these three positions is not consistent between or during flaring events due to fluctuations in hydrocarbon and steam flow rate as well as wind speed and direction. Elevated flare noise has been more prominent during the evening and night time periods as the background noise levels due to road traffic noise are reduced. Flaring events in June 2017 and April 2019 caused abnormally high levels of public complaints to SEPA prompting further investigation into noise from flaring. Details and quantification of the noise emitted from flaring activities is summarised in Section 3.2. Available Data for Impact Assessment.

4.2.2. Sources of Emission from FEP

For normal plant operation FEP carry out regular on-site noise monitoring for health and safety purposes and have noise contour maps for the site - this information has been used to identify the main sources of noise across the site. The main sources include major equipment such as the gas turbine, and refrigeration compressors steam turbine drivers as well as steam letdown valves, cooling tower circulation pump and air compressor. Periodic events like furnace decoking are also considered part of normal plant operation.

Infrequent sources of noise include pressure safety valves and flaring. Flaring is demonstrated to have the most significant associated noise and vibration emissions and as such has been the focus of targeted monitoring programmes. Details and quantification of the noise emitted from flaring activities is summarised in Section 3.2. Available Data for Impact Assessment.

4.2.3. Mitigating Measures

Mitigative measures that eliminate, or where that is not practicable, reduce emissions from FEP can be summarised as the control of noise at source, monitoring and protection against over-exposure.

The following hierarchy of techniques are used to implement noise mitigations at FEP:

1. Design and engineering standards for plant
    - Ensures acceptable noise emission criteria for equipment is established
2. Physical controls
    - Includes acoustic enclosures, insulation etc.
3. Preventative maintenance
    - Potential noise sources, such as pumps, compressors, blowers and airfins, are included in the site's preventative maintenance schedule as required. The preventative maintenance programme ensures that all equipment on site is operating under optimum conditions.
4. Work place health monitoring surveys
    - The site has had a regular programme of workplace noise surveys since commissioning. These are used to identify any changes in noise levels and generation. As well and health and safety requirements, findings are used by the plant to ensure there are no cases of 'noise creep' where (possibly due to aging equipment) noise levels increase slowly over time.
5. Noise monitoring at local receptors (see Section 3.2.2. Noise & Vibration).
    - Fit-for-purpose monitoring (as described in Section 3.2.1 Air Quality) enables the effectiveness of mitigative measures to be assessed
6. Recording, investigating and responding to complaints
    - Identifies potential changes in noise levels and generation. Informs monitoring surveys

For normal operations, the effectiveness of these measures is demonstrated through onsite workplace monitoring, noise mapping and measure of potential noise 'creep' with a focus on immediate, onsite sensitive receptors (plant personnel). Four yearly noise monitoring in communities during normal plant operations is also undertaken to confirm the plant continues to have minimal impact at offsite receptors (2008, 2012, 2016, 2020 and ongoing).

4.2.3.1. Specific Noise Mitigations for Flaring

Flaring is recognised to pose a more significant risk of potential noise and vibration impacts to offsite receptors than normal plant operations. The same hierarchy of controls applies to prevent, and where that is not possible, minimise noise impacts associated with flaring. A targeted Flaring BAT Evaluation was undertaken and submitted to SEPA on 30th April 2019 which identified the Best Available Techniques (BAT) to prevent, and where that was not possible, minimise noise, vibration and smoke impacts from flaring. The evaluation identified that the majority of currently defined BAT are applied to flaring at FEP.

- BAT is demonstrable for all areas relating to the elevated flare
- Specialist assessment concluded 'acceptable' noise levels are not clearly defined or quantifiable but an approach is needed to demonstrate future compliance
- Four areas were identified where current techniques did not meet the definition of 'best available';
    - Use of ground flares is limited due to low reliability
    - Ground flare technology is outdated
    - Smokeless capacity of the ground flares is insufficient
    - Available noise control techniques have not been incorporated on the ground flares

One major improvement was proposed to address the four areas where current techniques did not meet the definition of 'best available'

- FEP committed to increasing the capacity of, and accessibility to, best available ground flare technology that minimises amenity impact

Additionally, 12 process improvements, and continued work to define 'acceptable' noise were proposed as demonstration of continuous improvement and commitment towards being a good neighbour. This included replacement of the elevated flare tip and continuation of targeted noise monitoring per agreed action plan with Specialist Consultant.

On 16th August 2019 SEPA responded to the BAT evaluation 'agree[ing] with your principles and approach to achieving BAT'.

SEPA agreed that BAT can be achieved by a combination of:

a) Prevention, and where that is not possible, minimisation of, flaring events (FEP indicated that the plant had, over a 10 year average, 2.5 flaring events per year)
b) Use of ground flares; and
c) Use of elevated flares when required to supplement the ground flare capacity.

Please refer to the 2019 Flaring BAT Evaluation for a detailed description of techniques applied at FEP to prevent and minimise impacts from flaring.

4.2.4. Acceptable Noise & Vibration Emission Levels

Health and safety regulation prescribes acceptable noise emission levels at which it safe to work for prolonged periods. These regulations require that noise exposure is prevented/minimised through demonstrated application of noise controls (see Section **Error! Reference source not found.**) and also identify noise levels at which specific levels of PPE must be worn. The objective of this regulation is to protect the most immediate noise sensitive receivers (operators, plant personnel etc).

An acceptable (or BAT) noise range does not exist for flaring as this is recognised as a safety mechanism, utilised infrequently and only as required to ensure safe operation. BAT for noise emissions when flaring cannot be prevented is application of techniques to minimise noise emissions. The 2019 Flaring BAT Evaluation identifies the applicable techniques and while noise monitoring will be undertaken to confirm their effectiveness, where they are demonstrated to be in place and achieving expected levels of mitigation, the associated noise levels will be considered acceptable.

4.2.5. Actual or Perceived effect on the Environment

The noise environment around the plant, excluding any contribution from the flares, is dominated by road traffic noise on the surrounding minor roads and A92 to the north. Other plant activities are audible at Dorloch Cottage and Little Raith Farm when there is no flaring activity.

During flaring activities, flare noise is clearly audible at Dorloch Cottage, Little Raith Farm and The Poultry farm. These three receptors are the closest to the Mossmorran complex and to the south of the A92 motorway. The intensity of the flare noise at these three positions is not consistent between or during flaring events. This is likely due to fluctuations in hydrocarbon and steam flow rate as well as wind speed and direction. Flare noise is particularly prominent

during the evening and night time periods as the background noise levels due to road traffic noise are reduced.

At receptors north of the A92 (Lochgelly, Cowdenbeath) monitoring data consistently concludes that traffic dominates the noise profile above 400Hz. Specialised acoustic monitoring has confirmed the presence of low frequency noise associated with the flare to be present, however variable/s other than flaring rates are known to affect the low frequency noise levels in these areas. The extent of the contribution of low frequency noise from flaring versus other contributing sources has not been confirmed by monitoring data to date. An assessment of noise levels at Lochgelly & Cowdenbeath during a major flaring event (April 2019) against NANR45 criteria for the assessment of low frequency noise concluded that the predicted internal levels were within criteria with minor (0.1 and 0.9dB) calculated exceedances at 25Hz and 50Hz. The data also showed an exceedance of the extrapolated 200Hz however this is not due to externally measured noise but rather a lack in the measured attenuation of the façade at 200Hz. Overall the measured impacts to date do not indicate major variance against criteria.

