Committee: Strategic Development	Date: 9 October 2008	Classification: Unrestricted	Agenda Item No: 8.1
Report of: Corporate Director Development & Renewal **Case Officer:** Michael Kiely		**Title:** Special Planning Considerations **Ref No:** PA/05/00421 **Ward(s):** Bethnal Green North	

1. DEVELOPMENT DETAILS

Location:	33-37 The Oval London E2 9DT
Existing Use:	Vacant land/construction site – former industrial use
Development:	Demolition of existing building and redevelopment to provide a five storey building comprising 3 Use Class B1 (business) units on the ground floor with 14 flats above (6 one bedroom, 6 two bedroom and 2 three bedroom flats).
Drawing Nos:	001A, 002B, 003B, 004B, 005, SK006 & 007 plus design & access statement and sunlight & daylight report
Applicant:	Neptune Group
Owner:	Warren Tyler
Historic Building:	No
Conservation Area:	No

2. RECOMMENDATION

2.1 The recommendation is that the Committee must decide with respect to planning permission number PA/05/00421:

EITHER

2.1.1 To revoke the planning permission pursuant to its powers under section 97 of the Town and Country Planning Act 1990 (as amended) on the grounds that:

The development would be in close proximity to a major hazard (the Bethnal Green Gas Holder Station) and the nature and extent of the uses proposed would represent an unacceptable level of risk for future residents and is contrary to the advice of the HSE and to Saved Unitary Development Plan policy DEV 54.

OR

2.1.2 Not to revoke the planning permission on the grounds that the Committee consider the benefits of the development, which meet Government targets for housing and employment floorspace, outweigh the risks, as set out in part 3 of the 8 November 2007 report (appendix 1).

LOCAL GOVERNMENT ACT 2000 (Section 97)
LIST OF BACKGROUND PAPERS USED IN THE DRAFTING OF THIS REPORT

Brief Description of background papers:	Tick if copy supplied for register	Name and telephone no. of holder:
Application, plans, adopted UDP. draft LDF and London Plan	✓	Michael Kiely 020 7364 5257

3. BACKGROUND

3.1 At its meeting on 8 November 2007, this committee considered the report attached at appendix 1 (with original appendices 1a to 1e and the update report at appendix 2). This report informed the committee of a planning decision at 33-37 The Oval London E2 for the development set out above and the fact that the HSE had not been consulted as part of the decision making process. The HSE are a statutory consultee under the General Development Procedure Order and they object strongly to the development because of its proximity to the gasholder installation to the west of the site. This means that the planning permission is unsafe and vulnerable to challenge.

3.2 The report set out the risks associated with the development at this location. After considering an independent assessment of the risks (the Atkins Report at appendix 1c together with HSE's comments, appendix 1d and Atkins' response, appendix 1e) and taking full account of the objections from the HSE, the report concludes that the nature and level of risk do not over-ride the planning benefits of the development to justify serving an order under either S97 or S102 of the Town and Country Planning Act to set aside the planning permission.

3.3 The committee, after considering the report and the recommendation, indicated that it was minded to revoke the planning permission. Further consideration of the matter was deferred to enable officers to prepare a report outlining the options available to the Council and the legal implications of those options.

3.4 Since the Committee last considered this matter the developer, after negotiation by officers, has suspended the development because of the uncertainty over the position of the HSE. This has effectively blighted the site and the purchasers who signed contracts 'off plan' now need clarity over the planning authority's position.

4. OPTIONS AVAILABLE TO THE COUNCIL

4.1 The options available to the Council as local planning authority (LPA) are limited to either revoking the planning permission or not. There are however a number of possible outcomes to each of those decisions.

A decision to revoke

4.2 If the Council decides to revoke planning permission they have to serve a notice. There is a right of appeal against this notice by all people with an interest in the land. This would be the owner/developer (Warren Tyler/Neptune Group) but also those prospective purchasers of the flats who have paid a deposit and entered into a contract with the owner. If there are objections then a public inquiry will be called so that the Secretary of State will decide the matter. All interested parties would be able to present their views at the inquiry.

A decision to not revoke

4.3 If the Council decides not to revoke planning permission, that is unlikely to be the end of the matter. As out lined in paras 7.2 to 7.3 of the report at appendix 1, the HSE's position is strongly held and it is likely to press the Secretary of State to use her powers to require the Council to revoke the planning permission. This would be an unusual step and we have no evidence that the Secretary of State would do this as it is a power that is rarely exercised. However, given that she called in (PA/06/1393) then the prospect must be a high one.

4.4 In the event of a call-in there would be a public Inquiry and again all interested parties would be able to present their views.

5. LEGAL COMMENTS

5.1 A decision to revoke a planning permission requires the LPA to follow different notification procedures depending on whether or not the revocation is opposed. When it is opposed, the LPA must serve notice on owners, occupiers and persons affected by the revocation and following a public hearing, seek confirmation of the revocation order from the Secretary of State. However, if the order is unopposed, then the LPA must advertise the order which can be confirmed after 28 days provided no further objections are received. The developer is entitled to compensation in accordance with section 107 of the Act.

5.2 The effect of a confirmed revocation order will revoke the planning permission and no further work can occur as the development will not be permitted. Any development without planning permission is unlawful and can be dealt with by the LPA's enforcement powers.

5.3 A decision not to revoke can be superseded by the Secretary of State as she had default powers under s100 and 102 of the Town and Country Planning Act 1990 to take action to revoke a planning permission or remove buildings or works following consultation with the LPA. Such a decision is likely to lead to further uncertainly for a long period of time, as even if the development is completed, the Secretary of State has overriding powers to order the building is removed if deemed necessary.

6. APPENDICES

6.1 Previous report to 8 November 2007 Strategic Development Committee comprising:

- Appendix 1 Main Report with the following appendices:
  - Appendix 1a 16 November 2006 Report to Strategic Development Committee on planning application PA/06/01393
  - Appendix 1b Map of site and HSE consultation zones
  - Appendix 1c Atkins Oil & Gas Assessment Report
  - Appendix 1d Comments on Atkins Oil & Gas Assessment by HSE
  - Appendix 1e Response by Atkins Oil & Gas to HSE comments.
- Appendix 2 Update Report

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Appendix 1

Committee: Strategic Development	Date: 8 November 2007	Classification: Unrestricted	Agenda Item No: 8.1
Report of: Corporate Director Development & Renewal **Case Officer:** Michael Kiely		**Title:** Special Planning Considerations **Ref No:** PA/05/00421 **Ward(s):** Bethnal Green North	

1. DEVELOPMENT DETAILS

Location:	33-37 The Oval London E2 9DT
Existing Use:	Vacant land/construction site – former industrial use
Development:	Demolition of existing building and redevelopment to provide a five storey building comprising 3 Use Class B1 (business) units on the ground floor with 14 flats above (6 one bedroom, 6 two bedroom and 2 three bedroom flats).
Drawing Nos:	001A, 002B, 003B, 004B, 005, SK006 & 007 plus design & access statement and sunlight & daylight report
Applicant:	Neptune Group
Owner:	Warren Tyler
Historic Building:	No
Conservation Area:	No

2. SUMMARY OF MATERIAL PLANNING CONSIDERATIONS

2.1 This report considers the risks associated with the development at this location that was given planning permission without proper consultation with HSE, a statutory consultee under the GDPO. After considering an independent assessment of the risks (the Atkins Report at appendix 1c together with HSE's comments, appendix 1d and Atkins' responses, appendix 1e), the report concludes that the nature and level of risk does not over-ride the planning benefits of the development to justify serving an order under either S97 or S102 of the Town and Country Planning Act. This decision is not seen as setting a precedent for future decisions due to the very special circumstances that surround it. It is considered desirable to secure measures that would mitigate some of the risks through negotiation with the developer. These can be secured using powers under S106 of the Act to enter into planning obligations.

2.2 The conclusions arrived at in the Atkins Report (and in this report) are not seen in any way as setting a precedent for future planning application decisions in this type of locality as they relate to a discrete set of circumstances limited to a particular site and do not address how the Council will assess future applications.

3. RECOMMENDATION

3.1 That the Committee resolve to not use the powers in S97 or S102 of the Town and Country Planning Act 1990 (as amended).

LOCAL GOVERNMENT ACT 2000 (Section 97)
LIST OF BACKGROUND PAPERS USED IN THE DRAFTING OF THIS REPORT

Brief Description of background papers:	Tick if copy supplied for register	Name and telephone no. of holder:
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3.2 That the Corporate Director Development & Renewal is delegated power to negotiate a legal agreement with the developer to secure the obligations described in paragraph 8.30 of the report.

4. BACKGROUND

Site and Surroundings

4.1 The site lies on the western side of The Oval, has a frontage of 22m, a depth of 25.5m and a site area of 0.056 hectares. It used to contain a single storey building that occupied most of the site and was used as a timber furniture manufacturer's. That building has been demolished and the development permitted under PA/05/00421 is currently under construction. The ground floor of the proposed development comprises 3 B1 (office/industrial) units. The remaining 4 floors of this 5-storey development provide 14 residential units: 6 x 1 bedroom, 6 x 2 bedroom & 2 x 3 bedroom. The immediate area is generally commercial in nature however the wider area has a significant residential population.

4.2 To the north of the site is a 2-storey building used as a printer's. To the south of the site is a 2-storey building used as a household furniture manufacturer's.

4.3 To the west of the site are the Bethnal Green gasholders operated by National Grid. The site occupies an area of around 150m x 150m (2.25 hectares). It includes 4 gas holders of the cup and grip water seal type, each of which consists of a series of co-axial cylinders which are able to rise and fall depending on the quantity of gas to be stored. Each cylinder is sealed against the next one by a series of water-filled troughs which are replenished as each seal drops back into the bottom cylinder, which acts as a reservoir. The details of the gas holders are as follows:

- No 1 4 lifts 26 t capacity
- No 2 2 lifts 19 t capacity
- No 4 3 lifts 78 t capacity
- No 5 3 lifts 92 t capacity

4.4 The typical operational profile for a gas holder is that they are only used in the winter months (for 6-7 months) and, when used, are filled from approximately 22.00 hours to 06.00 hours and emptied from 06.00 hours to 22.00 hours.

4.5 In addition to the gas holders, there is pipework connecting this storage to the main gas network. Most of this pipework is 90cm diameter and is buried, although there are some smaller sections of 60cm and 75cm diameter above ground. There is around 600m of pipework on the site above and below ground, together with a number of valves. These valves are mostly situated to the west of the site. Indeed, the closest approach of any overground pipework to the site boundary adjacent to the development at 33-37 The Oval is around 70m. The gas holders and much of the pipework are at low pressure, although there is some of the distribution pipework which is up to around 7 bar.

Planning History

4.6 Address: 33-37 The Oval, London, E2 9DT

Application Number:	PA/06/01393
Proposal:	Demolition of existing building. Redevelopment to provide a five storey building for use as 2 Class B1 (business) units on the ground floor with 14 flats above (6 one bedroom, 6 two bedroom and 2 three bedroom flats).
Decision:	Withdrawn by applicant on 13th April 2007

Application Number: PA/06/01329
Proposal: Submission of details pursuant to condition 2a (facing materials), 2b (external lighting), 2c (landscaping) and 6 (contamination) of planning permission dated 15th December 2005, reference PA/05/421
Decision: Permitted on 26th September 2006

Application Number: PA/05/00421
Proposal: Demolition of existing building and redevelopment to provide a five storey building comprising 3 Use Class B1 (business) units on the ground floor with 14 flats above (6 one bedroom, 6 two bedroom and 2 three bedroom flats)
Decision Permitted on 15th December 2005

4.7 Address: Bethnal Green Holder Station, Marian Place, London, E2

Application Number: PA/02/00453
Proposal: Continuation of Hazardous Substances Consent following a change in control of part of the land.
Decision: Permitted on 26th June 2002

Application Number: PA/00/01825
Proposal: Continuation of Hazardous Substances Consent (relating to change in control of part of site)
Decision: Permitted on 22nd January 2001

Application Number: PA/00/01466
Proposal: Installation of a 15M high extendable and shareable telecommunications tower associated cabins in 2.5m high fenced compound
Decision: Permitted Development

Recent events

4.8 Planning permission PA/05/00421 was processed and determined (permission was granted on 15 December 2005) without consultation with the HSE, as required by the General Development Procedure Order. This came to HSE and NGG's attention past the time when they could challenge the decision in the courts. A decision at a site to the north (5-10 Corbridge Crescent), where a similar error occurred, was challenged by National Grid on 12 June 2006 and the decision was eventually set aside by the High Court 0n 6 June 2007. The council did not contest that challenge.

4.9 In response to a design rethink for 33-37 The Oval, a revised application (PA/06/01393) was submitted on 1 August 2006. The opportunity was taken by officers to negotiate an amendment to this new scheme to address a requirement from National Grid for there to be no development within 18m of the holders. This distance is recommended by the Institute of Gas Engineers Code of Practice SR4 Edition 2 and represents the distance needed for gas leaking from an installation to rise and dilute with air so that it is no longer capable of being ignited. That amendment was secured. On consultation, National Grid no longer objected to the development, however the HSE maintained their objection. (It should be noted that HSE's view is that the distance of 18 metres is now out of date and that flammable clouds can exist in certain circumstances for up to 80 metres from the side of a gasholder, however 18 metre remains the industry's position). The Council's Strategic Development Committee considered the application on 16 November 2006 (committee report attached as appendix 1a) and resolved to grant planning permission.

4.10 As required by Circular 04/2000 the HSE were notified of our decision before it was issued. HSE considered this case to be exceptional enough, particularly because of the significant level of risk, to request the Secretary of State to call-in the application for her own determination. She agreed to that request. This would have resulted in a public inquiry, however the applicant withdrew the application, and consequently the application was incapable of being called-in.

4.11 By now work had commenced on site to construct the amended scheme (PA/06/01393) however in view of the call-in and withdrawal of the application, the frame that was formed has been altered to enable the original scheme (approved under PA/05/00421) to be constructed. Work is currently underway on site to implement PA/05/00421 with completion expected around spring 2008.

4.12 In view of the concerns of the HSE about safety in relation to this development, an independent assessment of the risks associated with the nearby gas holders was commissioned by the Council. This was carried out by Atkins Oil & Gas and is attached at appendix 1c. This report is as a result of consideration of the Atkins report.

5. LEGAL POSITION

5.1 Despite the admitted failure of the consultation process, PA/05/00421 remains valid and capable of implementation unless and until quashed by the courts. Any attempt to challenge the lawfulness of the permission by judicial review is now out of time. While the court does have power to extend time, it very rarely exercises this power and would be reluctant to do so in the absence of a compelling justification.

5.2 Accordingly, the developer has a valid planning permission to develop the site and that is his present intention. Any development which accords with that permission will be lawful.

5.3 The Planning Act does give local planning authorities powers that may be used in these circumstances. These powers are also available to the Secretary of State.

Revocation or modification powers

5.4 Section 97 of the Act gives a local planning authority the power to make either a revocation or a modification order to amend a planning permission PA/05/00421:

(1) If it appears to the local planning authority that it is expedient to revoke or modify any permission to develop land granted on an application made under this Part, the authority may by order revoke or modify the permission to such extent as they consider expedient.
(2) In exercising their functions under subsection (1) the authority shall have regard to the development plan and to any other material considerations.
(3) The power conferred by this section may be exercised—
  (a) where the permission relates to the carrying out of building or other operations, at any time before those operations have been completed;
  (b) where the permission relates to a change of the use of any land, at any time before the change has taken place.
(4) The revocation or modification of permission for the carrying out of building or other operations shall not affect so much of those operations as has been previously carried out.

5.5 Because the development has already commenced, section 97(4) would exclude the making of a revocation order against any works already carried out. A modification order could still be made against permitted operations that have yet to be carried out.

5.6 The power is discretionary. The council are under no duty to make a modification order. In deciding to make an order regard must be had to the development plan and to any other material considerations. The order would effect a modification at the time it was made subject to its being confirmed by the Secretary of State. The developer could, however, oppose the order under section 98 of the Act and be afforded an opportunity to be heard by the Secretary of State.

5.7 Were a modification order to come into effect compensation would be payable by the council to the developer under section 107 of the Act. The compensation would cover any expenses incurred in carrying out the work which is rendered abortive (including the preparatory work such as plans) and any other loss or damage directly attributable to the modification order.

Discontinuance powers

5.8 Section 102 of the Act gives a local planning authority the power to make an order requiring the discontinuance of a use or the alteration or removal of buildings or works that are completed:

1) If, having regard to the development plan and to any other material considerations, it appears to a local planning authority that it is expedient in the interests of the proper planning of their area (including the interests of amenity)—

(a) that any use of land should be discontinued or that any conditions should be imposed on the continuance of a use of land; or

(b) that any buildings or works should be altered or removed,

they may by order—

(i) require the discontinuance of that use, or

(ii) impose such conditions as may be specified in the order on the continuance of it, or

(iii) require such steps as may be so specified to be taken for the alteration or removal of the buildings or works,

as the case may be.

(2) An order under this section may grant planning permission for any development of the land to which the order relates, subject to such conditions as may be specified in the order.

(3) Section 97 shall apply in relation to any planning permission granted by an order under this section as it applies in relation to planning permission granted by the local planning authority on an application made under this Part.

(4) The power conferred by subsection (2) includes power, by an order under this section, to grant planning permission, subject to such conditions as may be specified in the order—

(a) for the retention, on the land to which the order relates, of buildings or works constructed or carried out before the date on which the order was submitted to the Secretary of State under section 103; or

(b) for the continuance of a use of that land instituted before that date.

(5) Any planning permission granted in accordance with subsection (4) may be granted—

(a) so as to take effect from the date on which the buildings or works were constructed or carried out, or the use was instituted, or

(b) in the case of buildings or works constructed or a use instituted in accordance with planning permission granted for a limited period, so as to take effect from the end of that period.

(6) Where the requirements of an order under this section will involve the displacement of persons residing in any premises, it shall be the duty of the local planning authority, in so far as there is no other residential accommodation suitable to the reasonable requirements of those persons available on reasonable terms, to secure the provision of such accommodation in advance of the displacement.

