Legislation, Guidance and Assessment of Noise and Vibration Effects from Shale Gas Drill Sites

Colin O’Connor
Introduction
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• AECOM
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Introduction

• Focus of presentation
  – Legislative and guidance framework
  – Potential sources of airborne noise and groundborne vibration effects from surface plant only
  – Not looking at seismological events from drilling / deep level fracturing
  – Example methods of mitigation and control
  – Case studies from within UK
  – Conclusion
  – Q&A
Legislative and Guidance Framework
Legislative and Guidance Framework

• Scotland
  – The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (CAR)
  – Pollution Prevention Control (PPC)
  – The Control of Major Accident Hazards Regulations 1999 (COMAH)
  – Environmental Impact Assessment Directive (EIA)
  – Environmental Liability (Scotland) Regulations 2009 (ELR)
  – The Management of Extractive Waste (Scotland) Regulations 2010
  – Waste Management Licensing Regulations
  – NORM Radioactive Substances
  – Scottish Government National Planning Policy

• Guidance
  – Planning Advice Note PAN 50 Annex A: The Control of Noise at Surface Mineral Workings
  – UK Onshore Shale Gas Well Guidelines, UKOOG (2013)

• British Standards
  – BS 5228:2009 ‘Code of practice for noise and vibration control on construction and open sites’
  – BS 4142:1997 ‘Method for rating industrial noise affecting mixed residential and industrial areas’
Legislative and Guidance Framework

• Recent Assessments
  – European Commission Directorate-General Environment ‘Support to the identification of potential risks for the environment and human health arising from hydrocarbons operations involving hydraulic fracturing in Europe’ (2012)
Potential Sources of Noise & Vibration Effects
Potential Sources of Noise & Vibration

For identification of noise & vibration sources, the process of well development can be broken down as follows:

- Stage 1: Well Pad Site Identification and Preparation
- Stage 2: Well Design, Drilling, Casing And Cementing
- Stage 3: Hydraulic Fracturing Stage
- Stage 4: Well Completion (Flowback)
- Stage 5: Well Production
- Stage 6: Plug & Abandon (P&A) and Site Restoration
Potential Sources of Noise & Vibration Effects

• **Stage 1: Well Pad Site Identification and Preparation**

  • Noise & vibration from:
    – Excavation
    – Earth moving
    – Other plant
    – Vehicle transport

• Period of site preparation typically up to 4 weeks.

• Construction noise impacts associated with site preparation would be similar to those associated with any comparable earth works activity of similar scale.

• Scale of Site varies but typical test well pad is approx. 100m x 100m with space for drilling rig equipment and site facilities.
Potential Sources of Noise & Vibration Effects

• **Stage 2: Well Design, Drilling, Casing and Cementing**

• Well drilling is one of the more significant sources of noise, other than hydraulic fracturing.

• Principal noise & vibration emissions from drilling and associated activities.

• Period of drilling up to 4 weeks per well but drilling may be continuous for 24 hours per day depending on ground conditions and other factors.

• If number of wells are developed on single pad, this would extend period that effects take place.

• **Flaring**
  - Noise levels generated will depend on gas volumes and pressures
  - May be used during exploratory/development drilling

Figure 2: Drilling rig (Source: AECOM)
Potential Sources of Noise & Vibration Effects

• **Stage 3: Hydraulic Fracturing (HF)**
  
  • Well site may require up to typically 20 diesel engine pump trucks operating simultaneously to provide water at the required pressure during HF.
  
  • The main operation at the well during HF is the use of Compressors on the trucks to pump the water. These are the main source of noise.
  
  • Noise emissions from Heavy Goods Vehicle (HGV) (water tanker) movements.
  
  • Noise emissions associated with operation of well and associated equipment.
  
  • The operation takes place over a period of several days for each well and would be repeated at a site for multiple wells and pads.

Figure 3: Truck-mounted Hydraulic Fracturing Pump (Source: New York State DEC dSGEIS)
Potential Sources of Noise & Vibration Effects

• **Stage 4: Well Completion (Flowback)**

• Well pad removal

• Installation of plugs/valves and the Christmas tree on the well head to make it ready for production

• Noise and vibration from on-site plant and construction/demolition machinery

Figure 4: Well head Christmas tree (Source: New York State Department of Environmental Conservation)
Potential Sources of Noise & Vibration Effects

- **Stage 5: Well Production**
  - New gas compressor stations and treatment facilities
    - Maybe needed to handle gas extracted from new well infrastructure
    - Operational noise & vibration from stations and facilities
- **Pipeline construction and operation**
  - Noise & vibration from pipeline construction
- **Re-fracturing**
  - May be needed during production phase
  - Similar to Stage 3: Hydraulic Fracturing
Potential Sources of Noise & Vibration Effects

• Stage 6: Plug & Abandon (P&A) and Site Restoration
  • Noise & vibration effects during decommissioning and site clean-up
  • No associated noise & vibration effects following abandonment
Potential Sources of Noise & Vibration Effects

• **All Stages (1 to 6): Vehicular and HGV Movements**

• Noise from HGV movements on local roads that lead to the site

• Vibration levels from HGV movements primarily dependent on existing road conditions.