The perception of noise during flaring may be inferred from complaints or social media, however this is understandably a subjective interpretation on environmental impact and may not be impartial and reports can be biased (8). This input has been used primarily to provide consideration to monitoring techniques (for example the transition to full frequency analysis to follow-up on references to vibration/low frequency noise). Complaints received by FEP from the community during flaring, summarised below, are low in relation to the total surrounding population (less than 10/155,000 for the majority of flaring events with a maximum of 35/155,000). It is understood that SEPA have also received complaints from the community but an analysis of how many, where from and whether they relate to noise and/or vibration has not been qualified or made available. The complaint data shows two major peaks in complaints (June 2017 and April 2019), which correlate with the two longest duration unplanned flaring events – significantly less (5) complaints were received for a longer duration planned event in September 2016. There is no correlation between complaint data and flow rate to flares or complaint data and recorded noise intensity. It is not possible to determine whether the received noise complaints are exacerbated by only duration, or other factors such as light, media coverage, or opinion towards the plant.

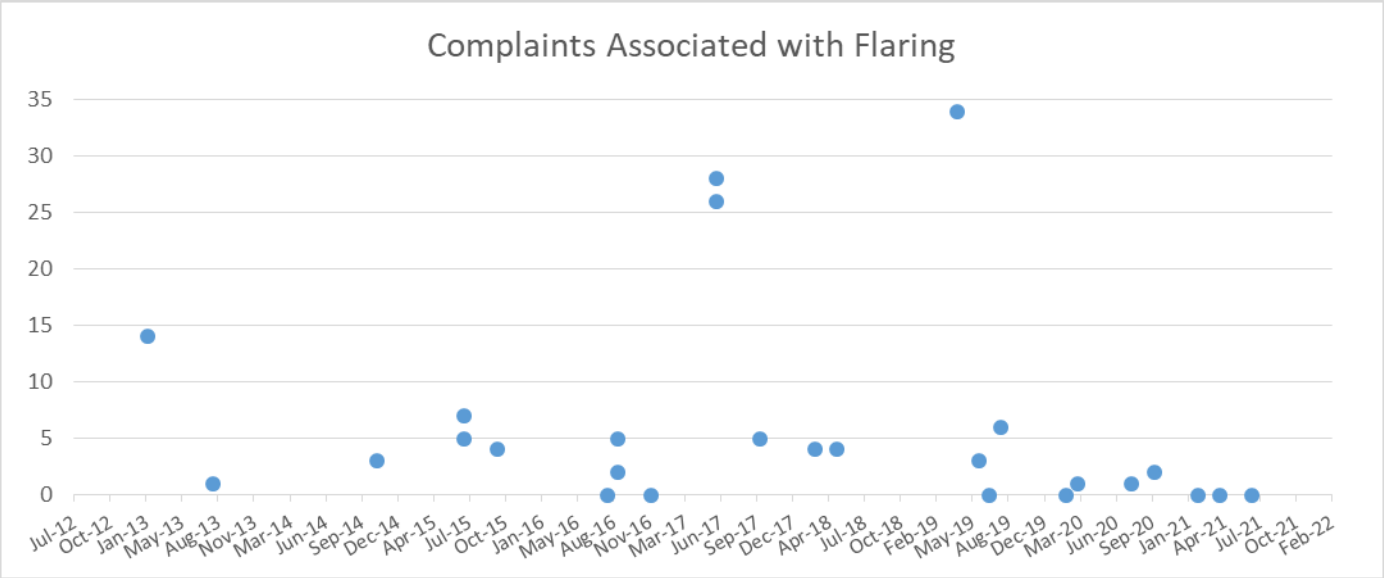

Figure 3: Record of complaints received in relation to flaring events

Transition to an alternate noise monitoring methodology in 2018 has significantly increased the level of understanding of noise emitted during flaring events, allowing for identification of fit-for-purpose mitigative measures focused on the source of specific noise tones (see FEP Flaring BAT Evaluation 2019).

However the relationship between noise and vibration associated with flaring and flow rates, wind direction, wind speed and low frequency noise levels is complex, and replacement of the elevated flare tip is anticipated to eliminate the majority of low frequency noise associated with the flare noise.

Future additional monitoring would allow the correlation at a range of elevated hydrocarbon flow rates to be further analysed with the aim of determining the elevated flow rates which meet the NANR 45 criteria and a reduced noise impact on the residential properties. It will also confirm the effectiveness of newly implemented noise controls (namely to elevated flare tip and new enclosed ground flare).

5. Forward Monitoring Plan

5.1. Air Quality

No air quality impacts are considered to require monitoring in addition to that currently undertaken, based on modelling, analysis and risk. In 2019 the Environmental Monitoring Plan concluded that the variation in the perception of air quality impacts from the facility are best addressed through improved communication of the substantial existing datasets which are not currently well understood.

Since then FEP has significantly upgraded its website, using this as a centralised repository for information. Communications material has been developed and made available via this channel, some key items including;

- Your Questions Answered Q&A pdf (Jan-20)
- Our plant process explained (animation) (Apr-20)
- Wood non-technical summary (air quality) (Jun-20)
- FEP and the Environment (5 videos) (Feb-21)
- New Enclosed Groundflare (animation) (May-21)
- Our Flare Explained (Jul-21)

Further materials, as and when required based on community feedback, requests and plant / monitoring updates will be developed and included on the website.

FEP will also continue to work with local stakeholders to share available information and seek feedback, by regularly attending meetings of the Air Quality Expert Advisory Group (EAG), led by Fife Council. The aims and objectives of this group are;

1. To provide advice on air quality related monitoring arrangements.
2. To review air quality monitoring data obtained at sites in the vicinity of the Mossmorran complex and the Braefoot Bay terminal.
3. To consider, advise and make recommendations on the outcome of monitoring data including to the Mossmorran and Braefoot Bay Community & Safety Committee. The EAG intends by inclusion in its membership of public health representation and where required, independent specialist consultants that timely and informative communications can be provided in respect of any relevant health issues that might arise in the local communities.
4. To submit reports to the Mossmorran and Braefoot Bay Community & Safety Committee, Fife Council and to make presentations as appropriate to representatives of the Community Councils that are local to the Mossmorran plants and the Braefoot Bay terminal. The EAG intends inclusion in its membership of representation from the local Community Councils to assist with these communications related responsibilities.

The group consists of a facilitator from Fife Council, other representatives from Fife Council (including Protective Services and local Councillors), NHS Fife Public Health Department, the Scottish Environment Protection Agency (SEPA), Shell and various Community Councils. The Institute of Occupational Medicine (IOM) have been engaged with the group for many years providing independent technical review of data. Similarly, specialists may be invited to attend on issues related to air quality.