(7) Subject to section 103(8), in the case of planning permission granted by an order under this section, the authority referred to in sections 91(1)(b) and 92(4) is the local planning authority making the order.

5.9 Again the power is discretionary and the council are under no duty to make such an order. In deciding to make an order regard must be had to the development plan and to any other material considerations. An order can be framed to have the same effect as a modification order.

5.10 Any order has to be confirmed by the Secretary of State and the owner of the land affected, the occupier of that land, and any other person who will be affected by the order (eg a mortgagee) can challenge it at a public inquiry.

5.11 Were a discontinuance order to come into effect compensation would be payable by the council under section 115 of the Act. The compensation would cover depreciation of the value of the land and disturbance in enjoyment of the land.

5.12 It is therefore the case that the power exists under the Planning Act to remove the development in its entirety if the planning considerations justified such a decision. Compensation would be payable whichever power (section 97 or 102) was considered appropriate.

6. POLICY FRAMEWORK

6.1 For details of the status of relevant policies see the front sheet for "Planning Applications for Determination" agenda items. The following policies are relevant to the development:

Unitary Development Plan 1998 (as saved September 2007)

Proposals:	SVCA	Strategic View Consultation Area
Policies:	DEV1 & 2	General design and environmental requirements
	DEV3	Mixed use development
	DEV4	Planning obligations
	DEV50	Development and Noise
	DEV51	Contaminated Land
	DEV53	Hazardous Development - conditions
	DEV54	Hazardous Development - consultations
	HSG7	Dwelling Mix and Type
	HSG9	Density
	HSG13	Internal Standards for Residential Developments
	HSG15	Development Affecting Residential Amenity
	HSG16	Amenity Space
	T16	Traffic Priorities for New Development
	T21	Pedestrian Needs in New Development

Interim Planning Guidance for the purposes of Development Control

Proposals:	CP50	Strategic View Consultation Area
	C6	Development Site (refer AAP)
Core Strategies:	CP1	Creating Sustainable Communities
	CP4	Good Design
	CP11	Sites in Employment Use
	CP19	New Housing Provision
	CP21	Dwelling Mix and Type
	CP22	Affordable Housing
	CP25	Housing Amenity Space
	CP41	Integrating Development with Transport
Policies:	DEV1	Amenity
	DEV2	Character and Design
	DEV3	Accessibility and Inclusive Design
	DEV4	Safety and Security

DEV10	Disturbance from Noise Pollution
DEV15	Waste and Recyclables Storage
DEV16	Walking and Cycling Facilities
DEV22	Contaminated Land
DEV23	Hazardous Development & Storage of Hazardous Substances
EE2	Redevelopment/ Change of Use of Employment Sites
HSG1	Determining Residential Density
HSG2	Housing Mix
HSG3	Affordable Housing Provisions in Individual Private Residential and Mixed-Use Schemes
HSG7	Housing Amenity Space

Supplementary Planning Guidance/Documents

Residential Space Standards

Spatial Development Strategy for Greater London (London Plan)

3A.2	Borough Housing Targets
3A.4	Housing Choice
3A.6-8	Affordable Housing
3B.4	Mixed Use Development
3C.1	Integrating Transport and Development
3C.21	Improving Conditions for Cycling
4A.17	Dealing with Hazardous Substances
4B.3	Maximising the Potential of Sites

Government Planning Policy Guidance/Statements

PPS3	Housing
PPG24	Planning and Noise

Community Plan The following Community Plan objectives relate to the application**:**

A better place for living safely
A better place for living well
A better place for creating and sharing prosperity

7. CONSULTATIONS

7.1 The HSE, National Grid, Government Office for London and the developer have been consulted on an earlier draft of this report. Their views are set out below.

HSE

7.2 HSE's role in the land use planning system is to provide local authorities with advice on the nature and severity of the risks presented by major hazards (such as the Bethnal Green Gas Holder Station) to people in the surrounding area so that those risks can be given due weight, when balanced against other relevant planning considerations, in making planning decisions. (DETR circular 04/2000)

- HSE has serious concerns regarding the significant level of risk to occupants of the 5 storey development at 33-37 The Oval, E2.
- If HSE had been consulted on this development prior to the granting of planning permission, HSE would have strongly advised against the granting of planning permission and if the council were minded to grant planning permission against

HSE's advice would have asked the Secretary of State to 'call in' the application for their own determination.

- HSE notes that under the Council's planning policies (Adopted Unitary Development Plan, Policies DEV 53 and DEV 54), 'Development near to these (hazardous) installations (e.g. the Bethnal Green Holder Station) should not go ahead if it exposes large numbers of people to increased risk.' and that in the 'Conclusions' section of this report, the Council accepts that the development at 33-37 The Oval would result in an increase in the level of risk.
- In HSE's opinion, Atkins Oil and Gas have underestimated the risk to occupants by at least a factor of 5. This means the risk of fatality would very probably be 60 chances per million (cpm) per year risk of death or more.
- HSE's long standing view of risk follows that reached by a Study Group of the Royal Society on the topic of Risk Assessment, published in 1983 and in HSE publications since then, that considers a risk of <1 cpm risk of death is negligible and 100 cpm (1 in 10,000 per annum) unacceptable for members of the public who have risks imposed on them in the wider interests of society. HSE recognise that in practice, most industries do much better than these limits and the risk to members of the public from work activity are much lower.
- Comparison of the risk to the occupants of the development with other benchmarks such as the annual risk of death for employees from working in the construction or manufacturing industry are misleading as those risks are willingly tolerated by the individuals for direct benefit from that employment.
- An individual risk of approximately 60 cpm in this case is very high and approaches an unacceptable risk level for a member of the public.
- The apartment block is within the hazard range of nearly all the major accident scenarios predicted by Atkins Oil and Gas, HSE and National Grid (The operator of Bethnal Green Holder Station). In HSE's opinion there would be minimal opportunity for escape and evacuation for the occupants of the 5 storey development and hence in the event of an incident multiple fatalities would be expected (up to 46).
- The impact of the proposed mitigation measures is considered to be minimal on the calculated risks. The difficulties in conservation and enforcement of these measures over time mean their contribution to any impact on the safety of occupants cannot be assured hence in HSE's opinion, such measures should be given very little weight in the committee's decision.
- According to National Grid records, last year there were two major gas releases from holders in London. In 1977 a major gas escape from the Bethnal Green Holder Station caused the closure of Liverpool Street Station.
- In HSE's opinion, 33-37 the Oval is an inappropriate location for a 5 storey apartment block and the safety of its occupants should be a significant material consideration for the committee and sufficient to support revocation or discontinuance of the existing planning permission.

7.3 HSE have also submitted a commentary on the Atkins report which is appended as appendix 1d. A response to this from Atkins Oil and Gas is also attached at appendix 1e.

National Grid

7.4 National Grid's comments are limited to the potential impact of a development on the holder station and they do not consider or cover risk to the proposed development or surrounding area in the event of a major accident at the holder station, which they consider to be the responsibility of HSE.

7.5 With regard to the impact of the development on the holder site they recommend that the development accords with the provisions of the Institute of Gas Engineers document SR4. This recommends that no source of ignition be permitted within approximately 18 metres of a gas holder and that buildings, lighting, etc should not be erected closer than 18 metres to a gasholder. They have noted the proposal does come within 18 metres and have noted the suggested mitigation measures. However, they consider that these are unlikely prevent potential sources of ignition within 18 metres of the holder. As such they recommend, as a minimum, that changes are made necessary to ensure consistency with IGEM document SR4.

7.6 National Grid also commented on the report at appendix 1a, which they consider did not, in parts, accurately reflect their representations; however that report relates to a different application.

Government Office for London

7.7 No comments received.

The Developer

7.8 No comments on the report but has confirmed willingness to enter in the legal agreement specified below in paragraph 8.31.

8. PLANNING CONSIDERATIONS

8.1 As explained earlier in the report, planning permission exists for a development at 33-37 The Oval against which a statutory consultee (the Health and Safety Executive) has raised an objection on the grounds of safety. That body was not consulted as required by the GDPO during the processing of the application. The permission cannot now be challenged due to the passage of time. The council therefore should consider (on the basis of the development plan and any other material considerations only) whether to take any action. The action available to the Council is as follows:

- To issue an Order either under section 97 (revocation or modification powers) or under section 102 (discontinuance powers) of the Planning Act
- To negotiate changes to the development with the developer to mitigate any residual risks
- To take no action

8.2 In order to enable the council to consider what is the right course of action, independent professional advice was obtained on the risk issues raised by the development from a qualified expert (the Atkins Report at appendix 1c). Legal advice from counsel has also been taken.

8.3 In making a decision on the planning merits, the circumstances resulting from the implementation of PA/05/00421 must create an unacceptable level of danger in order to justify serving an Order. If the development, either as permitted by PA/05/00421 or as amended through negotiation, is acceptable in the particular circumstances at the Oval then there would be no need for the council to take any further action.

8.4 If the development permitted under PA/05/00421 was constructed there would be relatively minor implications with respect to the Council's function in determining future planning applications. Each case has to be treated on its individual planning merits. Such development on the site would not be likely to set a precedent for development elsewhere. It would not prevent the local planning authority considering future applications on their merits.

Summary of advice received on risk assessment

8.5 The system used by the HSE to assess risk when considering planning application consultations (known as PADHI) is based upon consideration of individual risk, although HSE is currently considering ways in which they can also address societal risk issues around certain major hazard installations which are surrounded by significant populations.

Their preliminary list of 54 such sites has included the gas holder installation at Bethnal Green. The Atkins report therefore considered both individual and societal risk.

8.6 Previously under the PADHI system, HSE as a statutory consultee had to be notified about specified development within the consultation distance of a notifiable installation (eg a gasholder site for which the consultation distance was, until 2006, 60m from the edge of the gasholder). They would look at each case and provide advice in the form of either “advise against” or “do not advise against” within the 21 day period given to reply.

8.7 The new system seeks to automate the process by having what is known as “standing advice”. However at about the same time as this change in methodology, HSE has also reviewed the risks associated with gas holder sites. This has resulted in much wider consultation zones for these installations (see map attached at appendix 1b). The development at 33-37 The Oval was also within the previous 60m consultation zone.

8.8 At the centre of the new consultation system is a matrix with distance from hazard against nature of the development resulting in either “advise against” or “don’t advise against” the development. There are 3 zones: inner (about 80m), middle (about 200m) and outer (about 280m), where the distances in parentheses relate to the largest gas holder on the Bethnal Green site, and are measured from the edge of the holder. There are 4 types of development. The following is just an illustration of them (the PADHI model has a more detailed definition):

Development Type 1	Low density uses such as warehousing and industry where there are low numbers of people
Development Type 2	Low density housing: < 40 dwellings per hectare (we hardly ever build at this density in Tower Hamlets)
Development Type 3	High density housing: > 40 dwellings per hectare
Development Type 4	very large or sensitive developments – eg sports stadia (high nos of people) or care home (hard to evacuate)

8.9 The implication of this new regime in Tower Hamlets is that there is effectively a 200 metre zone around all gas holders within which the HSE will “advise against” most residential development. Such an area (10.31 hectares in the case of Bethnal Green, when the area of the holder site is deducted) could hold between 2,480 and 4,480 dwellings given the Public Transport Accessibility Level of the area (PTAL 5) and development plan density policies (ie between 240 and 435 dwellings per hectare). If say only about a quarter of the area was capable of redevelopment and this was advised against by the HSE and Tower Hamlets followed this advice, between 620 and 1120 new dwellings could be lost and given recent trends in development densities, this is likely to be at the upper end of this range or even beyond it. We have 4 such installations in our borough. This is a significant issue in terms of housing provision; representing nearly 18 months provision of new housing in the borough.

8.10 The site at 33-37 The Oval is located within the Inner Planning Zone of the adjacent Bethnal Green gas holder site. The basis of the HSE ‘Advise Against’ decision has therefore been assessed in relation to the actual risks at the development site. Detailed information concerning the site and its operation has been used, together with the appropriate publications from HSE, to provide a list of credible potential major hazard accident scenarios from the site. The consequences of the scenarios have been calculated using standard methodologies, and the results matched, where possible, with information supplied from the National Grid COMAH report. Event frequencies have been estimated based both on recommendations of HSE, and also on interpretation of available accident statistics. The combination of consequences and frequencies has enabled the risks to be calculated, and the predictions match closely to the expectations based upon HSE’s Planning Zones.

Individual Risk

8.11 The individual risk of fatality at 33-37 The Oval is estimated by Atkins Oil and Gas to be around 12 cpm (chances per million per year) for a typical residential population. That means that a person can be expected to be fatally injured as a result of an accident at the gasholder site every 80,000 years. The results of this assessment are therefore clearly consistent with the screening process which is applied within the PADHI process: ie this value is high compared with the level at which HSE would Advise Against for any development containing more than a few people.

8.12 In order to help understand the level of risk at the proposed development, it is worthwhile to compare it with historical data on the other risks to which people are typically exposed. HSE's "Reducing Risks, Protecting People" document provides some data on the risks to which people are routinely exposed. Some of this information is reproduced below, in terms of risk of fatality as annual experience per million, or chances per million per year (cpm).

	Risk as annual experience per million	Risk as annual experience
Annual risk of death (entire population)	10,309 cpm	1 in 97
Annual risk of cancer	2,584 cpm	1 in 387
Annual risk from all types of accident	246 cpm	1 in 4,064
Annual risk from all forms of road accident	60 cpm	1 in 16,800
Construction	59 cpm	1 in 17,000
Agriculture, hunting, forestry and fishing	58 cpm	1 in 17,200
Manufacturing industry	13 cpm	1 in 77,000
The development	**12 cpm**	**1 in 80,000**

8.13 These risks can be compared with the additional annual risk for the most exposed people at the proposed development of up to about 12 cpm (once in 80,000 years) due to major accidents. For example, the annual risk of death for the most exposed person would increase by about 0.12% (from 10,309 to 10,321 cpm), and this increase would be less than a twentieth of the risk of dying in all types of accident. HSE point out that comparing voluntarily accepted risks with imposed risks is misleading. However, there are few other ways in which the numbers can realistically be put into context.

8.14 The individual risk is therefore not intolerable (100cpm), but is above what could be described as negligible (1cpm) or broadly acceptable.

Societal Risk

8.15 In addition to the above individual risk, it should be remembered that the worst case accident, involving a major fireball, could theoretically result in large numbers of people being affected in a single incident, although the likelihood of such a very severe event is very low (probably of the order of less than once in 120,000 years). This possibility of multiple fatalities may be regarded as a greater concern than the individual risks of around 12 cpm.

8.16 The report by Atkins Oil and Gas at appendix 1c demonstrates that the societal risk associated with the Bethnal Green gas holder site is not at present exceptionally high for a typical COMAH site. It has also been shown that the societal risk would not increase to an intolerable level if the proposed development were to be allowed. The potential for a precedent being set by allowing this development is a possible concern, as further such developments could result in a significant increase in societal risk. This development represents a 32% increase, which would imply that only 3 such developments would be required before the societal risk was almost doubled.

8.17 The question of precedent in planning is well established. In the strict legal sense, it does not operate in planning decisions. The dominant principle is that all planning decisions must be taken on their individual merits. The existence of a comparable decision on another site, or even the same site, may set up an expectation that a similar decision will be taken on a current application, but it does no more than that. If circumstances have changed or there are material differences, then the decision maker is entitled to come to a different conclusion on the merits of the case. Given that this decision relates to a very particular set of circumstances at this site (including previous procedural issues and the fact that the decision is taken in regard to section 97 or 102 of the Act, rather than the determination of a planning application) any decision is not seen as in any way setting a precedent for the determination of future planning application and would not indicate how the Council will assess future applications.

8.18 HSE has identified in CD212 the Bethnal Green Gasholder as being amongst the 54 or so of the 1130 COMAH sites in the UK that may require explicit consideration of societal risk. HSE is of the view that the location of this development places it within the range of nearly all the potential major accidents from the closest gasholder. In the event of a serious incident, the likelihood that it would lead to multiple casualties is high. They therefore state that as no criteria has yet been agreed as to what is considered acceptable or not in terms of societal risk, any statement implying acceptance or otherwise of societal risk should not be made.

<u>Conclusions on the assessment of risk</u>

8.19 It is therefore clear that, when considering potential individual developments close to major hazard sites, both individual and societal risk need to be considered. In some cases, robust calculations of these risks may show them to be below some ‘broadly acceptable’ level, as defined by HSE. Conversely, they may be shown to be intolerable in all circumstances. Between these levels (as is the case for the proposed development), the acceptability of the risks, either individual or societal, can only be judged by balancing the calculated risks with the socioeconomic benefits (both for the hazardous installation and for developments in the vicinity). Ultimately, although HSE provides advice, it is for the planning authority to make such judgements, taking account of factors such as:

- nature and scale of benefits to the local / wider community
- provision of jobs / employment
- contribution to GDP and local taxes
- consistency with local development plans
- views of the public
- etc

8.20 and balancing these benefits against the risks in terms of:

- number and likelihood of people affected (fatalities and injuries)
- nature of harm

8.21 For example, a gas holder site such as Bethnal Green could be regarded as providing a significant regional benefit in terms of providing a fuel supply to a large community, and hence a planning authority might consider that a moderate level of societal risk associated with the installation was acceptable (provided it could be demonstrated to be As Low As Reasonably Practicable – ALARP), whilst for a smaller industrial activity with no significant socioeconomic benefits, a planning authority might consider the same level of societal risk to be unacceptable (even if it was also ALARP).

8.22 Similarly, where a development is proposed near an existing major hazard site, it is also the responsibility of the planning authority to make such judgements, taking account of the factors noted above. If there was such a pressing need for residential development in the area, and no other land was available, then the local planning authority may be more inclined to grant planning permission than in an area where such a pressing need was absent.

8.23 It is therefore concluded that:

1. The individual risk, at around 12cpm, is not intolerable, but is above the level at which HSE would advise against for this type of development.
2. The current societal risk associated with the gas holder site is not exceptionally high for a Top Tier COMAH site.
3. The addition of the extra population will increase societal risk by around 32%.
4. Whilst it is possible that a case could be made for accepting this additional risk, HSE is likely to be concerned at the potential for cumulative societal risk effects if adjacent properties were to be developed in a similar way.

