Soils Limited Guide to Soil Gas Management:

Soil gases posing risks to health or safety can include explosive gases (such as methane or natural gas), asphyxiant gases (such as carbon dioxide) or a variety of other toxic or odorous gases and vapours. Sources can include natural processes (e.g. anaerobic sediments and weathering of chalk), man-made processes (e.g. landfill gas, historical waste and industrial activities) or result from direct contamination (e.g. decomposition of organic industrial contaminants).

Consequences of a lack of recognition or management of this issue can be severe and their investigation is a requirement under planning. However guidance on the assessment and management of such gases only became available in the 1980s, and formal guidance only really became available in the 1990s.

Several guides are now available to supplement the original CIRIA guidance including British Standard BS 8485 “Code of practice for the characterisation and remediation from ground gas in affected developments”, BS8576 “Guidance on Investigations For Ground Gas, Permanent Gases And Volatile Organic Compounds (VOCs)” and the National House Building Council’s “Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present”, though the latter is more specific to UK house-building. CLaire (Contaminated Land; applications in real environments) have also produced a document detailing a methodology for determination of risk based on the potential carbon available in soils as a screening tool.

All of these documents take a broadly similar scientific based approach based on an understanding of the potential variability of the underlying source materials and gas regime with a consideration of the sources, pathways and receptors inherent in the conceptual site model, in line with current UK contaminated land risk assessment procedures and protocols.

Most of these documents describe the current state of the art in ground gas detection and assessment, often with specific requirements in relation to calibration and QA/QC requirements to ensure scientific accuracy and validity of the results. It is critical that ground gases are both correctly identified and quantified and in particular that 'worst case' conditions are correctly determined, since this data and consideration is the basis both of the risk assessment process and of the choice of the appropriate controls or remediation measures to emplace.

A detailed quantitative risk assessment must be carried out in light of the current understanding of the gas regime and proportionate to the risks as defined by the conceptual site model and modified by any practical site measurements. Meteorological conditions, tidal effects, geology, vegetation and of course the precise form of development planned must all be taken into account as part of this process. Here the documents can differ somewhat. BS8485 for example aims to apply to all types of development, using a careful mathematically calculated approach. The NHBC document by contrast has already assumed residential development and some of the maths involved so is able to present a more simplified 'traffic light' approach.

The result in both cases are bands of risk ranging from no to high risk, each band being given a recommended level of the gas protection required, as below:

- Low risk = characteristic situation 1 = NHBC Green (no control required)
- Medium risk = CS 2 and 3 = NHBC Amber 1 and 2 (control levels 1-4)
- High risk = CS 4, 5 and 6 = NHBC Red 6 (control levels 3-7)

Finally the recommended management controls are described and assigned a suitable and appropriate control level, the sum of which levels should be sufficient to mitigate the identified risk level. For example, a basic sub-floor ventilation system or a gas membrane might each provide level 1 control alone (and hence provide level 2

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protection when used together), whereas a ventilated basement built to suitable Building Regulations is deemed to offer control to level 4.

Each of the above steps requires specialists with appropriate qualifications, experience and competence to interpret and process in accordance with the relevant guidance and standards. Gas control is usually the responsibility of the local authority, for both the contaminated land officers and building control and these are now fully aware of the dangers possible when gas is not properly assessed and mitigated.

As an example of the changes in procedures over the years, the old-fashioned spike surveys are no longer considered adequate due to the way they are emplaced and the effect this has on the permeability of the surrounding ground (especially if clayey and/or wet), and site specific gas monitoring wells are now usually required so that gas composition and flow-rate can be assessed on multiple occasions. The amount of occasions of monitoring required depends ultimately on the risk identified in the conceptual site model linkage (source, pathway, receptor) and must be related to it, with the figures in the guidance being indicative of how relatively important it is to achieve or deduce a worst case gas rate.

Thus, landfills as a source are considered higher risk than natural ground and housing as a receptor is more at risk than industrial buildings. All pathway considerations being equal it is therefore it is more important to know what that worst case could be if building a house on a landfill than an industrial one on natural ground, where risk is naturally less. These considerations are linked and cross-referenced in the guidance to determine the exact number of recommended monitoring visits. Alternatively, continuous monitoring can be undertaken in critical areas to achieve the same end usually over less time.

The collected data then needs to be expertly assessed and interpreted and decisions made as to if the monitoring that has been undertaken captured or indicated any

trends in the gas regime to determine or indicate a worst-case event (usually defined as a falling low pressure <1000mb) to be used in the assessment. As noted, the subsequent risk assessment also requires an appreciation of the significance of small details of site geology, pathways and especially the proposed building design and occupancy. Also required, but often not expressed reports should be an objective professional evaluation of the reliability of the data (i.e. were all locations monitored every visit) and any obvious data gaps or anomalies (i.e. were all readings taken in summer where water levels are low and pressure > 1010mb). It should also highlight any remaining unknowns (i.e. locations where it was not possible to emplace monitoring) and suggest how to overcome them (i.e. emplacement of additional locations, extend monitoring period, installation of continuous monitoring meters) as appropriate to the perceived risks of any remaining uncertainties.

It should be noted that this process is not exhaustive, should be site specific, is always iterative and is also frequently subject to regulatory oversight. The recommended solution(s), once agreed and installed, can rarely be changed (without significant expense and disruption) or improved on, so are better off being right first time.