FEP will also continue to engage directly with Community Councils on a periodic basis to provide updates on plant activities and respond to any queries from surrounding communities. This engagement provides a feedback loop on communications to date and can highlight if additional information would benefit from being shared. Previous meeting topics have included:

- Answers to perceived air quality concerns
- Overview of independent air quality assessments
- Community requests for non-technical summary of air monitoring results (since been provided)

5.2. Noise & Vibration

The focus of noise monitoring going forward is to ensure that noise impacts associated with flaring are reduced to as low as practicable through effective management and application of BAT as defined in the 2019 Flaring BAT Evaluation. In order to achieve this the following objectives have been identified;

- Confirm the effectiveness of installed mitigative measures;
    - New elevated flare tip
        - Confirm noise levels and frequencies generated during operation and reduction in noise impact
        - Consider optimized steam to hydrocarbon ratio range for both smoke suppression and noise
    - Enclosed Ground Flare
        - Confirm noise levels and frequencies generated during operation and reduction in impact
        - Consider optimized steam to hydrocarbon ratio range for both smoke suppression and noise
- Define what levels of flaring present a risk of causing offsite impact (this is intended with a view of establishing trigger levels, above which monitoring and assessment may be required)

While subjective sound level monitoring (community feedback/complaints, operator experiences etc) will be used to advise the programme, objective sound level monitoring will be the primary source of data for decision-making and follow-up. This will be undertaken by RMP acoustics utilising the existing permanent noise monitor network setup in 2020. A description of the monitoring locations, summary of technology used and reporting approach is included in Appendix 4 Noise Monitoring Plan (Flaring).

FEP will continue to work closely with acoustic specialists to respond to emerging information and adapt the monitoring program as required to achieve the highlighted objectives.

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Appendices

1. Stakeholder Engagement

FEP engaged many key stakeholders during the development of this monitoring plan in 2019 to discuss air quality, noise and vibration actual and perceived impacts. A summary of this engagement including identification of key stakeholders, method of engagement and any actions/follow-ups or observations are included in the table below.

Stakeholder	Date & Forum	Method of Engagement	Comments
NHS Fife	NHS Fife Chief Executive contacted and declined **08-Aug-19:** NHS Fife Consultant in Public Health Medicine	Onsite visit with Operations Manager, Environmental Engineer and External Affairs Manager. Verbal overview of plant and process. Opportunity for site walk around	Advised no evidence exists to link FEP to any health impact. No further follow-ups or information requested.
Fife Council	**31-May-19:** Cllr (Environment, Protective Services & Community Safety Committee) **12-Jun-19:** *Fife Council:* *Cllr (Lab)* ▪ *Cllr (SNP)* ▪ *Cllr (SNP)* ▪ *Chief Executive* ▪ *Interim CO* ▪ *Cllr (Lab)* **28-Nov-19:** Cllr (Environment, Protective Services & Community Safety Committee)	Face-to-face meeting with External Affairs Manager and Environmental Engineer to discuss community perception of environmental issues. Face-to-face discussion at Fife Council buildings with Plant Manager, Environmental Engineer and External Affairs Manager. Answered queries around perceived air quality and amenity impacts. Advised of upcoming non-technical summary on air quality modelling and conclusion on proposed monitoring. Provided update on noise data to date and proposed ongoing monitoring.	Invited to present Wood PLC Non-Technical Summary (Air Quality) and noise update at an upcoming Fife Council Environment Committee. Agree that community perception and communications are a focus area. No further follow-ups or information requested.
Councillors & MSP's	**27-Jun-19:** *Cllr Allie Bain* *Cllr Altany Craik* *Hill of Beath CC (x2)*	Face-to-face onsite meeting with Plant Manager, Operations (Process) Manager, External Affairs Manager and Community Liaison Officer.	No further follow-ups or information requested.

Stakeholder	Date & Forum	Method of Engagement	Comments
Councillors & MSP's	*Lumphinnans CC (x1)* *Auchtertool CC (x1)* *Cowdenbeath CC (x2)* *Burntisland CC (x2)* *Lochgelly CC (apology)* *Annabelle Ewing (apology)* *Mark Ruskell (apology)* *Alexander Stewart (apology)* *Alex Rowley (apology)* *David Torrance (apology)* *Lesley Laird (apology)* *Cllr Darren Watt (apology)* *Cllr Kathleen Leslie (apology)* *Cllr Ross Vettraino (apology)*	Open discussion on plant process and any community queries or concerns.	No further follow-ups or information requested.
	28-Jun-19: Lesley Laird Meeting (Specific Agenda Item) No attendee list provided	Face-to-face meeting chaired by Lesley Laird and Wilson Sibbett with FEP Plant Manager, Environmental Engineer, External Affairs Manager and Community Liaison Officer. Specific agenda slot for discussion of air modelling non-technical summary attended by representative of Wood PLC. Provided update on findings of noise data to date.	Requested non-technical summary/overview of FEP BAT Evaluation commitments. No further follow-ups or information requested.
MAG	**28-Jun-19:** Lesley Laird Meeting (Agenda slot confirmed) No attendee list provided	Face-to-face meeting chaired by Lesley Laird and Wilson Sibbett with FEP Plant Manager, Environmental Engineer and External Affairs Manager. Specific agenda slot for discussion of air modelling non-technical summary attended by representative of Wood PLC. Provided update on findings of noise data to date.	Queried whether ozone had been considered in the air quality model. Wood PLC answered verbally during meeting and provided additional technical supplement to non-technical summary in response. Advised of noise monitoring assessment undertaken in 2014 in Lochgelly which was

Stakeholder	Date & Forum	Method of Engagement	Comments
	18-Jul-19: Site visit MAG Member (Declined) MAG Member (Declined)		subsequently reviewed during the development of this monitoring plan.
IAQMRG	Meeting requested late June - declined **30-Jul-19:** Scheduled meeting (Specific agenda slot) *Independent Chair, University of St Andrews* *Business Support Assistant, Fife Council* *Manager, Fife Council* *Head of Workplace Exposure, Institute of Occupational Medicine* *Specialist 1, SEPA* *Consultant Public Health, NHS Fife* *Cllr. (SNP), Fife Council* *Burntisland Community Council* *Aberdour Community Council (apology)* *Cowdenbeath Community Council (apology)* *Cllr (SNP), Fife Council (apology)* *Lead Officer Air & Quality Team, Fife Council (apology)* *Cllr (SNP), Fife Council (apology)*	Face-to-face meeting at Dunfermline City Chambers chaired by Professor Wilson Sibbett with FEP Environmental Engineer and External Affairs Manager. Specific agenda slot for discussion of air modelling non-technical summary attended by representative of Wood PLC. Open discussion on air quality.	Requested further information on; • The use of models to assess air quality; their standardisation and appropriate methodology for assessing air quality impacts versus monitoring • The effects of ground flare contribution to air quality (lower lying emission source) • The effects of wind turbines on air quality • Any queries already raised by stakeholders with regards to air quality Queries were answered verbally by representative of Wood PLC and provided as an addendum to the Non-Technical Summary by Wood PLC on 22-Aug-19 for inclusion in the 2018 report.
Safety Liaison	**13-Jun-19:** Quarterly meeting **12-Sep-19:** Next meeting (post submission)	Quarterly meeting with Plant Manager and External Affairs Manager. Wood PLC Non-Technical Summary report (draft) discussed.	No further follow-ups or information requested.
Community members	**4-Jul-19**: Public release of NTS via Twitter for comment Release of NTS to employees for comment (70% local)	Link to the Wood PLC Non-Technical Summary uploaded to Twitter inviting comment and queries. Uploaded to ExxonMobil UK Website with interaction invited via Twitter.	1 comment received. No further follow-ups or information requested. No further follow-ups or information requested.