Potential for further mitigation

8.24 There are features of the development which have the potential to be amended or controlled and in certain circumstances these could be beneficial to future occupants. These measures do not however materially impact on the overall risk assessment.

Use of roof terraces

8.25 While there would be no mitigation possible against a major incident (such as a fireball) in practice, however, one of the key risk reduction factors is expected to be control of ignition sources close to the gas holder. The terraces at two levels (1st floor and 4th floor) should therefore be considered in relation to controlling ignition sources. Ideally, both should be removed or made inaccessible for normal use. It is recommended that the lower terrace, which is within 18m of the gas holders, is removed. If it is not possible to remove the upper level terrace, then ignition source restrictions should be applied, since there is the potential for a greater travel distance of a flammable cloud at this higher level. This could take the form of appropriate signage advising against smoking and the use of barbeques when the adjacent gas holders are in use (ie during the winter months). In view of both the greater distance from the gas holders, and the intervening presence of the building, no similar restrictions need to be applied to any terraces at the front of the building.

Design of boundary wall

8.26 The rear boundary wall will be 5.2m high, and will have no openings. This would ensure that any low level gas releases would be deflected upwards by the presence of this wall as well as by its buoyancy. Moreover, this would be true of all wind conditions, including those higher wind speeds which would otherwise deflect the cloud towards the ground.

Minimising potential for gas ingress

8.27 The risk is reduced if any gas released is unable to encounter an ignition source. This can be achieved by minimising the openings facing and within 18m of the gas holders, and ensuring that any which are within 18m are protected, as noted above, by the boundary wall.

Installation of shatter-proof glass

8.28 One of the contributors to the risk is explosion. Since much of the injury potential is from flying glass, the effects of explosion can be reduced by ensuring that the glass in any windows facing the gas holders is shatterproof. This can be achieved either through use of specialist glass from a supplier such as Romag, or by application of window film such as Llumar to the internal face of the glazing.

Provision of adequate means of evacuation

8.29 In the event of a fire on one of the gas holders, the thermal radiation at the rear of the building is likely to be sufficiently intense that evacuation would be impeded. The building design should therefore ensure that all occupants, including those using the terraces, can be evacuated safely to the front of the building.

Applicability of the desirable design features

8.30 The following were recommended by Atkins with comments by officers on their applicability to the development.

Ensure impermeability of rear wall up to 5m height: The approved plans show the wall as impermeable. The developer has indicated a willingness to agree to enter into a planning obligation to secure this in perpetuity.

Minimise window openings facing gas holders within 18 metres of the holder or where not protected by the rear wall: There are no windows that breach this criteria. The only risk would be the insertion of windows into the rear wall, which would be prevented by the aforementioned planning obligation.

Specify heat/blast resistant or shatterproof glass for windows facing gas holders: The developer has indicated a willingness to agree agreed to this, subject to the Council covering the additional costs. It would be secured by a planning obligation.

Prevent the use of the lower level rear-facing roof terraces: The developer has indicated a willingness to agree to this and it would be secured by a planning obligation.

Display signage restricting the use of ignition sources on the upper level rear-facing roof terraces when gas holders are in use: The developer has indicated a willingness to agree to this and it would be secured by a planning obligation.

Ensure adequate provision is made for evacuation to the front of the building in the event of minor fires: The approved plans provide for this with the interior layout.

Development Plan Considerations

8.31 A wide range of policies will impact on the development, and the Council's assessment of the two applications at this site (PA/05/00421 & PA/06/01393) demonstrates that in land use planning terms a mixed commercial and residential development is acceptable at this location. For the purposes of the considerations in this report the need for the development has to be examined in order to balance it against the increase in risk that it represents.

8.32 The area is one that is in need of regeneration. It is characteristic of many locations within Tower Hamlets where the former industrial base has declined and the area is now characterised by vacant and sometimes derelict buildings. The need to regenerate such areas generally and the large potential that exists in east London specifically is strongly recognised in national, regional and local planning policies. The site is within the wider Thames Gateway area where a large part of the significant growth that London is experiencing is planned to be accommodated.

8.33 Over and above the specific strategic policies that apply to the wider area, there is a national shortage of housing that government is giving the highest priority to addressing. Developing brownfield sites at high densities, particularly where they are near good transport links such as here, is strongly encouraged.

8.34 Although government is prioritising the provision of housing, it also recognises that the industrial base has declined and it can be difficult to bring forward new commercial floorspace that is needed to meet demand. Mixed use schemes, where the provision of commercial floorspace can be subsidised by more profitable uses (such as residential), are seen as necessary and desirable.

8.35 The site therefore can be seen as playing a small but important role in delivering a wider range of regeneration policy objectives that are important at a local, regional and national level.

8.36 Set against these considerations are policies DEV53 & 54 in the UDP that seek to ensure that the risks associated with hazardous installations are properly taken into account as required by Article 12 of the Seveso II Directive.

Conclusions

8.37 Consideration of risk is a balance like any other consideration. In this case the benefits that the development brings in providing much needed housing and employment floorspace to an inner city area in need of regeneration have to be weighed against the risks represented by the development's proximity to a gas holder site.

8.38 When individual risk is considered, the development could be seen as being one where there is an increase that results in that risk moving from one that is broadly acceptable, but not to one which is intolerable. A range of measures that could be beneficial for future occupiers have been identified, agreed in principle and will be secured. The societal risk is not currently high and this development increases it by 32%. At these levels HSE is likely to be concerned at the potential for cumulative societal risk effects if adjacent properties were to be developed in a similar way. This risk is very low given the special circumstances of this case and the principle that planning applications are assessed on their individual merits.

8.39 It is therefore concluded that on balance the implementation of PA/05/00421 would not create an unacceptable level of danger when considered against the gains that the development represents in terms of much needed housing and modern commercial floorspace. Accordingly the serving of an Order would not be justified in the specific circumstances of this case. However, the mitigation benefits identified in this report at paragraph 8.30 are desirable and should be secured.

8.40 All other relevant policies and considerations have been taken into account in arriving at these conclusions.

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Appendix 1a

Committee: Strategic Development	Date: 16th November 2006	Classification: Unrestricted	Agenda Item No: 6.1
Report of: Corporate Director of Development and Renewal Case Officer: Ila Robertson		Title: Planning Application for Decision Ref No: PA/06/01393 Ward: Bethnal Green North	

1. APPLICATION DETAILS

Location: 33-37 The Oval, London, E2 9DT
Existing Use: Scheme approved under PA/05/00421 partly constructed on site.
Proposal: Demolition of existing building. Redevelopment to provide a five storey building for use as 2 Class B1 (business) units on the ground floor with 14 flats above (6 one bedroom, 6 two bedroom and 2 three bedroom flats). Amendments to the scheme granted permission on 15th December 2005 (PA/05/421).(Further Revisions).

Drawing Nos: 001 REV C, 002 REV D, 003 REV C, 004 REV C and 005 REV B
Applicant: Neptune Group
Owner: Neptune Group
Historic Building: N/A
Conservation Area: N/A

2. SUMMARY OF MATERIAL PLANNING CONSIDERATIONS

2.1 The local planning authority has considered the particular circumstances of this application against the Council's approved planning policies contained in the London Borough of Tower Hamlets Unitary Development Plan, associated supplementary planning guidance, the London Plan and Government Planning Policy Guidance and has found that it:

a) Is a suitable land use for the site and satisfies environmental and safety criteria adopted by the Council;

b) Does not result in material harm to the amenity of residents or to the character and environment of the adjacent area.

3. RECOMMENDATION

3.1 That the Local Authority give the Health and Safety Executive:

- advanced notice of its intention to grant permission,
- 21 days from the date of the notice to give further consideration of this matter and allow them to consider whether they wish to request that the Secretary of State call-in this application for her determination.

3.2 That the Committee resolve to **GRANT** planning permission subject to:

A. The prior completion of a **legal agreement** to secure the following aspects secured under the original scheme PA/05/00421:

a) Car free agreement
b) Repaving / S 278 highways works
c) Environmental improvements to The Oval.

3.3 That the Head of Development Decisions is delegated power to impose conditions [and informatives] on the planning permission to secure the following:

Conditions

1) Three year Time Limit
2) Reserved matters:
(i) External materials;
(ii) External lighting;
(iii) Hard and soft landscaping.
3) Landscape Maintenance
4) Construction Hours
5) Cycle Storage
6) Refuse Storage
7) Site Investigation
8) Sound Insulation
9) Signage for the western outdoor area

Informatives

1) Permission subject to Section 106 legal agreement.
2) Environmental Health
3) Signage

4. PROPOSAL AND LOCATION DETAILS

Proposal

4.1 A scheme was approved for the site on the 12th December 2005. However, following interventions by the Health and Safety Executive and the National Grid regarding the proximity of the development to the adjacent gas holders various discussions were held with the developer and a revised scheme was developed. The amended scheme results in the occupied areas of the building being set back by 18m from gas holders.

The revised scheme provides two Class B1 units on the ground floor with 14 residential flats above being 6 one bedroom, 6 two bedroom and 2 three bedroom flats. The access arrangements have altered slightly from the previously approved scheme.

Site and Surroundings

4.2 The previously approved scheme (PA/05/00421) has been partially constructed on site with the reinforced concrete structural framework for the five storey building complete. Works have been ceased until the revised scheme has been considered by Council.

The surrounding area consists of commercial uses with various light industrial, manufacturing and offices uses. To the west of the site is situated a large works site comprising of four gas holder tanks.

To the north of the site is Regents Canal and a number of residential developments are located along the northern side of the canal.

Planning History

4.3 The following planning decisions are relevant to the application:

PA/05/00421	Planning permission approved on the 15 December 2005 for the demolition of existing building and redevelopment to provide a five-storey building comprising 3 business units (B1) on the ground floor with 14 flats above (6 one bedroom flats, 6 two bedroom flats and 2 three bedroom flats).

5. POLICY FRAMEWORK

5.1 For details of the status of relevant policies see the front sheet for "Planning Applications for Determination" agenda items. The following policies are relevant to the application:

Unitary Development Plan

Proposals:	SVCA	Strategic View Consultation Area
Policies:	DEV1 & 2	General design and environmental requirements
	DEV3	Mixed use development
	DEV4	Planning obligations
	DEV50	Development and Noise
	DEV51	Contaminated Land
	EMP2	Retaining Existing Employment uses
	HSG2	Location of New Housing
	HSG7	Dwelling Mix and Type
	HSG9	Density
	HSG13	Internal Standards for Residential Developments
	HSG15	Development Affecting Residential Amenity
	HSG16	Amenity Space
	T15	Location of New Development
	T16	Traffic Priorities for New Development
	T17	Planning Standards
	T21	Pedestrian Needs in New Development
	T24	Cyclist needs in New Developments

Emerging Local Development Framework

Proposals:	CP50	Strategic View Consultation Area
	C6	Development Site (refer AAP)
Core Strategies:	CP1	Creating Sustainable Communities
	CP4	Good Design
	CP11	Sites in Employment Use
	CP19	New Housing Provision
	CP21	Dwelling Mix and Type
	CP22	Affordable Housing
	CP25	Housing Amenity Space
	CP41	Integrating Development with Transport
Policies:	DEV1	Amenity
	DEV2	Character and Design
	DEV3	Accessibility and Inclusive Design
	DEV4	Safety and Security
	DEV10	Disturbance from Noise Pollution
	DEV15	Waste and Recyclables Storage
	DEV16	Walking and Cycling Facilities
	DEV22	Contaminated Land
	DEV23	Hazardous Development & Storage of Hazardous Substances
	EE2	Redevelopment/ Change of Use of Employment Sites
	HSG1	Determining Residential Density
	HSG2	Housing Mix
	HSG3	Affordable Housing Provisions in Individual Private Residential and Mixed-Use Schemes

HSG7 Housing Amenity Space

Supplementary Planning Guidance/Documents

Residential Space Standards

Spatial Development Strategy for Greater London (London Plan)

N/A

Government Planning Policy Guidance/Statements

PPG3	Housing
PPG24	Planning and Noise

Community Plan The following Community Plan objectives relate to the application:

A better place for living safely

A better place for living well

6. CONSULTATION RESPONSE

6.1 The views of officers within the Directorate of Development and Renewal are expressed in the MATERIAL PLANNING CONSIDERATIONS section below. The following were consulted regarding the application:

LBTH Design and Conservation

6.2 No objection

LBTH Highways

6.3 No objection, as s278 and s106 agreement has already been secured by previous planning permission PA/05/00421.

LBTH Environmental Health

6.4 No objection, subject to conditions being included to control hours of construction, sound insulation and site investigations due to contaminated land.

Health and Safety Executive (Statutory Consultee)

6.5 Objects to the scheme advising that there are sufficient reasons on safety grounds for the scheme to be refused.

National grid (Statutory Consultee)

6.6 No objection, subject to the occupied parts of the building being more than 18 metres from the nearest gas holder(s). However, the scheme as currently constructed on site appears considerably closer than the 18 metres shown on the submitted plans and the valid planning permission and construction appears to be continuing despite LBTH directing applicant to stop work.

Recommends that potential ignition sources within the open area adjoining the gas holders are restricted in accordance with the Institute of Gas Engineers document SR4.

(Officers visited the site on the 16th October 2006 and confirm that building works have ceased).

7. LOCAL REPRESENTATION

7.1 A total of 23 neighbouring properties within the area shown on the map appended to this report were notified about the application and invited to comment. [The application has also been publicised in East End Life and on site.] The number of representations received from neighbours and local groups in response to notification and publicity of the application were as follows:

No of individual responses:	0	Objecting: 0	Supporting: 0
No of petitions received:	N/A		

8. MATERIAL PLANNING CONSIDERATIONS

8.1 The main planning issues raised by the application that the committee must consider are:

1. Land use
2. Design and Amenity
3. Health and Safety
4. Highways

Land use

8.2 The principle of a mixed use development in this locality has already been accepted because of the granting of planning permission on the 15th December 2005 (PA/05/00421). The scheme still includes provision of 307sqm of employment generating B1 use class floor space on the ground floor. The residential accommodation on the upper floors does not involve the loss of any existing employment generating floorspace. The application is therefore considered to be consistent with UDP Policy EMP2. It is therefore considered in land use terms that the revised scheme is acceptable.

8.3 The UDP policies HSG1 and HSG2 seek to encourage residential proposals within localities which are adequately serviced and where an overall satisfactory residential environment can be assured. Given the location of the site, the design of the proposed buildings and residential use within the vicinity, it is considered that this test is met.

8.4 The proposed mix of units (6 one bedroom, 6 two bedroom and 2 three bedroom flats), in consideration of the urban context of the site and the existing nature of the building, is acceptable in accordance with policy HSG7 of the adopted Unitary Development Plan.

Design and Amenity

8.5 The proposed revised building design is considered acceptable in terms of the requirements set out under the UDP. In particular, the revisions to the scheme are restricted to the rear of the building where it has been redesigned to achieve an 18m set back from the western gas holders. There have been no alterations to the overall height, massing or scale of the proposal as previously granted.

8.6 The amended design has been reviewed by Council Design officers. No objections have been raised.

8.7 The adopted Council UDP policies HSG15, DEV2 and DEV50 place a particular emphasis on protecting the amenity of existing and prospective surrounding residential occupiers. It is considered that the scheme provides a satisfactory level of amenity for potential occupants with the provision of both communal and exclusive amenity spaces and unit sizes in excess of the minimum space standards. Furthermore, given the location and design of the building it is not considered that the amenity of any adjoining residential properties will be affected.

Health and Safety

8.8 The Health and Safety Executive (HSE) is a statutory consultee for certain developments within the consultation distance of major hazard installations/ complexes and pipelines.

8.9 Their assessment indicates that there is a risk of harm to people at the proposed development. As such, the HSE's advice is that there are sufficient reasons, on safety grounds for advising against the granting of planning permission in this case. However, they do not give specific reasons why they consider this, other than to indicate that there is a possibility that a major accident could occur at an installation and that this could have serious consequences for people in the vicinity. Moreover, they admit that the likelihood of a major accident occurring is small.

8.10 National Grid have advised that they have no specific objection to the proposal, subject to all occupied parts of the scheme being set back by 18 metres from the gas holder tanks. This is the distance they consider is sufficient to ensure the safety of adjacent people. National Grid has also recommended that potential ignition sources are restricted within the open areas directly adjacent to the gas works site in accordance with Gas Engineers document SR4.

8.11 The building has been redesigned following the above comments to ensure that the occupied parts of the building are set back by 18m from the nearest gas holder. This distance provides a sufficient separation to ensure that, if an incident did occur at the adjoining site, the occupants would be adequately protected. It is therefore considered that the proposal accords with policy DEV 23 of the emerging LDF submission document, which states that Council will resist proposals where it would cause a significant hazard to health unless suitable mitigation measures have been demonstrated.

8.12 In addition, it is recommended that potential ignition sources should be restricted within the open areas directly adjacent to the gas works site. It is therefore considered that a condition should be included to ensure that signage is installed within the rear communal open terraces and courtyards clearly advising future users of this restriction.

8.13 As mentioned in section 3.1 of the report, the Council must refer the application back to HSE for a 21-day period if they propose to approve this application. This is to allow them time to consider this matter further, to give sound planning reasons justifying a potential refusal of this application and an opportunity to request that the Secretary of State calls-in this application for her determination. Nevertheless, the Council do not consider that there are sufficient grounds to justify a refusal of this application in this instance.