• The effects on the local community dependent on:
  – Location of sites
  – Frequency, timing and routing of HGV movements
  – Proximity to sensitive receptors
  – Existing levels of noise

Figure 6: HGV movement (Source: AECOM)
Mitigation and Control Measures
Mitigation and Control Measures

• Location
  – Where appropriate, well pads and access roads should be located as far as practicable from receptors.
  – Benefits of a multi-well pad:
    • A platform to extract gas over a wider area than a single vertical well – provides opportunity to locate pad away from receptors
    • Flexibility to site the pad in the best location to mitigate the impacts
    • Reduced number of sites generating noise
    • Greatly reduce the amount of HGV movements
      – Rigs/equipment delivery and removal to single site
      – Possible to reuse water for multiple fracturing jobs

• Scheduling
  – Limiting operations to certain hours (e.g. perform noisier activities, when practicable, during less sensitive periods).
  – Scheduling drilling operations to avoid simultaneous effects of multiple rigs on common receptors.
  – Limiting hydraulic fracturing operations to a single well at a time.
  – Sometimes, a greater noise level may be acceptable if the overall construction time and therefore length of disruption is reduced.
Mitigation and Control Measures

• Plant and Equipment
  – Use of Best Practicable Means (BPM) as per COPA 1974.
  – Use of Best Practice with reference to BS5228.
  – The use of sound barriers, blankets and walls to supplement attenuation from natural features.
  – Encasing compressor stations with specifically-designed acoustic enclosures or barriers.
  – Employing electric pumps.
  – Maximising separation between drilling operation and sensitive locations.

• HGVs
  – Scheduling, timing and frequency of movements.
  – Speed restrictions.
  – Use of alternative routes to and from the site.

Figure 7: Sound Barrier (Source: Penn State Cooperative Extension)
Mitigation and Control Measures

• Flaring
  – Verein Deutscher Ingenieure (VDI) 3732:1999 ‘Characteristic noise emission values of technical sound sources – Flares’ provides a number of design mitigation measures.
  – Flaring in an enclosed system or other methods of oxidising waste gas.
  – Use of gas to generate energy or feed directly into the gas grid.

• Monitoring
  – Specification of maximum noise and vibration levels at sensitive locations.
  – Monitoring of noise and vibration levels during well pad construction, drilling, hydraulic fracturing, and decommissioning.

• Community Relations
  – The establishment and maintenance of good relations with the local residences is important.
  – Advanced notice of works commencing, supported by regular liaison meetings held on site with all relevant parties affected by the works, and appropriate consultants and contractors.
  – Providing advance notification of the drilling schedule to nearby receptors.
UK Case Studies
UK Case Studies

• Anna’s Road Hydrocarbon Exploration Site, Westby, Lancashire
  – Lancashire County Council
  – Planning ref. no. 05/10/0634
  – Originally issued for development in 2010
  – Cuadrilla Resources Limited
  – Noise Impact Assessment report number 2434.01.ifb (August 2010)

• Lower Stumble Hydrocarbon Exploration Site, Balcombe, Haywards Heath, West Sussex
  – West Sussex County Council
  – Planning ref. no. WSCC/027/10/BA
  – Permitted April 2010
  – Cuadrilla Resources Limited
  – Noise Impact assessment report number PJ2689/29140 (October 2009)
UK Case Studies

• Scope of Noise Impact Assessments (both sites)
  
  – Baseline noise survey
    
    • Determine existing noise climate at nearby Noise Sensitive Receptors
  
  – Assessment of construction noise levels
    
    • Site preparation, excavation, ground levelling, gravel compacting
    
    • Assessment following guidance from BS 5228:2009 ‘Code of practice for noise and vibration control on construction and open sites’
  
  – Assessment of noise from exploration well sites
    
    • Drilling rigs
    
UK Case Studies

• MPS2: Noise Limiting Criteria (para. 2.18-2.21)
  – Daytime (0700-1900)
    • Levels should not exceed background (L_{90}) level by more than 10 dB(A), subject to a maximum of 55 dB L_{Aeq,1h} (free field)
    • Increased temporary limit of 70 dB L_{Aeq,1h} (free field) for up to 8 weeks/year
  – Evening (1900-2200)
    • Levels should not exceed background (L_{90}) level by more than 10 dB(A)
  – Night-time (2200-0700)
    • Levels should not exceed 42 dB L_{Aeq,1h} (free field)

• PAN 50 Annex A: Noise Limiting Criteria (para. 30-42)
  – Daytime (0700-1900)
    • Levels should not exceed background (L_{90}) level by more than 10 dB(A), subject to a maximum of 55 dB L_{Aeq,1h} (free field)
    • Exceptionally quiet rural areas: Levels should not exceed 45 dB L_{Aeq,1h} (free field)
  – Night-time (1900-0700)
    • Levels should not exceed 42 dB L_{Aeq,1h} (free field)
UK Case Studies

- MPS2 and PAN 50 Annex A do not contain vibration criteria

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<tr>
<th>Peak Particle Vibration Level</th>
<th>Impact</th>
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<tr>
<td>0.14 mm/s</td>
<td>Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.</td>
</tr>
<tr>
<td>0.3 mm/s</td>
<td>Vibration might be just perceptible in residential environments.</td>
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<tr>
<td>1.0 mm/s</td>
<td>It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.</td>
</tr>
<tr>
<td>10 mm/s</td>
<td>Vibration is likely to be intolerable for any more than a very brief exposure to this level.</td>
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Conclusions
Conclusions

• Noise and vibration impacts depend on location of well pad and techniques used in construction of access roads and well sites.

• Impacts associated with preparation of Shale Gas Drill sites similar to those associated with any comparable earth works activity or industrial facilities of similar scale.

• Existing legislative controls (COPA 1974), relevant guidance and assessment criteria (noise - PAN 50 Annex A, vibration - BS5228:2009 Part 2) are already in place.

• Impacts can be mitigated throughout project life cycle with proper planning prior to site establishment and Best Practice management & monitoring during operations.
Thank You

Questions?

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