Stakeholder	Date & Forum	Method of Engagement	Comments
	16-Jul-19: Hill of Beath Community Council Meeting	Link to the Wood PLC Non-Technical Summary emailed to employees and contractors inviting comment and queries. Attended HoB face-to-face meeting with Plant Manager, External Affairs Manager and Community Affairs Officer. Provided Wood PLC Non-Technical Summary and invited follow-up questions.	No further follow-ups or information requested.

2. Summary of Noise Monitoring & Key Findings

Year	Date	Activity	Summary of Monitoring Undertaken and Key Findings	Complaints
Pre 2000	N/A	N/A	Monitoring of community noise was, under the IPC Authorisation (pre-2000), carried out by SEPA quarterly and the results were reported in tabular and graphical form to Fife Council Environmental Health Department as well as ExxonMobil and Shell NGL at Mossmorran. With the introduction of the PPC permit, it was agreed with SEPA that the quarterly monitoring would cease (due to consistent results showing that the site was having no effect on the local community).	N/A
2005-2007	N/A	Best Available Technique Evaluation (PPC Application) Community Monitoring (baseline)	To support FEP's application under the new Pollution Prevention and Control (PPC) Regulations a best available technique 'BAT' evaluation was undertaken and used as the basis for the current site permit. This was submitted to SEPA in Aug-2006. As part of the evaluation a series of ten environmental noise investigations were commissioned by FEP to study acoustic conditions in the vicinity of the site following the guidance set out in *Technical Guidance Note IPPC H3 Horizontal Guidance for Noise Part 2- Noise Assessment and Control* (Environment Agency 2002). The studies concentrated on noise measured at 6 points around the site perimeter and beyond, some of which were directly in line with the nearest noise sensitive areas (i.e. housing to the east of the plant). In addition, periods of specific activity (including a shut-down, and de-coke operation) were assessed to determine if there was any impact on local communities. The conclusion reached by the consultants (Entec) was that: *"there was no obvious environmental impact from the operations controlled by ExxonMobil as far as noise was concerned".* The conclusions were '*supported by the references and guidance within BS 4142'.* The noise from the plant was summarized as minimal and the distances to the receptors were considered substantial, in addition, the data indicated that there were a number of major roads in the area which appeared to have a significant impact on the background noise. A requirement to continue systematic noise and vibration emission assessments and to review the site Noise & Vibration Management Plan on a minimum 4 yearly basis was incorporated into the subsequent permit issued on 29 October 2007 (Conditions 3.1.1-3.1.4).	N/A

Year	Date	Activity	Summary of Monitoring Undertaken and Key Findings	Complaints
2008	Aug	Community Monitoring (Planned flaring)	During planned maintenance, SEPA undertook noise monitoring at locations in Westerton, Camilla and at the foot of the flare stack. The monitoring was not completed to any referenced standard, however it was concluded that flaring activity '*was likely to increase the level of noise at the existing and proposed residential areas'*. A second assessment was scheduled for the end of the maintenance period during the night time period and it would have assessed the impact of flaring against appropriate assessment criteria. However the second assessment was cancelled due to unfavourable weather conditions (high winds and heavy rain).	N/A
2012	19-Aug	Community Monitoring (Planned Flaring)	At the next scheduled maintenance (August 2012, four years later), during plant shutdown and start-up, a series of four noise assessments were undertaken by Environmental Scientifics Group (ESG) on behalf of FEP to determine the impact of flaring noise on communities. 19-Aug-12: Flaring activities were not audible at Mossbank Poultry Farm. Exxon plant noise especially flaring off activities was evident at monitoring location Dorloch Cottage. Noise from the Plant at Watson Street, Cowdenbeath was not audible. Road traffic noise along the A92 contributes significantly to the local ambient noise environment in the general area and is audible at locations in Lochgelly, Cowdenbeath and at the poultry farm. 5-Oct-08: During the monitoring exercise it was not possible to quantify and ascertain meaningful noise receptor measurements from Watson Street, Cowdenbeath and Watters Crescent, Lochgelly, as the dominant noise source in the area of these receptors is road traffic on the A92. 22-Oct-08: Production and Flaring off activities were not audible at Mossbank Poultry Farm and Little Raith Farm. Due to other noise sources it was not possible to gain meaningful results at Dorloch Cottage during day time hours and at Watson Street Cowdenbeath during day and night time hours. Road traffic is a constant and predominate ambient noise source in the area of Watson Street Cowdenbeath and as such masks Exxon's production noise. During night time hours when other ambient noise sources are suppressed four noise measurements were taken at Dorloch Cottage during this monitoring exercise all noise measurements were below 45 dB(A). The noise measurements taken at Watters Crescent Lochgelly remained below 45 dB(A) in the evening, and production and flaring off noise was only audible in-between road traffic noise. 29-Oct-12: Adverse weather conditions made it impossible to conduct a meaningful noise survey	N/A

Year	Date	Activity	Summary of Monitoring Undertaken and Key Findings	Complaints
2012	11-Dec	Community Monitoring (Normal operations)	A baseline noise monitoring assessment was completed by Environmental Scientifics Group on behalf of FEP. The assessment concluded that ambient noise at the Poultry Farm, Lochgelly and Cowdenbeath is likely to be greatly influenced by road traffic noise. This is likely to mask noise emitted by the plant. The amount of masking at Lochgelly and Cowdenbeath is likely to ensure plant noise is inaudible during normal operations. At Mossbank Poultry Farm the plant has been audible during 'lulls' in local traffic movement and different wind directions but was not audible during this monitoring period.	N/A
2014	Aug-Sep	Internal monitoring of residents home	SEPA undertook noise monitoring in Lochgelly inside a resident's home at their request following complaint. No recognised standard was used for this monitoring and the subsequent report stated that *'the unattended measurements taken by the MATRON should be taken with caution as the MATRON measures all noise (including traffic, talking, etc.) and not just that specific to the Mossmorran Complex. Without undertaking attended measurements it is difficult to determine the contribution of the specific noise from The Mossmorran Complex to the overall noise level'.* (3) The measurements taken identified some elevated levels of noise, however no flaring occurred over the monitoring period (15-Aug-14 to 5-Sep-14).	N/A
2016	8-Aug	Community Monitoring (Normal operations)	A baseline noise monitoring assessment was completed by Environmental Scientifics Group on behalf of FEP in August 2016. This assessment was completed to a modified BS4142:2014 standard and was undertaken at the same noise sensitive receptors used for the 2012 assessments as well as several points around the plant boundary. The assessment concluded; *'The results show that the site noise during normal operations, has no impact during the day or night periods at any of the NSRs identified. This is partially due to high traffic flows on nearby roads.'* Environmental Scientifics Group repeated a similar assessment on behalf of Shell FNGL in December 2016 and the results were consistent.	N/A
2017	12-Jun 17-Jun	Community Monitoring (Flaring)	An unplanned flaring event occurred and responsive noise monitoring was initiated to capture data from the event. Environmental Scientifics Group, on behalf of FEP, responded and conducted noise monitoring at 4 of the 5 targeted noise sensitive receptors (Little Raith Farm was not accessible at short notice). The assessment was completed to a modified BS4142:2014 standard and concluded that; *'Allowing for the noise generated by the wind blowing through trees and vegetation, the flaring operation would appear to have minimal impact on the noise levels measured at all of the receptors. At Lochgelly and Cowdenbeath, the flaring was just audible between traffic flows.*	28 + 26