Highways

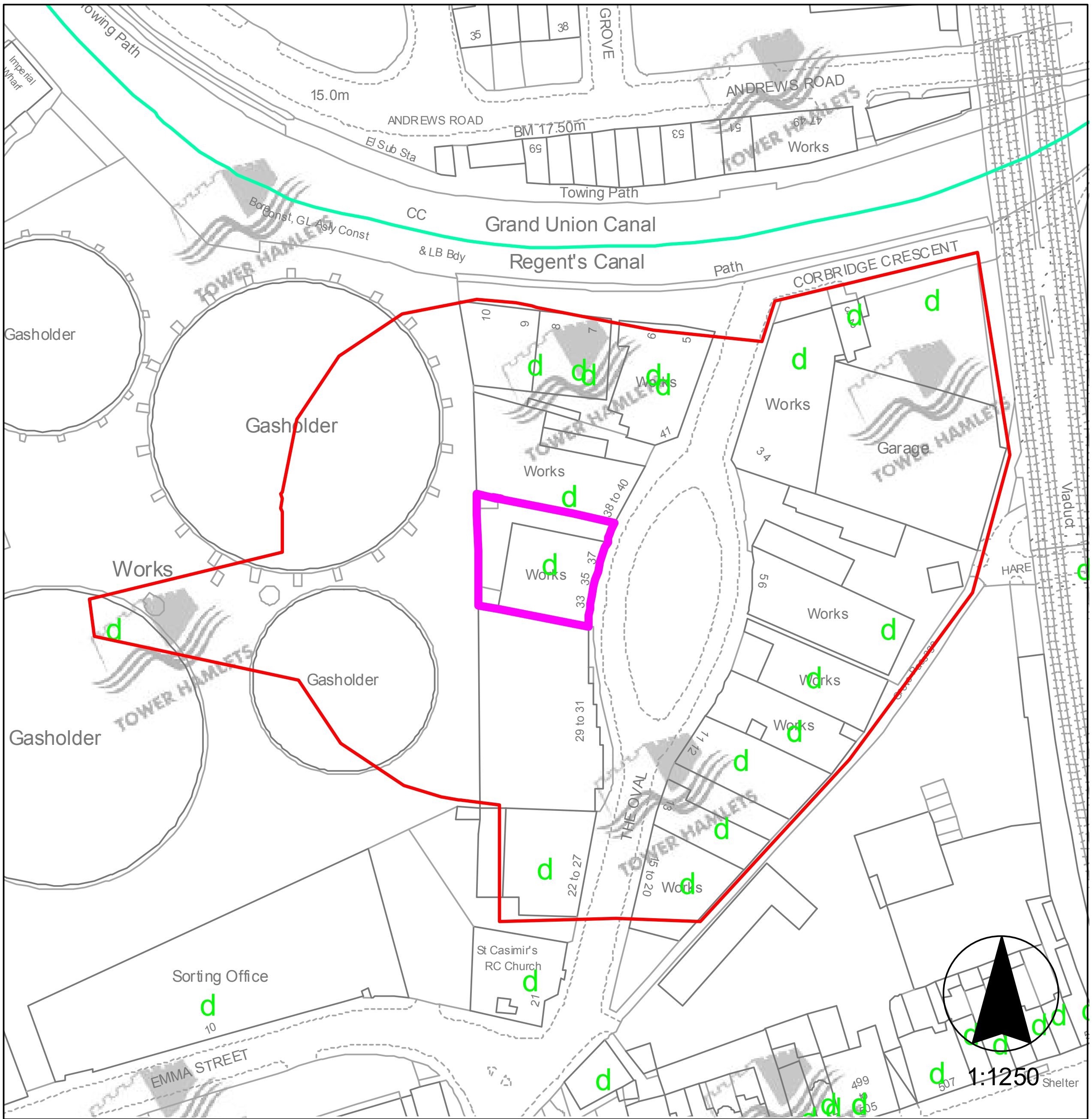
8.5 The application site is well serviced by public transport links. The site is located within a 5min walk of the Cambridge Heath railway station that serves both North London and provides access to Liverpool Street Station. The site is within easy walking distance of Bethnal Green Road, Cambridge Heath Road and Hackney Road that are well served by numerous bus routes

The original scheme incorporated both a 'car-free' and streetscape contribution of £21,000 as part of the s106 agreement. To ensure that development would not add pressure to the existing on-street parking in the locality. It is considered that the existing agreement should be carried over to the revised scheme to ensure that the car-free status is maintained.

8.7 All other relevant policies and considerations have been taken into account. Planning permission should be granted for the reasons set out in the SUMMARY OF MATERIAL

PLANNING CONSIDERATIONS and the details of the decision are set out in the RECOMMENDATION at the beginning of this report.

Site Map



Legend

Planning Application Site Boundary | Consultation Area | d Land Parcel Address

This Site Map displays the Planning Application Site Boundary and the neighbouring Occupiers / Owners who were consulted as part of the Planning Application process. The Site Map was reproduced from the Ordnance Survey mapping with the permission of Her Majesty's Stationery Office © Crown Copyright.
London Borough of Tower Hamlets LA086568

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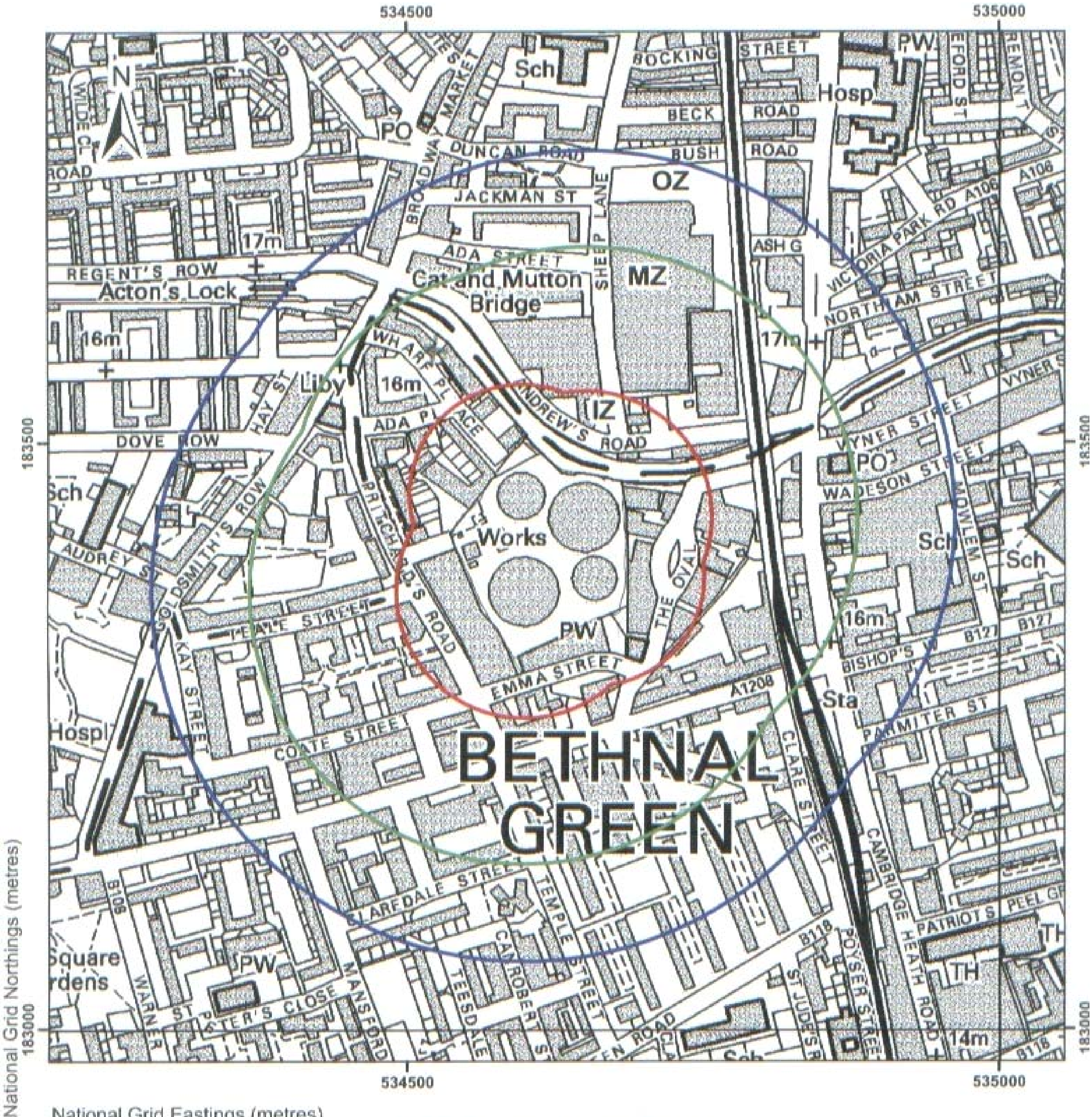
Appendix 1b



HSE Consultation Zones

Transco, Bethnal Green Holder Station, Marian Place, Bethnal Green, London, E2 9AX

CIS Location 1360
HSE Ref: #1754
Grid Ref: TQ 346 834

Prepared - January 2006
This map supersedes all previous or undated maps

IZ = Inner Zone
MZ = Middle Zone
OZ = Outer Zone

0 50 100 200 Metres

Appendix 1c

Bethnal Green Gas Holder:

Quantified Risk Assessment for Land Use Planning

Tower Hamlets

Report No: 5054615/R1/Final

Issue Date: August 2007

Bethnal Green Gas Holder:
Quantified Risk Assessment for Land Use Planning

A Report Prepared by
Atkins Oil & Gas

On Behalf of
Tower Hamlets

COMMERCIAL IN CONFIDENCE

Author:..
D. M. Deaves & G. N. Tsiattalou

Checked:........................
I. G. Lines

Approved:........................
P. Gallagher

Atkins Oil & Gas
Woodcote Grove
Ashley Road
Epsom
Surrey, KT18 5BW
Tel.: (01372) 726410
Fax.: (01372) 740055

Tower Hamlets
PO Box 55739,
5, Clove Crescent,
London, E14 1BY

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Bethnal Green Gas Holder: Quantitative Risk Assessment for Land Use Planning

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SUMMARY

The proposed development at 33-37 The Oval is located within the Inner Planning Zone of the adjacent Bethnal Green gas holder site. The basis of the HSE 'Advise Against' decision has therefore been addressed in relation to the actual risks at the development site.

Detailed information concerning the site and its operation has been used, together with the appropriate publications from HSE, to provide a list of credible potential major hazard accident scenarios from the site. The consequences of the scenarios have been calculated using standard methodologies, and the results matched, where possible, with information supplied from the National Grid COMAH report. Event frequencies have been estimated based both on recommendations of HSE, and also on interpretation of available accident statistics. The combination of consequences and frequencies has enabled the risks to be calculated, and the predictions match closely to the expectations based upon HSE's Planning Zones.

The results show that the individual risk is above the 'broadly acceptable' level, but is not 'intolerable'. They have also shown that the societal risk associated with the population around the gas holder site lies within a similar band, but would be increased by around 32% by the addition of this extra population (of order 60 people) within around 40m of the nearest gas holders. It is therefore concluded that:

1.) The individual risk, at around 12cpm, is not intolerable, but is above the level at which HSE would 'advise against' for this type of development.

2.) The current societal risk associated with the gas holder site is not particularly high for a Top Tier COMAH site.

3.) The addition of the extra population will increase societal risk by around 32%, but it will still remain well within HSE guidelines.

4.) Whilst it is possible that a case could be made for accepting this additional risk, HSE is likely to be concerned at the potential for cumulative societal risk effects if adjacent properties were to be developed in a similar way.

1. INTRODUCTION

1.1 Background

Planning Permission has been granted by Tower Hamlets Council for a development of 14 residential units and 3 small business units at 33 - 37 The Oval, Bethnal Green, London E2. This is a relatively small 5 storey development close to the Bethnal Green gas holder station, which is operated by National Grid.

Since this development falls inside the Inner Planning Zone of the gas holder station, within which HSE would advise against the granting of Planning Permission, Tower Hamlets is seeking an understanding of the actual risks to which users of the development would be exposed. This will provide the Planning Authority with assurance that whatever ultimate planning decision is taken will be based on a full understanding of the risks. This study has therefore been undertaken in response to a request made at a meeting at Tower Hamlets' offices on 27th March 2007.

1.2 Objectives and Scope of Work

The primary objective of this study is to provide realistic estimates of the risks associated with the presence of the Bethnal Green gas holder station which is in close proximity to the proposed development. In order to achieve this, Atkins has followed the scope as agreed with Tower Hamlets, and as set out below:

1) Meet with Tower Hamlets to clarify scope/ requirements.
2) Obtain and assess information regarding gas holder operations from National Grid.
3) Review HSE information regarding recent changes to Planning Zone methodology for gas holders to assess uncertainties and conservatisms, and to determine representative events for consideration in the Quantified Risk Assessment (QRA).
4) Obtain detailed population information (i.e. numbers and types) for areas covered by Planning Zones.
5) Produce QRA of risks from gas holder site, using best estimate methodologies as determined from Task 3, and ensuring that all the event types identified in HSE's Methane gas holders Safety Report Assessment Guide are considered. This will provide estimates of the Individual Risk to the following population types at the development:
    a) Indoor residential population in nearest (top floor) flat.
    b) Indoor office worker in nearest ground floor office.
    c) Outdoor user of communal terrace area at top floor roof level.

   It will also provide estimates of the Societal Risk (risk of large numbers of fatalities arising as a result of a particular incident) associated with the presence of the existing population in the vicinity of the gas holders, together with an estimate of the change to the Societal Risk when the new development is completed and occupied.
6) Assess significance of individual risks at the new development in relation to other everyday risks, and to criteria set by HSE.

The following information was requested to be supplied by Tower Hamlets Council, in order to complete the above scope of work;

1) Details of amounts stated (for each individual gas holder) in the Hazardous Substances Consent.
2) Typical annual operational profile of the gas holder station.
3) Existing population data for the surrounding area (see Item 4 under Scope of Work).
4) Copy of predictive aspects section of COMAH safety report for Bethnal Green gas holder station.

1.3 Structure of Report

Section 2 considers the proposed development in the context of the existing local environment. In particular, it identifies the land uses around the gas holder site, and sets out the population types within the area. Section 3 then describes the way in which HSE consider planning applications in the vicinity of Major Hazard sites, and the particular relevance of HSE's methodology to the proposal.

The detailed quantified risk assessment is given in Section 4, where it is compared with assessments both from HSE and from National Grid. The results of the QRA are then set into context in Section 5, where their implications in relation to the development are discussed. Conclusions are drawn out in Section 6, and background information and analyses are given in the appendices.

2. THE PROPOSED DEVELOPMENT IN CONTEXT

2.1 The Development at The Oval

The four gas holders at National Grid's Bethnal Green site occupy an area of around 150m x 150m. Immediately to the east of this site is a road called The Oval, and the proposed development is at numbers 33-37, backing onto the gas holder site, approximately between Gas Holder 2 and Gas Holder 5. The development area covers around 22m x 25.5m (0.056 ha), and is shown in Figure 2.1. The current stage of the construction (as at 16.06.07) is shown in the photograph in Figure 2.2. The development is also shown in the context of the gas holders and the wider area in Figure 2.3, which also includes HSE's planning zones (see Section 3).

The ground floor of the development will comprise 3 B1 (office/industrial) units. The remaining 4 floors of this 5 storey development will provide 14 residential units: 6 x 1 bedroom, 6 x 2 bedroom & 2 x 3 bedroom, with a likely maximum residential population of around 46 persons. The three B1 units could potentially contain a further 16 people, but only during office hours. It is understood that this development will replace a single storey light industrial unit with an occupancy of around 10 employees.

2.2 Existing Residential Developments

The area around the Bethnal Green gas holders is densely populated, with typical residential population densities of around 200 people / ha. Although there are no very tall buildings, much of the existing housing stock is high rise (typically 5-6 storey) since land is at a premium in this area of East London. It is also noted that a considerable amount of urban regeneration has taken place in the last few decades, in many cases making use of land which had been left derelict since the destruction which took place during the Second World War.

Tower Hamlets Council has provided detailed residential population data based upon the 2001 census. This is given on a ward-by-ward basis, and the information is presented in Appendix A. This shows that there are around 12,600 residents within 500m of the gas holder station. Information drawn from this appendix has been used within the RiskTool model to determine the Societal Risk associated with the gas holder site (see Section 4).

Whilst much of the residential population is separated from the gas holder site by the various industrial and commercial units, there are exceptions. In particular, it is noted that the old Council Depot to the north of the site has been redeveloped, and that housing now exists along the extended Wharf Place right up to the National Grid site boundary.

2.3 Existing Industrial and Commercial Developments

Although the area within 500m of the gas holder station is primarily residential, it also includes industrial, commercial and retail units. For example, review of the population data in Appendix A shows that there are some areas within which the population density is extremely low for this densely populated area. This is at least partly accounted for by the presence of industrial and commercial units adjoining the eastern, southern and western boundaries of the National Grid site.

In addition to the gasholder site, other relevant sites have been identified from the local map, and the non - residential (employee) population information has also been included (to be applied only during normal office hours) in the Societal Risk calculations.

2.4 Sensitive Populations

There are also some facilities within the area which are provided for specific community use. These include:

- schools
- hospitals
- day centres
- surgeries
- nurseries

Such facilities are likely to be used either by large numbers of people, or by more sensitive populations (e.g. the elderly or the very young). They have therefore been identified separately in Appendix A, and this sensitive population information has also been included in the Societal Risk calculations. For hospitals, the populations have been included for 24 hours per day (as for the residential population); for all other cases they have been included only during normal office hours.

It is noted in particular that there are two such facilities which are close to the gas holder site, both adjoining Marian Place, to the west of the site:

- St Peter's North Community Centre
- Pritchard Road Day Centre

3. THE HSE LAND USE PLANNING SYSTEM

3.1 Summary of Land Use Planning Methodology

In order to understand how the land use planning system operates, it is important to have a clear understanding of the key terminology.

A ***hazard*** is simply an item of equipment or process which could lead to harm, i.e. it is the thing which presents the risk, such as a fuel tank or pipeline containing a hazardous substance.

A ***risk*** is the chance of specified level of harm occurring, such as the chance of fatality per year.

There are two main types of risk which may be relevant:

The ***individual risk*** is the chance of a particular individual incurring a specified level of harm (e.g. fatality). Individual risks are generally calculated for a hypothetical individual at a particular location, such as a member of a residential population who spends all their time at home, or a worker who spends say 25% of their time at a work location. Individual risks are often quoted in cpm (chances of occurring per million years).

The ***societal risk*** is a more complex measure which reflects the likelihood of numbers of people being affected in a particular event.