Year	Date	Activity	Summary of Monitoring Undertaken and Key Findings	Complaints
			The flaring was clearly audible at Dorloch Cottage and barely detectable at Mossbank Poultry Farm.' However, during the course of the flaring, and the subsequent process upset which occurred on the 17th June, FEP received an unprecedented number of complaints (28 and 26 respectively) from the community, many of which referenced noise and vibration. Up to this point, complaints typically numbered <5 during flaring episodes and this correlated with the results obtained during assessments which indicated minimal noise impact from flaring.	
2017	30-Oct	Community Monitoring (Flaring)	Noise monitoring was again completed by Environmental Scientifics Group in October 2017 during a 3 day process upset which resulted in flaring. Their assessment concluded *'The results show that, on the day of monitoring, the site noise during flaring operations has minimal impact during the day periods at any of the NSLs identified except for Dorloch Cottage. This can be partially attributed to the high traffic flows on nearby roads.'* FEP received 5 complaints from the community which was more consistent with previous events.	5
2018	23-27 Mar	Community Monitoring (Flaring)	A short process upset resulting in flaring enabled acoustic monitoring to be undertaken over a five day period while flaring occurred and once flaring had ceased. Their assessment was performed at targeted noise sensitive receptors and the associated report concluded; *'A significant low frequency tonal component was identified around the 25Hz 1/3 octave band. This tonal component does not appear to follow typical point source hemispherical attenuation i.e. 6dB per doubling of distance. This may be due to wind direction/speed, however to confirm this further investigation is necessary.* *'..At Positions 4 & 5 [Lochgelly & Cowdenbeath] the BS 4142 assessment is significantly affected by road traffic noise which cannot be excluded from the measurements and we would therefore consider it is not an accurate assessment of the flaring activity impact. The BS 4142 assessment at Positions 4 & 5 is in reality an assessment of the road traffic noise, which dominates the measured LAeq, and is not an assessment of the plant flaring activity, which resides in a different spectral zone and does not significantly affect the broadband LAeq measurements.'*	4
2018	21-22 May	Community Monitoring (Flaring)	A second process upset in May 2018 enabled a NANR45 assessment (see 4.2.4. Acceptable Noise & Vibration Emission Levels for a description of this technique) to be conducted, with the assistance of community members in Lochgelly who allowed their home to be used for the monitoring. The assessment report concluded that;	4

Year	Date	Activity	Summary of Monitoring Undertaken and Key Findings	Complaints
			'Chart 1 indicates that the flaring event in May 2018 did not exceed the NANR45 (12.5Hz-160Hz) criteria indicating that low frequency disturbance may occur. However, at 200Hz the internal noise level would exceed an extended criterial curve. Graph 2 indicates that the NANR45 criteria is exceeded at 160Hz with the windows open, however this may be due to the influence of road traffic noise. Graph 3 confirms that the NANR45 (indicated by the red line) criteria was not exceeded at any point. Graph 4 indicates that the NANR45 extended curve was exceeded until approximately 9pm. The dip in level between 10pm and 8am may be due to reduction in traffic flow on the A92 during the night time period.'	
2018	11-Jul	Community Façade Insulation Test	The May-18 noise report recommended that a façade analysis was conducted to determine to what extent the detected low tonal frequency component penetrated building facades. This was undertaken in July 2018 and the report concluded; *'During the flaring event peaks were identified internally at 20Hz and 200Hz third octave bands. A façade sound insulation deficiency was measured at 200Hz when using the simulated flare source as well as the flaring event itself. No such deficiency was apparent when a pink noise source was used. The deficiency was not due to low frequency ~25Hz flare noise interacting with the house structure giving rise to the 200Hz reading. The apparent insulation dip is most likely to be due to the flare energy in the 160Hz bandwidth contributing to the internal 200Hz reading due to the interaction with the building structure as it passes through.'*	N/A
2018	Jul	Acoustic Assessment	RMP Acoustics were requested by FEP to predict internal noise levels from previous flaring events and to determine if any correlation could be identified that would help identify the source of the low frequency peaks at 20Hz and 200Hz. Their assessment concluded; *'A correlation between elevated hydrocarbon flare rate and the 200Hz third octave band was found during the flaring event on the 25th of March 2018.'* This confirmed the presence of low frequency noise vibration and initiated further investigation into the source of the low frequency noise. While a correlation with elevated flare rate was found at 200Hz, contribution from other sources included steam flow and ground flare rate could not be quantified. In addition, no correlation was found between any aspect of flaring and the 20Hz frequency. Without a better understanding of the source of the low frequency noise engineering solutions could not be targeted to ensure reduction or elimination of the noise. Further data was required, however opportunities to monitor during flaring were limited as no planned flaring events were scheduled in the near future, and unplanned flaring is not predictable.	N/A

Year	Date	Activity	Summary of Monitoring Undertaken and Key Findings	Complaints
			In addition to the façade test, RMP Acoustics were requested by FEP to predict internal noise levels from previous flaring events and to determine if any correlation could be identified that would help identify the source of the low frequency peaks at 20Hz and 200Hz. Their assessment concluded; *'A correlation between elevated hydrocarbon flare rate and the 200Hz third octave band was found during the flaring event on the 25th of March 2018.'*	
2018	13-Aug to 29-Sep	Community Monitoring (Baseline)	From August to September 2018 continuous acoustic monitoring was undertaken in Lochgelly to measure background noise level in order to establish a comprehensive reference database of broadband and spectral background noise levels with the aim of providing a reference for future flare event measurements. The assessment identified; *'The spectral nature of the background noise at the measurement location has been assessed and it was found that road traffic noise is dominant above 400Hz. This also indicates that when an A weighting is applied the low frequency energy in the flare source measurements is not a dominant factor in the A weighted broadband level. This suggests that a spectral method of low frequency assessment would be more appropriate for monitoring and quantifying future flaring events.'*	N/A
2019	21-27 Apr	Community Monitoring (Flaring)	RMP were deployed in response to a process upset and began acoustic monitoring within hours. Monitoring occurred continuously at noise sensitive receptors in Cowdenbeath and Lochgelly, and periodically at other targeted noise receptors for the period of flaring 21st – 27th April 2019. The assessment was performed to BS4142:2014 and/or NANR45 adapted standards. During this event, there was opportunity to assess the priority areas identified from the March analysis including various steam to hydrocarbon ratio's and varying rates to the elevated and ground flares. Spot measurements were taken at the flare source. Analysis of the April results showed a correlation between the measured low frequency noise at a specific steam to hydrocarbon ratio range at the elevated flare.	34
2019	14-Jun	Community Monitoring (Flaring)	RMP were deployed in response to a process upset and began acoustic monitoring within hours. The event flaring only occurred for 6 hours and minimal data was obtained. Noise peaks at 25 and 50 Hz bands (very low frequencies) were identified.	3
2019	4-6 Jul	Community Monitoring (Planned Flaring)	Planned maintenance was undertaken during which noise monitoring against NANR45 criteria was undertaken. An additional continuous monitor was placed close to the flaring sources to confirm contribution of flaring source to noise profile. The planned nature of the flaring activity allowed the ratio of ground to elevated flare hydrocarbon flow rates to be altered to confirm the	0

Year	Date	Activity	Summary of Monitoring Undertaken and Key Findings	Complaints
			elevated flare was the primary source of noise and vibration impacts (suspected based on Apr-19 acoustic analysis). A clear correlation was established between the increase in hydrocarbon flow/steam rates to the elevated flare and the increase in low frequency noise at the source. The key finding from the monitoring was that a reduced flow rate to the elevated flare resulted in reduced noise levels at the surrounding residential properties. Measurements at Lochgelly also showed a change in low frequency noise level not replicated in the flaring noise output, likely due to a change in wind conditions. Continued monitoring during events at the source position along with higher resolution meteorological data was recommended to allow for a better understanding of the relationship between flow rates, wind direction, wind speed and low frequency noise levels.	
2019	13-26 Aug	Community Monitoring (Flaring)	RMP were deployed in response to a process upset where elevated flaring occurred from 12th to the 15th of August and ground flares were active from the 12th to the 2nd of August. The report concluded that: *'An attempted BS 4142:2014 assessment at Lochgelly confirmed previous findings that the assessment methodology was not appropriate for locations with high background levels, dominated by mid frequency traffic noise.'* Furthermore, a clear correlation was established between the increase in hydrocarbon flow rates in the elevated flare and the increase in low frequency noise at the source (flare). No correlation between low frequency noise and ground flare flow rates was identified.	6
2020	10-Jan to 24-Feb	Community Monitoring (Planned flaring)	RMP undertook analysis of planned flaring during plant startup. Elevated flaring was undertaken from 2nd to the 13th of February with other sporadic flaring occurring for short periods of time (minutes). Ground flares were active from the 13th of January to the 15th of February 2020. Consistent with principles outlined in the 2019 Flaring BAT Evaluation, the detailed start-up flaring plan reduced the total hours of higher rate (>40T/H) elevated flaring by 50% compared to last cold start-up (2012) and by over 90% compared to June 2017/April 2019 process upset events. The acoustic assessment stated that: '*It has been established during previous assessments and reinforced during this assessment that low frequency noise is the dominant characteristic of the flaring activity*.' The assessment also confirms that correlations with low frequency noise have only been identified with the elevated flare, not the ground flares. A BS 4142:2014 assessment at Lochgelly and Little Raith Farm confirmed that the standard could not be used to produce an assessment level as the measured ambient level during periods of	0

Year	Date	Activity	Summary of Monitoring Undertaken and Key Findings	Complaints
			flaring was lower than the representative and lowest residual level with no flaring due to the typically high background levels from road traffic and other environmental sources. The only exception to this was Little Raith farm at night using the lowest residual recorded to determine the specific level from the ambient resulting in a BS 4142: 2014 assessment level of 'low impact'. The assessment concluded that '*the inability to undertake a BS 4142:2014 assessment during representative residual periods is a clear indication that the broadband noise from the flaring activity was not having a significant impact on the residential properties*.'	
2020	3-4 Mar	Community Monitoring (Flaring)	This was the first use of the permanent noise monitors deployed within the community. Flaring was initiated at 14:45 on the 3rd of March 2020 and lasted until 13:00 on the 4th of March 2020 and acoustic data, including audio recording, was collected throughout. Consistent with principles outlined in the 2019 Flaring BAT Evaluation, demonstrable reductions were achieved to minimize required flaring achieving 62% reduction in hours of elevated flaring, 52% reduction in average elevated flaring rate and 82% reduction in hours of higher level elevated flaring (>40T/H) compared to similar process upset events in the past. The acoustic assessment concluded that in terms of the low frequency noise source from the flaring activity this was predicted to be below the NANR 45 criteria within the residential properties at Lochgelly during the point of the highest elevated flare noise output (elevated or ground). Indicating that disturbance was not occurring. A BS 4142:2014 assessment at Lochgelly confirmed that the assessment in context would be of a low impact. The assessment also confirmed that due to the similar levels between ambient and residual and the fluctuations BS 4142 is not a reliable assessment method at this location.	1
2020	12-14 Aug	Community Monitoring (Flaring)	RMP analysed data from the permanent noise monitors to assess noise associated with flaring. The elevated flare was active from 03:24 on the 12th until 22:18 on the 13th and the ground flares were active from 15:11 on the 12th until 03:45 on the 14th. Data analysis identified significant variations in relationships between flare rates and noise levels noted during this event indicates that there are other elements outside hydrocarbon and steam flow rates influencing the noise level. The assessment has indicated that in terms of the low frequency noise source from the flaring activity at Lochgelly this was predicted to be below the NANR 45 criteria within the residential properties during the point of the highest elevated flare noise output (elevated or ground). Indicating that disturbance was not occurring. A BS 4142:2014+A1:2019 assessment was not possible at Lochgelly as the residual noise levels	1