The societal risk can be characterised in a number of ways:

f-n pairs – A series of pairs of values for every possible major accident event, each pair giving the frequency (f) of the event and the number (n) of people affected by that event. This approach is rarely presented as there may be hundreds of such pairs.

FN curve – A graph which shows the cumulative frequency (F) of all events that could lead to N or more people being affected. This curve is derived from the basic f-n pairs, but is much easier to interpret.

Expectation Value (EV) or Potential Loss of Life (PLL) – The average number of people affected per year. It corresponds to the sum of the products of the f-n pairs, and is equal to the area under the FN curve. It provides a simple single measure of the societal risk, and is particularly useful in Cost Benefit Analysis (CBA).

Scaled Risk Integral (SRI) – A simple measure of societal risk devised by HSE for considering specific developments, which takes account of the number of people at the development, the risk to which they are exposed, and the area of the development.

The HSE is responsible for providing advice to Local Planning Authorities on proposed developments in the vicinity of major hazard sites in the UK. The HSE uses information provided by the site operators, generally in the Hazardous Substances Consent applications, to define the extents of 3 zones (Inner, Middle and Outer), which correspond to areas of progressively lower levels of risk. HSE's advice is provided through a system known as PADHI (Planning Advice for Developments near Hazardous Installations), and this system has now been disseminated for use by the Local Planning Authorities.

When a planning application is received by the Local Planning Authority (LPA) for a development which falls within the Consultation Distance (which is defined by the outer limit of the Outer Zone), the LPA uses a set of rules to determine the Sensitivity Level (1 to 4) of the proposed development, and then applies the following decision matrix (Table 3.1, reproduced from PADHI) to determine whether or not HSE would advise against the development, depending on sensitivity and location. The sensitivity levels range from the least sensitive, Level 1 (working populations which could easily respond to emergency actions), to the most sensitive, Level 4 (e.g. the elderly or children, who could not easily respond to emergency actions), with some variations to allow for size and density of developments.

Table 3.1 - HSE Decision Matrix for Land Use Planning

Level of Sensitivity	Inner Zone	Middle Zone	Outer Zone
Level 1	Don't Advise Against	Don't Advise Against	Don't Advise Against
Level 2	Advise Against	Don't Advise Against	Don't Advise Against
Level 3	Advise Against	Advise Against	Don't Advise Against
Level 4	Advise Against	Advise Against	Advise Against

It is noted that, although the HSE rules are designed to minimise the number of people exposed, it is possible that they would allow some population types but not others. The main reason for this is related to the 'sensitivity' of the population. For example, although an industrial or commercial development may be allowed within the Inner Zone, this could be deemed acceptable by HSE because:

a.) The personnel affected would only generally be present for around 25-30% of the time.

b.) A workforce would be expected to be subject to regular fire drills, would be able-bodied and would be expected to be able to respond in an emergency

3.2 Major Hazards from Gasholder Site

The gas holder site is capable of storing around 215t of natural gas. It is used for around 6 months of the year (during winter) as a buffer store to smooth out the peaks of demand, in order to match this demand to a reasonably constant supply. The gas holders are filled during the night, and emptied during the day.

Natural gas comprises around 95% methane. Methane is a highly flammable gas, which can also explode if ignited within a congested region, but will more usually burn without any accompanying high overpressures. It is less dense than air, and hence will begin to rise if it is released into the atmosphere. For this reason, it is less likely to ignite than some other materials, such as LPG (propane/butane) which, since it is denser than air, will disperse at ground level.

Whilst the likelihood of a release of gas is relatively low, there is always a chance that corrosion, structural failure, human error or third party activity could lead to an accidental release. The severity of the incident will depend on the size of the breach, which could be anything from a tiny pinhole to catastrophic rupture. The main types of major accident event which could occur at the gas holder site would result from the ignition of a flammable release and are:

Fireball – If a large release of gas is ignited within a few seconds then a large fireball lasting 10 to 15 seconds may be produced, with very high levels of thermal radiation in all directions.

Jet Fire – Any ignition of gas will burn back to the point of release and may form a jet fire if the release is under pressure. Depending on the nature of the failure, the jet fire may be directed horizontally or vertically. Jet fires continue to burn for as long as the release of gas is not isolated, and the prolonged thermal radiation (or flame impingement) can lead to significant risks, although the impact tends to be relatively local.

Flash Fire – If a release of gas is not ignited within a few seconds of the release, then a cloud of gas will disperse downwind some distance from the point of release. If this cloud then finds a source of ignition, the area covered by the vapour cloud will burn rapidly as a flash fire, with significant risks to all those within the flash fire envelope. The flash fire would probably be followed by a jet fire.

Vapour Cloud Explosion – This is similar to a flash fire, except that, if the vapour cloud is in a partially confined area, then the ignition of the cloud could also lead to a vapour cloud explosion (VCE), generating significant levels of blast overpressure, which would present a risk to people beyond the flash fire envelope.

For the gas holder site, the main concern is a major fireball following catastrophic vessel failure, but lesser events, such as flash fires and VCEs, could also have off-site impact. Jet fires tend to be more local in their effects. Since any release from the gas holder will be at low pressure, the 'jet fire' type event will not have significant momentum, and in many cases would form a vertical wall of flame around part of the circumference of the gas holder, described in this assessment as a seal fire. Also, as noted above, the buoyancy of the natural gas will make it less likely to ignite downwind, and this effect has been accounted for in the QRA modelling.

Most credible fire events are relatively limited in extent (see Section 4). However, the worst case events, fireballs which could involve the complete contents of a single gas holder (i.e. up to 92t), can cause significant damage and potential fatality for distances of order hundreds of metres. It is the inclusion of such events, previously considered as 'incredible', which has caused HSE to increase their Consultation Distance at this site from 60m to around 300m.

3.3 Application of PADHI to Proposed Development

The primary risk which has been identified at the site is a fireball, either from a complete holder collapse (100% of holder contents involved), or from a decoupled seal (50% of holder contents involved). In practice, the decoupled seal events are taken by HSE to define the land use planning zones since complete holder collapse events are much less likely.

A fireball could occur as the result of the immediate ignition of a large volume of gas released to the atmosphere. For the quantities of gas within the Bethnal Green gas holders, the fireball radius (FBR) is of order 100m, and the duration of the event is around 15 seconds. The effects of a fireball are as follows:

a) Within the FBR, there is a high probability that anyone exposed, either outdoors or indoors, could become a fatality. This is taken as the boundary of the Inner Zone.

b) The next level of hazard relates to a normal person exposed outdoors receiving a 'Dangerous Dose', which is a combination of thermal radiation (I, in units of kW/m^2)

and exposure time (t, seconds) such that $I^{4/3}t$ = 1000 thermal dose units (tdu). This is taken as the boundary of the Middle Zone.

c) The final level of hazard relates to a sensitive person exposed outdoors receiving a 'Sensitive Dose', which is set at $I^{4/3}t$ = 500 thermal dose units (tdu). This is taken as the boundary of the Outer Zone.

The use of the PADHI matrix shown in Table 3.1 then requires an assessment of the sensitivity category of the development. From the PADHI sensitivity table (see excerpt in Appendix B), it can be seen that up to 30 units of housing would be considered to be Sensitivity Level 2 (DT2.1). There is an exception, however, such that the housing density should not exceed 40 units/ha. In this case, there are 14 units in an area of 0.056ha, which gives a density of around 250 units/ha, and therefore moves the development into Sensitivity Level 3 (DT2.1X3). From Table 3.1, it can be seen that this would be allowed within the Outer Zone, but would not be allowed within the Middle or Inner Zones.

The Inner Zone extends to around 100m from the centres of the gas holders, and, as can be seen in Figure 2.3, the proposed development is completely covered by this zone. It is also noted that the earlier HSE assessments gave a Consultation Distance of 60m from the edge of the larger gas holders. In either case, the HSE screening tool would provide an initial 'Advise Against' decision.

As an alternative to the above hazard-based approach, HSE also use the concept of Dangerous Dose, which is sometimes taken to represent a probability of fatality of around 1% for an average population, but is generally taken to correspond to a level of harm which would cause:-

- Severe distress to almost everyone.
- A substantial fraction of the exposed population needing medical attention.
- Some people to be seriously injured, requiring prolonged treatment.
- Any highly susceptible people possibly being killed.

When HSE use this concept, they determine the risk to an individual of receiving a Dangerous Dose or more of whatever harm is being considered. The Inner Zone is then set at 10cpm of exceeding the Dangerous Dose, the Middle Zone at 1cpm, and the Outer Zone at 0.3cpm. It is noted, however, that Societal Risk calculations are generally based on the risk of fatality.

4. ASSESSMENT OF RISKS FROM GASHOLDER SITE

4.1 Site Description

National Grid's Bethnal Green gas holder site occupies an area of around 150m x 150m to the SW of Regents Canal in the northern part of the borough of Tower Hamlets. It includes 4 gas holders of the cup and grip water seal type, each of which consists of a series of co-axial cylinders which are able to rise and fall depending on the quantity of gas to be stored. Each cylinder is sealed against the next one by a series of water-filled troughs which are replenished as each seal drops back into the bottom cylinder, which acts as a reservoir. The details of the gas holders are as follows:

- No 1 4 lifts 26 t capacity
- No 2 2 lifts 19 t capacity
- No 4 3 lifts 78 t capacity

- No 5 3 lifts 92 t capacity

The typical operational profile for a gas holder is as follows. Gas holders are not used for 5-6 months in a year so they are at minimum stock level. The gasholders are in operation for 6-7 months in the year and the normal operating model is that the gasholders are filled and emptied on a diurnal cycle; they are filled from approximately 22.00 hours to 06.00 hours and emptied from 06.00 hours to 22.00 hours.

In addition to the gas holders, there is pipework connecting this storage to the main gas network. Most of this pipework is 36" diameter and is buried, although there are some smaller sections of 24" and 30" diameter above ground. There is around 600m of pipework on the site above and below ground, together with a number of valves. These valves are mostly situated to the west of the site. Indeed, the closest approach of any overground pipework to the site boundary adjacent to the development at 33 - 37 The Oval is around 70m. The gas holders and much of the pipework are at low pressure, although there is some of the distribution pipework which is up to around 7 bar.

4.2 Existing Assessments

4.2.1 HSE

The assessment undertaken by HSE is based upon their standard methodology as described in Section 3.3. The reasons for using the specific event (decoupled seal resulting in fireball involving 50% of maximum contents) as a basis for setting the zones are based upon a recent review of gas holder accident statistics. This review identified a number of such large ignited events in the early part of the 20th century, and used these to demonstrate that such events were credible enough to form the basis of the Land Use Planning Zones.

It should be noted that HSE's assessment on this basis primarily considers 'credible' consequences, and does not constitute a complete Quantified Risk Assessment (QRA); in order to do so, it would have to include some of the lesser events which have higher frequencies but shorter hazard ranges. Whilst this would not affect the planning zones significantly, inclusion of such events is relevant to the risk at locations close to the gas holders, such as the development under consideration at The Oval.

In summary, therefore, it is emphasised that the HSE assessment is primarily a high-level screening tool which allows simplified and consistent responses to be made to individual planning cases.

4.2.2 National Grid COMAH Report

Since the site has potential hazardous storage which exceeds the COMAH threshold, a Safety Report, demonstrating that the risks are being managed to a level which is As Low As Reasonably Practicable (ALARP), has been produced by the operator, National Grid. This document includes a section on 'Hazard Information', which identifies possible accidental events, and provides estimates of the effects of such events. A copy of the relevant section (Section 4), together with the hazard range contours from Appendix 5, was supplied by National Grid in order to assist with this assessment.

The events considered are:

- Split in 750mm medium pressure pipework
- Release through water tank seal

- Cup and grip seal failure
- Fracture of 750mm pipework
- Fracture of 600mm pipeline
- Decouplement
- Total loss of inventory of gas holder
- Gasholder internal explosion (Split Crown explosion)
- Release of gas holder water
- Firewater runoff

The last two of these were included in order to cover potential environmental effects, and will not be considered in this study. For the remaining cases, calculations were provided, where appropriate, of the dispersion of gas releases in wind speeds of 2, 5 & 10 m/s, so that worst case effects could be identified. Distances to the Lower Flammable Limit (LFL) were given, which showed the hazard ranges for flash fires.

Results for fires were presented in the form of distance to the following effects:

- 1000 tdu, representing serious injury or 1% fatality probability
- 1 kW/m^2, representing minor burn injury (skin blistering)
- 15 kW/m^2, representing piloted ignition of wood

Results for explosions were presented in the form of distances to the following effects:

- 40 mbar, representing 90% window glass breakage
- 200 mbar, representing serious structural damage to buildings

The greatest hazard ranges occur for total loss of inventory of gas holder, for which minor burn injury distances ranged from 320m for Gas Holder 2 to 580m for Gas Holder 5. These are closely followed by the hazard ranges for decouplement, for which minor burn injury distances ranged from 250m for Gas Holder 1 to 350m for Gas Holder 5. (Gas holder 2, containing only 2 lifts, was not considered to be capable of decouplement.) The cup and grip seal failure events gave minor burn injury distances which ranged from 71m for Gas Holder 1 to 90m for Gas Holder 5. The release through water tank seal events gave minor burn injury distances of around 40 - 60m.

The greatest hazard ranges for releases from pipework are a dispersion distance of 77m (flash fire distance), and 57m for minor burn injury, both associated with the fracture of 750mm pipework. The gasholder internal explosion events gave hazard ranges for 90% window glass breakage which ranged from 120m for Gas Holder 2 to 205m for Gas Holder 4.

The information which was supplied did not include any estimates either of the frequency of these events, nor of their severity (i.e. number of people affected). Both these issues are important in the present context, since most of the large hazard range events would have extremely low frequencies. In addition to this, the ranges of many of the smaller events would either not extend beyond the gas holder site, or would only affect small numbers of people occupying nearby industrial premises.

4.2.3 Institution of Gas Engineers

Whilst not an assessment which is specific to this site, the Institute of Gas Engineers and Managers has produced a publication (Reference 1) which provides safety recommendations in relation to developments around gas holder sites. These set a distance of 18m within which buildings would not normally be allowed, on the basis that gas released from minor leaks on the gas holder seals could be drawn into any building within this distance and reach an ignition source. This rule of thumb is based upon calculation of the dispersion of gas from typical seal leaks in a range of credible wind speeds.

For example, it is found that the lighter-than-air methane will rise at low to moderate wind speeds, and is only likely to affect low level locations beyond 18m in high wind speed conditions which are relatively rare. The 18m value is derived from the dispersion calculations for a 5m/s wind in neutral (D stability) conditions, which is generally typical for prevailing winds in the UK (see Section 4.4.2).

4.3 Hazard Identification/Screening

The National Grid COMAH Report for the Bethnal Green site (Reference 2), along with the HSE Safety Report Assessment Guide for Methane Gas Holders (Reference 3), have been reviewed as part of the Hazard Identification process. The following represents a complete list of generic gas holder hazards, which have been identified within either of these reports;

- Catastrophic gas holder failure - 100% contents into fire ball / flash fire
- Split crown accident - 100% contents into fire ball / flash fire
- Decoupled lift - 50% contents into fire ball / flash fire
- Water seal failure over 10m - seal fire / flash fire
- Waterless seal failure - internal explosion
- Puncture of holder, 1m diameter - wall fire / flash fire
- Overfill - ignited flare
- Filling/export line failure at worst case locations
- Pipeline rupture - fireball / jet fire / flash fire / Vapour Cloud Explosion (VCE)
- Pipeline puncture - fireball / jet fire / flash fire / VCE
- Pipeline small leak - jet fire / flash fire
- Pressure regulator failure – VCE

Of the list of generic hazards above, a number of hazards are not considered to be credible at the Bethnal Green site. These hazards omitted from this QRA have been identified in Table 4.1 below along with a justification for their exclusion.

Table 4.1 - Hazards excluded from consideration within this study

Hazard description	Justification for exclusion of hazard
Catastrophic holder failure / Decoupled lift - flash fire	The density of methane (and hence its buoyancy) is such that any instantaneous release of a large volume would rise at such a rate as to clear the dispersing cloud of any potential delayed ignition source. (Note that instantaneous ignition is considered with the fireball event, and the consequences of any other ignited release would be bounded by that event).
Split crown - flash fire	Split crown events are caused by over extraction of gas from the holders, which creates abnormal stresses on the domed head of the holder in a near empty scenario. In this instance it is hard to envisage a release of a significant volume of methane from the gas holder.
Waterless seal failure - internal explosion	The gas holders in question are water sealed.
1m diameter puncture of holder wall	The causes of such an event are considered extremely unlikely. The holders are protected by concrete bollards and the perimeter of the site is fenced off from public access. Catastrophic failure of the holders has been considered to account for failure by earthquakes, aeroplane collision etc. Note that the National Grid COMAH document for the Bethnal Green site has also omitted this event.
Pipeline puncture - fireball / jet fire / flash fire / VCE	For the purpose of Location Specific Individual Risk calculations, these events are bounded by the rupture of the 30” diameter pipework at the worst case location.
Pipeline small leak - jet fire / flash fire	For the purpose of Location Specific Individual Risk calculations, these events are bounded by the rupture of the 30” diameter pipework at the worst case location.
Pressure regulator failure – VCE	For the purpose of Location Specific Individual Risk calculations, these events are bounded by the rupture of the 30” diameter pipework at the worst case location.
Decouplement of Gas Holder No. 2 only	This gas holder comprises two lifts which makes decouplement highly unlikely. Note that this is consistent with the National Grid COMAH document for the Bethnal Green site.

The list of hazards considered within this Quantitative Risk Assessment is therefore:

- Catastrophic failure - fireball
- Split crown - VCE
- Decouplement of lifts - fireball
- Water seal failure - seal fire
- Water seal failure - flash fire
- Overfill jet fire
- Pipework rupture - flash fire
- Pipework rupture - VCE

- Pipework rupture - jet fire

4.4 QRA input data

The following is a summary of the key inputs into the Atkins Quantitative Risk Assessment software RiskTool, which has been used for many similar assessments, and has also been used in some recent studies for HSE.