Year	Date	Activity	Summary of Monitoring Undertaken and Key Findings	Complaints
			were equal to or higher that the noise from the flaring (Ambient). Therefore the assessment would be for no or low impact.	
2020	4-6 Oct	Community Monitoring (Flaring)	RMP analysed data from the permanent noise monitors to assess noise associated with flaring. Flaring was initiated at 03:31 on the 4th of October 2020 and was active until 11:16 on the 6th of October 2020. The noise from the process upset event contains the characteristic low frequency element identified in previous process upset events. However, it was also identified that there was a significant element at around 100Hz which had not been recorded previously. The assessment has indicated that in terms of the low frequency noise source from the flaring activity at Lochgelly this was predicted to be above the NANR 45 criteria within the residential properties during the point of the highest elevated flare noise output (elevated or ground). This analysis was based on predicted internal levels calculated from external measurements during a point of high elevated flaring activity where wind speeds were low. The source level used was a 5-minute period at 08:55 on the 4th when elevated flaring rates were 90T/H. The external levels have been converted to internal levels assuming a façade sound insulation as measured in Lochgelly in Jul-18. The external levels measured during the period of elevated flare activity selected from the October 2020 event exceed the NANR 45 criteria at the 50, 125 & 160Hz 1/3octave bands (low frequencies). The BS 4142:2014+A1:2019 assessment at the Noise Sensitive Receivers confirmed that the quantitative assessment during the worst case 5-minute snapshots would indicate an 'impact' or 'significant impact' at each NSR although when considered in context of the short period within a total year that the emergency response elevated flaring occurs the adjusted BS4142 assessment would be of a low impact. However, BS 4142 is considered to be useful in quantifying whether existing complaints based on subjectivity have an objective basis for follow-up action. The Flaring BAT Evaluation 14 point action plan was established and underway at this point in time and is considered suitable follow-up action.	2
2021	2-Feb	Community Monitoring (Flaring)	RMP analysed data from the permanent noise monitors to assess noise associated with flaring. The elevated flare was active from 15:56 until 16:36 on the 2nd, averaging 16T/H. Ground flares were active from 15:28 on the 2nd until 02:38 on the 3rd. At the North Access Road it was noted that noise levels increased when steam flow rate was increased. Further analysis was inconclusive due to adverse weather conditions affecting the measurements.	0

Year	Date	Activity	Summary of Monitoring Undertaken and Key Findings	Complaints
			A NANR 45 or BS 4142:2014+A1:2019 assessment was not possible at the NSR's due to adverse weather conditions affecting the measurements	
2021	12-13 Apr	Community Monitoring (Planned flaring)	RMP analysed data from the permanent noise monitors to assess noise associated with flaring. The event was planned flaring to shutdown plant in preparation for maintenance. Elevated flaring was initiated as part of the plant shut down at 09:09 on the 12th and was active intermittently until 01:49 on the 13th. Ground flares were active during the entire period and ran throughout the plant shut down. Actual performance significantly exceeded planned ambitions; Duration of visible, elevated flaring reduced from ~6 days to 4hrs (a 98% reduction on TA12, 66% better than planned); elevated flaring intensity (high rates >30T/H causing noise/vibration) minimised (83% reduction on TA12, 59% better than planned). The finalized noise impact assessment concluded that the NANR45 criteria was not exceeded by low frequency noise generated by the elevated flare at all noise sensitive receivers covered in this report. Some exceedances at frequency bands not typical of the flare profile were noted but were linked to road traffic noise. The BS 4142:2014+A1:2019 assessment at the Noise Sensitive Receivers confirmed that the quantitative assessment would be for and no or low impact at all noise sensitive receivers covered in this report with the exception of the daytime assessments at Dorloch cottage, Mossbank poultry farm and Little Raith Farm. This was modified to a 'low impact' upon further examination of the data and context.	0
2021	1-12 Jul	Community Monitoring (Planned flaring)	RMP analysed data from the permanent noise monitors to assess noise associated with flaring. The event was planned flaring to startup plant following maintenance. Actual performance viewed very positively by regulator and community. Overall elevated flaring duration significant lower than planned; 4.6hrs, 97% below TA12. High rate (>40T/H) elevated flaring almost eliminated (0.2hrs only). Elevated flaring was initiated at 19:16 on the 1st and was active intermittently until 08:06 on the 12th. Ground flares were active during the entire period. The elevated flaring was undertaken using a new elevated flare tip installed during the period of planned maintenance and which has been designed specifically to reduce the noise output of the elevated flare as part of FEP's commitment to reduce noise emissions. The initial data indicates the elevated flare tip generates less noise, however more data is required to confirm this conclusion. Correlations between low frequency noise at the noise sensitive receivers and elevated flow rates have been identified but are lower than previously identified with the old flare tip. The NANR45 criteria was not exceeded at all noise sensitive receivers covered in this report.	0

Year	Date	Activity	Summary of Monitoring Undertaken and Key Findings	Complaints
			The BS 4142:2014+A1:2019 assessment at the Noise Sensitive Receivers confirmed that the quantitative assessment would be for and no or low impact at all noise sensitive receivers covered in this report with the exception of the daytime assessment at Mossbank poultry farm. This was modified to a 'low impact' upon further examination of the data and context.	
2022	Mar	Community Monitoring (Planned flaring)	RMP analysed data from the permanent noise monitors to assess noise associated with flaring. Planned use of the elevated flare was intended to provide further data to confirm effectiveness of the new elevated flare tip to reduce noise, however sustained low levels of elevated flaring (averaging 6T/H) is unlikely to have provided adequate data. Additional work was also undertaken to test for potential 'noise shadow' in the vicinity of the North Access Road. The report is pending finalisation.	0

3. Noise Assessment Criteria

The ratio between the quietest audible sound and the loudest tolerable sound is a million to one in terms of the change in sound pressure. Because of the wide range, a scale based on a logarithmic basis is used in noise level measurement. The scale used is the decibel (dB) scale which extends from 0 to 140 decibels (dB) corresponding to the intensity of the sound pressure level. The ear has the ability to recognise a particular sound depending on the pitch or frequencies found at the source. Microphones cannot differentiate noise in the same way as the ear; and to counter this weakness the noise-measuring instrument applies a correction to correspond more closely to the frequency response of the ear. The correction factor is called "A Weighting" and the resulting measurements are written as dB(A). "A Weighting" refers to the noise level that represents the human ear's response to sound. The dB(A) is internationally accepted and has been found to correspond well with people's subjective reaction to noise.

Typical dB(A) noise levels for familiar noises are given in Table 2.9.1

Approximate Noise Level dB(A)	Example
0	Limit of hearing
30	Rural area at night, no wind or adverse weather conditions
40	Library
50	Quiet office without noisy machinery, such as typewriters
60	Normal conversation
70	In car noise without radio
80	Household vacuum cleaner
100	Pneumatic drill
140	Threshold of pain

Table 1: Extract from PPC Application August 2006 Section 2.9

British Standard 4142:2014

Due to its variable character, industrial noise can be difficult to assess. BS 4142 '*A Method for Rating Industrial Noise Affecting Mixed Residential and Industrial Areas'* promotes a method for assessing whether industrial noise is likely to give rise to complaints from people living nearby. The standard supports current UK planning guidance and Environment Agency requirements on noise impact assessments.

The standard uses comparisons between the measured background levels of a location (measured as the LA90) and the noise levels from the activity (measured as LAeq). BS 4142 suggests that in general a difference of 5dB is likely to be marginal, whilst an increase in 10dB will likely give rise to complaints. Tonal or impulsive characteristics are likely to increase the likelihood of complaints and this is taken into account by the assessor applying 'penalties'. The conclusion reached by the Acoustic Consultant of *"there was no obvious environmental impact from the operations controlled by ExxonMobil as far as noise was concerned"* indicates that the comparison of FEP activities, against background noise, was not significant.

BS4142:2014 *Methods for rating industrial and commercial sound* (BS 4142) is widely accepted in the UK and is based on simple A-weighted sound level measurements. This standard provides a methodology for;

- Assessing noise from a new fan or piece of equipment to be installed
- Assessing the potential impact of a new commercial or industrial enterprise on surroundings
- Assessing the likelihood of complaint from residents arising from a new industrial or commercial development
- Quantifying whether existing complaints based on subjectivity have an objective basis for action

BS 4142 does not allow a nuisance to be determined. It is also not appropriate for use in certain circumstances, for example, to quantify the impact of low frequency noise.

Longer term noise monitoring undertaken in Lochgelly in 2018 by a specialist acoustic consultant during normal operating conditions concluded that;
'The spectral nature of the background noise at the measurement location has been assessed and it was found that road traffic noise is dominant above 400Hz. This also indicates that when an A weighting is applied the low frequency energy in the flare source measurements is not a dominant factor in the A weighted broadband level. This suggests that a spectral method of low frequency assessment would be more appropriate for monitoring and quantifying future flaring events.'

On this basis, BS 4142 is considered to be useful in quantifying whether existing complaints based on subjectivity have an objective basis for follow-up action, however alternate noise criteria should be found for monitoring and quantifying low frequency noise (vibration).

DEFRA NANR45

The NANR45 Criterion and *Procedure for the Assessment of Low Frequency Noise Complaints* (6) was developed by the Acoustics Research Centre, Salford University for DEFRA. It is based on field noise measurements inside peoples' homes who complain of low frequency noise, and laboratory noise experiments that include results from a wider range of participants.

Assessing noise against the NANR45 criteria is invasive to residents. It requires sound recordings and detailed one-third octave band noise measurements be made over a multiple day timespan inside residents' homes.

The Environmental Protection Authority of New South Wales published a paper at the 12th International Commission on Biological Effects of Noise (ICBEN) Congress on Noise as a Public Health Problem entitled, *Assessing low frequency noise from industry – a practical approach* (7), in which they suggest using the NANR45 criterion with a correction factor applied to each one-third octave band to translate the indoor criterion to an outdoor criterion. The correction factor is based on a general noise reduction for a typical residence in NSW, but they also suggest the use of a building specific noise reduction. A specific noise reduction for a residence (typical) in Lochgelly was established by a specialist acoustic consultant on behalf of FEP and this approach has been utilised to determine the extent of low frequency noise (vibration) effects from FEP. FEP appreciates the cooperation of the Lochgelly residents to allow this data to be collected.

4. Noise Monitoring Plan (Flaring)

12th February 2021

R-8130N-ST1-RGM

Kylie Bishop
Fife Ethylene Plant
Cowdenbeath,
Fife, Scotland
KY4 8EP

50 RMP Est. 1969
acoustics energy vibration

Unit 1, 7Hills Business Park
37 Bankhead Crossway South
Edinburgh
EH11 4EP

T: 0345 062 0000
E: rmp@napier.ac.uk
www.rmp.biz

Dear Kylie,

Addendum to Noise Management Plan - SEPA Variation to Permit PPC/A/1013494

Thank you for instructing RMP to prepare an addendum to the Noise Management Plan presenting the Exxon Mobil Noise Monitoring Plan following a process upset event in line with the SEPA Variation to permit relating to the measurement of noise during a process upset event.

Measurement Equipment and Set-up

After undertaking responsive measurements of flaring events and a period of longer-term monitoring at Lochgelly during 2019 a network of permanent noise monitoring stations were installed around the plant.

A network of permanent monitors was identified as adding further benefit to the existing noise assessment approach as it allows for a greater understanding of representative residual and background noise at each measurement position as recommended in BS 4142 2014 + A1 2019 Section 8.1, due to the permanent nature of the noise monitoring. It also provides data immediately in the event of a process upset causing flaring, rather than data availability being subject to call-out response time.

Three monitoring stations were installed at the North Access Road, Lochgelly and Dorloch Cottage in 2020 representing the closest noise sensitive property and the largest grouping of residential properties. Two further monitoring stations have been installed at Little Raith Farm

and Mossbank Poultry Farm at the beginning of 2021 in order to provide monitoring at the closest noise sensitive property in each direction and to allow for assessment under different wind directions.

Figure 1 shows the location of the monitors relative to the flares and Figure 2 a photograph of the Lochgelly measurement position as an example of the equipment set up.

Figure 1: Noise Monitor and Flare Source Locations

A summary of the locations shown in Figure 1 can be found below;

Potential Noise Sources

- **A – Exxon FEP Elevated Flare**
- **B – Shell NGL Ground Flare**

Monitoring Locations

- 1 – **North Access Road** – Adjacent to elevated flare
- 2 – **Lochgelly** – 2650m North of elevated flare, NSR.
- 3 – **Mossbank Poultry Farm** – 1800m South West of elevated flare, NSR
- 4 – **Dorloch Cottage** – 1350m South East of the elevated flare, NSR.
- 5 – **Little Raith Farm** – 2300m North East of elevated flare, NSR.

Figure 2: Example Monitoring Station, Lochgelly

The measurement systems at all monitoring locations log and upload 1 minute 1/3 octave noise data from 12.5 Hz – 20 KHz including percentiles 365 days a year 24 hours a day to a web portal. 100ms data is also recorded and stored locally on the monitors and is downloaded during calibration and maintenance checks. Each system has a meteorological station located adjacent to the microphone which logs all meteorological parameters at one minute intervals which is also uploaded to the web portal.

As the raw noise data includes all environmental sources and is also affected by meteorological conditions it is important that the raw data is fully analysed to enable

conclusions to be drawn. The use of audio recordings to identify noise sources and meteorological affects is important. The system is capable of audio recording which is remotely activated once a flaring event is confirmed by Exxon Mobil to RMP. Snapshots of audio up to 24 hours prior can also be downloaded at particular points of interest.

Measurements are undertaken in accordance with BS 7445:2003 *"Description and measurement of environmental noise — Part 1: Guide to quantities and procedures*" as far as practicable. Acoustical instrumentation used within the monitoring stations conforms to a Class 1 integrating sound level meter specification in accordance with BS EN 61672-1: 2003. Microphones are fitted with a windshields at all times. The monitoring stations are calibrated in line with manufacturer's instructions.

Reporting

Following a major flaring event as defined in PPC/A/1013494, a report prepared in line with the referenced standards will be issued within 6 weeks of the end of the event.

The report will include the following analysis;

- Analysis of the flaring flow rates and noise measurements over the duration of the flaring event at each NSR.
- Analysis of noise impact using the methodology outlined in BS 4142: 2014 +A1 2019 - *'Methods for rating and assessing industrial and commercial sound'* at each NSR.
- Analysis of noise impact using the methodology outlined in NANR 45 *'Proposed criteria for the assessment of low frequency noise disturbance'* at each NSR. This methodology is recommended for the assessment of low frequency noise in BS 4142: 2014 +A1 2019.
- Possible mitigation and suggested best practice to reduce noise impact of future flaring events if relevant.

Should there be any point requiring clarification, please do not hesitate to contact the undersigned.

Yours faithfully,

Scott Tunnah
for
Robin Mackenzie Partnership