4.4.1 Population Information

The population data supplied by Tower Hamlets are given in Appendix A. These are used in the RiskTool modelling in different ways, depending upon the amount of time particular groups are likely to be present. For example, it is assumed, as a worst case, that the residential population will be present for 100% of the time, whereas the employee population will only be present during the working day. The major hazard events which have been modelled may also have different effects depending on whether the persons affected are indoors or outdoors. The risk modelling takes this into account, and assumes the following:

Table 4.2 - Assumptions on population locations

Time Period	Indoor	Outdoor
Day time	90%	10%
Night time	99%	1%

The situation for sensitive populations is not so simple. For example, schools and day centres will only generally be occupied during the day, whereas any hospital / care institutions would be occupied 24 hours per day. The only such facility considered in Appendix A is St Joseph's Hospice, for which the 'residential' assumption is used. All other sensitive locations identified will be treated in the same way as for the employee population, and will be considered to be present only during the day time.

4.4.2 Weather data

Some of the events identified involve the dispersion of gas released from pipework, or from the gas holders. The consequences of such releases will depend upon the wind speed and direction, and dispersion modelling has been undertaken for typical and worst case conditions. These are F2, D5 and D8 conditions, where the notation, which is standard in this context, is:

F	-	Stable conditions (light wind, little mixing)
D	-	Neutral conditions (higher wind, turbulent mixing)
2	-	Wind speed = 2 m/s
5	-	Wind speed = 5 m/s
8	-	Wind speed = 8 m/s

The low wind speed (F2) is chosen since it normally represents a worst case, in which the mixing is suppressed. In this case, any gas released will rise because of the buoyancy effects, but could become deflected back towards ground level (where it is more likely to encounter an ignition source) in higher wind speeds; hence the use of the extra D8 weather category.

Wind directional probabilities are taken from Heathrow Airport data, and are shown in Table 4.3 below. The direction represents that from which the wind is blowing.

Table 4.3 - Wind directional probability

Wind Direction (^{o} from N)	341 - 10	11-40	41 - 70	71-100	101-130	131-160	161-190
Probability (%)	7.57	9.50	6.24	4.99	3.87	3.54	8.26

Wind Direction (^{o} from N)	191-220	221-250	251-280	281-310	311-340	Calm	Total
Probability (%)	15.04	13.39	10.97	7.22	7.12	2.26	99.97

The probabilities associated with the wind speed conditions identified above are:

F2 - 20%

D5 - 79%

D8 - 1%

It is noted that the National Grid COMAH document uses D10 as the high wind speed condition. However, since analysis of the Heathrow data indicated that such high values were of extremely low probability, the D8 category was chosen on the basis that it would be expected for around 1% of the time.

4.4.3 Harm criteria

This QRA has been undertaken to determine the risk of fatality to people either indoors or outdoors. The criteria applied depend on the type of effect and the type of event, and there is also some allowance made for the protection afforded by being indoors. These criteria are set out for the various event types below.

Risks of fatality have been calculated using probit equations (Reference 5), which relate the dose received to the probability of a particular level of harm, such as fatality. The probit is a non-dimensional number which relates to a specific probability of fatality via the Normal Probability Distribution, as shown in Table 4.4.

Table 4.4 - Relationship between probit and fatality probability

Probit	**Probability of Fatality**
2.67	1%
5.00	50%
7.33	99%

The precise relationship between the probit Y and probability is defined by:

$$Probability = \frac{1}{\sqrt{2\pi}} \int_{u=-\infty}^{u=Y-5} \exp\left(-\frac{u^2}{2}\right) du$$

where u is an integration variable.

Explosion

The blast overpressure and impulse effects associated with vapour cloud explosion events have the potential to cause injury/fatality to building occupants by:

- causing building collapse;
- generating missiles which impact the occupants; or
- propelling occupants against structures.

To predict the probability of occupant fatality due to explosion effects, vulnerability curves are presented in Reference 4. These curves depict the relationship between the peak side-on blast overpressure and the probability of occupant fatality for 4 different building types:

1 - Hardened structure building: special construction, no windows.

2 - Typical office block: four storey, concrete frame and roof, brick block wall panels.

3 - Typical domestic building: two storey, brick walls, timber floors.

4 - 'Portacabin' type timber construction, single storey.

The curve chosen (Curve 2) is considered to be representative for the proposed development, as can be seen from Figure 2.2.

For those personnel outdoors, a probit relationship is used to estimate the probability fatality resulting from the predicted level of blast overpressure. The probit implemented into RiskTool is:

Probit = 1.47 + 1.35 ln(P), where : P = overpressure (psi)

Fireball, jet fire, seal fires

Scenarios involving the release and ignition of flammable substances have the potential to cause fatalities by exposing individuals to high thermal radiation "dose" levels.

For fireballs, a probit relationship (Reference 6) is used to estimate the probability of fatality resulting from the predicted thermal dose indoors. The probit implemented in RiskTool is:

Probit = -14.9 + 2.56 ln(tdu)

where :

tdu = 3150 R^2/x^2 -150 (Reference 7)

R = fireball radius (m)

x = distance from fireball (m)

For jet fires, the probability of fatality indoors is assumed to relate to the thermal radiation level outdoors (I) according to the following criteria (Reference 8) :

$I > 25.6$ kW/m^2 outdoors	implies 100% fatality indoors
$14.7 < I < 25.6$ kW/m^2 outdoors	implies the same fatality probability as outdoors (i.e. people indoors would try to escape)
$I < 14.7$ kW/m^2 outdoors	implies 0% fatality indoors

For those personnel not located in buildings, the same thermal dose response probit relationship is used to predict the probability of fatality from all thermal radiation effects. However, in this case, the outdoor thermal dose is used ($tdu=I^{4/3} \times t$) (Reference 9).

An exposure time (t) is required in order for the probability of fatality to be derived, and this is an output only from the fireball model. However, for this assessment an exposure time for the effects of jet fires of 20 seconds is used for persons located outdoors, after which time it is assumed that they will have escaped to a place of safety (Reference 10).

Flash fires

In general, flash fires only present a hazard to those personnel trapped or located within the flammable envelope of the cloud, although flame penetration may also occur through open or failed windows and doors. For people adjacent to a window, it is reasonable to assume that the effects of flame penetration will be the same as if they were outside. For people not adjacent to windows, the direct effects of flame penetration are not so easily defined.

Even if flame penetration does not occur, occupants may be exposed to heat radiated through windows. The resulting thermal dose may be sufficiently high to cause 50% fatality for an average population adjacent to the window, although the thermal dose drops significantly (equivalent to less than 1% fatality at 0.7 m) away from the window (Reference 11).

In the event of a flash fire, approximately 5% of those who are sheltered by typical domestic housing will be fatalities as a result of secondary fires (Reference 9). Based on the above discussion, the probability of fatality indoors, within the outdoor LFL envelope, is taken to be 10% (best estimate).

For those persons located outdoors, it is assumed that if they are located within the potential envelope of the un-ignited cloud (i.e. the area covered by the LFL), then the probability of fatality is 1 in the event of ignition (Reference 12).

Dangerous Dose criteria

Risk calculations have also been undertaken using the 'Dangerous Dose' concept, for direct comparison with the way in which HSE set the planning zones (see Section 3.3). The criteria used for this part of the assessment are given below:

	Outdoor	**Indoor**
Fireballs	1000 tdu	1000tdu

VCEs from holders	140 mbar	140 mbar
Seal fires and jet fires	1000 tdu	1000 tdu
Flash fires	100% in cloud envelope	0% in cloud envelope

4.5 Consequences of Major Hazard Events

This section represents a summary of the manner in which the major hazards have been modelled in order to determine their consequences.

The Quantitative Risk Assessment carried out has been based on a limited amount of available site data. In a small number of instances, where site data have been insufficient to determine hazard consequences, the consequence results of the National Grid COMAH study have been replicated within this report by adjusting modelling inputs. Below is a summary of the data which have been obtained in this manner;

1. The release rate from seal leaks has been taken as 1.35m^3/s per metre of water seal (as per Reference 13).
2. The release rate from pipework ruptures has been matched to National Grid dispersion results to give 15 kg/s from a rupture of the 30" line. Note that the 36" pipe line at the site is buried beneath the ground.
3. The overpressures created by split crown VCE events have been calculated using 1.5% of the volume of the gas holder maximum working capacity. This value has been taken based upon matching the 'distance to overpressure' results presented by the National Grid.

For consequences which depend on the wind, the conditions used have been taken as F2, D5, D8 (see Section 4.4.2).

4.5.1 Fire Modelling

Fireballs

For the purposes of this study, the fireball resulting from a catastrophic failure being ignited immediately has been assumed to involve the full contents of the gas holder (50% for decouplement events). The fireball has been assumed to be just touching the ground and to have a diameter (D) given in terms of the mass of fuel M_F (kg) (Reference 14) by:

$D = 5.8\ M_F^{1/3}$ (metres)

The fireball duration (T) in seconds is given as (Reference 15):

$T = 0.45\ M_F^{1/3}$ for $M_F < 37{,}000$ kg

$T = 2.59\ M_F^{1/6}$ for $M_F > 37{,}000$ kg

The level of thermal radiation has been based on the solid flame model as described by Crossthwaite (Reference 7). The thermal radiation is given by:

$I = F\ E\ t_a$

where:

I = Thermal radiation intensity (kW/m^2)

F = View Factor

E = Surface emissive power (kW/m^2).

t_a = Atmospheric transmissivity, taken as 1 – 0.0565 ln(x – R) for x>R+1

x = Horizontal distance between receptor and fireball centre (m)

R = Fireball radius (m)

Flash fires

For flash fires, dispersion to the Lower Flammable Limit values has been modelled using the HGSYSTEM HEGADAS-S code within CIRRUS, with a surface roughness of 0.3m to represent the suburban environment.

The consequences of flash fires are calculated in terms of the flammable gas concentration versus distance, with the length of the region covered by the flash fire taken to be the distance to the Lower Flammable Limit. Within the modelling, the effects of flash fires are represented as a step function; i.e. the probability of fatality outdoors within the cloud area is one, whereas outside the cloud area it is zero. No account has therefore been taken of any distance/heat radiation decay relationships when assessing flash fire hazards. For indoor populations, the probability of fatality is 10% within the LFL envelope, and 0% outside of this boundary.

Jet fires

Jet fires have been modelled using the SHELL Chamberlain Jet Flame Model which has been coded within the Atkins RiskTool computer code.

Seal fires

Thermal radiation from seal fires has been modelled using a simple 'point source' model. Modelling has assumed a release rate of $1.35m^3/s$ per meter of water seal (as per Reference 13). A value of 0.3 has been taken as the proportion of the heat of combustion emitted from the fire.

4.5.2 Explosion Modelling

Vapour cloud explosions

The consequences of vapour cloud explosions have been modelled using the TNO 'Multi-Energy' model (Reference 16), with explosion strength 7. The overpressure effects from the explosion are determined by the material involved in the explosion and the volume of the gas cloud. This volume has been estimated on the basis of the lateral and vertical extent of flammable clouds suggested by dispersion modelling, and by the estimated volume of nearby congested plant areas where build-up of gas is possible, as follows:

> For VCE from a pipeline release, the combustible volume was calculated based upon site drawings, and estimation of the volume of congested areas close to the source of the leak (between the 'valve room', 'MEG storage tank' and Gas Holder 4. The stoichiometric mixture of the cloud of air/methane was then used in explosion calculations. Where the estimated flammable cloud volume was less than the maximum congested volume, the calculated lower value was used in the explosion modelling.

Split crown explosions

The overpressures created by split crown VCE events have been calculated using a 1.5% volume of the gas holder maximum working capacity. This value has been taken based upon a back calculation from the 'distance to overpressure' results presented within the National Grid COMAH report.

4.6 Frequencies of Major Hazard Events

Base event frequencies

The base case frequencies for the hazards considered are summarised below. These frequencies relate to the unignited releases, except where otherwise indicated. The probability of ignition for the various events is described later in this section.

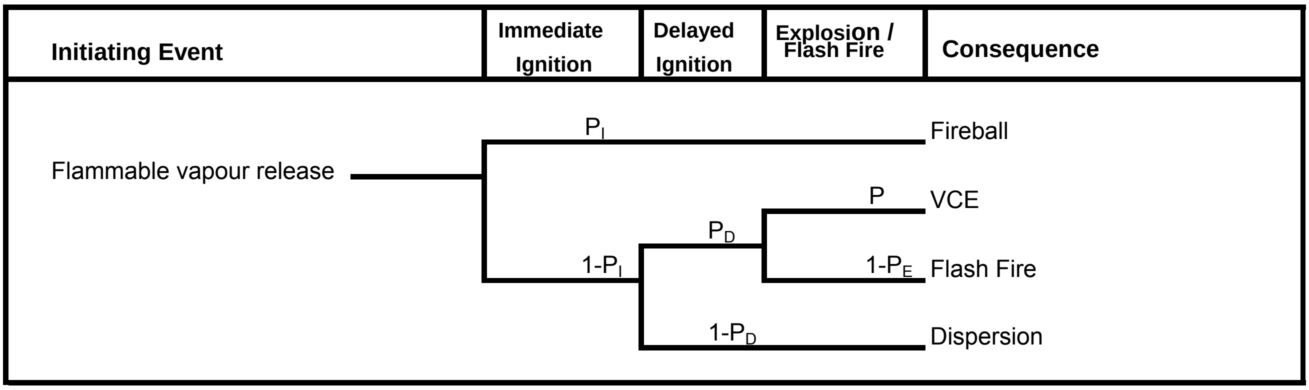
Table 4.5 - Initiating event frequencies used in QRA

ID	Initiating event	Frequency (/ holder / yr)	Reference for initiating frequency
a	Catastrophic vessel failure	2.00E-06 +	Appendix C Table C7
b	Split crown event	1.00E-06 +	See 'Ignition probabilities' section below
c	Decouplement of lifts	2.00E-05 +	Appendix C Table C7
d	Seal failure	1.40E-03	Appendix C Table C5
e	Overfill event	5.60E-04	Appendix C Table C5
f	Pipework rupture	3.10E-04	Reference 17
g	Pipework major leak	8.47E-03	Reference 17
h	Pipework minor leak	8.08E-02	Reference 17

+ value includes probability of ignition

The following diagram shows a graphical representation of the events which may follow a flammable vapour release. Each branch of this event tree represents a different conditional probability of ignition.

Flammable release event tree



Ignition probabilities

The ignition probabilities for the catastrophic failure and decouplement events (labelled a and c in Table 4.5 above) have already been factored in to the event frequencies calculated from historical data in Appendix C. For the case of a split crown VCE event, an ignited split crown event frequency of 10^{-6} has been used, based upon the re-assessment which HSE has quoted in some of their more recent Panel Papers. For the remaining continuous release events, the ignition probability varies depending upon the release rate. These ignition probabilities have been calculated using Reference 17 and are summarised below in Table 4.6.

Table 4.6 - Ignition probabilities used for continuous releases (Reference 17)

Ignition event	Release rate (kg/s)	Ignition Probability	
		Immediate	Delayed
Gas holder 1 overfill	0.79	4.19E-03	*
Gas holder 2 overfill	0.58	3.98E-03	*
Gas holder 4 overfill	2.35	5.05E-03	*
Gas holder 5 overfill	2.84	5.21E-03	*
Gas holder 1,2,4,5 seal fail	9.20	6.42E-03	5.97E-02
30" pipe release	15.00	6.92E-03	8.07E-02

* All such events considered to be immediate ignition

Wind direction

Historical data taken from Heathrow airport weather station have been used to determine the probability of the wind blowing from various sectors of the wind rose. These data are represented in Table 4.3 above.

Seal fire probability

Seal fires could occur at any point on the circumference of the gas holders. In order to keep the total number of events modelled in RiskTool manageable, each gas holder has been divided into 4 quadrants, and the seal fire probability split equally between each location. For offsite risk determination, not all of these points on the circumference of each holder will radiate outwards from the gas holder site in the case of a seal fire. Therefore the quadrants have been arranged using site plans to ensure that the offsite effects (in particular those at the development site, and at other nearby densely populated sites) are realistically and conservatively modelled.

4.7 Overall Risk Assessment

4.7.1 Presentation of results

The following is a summary of the frequency and consequence data used in the Quantitative Risk Assessment (Table 4.7).

Table 4.7 - Summary of Frequency and Consequence Data for all hazards analysed

Vessel	Event	Frequency with ignition (/yr)	Consequence criterion & units	Approx hazard range to criterion (m)
GH1	Catastrophic failure fireball	2.00E-07	FB radius	82.0
GH1	Decouplement fireball	2.00E-06	FB radius	65.0
GH1	Seal failure seal fire	6.75E-06	1000 tdu	23.0
GH1	Overfill jet fire	2.35E-06	1000 tdu	31.0
GH2	Catastrophic failure fireball	2.00E-07	FB radius	74.0
GH2	Seal failure seal fire	6.75E-06	1000 tdu	23.0
GH2	Overfill jet fire	2.23E-06	1000 tdu	28.0
GH4	Catastrophic failure fireball	2.00E-07	FB radius	118.0
GH4	Decouplement fireball	2.00E-06	FB radius	94.0
GH4	Seal failure seal fire	6.75E-06	1000 tdu	23.0
GH4	Overfill jet fire	2.83E-06	1000 tdu	44.0
GH5	Catastrophic failure fireball	2.00E-07	FB radius	126.0
GH5	Decouplement fireball	2.00E-06	FB radius	100.0
GH5	Seal failure seal fire	6.75E-06	1000 tdu	45.0
GH5	Overfill jet fire	2.92E-06	1000 tdu	30.0
30"	Pipework rupture jet fire	2.14E-06	1000 tdu	107.0
GH1	Split crown VCE	1.00E-06	200 mbar	44.0
GH2	Split crown VCE	1.00E-06	200 mbar	39.0
GH4	Split crown VCE	1.00E-06	200 mbar	60.0
GH5	Split crown VCE	1.00E-06	200 mbar	67.0
30"	Pipework rupture VCE	3.74E-06	200 mbar	60.0
GH1	Seal failure flash fire (F2)	1.12E-05	5% vol	18.6
GH1	Seal failure flash fire (D5)	4.41E-05	5% vol	13.7
GH1	Seal failure flash fire (D8)	5.58E-07	5% vol	11.5
GH2	Seal failure flash fire (F2)	1.12E-05	5% vol	18.6

Vessel	Event	Frequency with ignition (/yr)	Consequence criterion & units	Approx hazard range to criterion (m)
GH2	Seal failure flash fire (D5)	4.41E-05	5% vol	13.7
GH2	Seal failure flash fire (D8)	5.58E-07	5% vol	11.5
GH4	Seal failure flash fire (F2)	1.12E-05	5% vol	18.6
GH4	Seal failure flash fire (D5)	4.41E-05	5% vol	13.7
GH4	Seal failure flash fire (D8)	5.58E-07	5% vol	11.5
GH5	Seal failure flash fire (F2)	1.12E-05	5% vol	18.6
GH5	Seal failure flash fire (D5)	4.41E-05	5% vol	13.7
GH5	Seal failure flash fire (D8)	5.58E-07	5% vol	11.5
30"	Pipework rupture flash fire (F2)	4.24E-07	5% vol	18.6
30"	Pipework rupture flash fire (D5)	1.67E-06	5% vol	13.7
30"	Pipework rupture flash fire (D8)	2.12E-08	5% vol	11.5

The integration of frequencies and consequences from the identified hazards has been conducted using RiskTool. Table 4.8 below gives a summary of the Individual Risk output from the software for the proposed development (nearest & furthest) for a residential population present 100% of the time, and the percentage contribution of each scenario to these risks is also shown. The effective risk for an office worker, present for 25% of the time at the nearest part of the development, will be around 3cpm.

Table 4.8 - Location Specific Individual Risk Results (cpm) at development

Location	Development nearest	Development furthest
Risk	**11.7 [15.4]**	**5.7 [8.9]**
Fireballs	58%	94%
Split crown VCEs	8%	4%
Seal fires	33%	0%
Jet Fires	<1%	<1%
Flash Fires	<1%	0%
Pipework events	1%	1%

Note: Risks quoted are Individual Risk of Fatality; Risks of receiving a Dangerous Dose or more are given in parentheses []

Since there are uncertainties in the modelling, some sensitivity cases have been undertaken. The variants which have been covered are indicated below, and the results are given in Table 4.9:

Increased Fireball Freq	Ignition probability increased from 0.1 to 0.5
Decreased VCE mass %	0.75% holder volume used (instead of 1.50%)
CIA building Category 1 or 3	Instead of CIA building Category 2

.

Table 4.9 - Sensitivity of Individual Risk Results (cpm) at development

Location	Development (nearest)		Development (furthest)	
	Fatality	Dangerous Dose	Fatality	Dangerous Dose
Base Case	**11.7**	**15.4**	**5.8**	**8.9**
Increased Fireball Freq	40.4	51.6	28.4	45.1
Decreased VCE mass%	11.3	15.4	5.6	7.9
CIA building Category 1	10.7	15.4	5.5	8.9
CIA building Category 3	11.9	15.4	6.1	8.9

Estimates of Societal Risk are also given, in the FN curve shown in Figure 4.1.

4.7.2 Robustness of results

Risks have also been calculated on a Dangerous Dose basis (see Section 4.4.3), and the results were found to be broadly consistent with the current HSE planning zones. The sensitivity studies reported in Section 4.7.1 have shown that the predicted ranges on a risk of fatality basis are 11-40 cpm at the western site boundary and 6-28 cpm at the eastern site boundary. The value of 11.7 cpm for the base case ('nearest') is therefore considered to be representative of the actual risk of fatality at the development.

A further consideration is the magnitude of the Societal Risk. The FN Curve in Figure 4.1 lies between the HSE comparison lines, as would be expected for most Top Tier COMAH sites. Indeed, because the FN line is around an order of magnitude below the upper comparison line, the site would not be considered to have a particularly high societal risk. This arises because the area close to the gas holder site is currently primarily occupied by industrial or commercial, rather than residential, premises. Figure 4.1 also includes the FN curve for the pre-development case, identified as 'Pre-Development'.

5. DISCUSSION OF ISSUES

5.1 Individual risk considerations

The individual risk of fatality at 33-37 The Oval is estimated to be around 12 cpm for a typical residential population. This compares with the individual risk of receiving a *dangerous dose* of around 10 cpm (which corresponds to a risk of fatality of around 2-5 cpm) at the inner zone boundary. The results of this assessment are therefore clearly consistent with the screening process which is applied within the PADHI system: i.e. this value is high compared with the level at which HSE would Advise Against for any development containing more than a few people.

It is further noted (see comments below Table 3.1) that the risks to a workforce would be effectively reduced to around 3cpm since any individual would only be present for around 25% of the time. Within certain limits on the numbers of people involved, HSE would therefore not 'Advise Against' such non-residential developments at this location.

5.2 Comparison with other risks

In order to help understand the level of risk at the proposed development, it is worthwhile to compare it with historical data on the other risks to which people are typically exposed. HSE's 'Reducing Risks, Protecting People' document (Reference 18) provides some data on the risks to which people are routinely exposed. Some of this information is reproduced below, in terms of risk of fatality as annual experience per million, or chances per million years (cpm).

Annual risk of death (entire population)	10,309 cpm	(1 in 97)
Annual risk of cancer	2,584 cpm	(1 in 387)
Annual risk from all types of accident	246 cpm	(1 in 4,064)
Annual risk from all forms of road accident	60 cpm	(1 in 16,800)
Construction	59 cpm	(1 in 17,000)
Agriculture, hunting, forestry and fishing	58 cpm	(1 in 17,200)
Manufacturing industry	13 cpm	(1 in 77,000)

These risks can be compared with the additional annual risk for the most exposed people at the proposed development of up to about 12 cpm (once in 50,000 years) due to major accidents. For example, the annual risk of death for the most exposed person would increase by about 0.12% (from 10,309 to 10,321 cpm), and this increase would be less than a twentieth of the risk of dying in all types of accident.

5.3 Levels of Risk and their Acceptability

Based on the results in Section 4.7 it is estimated that the total level of individual risk of fatality for a resident at the new development is around 12 cpm. In order to set this level of risk in the context of typical major hazard risks, it can usefully be compared with standard risk tolerability criteria. The HSE's framework for judging the tolerability of risk is represented in Figure 5.1, and described in paragraphs 122 to 124 of R2P2 as follows:

> *The triangle represents increasing level of 'risk' for a particular hazardous activity (measured by the individual risk and societal concerns it engenders) as we move from the bottom of the triangle towards the top. The dark zone at the top represents an unacceptable region. For practical purposes, a particular risk falling into that region is regarded as unacceptable whatever the level of benefits associated with the activity. Any activity or practice giving rise to risks falling in that region would, as a matter of principle, be ruled out unless the activity or practice can be modified to reduce the degree of risk so that it falls in one of the regions below, or there are exceptional reasons for the activity or practice to be retained.*
>
> *The light zone at the bottom, on the other hand, represents a broadly acceptable region. Risks falling into this region are generally regarded as insignificant and adequately controlled. We, as regulators, would not usually require further action to reduce risks unless reasonably practicable measures are available. The levels of risk characterising this region are comparable to those that people regard as insignificant*

or trivial in their daily lives. They are typical of the risk from activities that are inherently not very hazardous or from hazardous activities that can be, and are, readily controlled to produce very low risks. Nonetheless, we would take into account that duty holders must reduce risks wherever it is reasonably practicable to do so or where the law so requires it.

The zone between the unacceptable and broadly acceptable regions is the tolerable region. Risks in that region are typical of the risks from activities that people are prepared to tolerate in order to secure benefits, in the expectation that:

- *the nature and level of the risks are properly assessed and the results used properly to determine control measures. The assessment of the risks needs to be based on the best available scientific evidence and, where evidence is lacking, on the best available scientific advice;*
- *the residual risks are not unduly high and kept as low as reasonably practicable (the ALARP principle – see Appendix 3 [of R2P2]); and*
- *the risks are periodically reviewed to ensure that they still meet the ALARP criteria, for example, by ascertaining whether further or new control measures need to be introduced to take into account changes over time, such as new knowledge about the risk or the availability of new techniques for reducing or eliminating risks.*

In terms of providing quantitative criteria to define these regions, paragraph 130 of R2P2 states that:

> *"HSE believes that an individual risk of death of one in a million per annum for both workers and the public corresponds to a very low level of risk and should be used as a guideline for the boundary between the broadly acceptable and tolerable regions."*

Paragraph 132 of R2P2 goes on to consider the boundary between the 'tolerable' and 'unacceptable' or intolerable region and concludes:

"For members of the public who have a risk imposed upon them 'in the wider interests of society' this limit is judged to be … 1 in 10,000 per annum".

As the risk of fatality for the most exposed people at the new development is considered to be up to about 12 cpm, or once in 80,000 years, it is reasonable to conclude that the maximum risks at the proposed development are about a factor of 12 times the level which would be regarded as insignificant (broadly acceptable), but a factor of 8 below the level at which they would be regarded as becoming intolerable. They are also rather higher than the levels which HSE would consider appropriate for a development of this nature.

5.4 Societal Risk due to Gasholder Site

In addition to the above individual risks being regarded as significant, it should be remembered that the worst case accident, involving a major fireball, could theoretically result in large numbers of people being affected in a single incident, although the likelihood of such a very severe event is very low (probably of the order of less than once in 120,000 years). This possibility of multiple fatalities may be regarded as a greater concern than the individual risks of around 12 cpm. There are few generally accepted criteria for judging the acceptability of such risks to groups of people, although paragraph 136 of R2P2 states that:

"HSE proposes that the risk of an accident causing the death of 50 people or more in a single event should be regarded as intolerable if the frequency is estimated to be more than one in five thousand per annum."

It is noted that HSE sometimes calculate another measure of societal risk known as the Scaled Risk Integral (SRI), as noted in Paragraphs 3c and 9 of Annex 2, which provides a simple approach which takes account of the most relevant factors. The methodology for calculating the SRI is described by Carter (Reference 19) and Hirst and Carter (Reference 20) as follows:

$$SRI = \frac{P \times R \times T}{A}$$

Where, P = population factor, defined as $(n + n^2)/2$

n = number of persons at the development

R = average level of individual risk (of exceeding dangerous dose) in cpm

T = proportion of time development is occupied by n persons

A = area of the development in hectares

Taking n = 46 people for 75% of the time and n=62 people (residents + workers) for 25% of the time, R = 12 cpm, and A = 0.056 ha (approximate area), gives:

$$SRI = \frac{(46 + 46^2)/2 \times 12 \times 0.75}{0.056} + \frac{(62 + 62^2)/2 \times 12 \times 0.25}{0.056} = 278{,}400$$

This is only an indicative calculation using maximum numbers of people present. Using a more typical occupancy of 35 people in the residential part of the development gives an SRI of 170,000. Both these results are close to the value of 500,000, above which HSE would consider recommending call-in (see Annex 2, paragraph 3c of R2P2), but they are not sufficiently low that HSE would be unconcerned by the societal risk associated with the development.

Clearly, however, the introduction of up to 62 people at the development will increase the societal risk. This increase can be seen in Figure 4.1, where there is an increase in frequency in the range of 5 - 500 fatalities. The PLL is increased from 2.77×10^{-3} without the development, to 3.67×10^{-3} post-development. It can therefore be seen that the development would increase the PLL by around 32%. It is noted, however, that the post development PLL is still a factor of around 20 below that which applies to the HSE upper comparison limit on Figure 4.1.

5.5 Potential for Risk Reduction

The results presented in Section 4 have shown that the Individual Risk at 33-37 The Oval is calculated to be around 12cpm. It has also been shown that there are significant uncertainties in some of the modelling, but that the prediction is considered to be a cautious best estimate. On the basis of the 'best estimate' modelling, this risk is derived from the following types of event:

Fireball ≈ 60%

Split crown explosion ≈ 10%

Seal fire ≈ 30%

It is noted that the current thinking of HSE (as applied to their Land Use Planning zone derivation) would increase this prediction to around 40cpm, split roughly 90:10 between fireball and seal fire, with a small contribution from explosion.

Since any risk reduction measure which could be applied will depend upon which type of event is to be mitigated against, a brief discussion of the issues associated with each event type is given below:

***Fireball* -** This is a short duration but very intense event. The fireballs from the adjacent gas holders are likely to be sufficiently large that they envelop the building. In such cases, there is little which could be done to mitigate the effects.

Explosion - In many cases, the risks from explosions are exacerbated by glass breakage. One potential for mitigation would therefore be to specify high strength or shatter-proof glass. In this case, however, the development is within the range where it is likely that some structural collapse would result, for which the only mitigation would be to provide a 'hardened' type of structure, which is likely to be inappropriate for a residential development.

Seal fire - The effects of thermal radiation from a seal fire will last for rather longer than the tens of seconds expected for a fireball. There is therefore the potential for evacuation, and escape routes should be provided which enable residents to reach a place of safety without being exposed to more radiation than necessary.

Other features of the development which could impact on the risks are:

a.) Use of roof terraces

While there would be no mitigation possible against a fireball, the risk outdoors may not be significantly greater than that indoors. For the explosion event, the risk at a general location outdoors could be slightly reduced (since most of the risk arises from being ***inside*** a building which collapses), although this would at best be a marginal effect for occupants of the roof terraces. In the case of the seal fire, it is possible that terrace occupants could escape indoors, and then evacuate from the building at ground level.

In practice, however, one of the key risk reduction factors is expected to be control of ignition sources close to the gas holder. The terraces at two levels (1^{st} floor and 4^{th} floor) should therefore be considered in relation to controlling ignition sources. Ideally, both should be removed or made inaccessible for normal use. It is recommended that the lower terrace, which is within 18m of the gas holders, is removed; if it is not possible to remove the upper level terrace, then ignition source restrictions should be applied, since there is the potential for a greater travel distance of a flammable cloud at this higher level. This could take the form of appropriate signage advising against smoking and the use of barbeques when the adjacent gas holders are in use (i.e. during the winter months). In view of both the greater distance from the gas holders, and the intervening presence of the building, no similar restrictions need to be applied to any terraces at the front of the building.

b.) Design of boundary wall

The thermal radiation from a fireball originates from a point which is around 100m above ground level. Thus most of the radiation would be downwards and would not be mitigated by a boundary wall. The same would apply for a seal fire, which could occur at any water-seal position. The explosion event will originate from ground level, and in principle its effects could be reduced by appropriate design of a boundary wall. However, the calculations indicate that overpressures of around 930mbar may be expected at the boundary; any wall designed to deflect such a blast would need to be at least half the building height, and is likely to be prohibitively expensive.

It is understood, however that the rear boundary wall will be 5.2m high, and will have no openings. This would ensure that any low level gas releases would be deflected upwards by the presence of this wall as well as by its buoyancy. Moreover, this would be true of all wind conditions, including those higher wind speeds which would otherwise deflect the cloud towards the ground.

c.) Minimising potential for gas ingress

The risk is reduced if any gas released is unable to encounter an ignition source. This can be achieved by minimising the openings facing the gas holders, and ensuring that any which are within 18m are protected, as noted above, by the boundary wall.

d.) Installation of shatter-proof glass

One of the contributors to the risk is explosion. Since much of the injury potential is from flying glass, the effects of explosion can be reduced by ensuring that the glass in any windows facing the gas holders is shatterproof. This can be achieved either through use of specialist glass from a supplier such as Romag, or by application of window film such as Llumar to the internal face of the glazing.

e.) Provision of adequate means of evacuation

In the event of a fire on one of the gas holders, the thermal radiation at the rear of the building is likely to be sufficiently intense that evacuation would be impeded. The building design should therefore ensure that all occupants, including those using the terraces, can be evacuated safely to the front of the building.

Summary of desirable design features:

1) Ensure impermeability of rear wall up to 5m height.

2) Minimise window openings facing gas holders within 18 metres of the holder or where not protected by the rear wall.

3) Specify heat/blast resistant or shatterproof glass for windows facing gas holders.

4) Prevent the use of the lower level rear-facing roof terraces.

5) Display signage restricting the use of ignition sources on the upper level rear-facing roof terraces when gas holders are in use.

6) Ensure adequate provision is made for evacuation to the front of the building in the event of minor fires.

6. SUMMARY AND CONCLUSIONS

The current PADHI system (see Section 3.3) is based upon consideration of individual risk, although HSE is currently considering ways in which they can also address societal risk issues around major hazard installations. As part of their considerations, there is a recent consultative document, CD212 (Reference 21), against which they requested responses from interested parties by 2nd July 2007. This document includes a list of 54 UK sites around which HSE has identified societal risk issues. There are 15 gas holder sites in this list, which includes the Bethnal Green site. CD212 covers a range of issues, including the consideration of the wider context. For example, there is a proposal that HSE may have some input during the preparation of development plans for areas affected by such sites, in order to ensure that any future development is appropriate to the area and to the risks from the major hazard site.

It has been shown in this quantified assessment that the societal risk associated with the Bethnal Green gas holder site is not at present exceptionally high for a typical COMAH site. It has also been shown that the societal risk would not increase to an intolerable level if the proposed development were to be allowed. The primary objection of HSE is therefore likely to be the precedent which this may set in allowing a significant increase in societal risk - for example, the 32% increase from the proposed development would imply that only 3 such developments would be required before the societal risk was almost doubled.

It is therefore clear that, when considering potential individual developments close to major hazard sites, both individual and societal risk need to be considered. In some cases, robust calculations of these risks may show them to be below some ‘broadly acceptable’ level, as defined by HSE. Conversely, they may be shown to be intolerable in all circumstances. Between these levels (as is the case for the proposed development), the acceptability of the risks, either individual or societal, can only be judged by balancing the calculated risks with the socioeconomic benefits (both for the hazardous installation and for developments in the vicinity). Ultimately, although HSE provides advice, it is for the Planning Authority to make such judgements, taking account of factors such as:

- nature and scale of benefits to the local / wider community
- provision of jobs / employment
- contribution to GDP and local taxes
- consistency with local development plans
- views of the public
- etc

and balancing these benefits against the risks in terms of:

- number and likelihood of people affected (fatalities and injuries)
- nature of harm

For example, a gas holder site such as Bethnal Green could be regarded as providing a significant regional benefit in terms of providing a fuel supply to a large community, and hence a planning authority might consider that a moderate level of societal risk associated with the installation was acceptable (provided it could be demonstrated to be ALARP), whilst for a smaller industrial activity with no significant socioeconomic benefits, a planning authority might consider the same level of societal risk to be unacceptable (even if it was also ALARP).

Similarly, where a development is proposed near an existing major hazard site, it is also the responsibility of the planning authority to make such judgements, taking account of the factors noted above. If there was such a pressing need for residential development in the area, and no other land was available, then the Planning Authority may be inclined to grant Planning Permission. In the present situation, however, in view of the relatively high risks, it may be considered to be more appropriate only to allow development of a less sensitive nature, such as light industrial or commercial. It is also noted that, although HSE may advise against this type of residential development anywhere within the Inner Zone, this detailed QRA has shown that the risks drop off quite rapidly away from the Bethnal Green gas holder site, implying that such a development could be more readily justified on other nearby sites, e.g. on the east side of the Oval.

It is therefore concluded that:

1.) The individual risk, at around 12cpm, is not intolerable, but is above the level at which HSE would advise against for this type of development.

2.) The current societal risk associated with the gas holder site is not particularly high for a Top Tier COMAH site.

3.) The addition of the extra population will increase societal risk by around 32%, but it will still remain well within HSE guidelines.

4.) Whilst it is possible that a case could be made for accepting this additional risk, HSE is likely to be concerned at the potential for cumulative societal risk effects if adjacent properties were to be developed in a similar way.

7. REFERENCES

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8. ABBREVIATIONS AND ACRONYMS

ALARP	As Low As Reasonably Practicable
CD	Consultation Distance
CIRRUS	Suite of consequence modelling codes developed by BP
COMAH	Control of Major Accident Hazards
cpm	Chances per million (years)
DTL	Dangerous Toxic Load
EV	Expectation Value
FBR	Fireball Radius
FN	Cumulative frequency of N or more fatalities
HGSYSTEM	Suite of gas dispersion modelling codes
HSE	Health and Safety Executive
LPA	Local Planning Authority
LPG	Liquified Petroleum Gas
LSIR	Location Specific Individual Risk
PADHI	Planning Advice for Developments near Hazardous Installations
PLL	Potential Loss of Life
QRA	Quantified Risk Assessment
R2P2	Reducing Risks, Protecting People (HSE publication, 2001)
SRI	Scaled Risk Integral
tdu	thermal dose units $(kW/m^2)^{4/3}$.seconds
VCE	Vapour Cloud Explosion

Figure 2-1 Plan of the proposed development at 33-37 The Oval

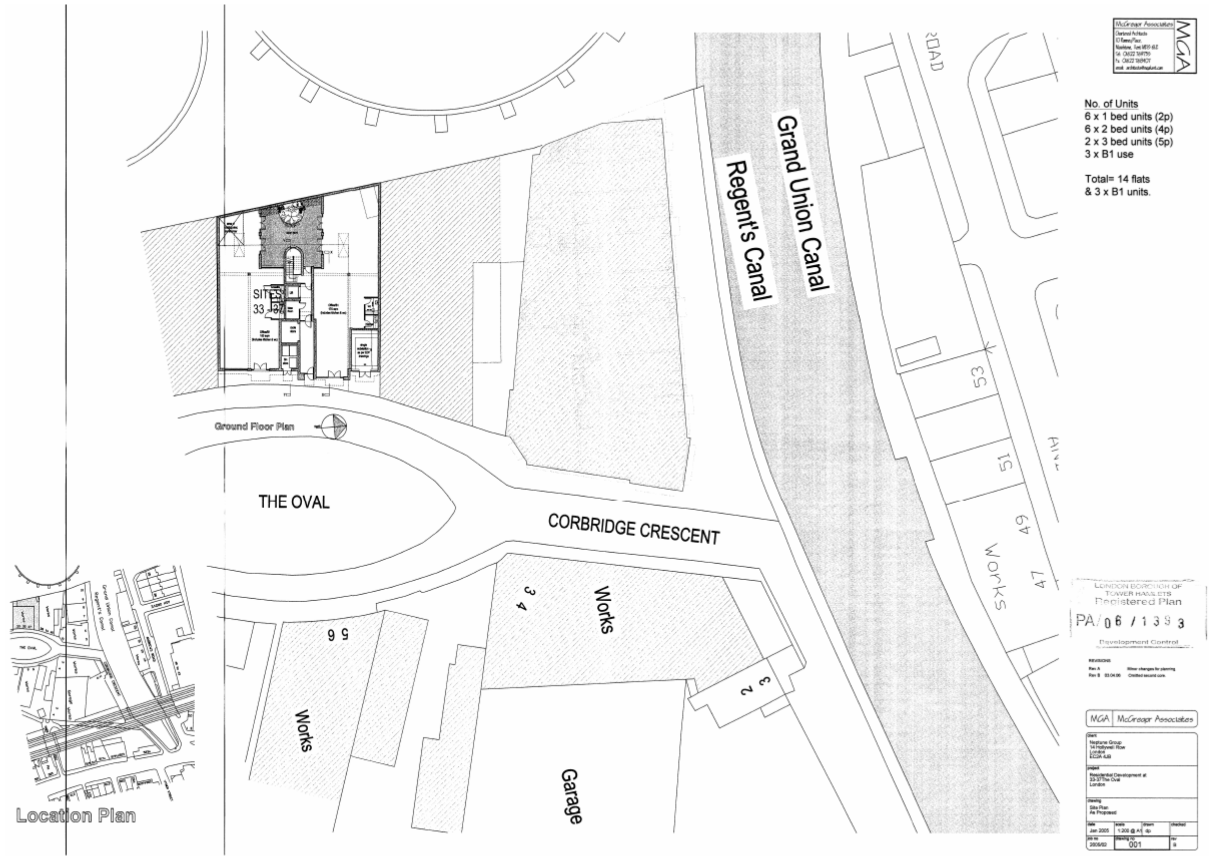


Figure 2-2 Photo showing development at 33 - 37 The Oval and Gas Holder no. 5

Figure 2-3 HSE Consultation Zones

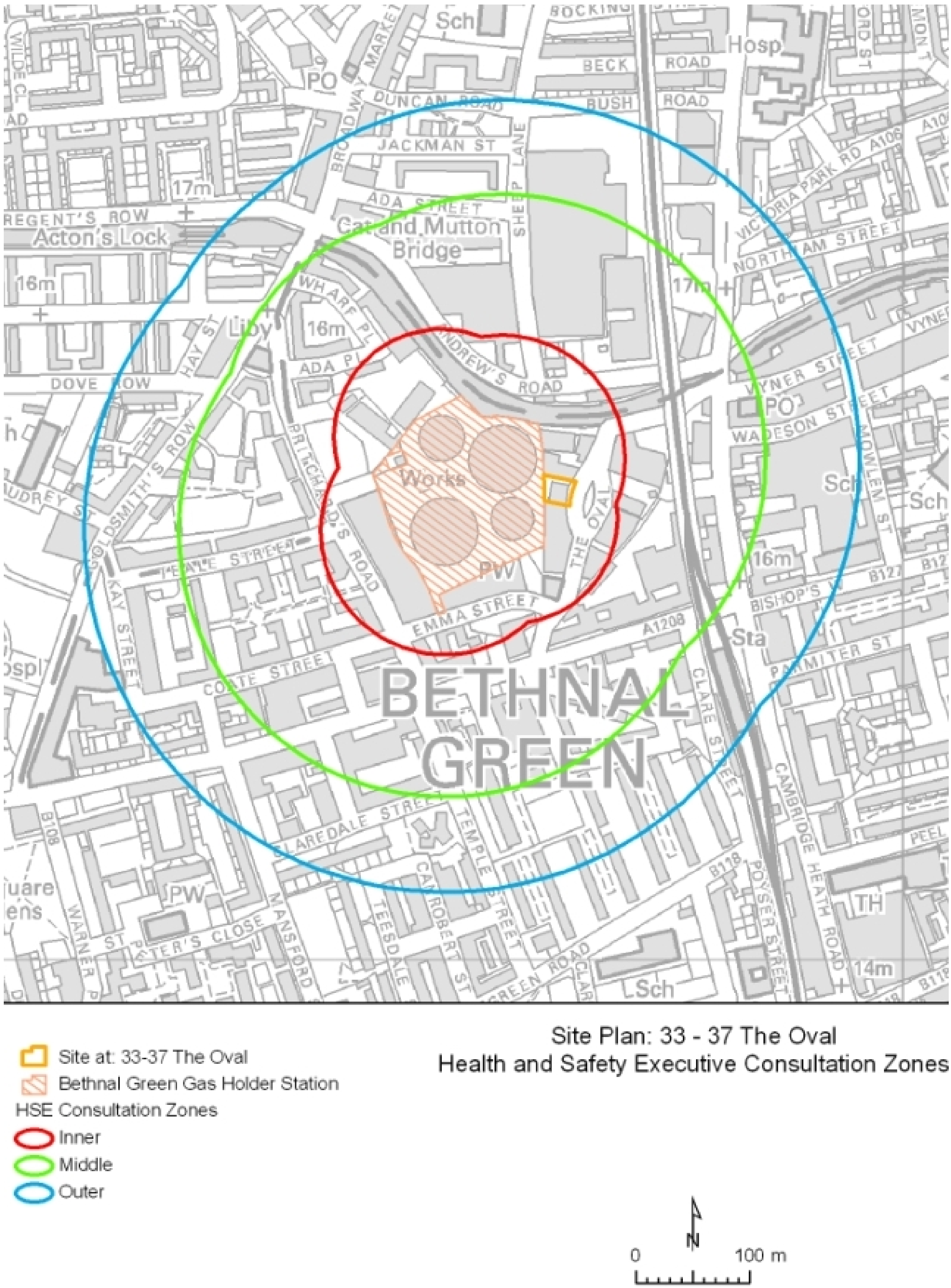


Figure 4.1 FN Curve

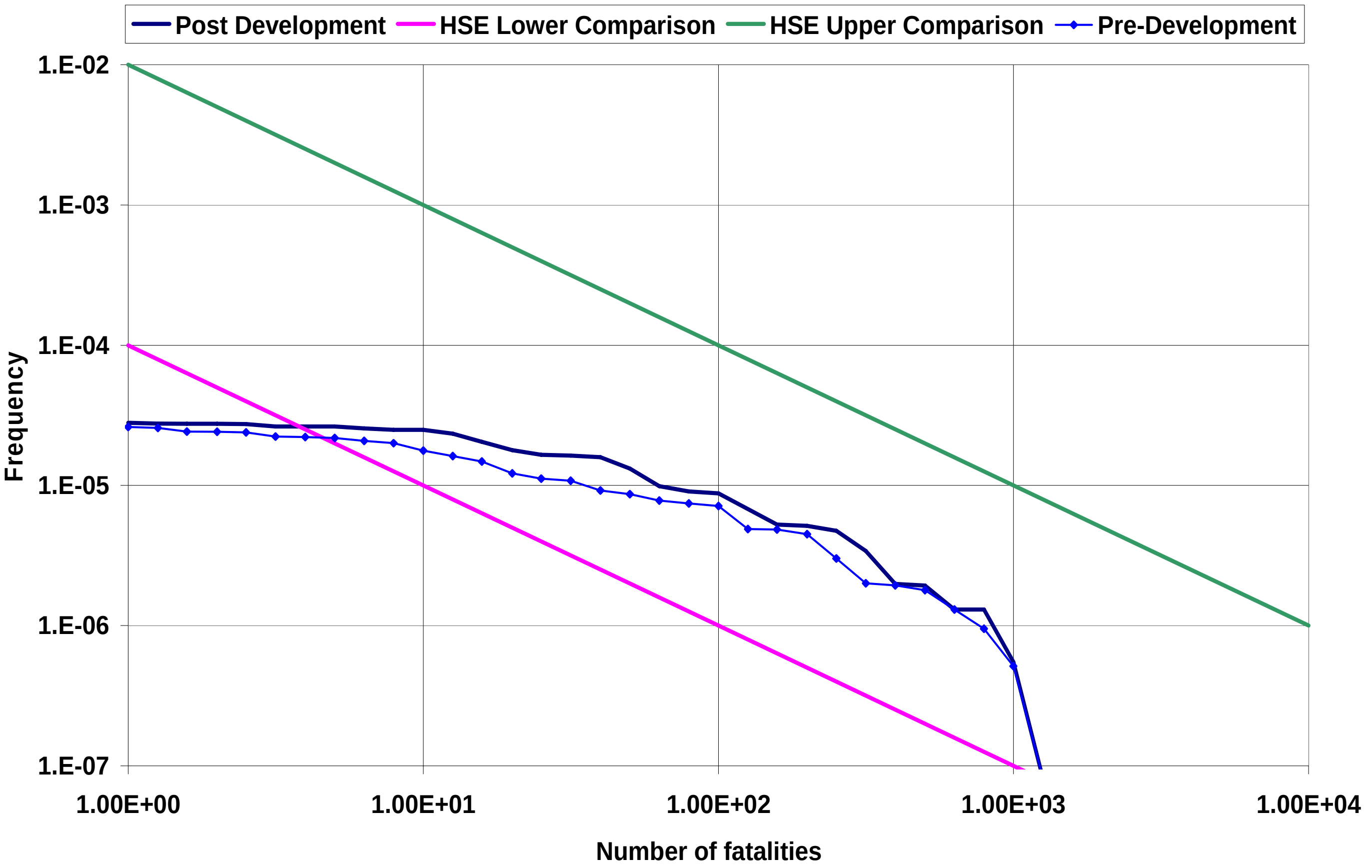
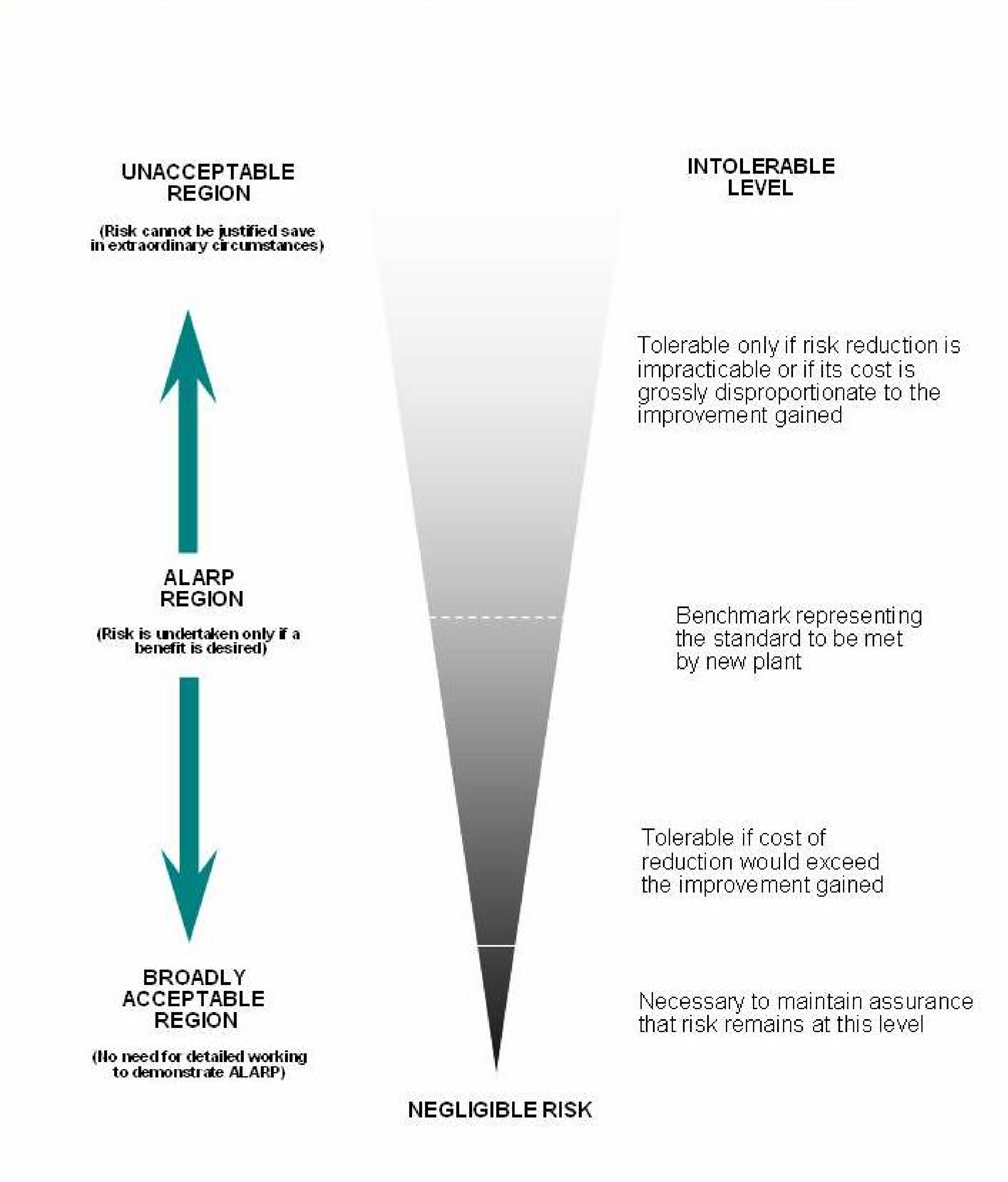


Figure 5.1 HSE Framework for tolerability of risk



APPENDIX A

Population Data

A1 INTRODUCTION

This appendix includes data for the following 3 categories of population:

1 Residential

This information is drawn from the 2001 census output, and is given in Table A.1 against the output areas identified in Figure A1. It is estimated that there is a total residential population of around 12,600 within 500m of the gas holder site.

2 Employee

This information is provided against regions which cover several census output areas. The key, to be compared with Figure A1, is given in Table A2, and the employee numbers are given in Table A3.

3 Sensitive populations

Schools and other facilities at which sensitive populations may be present are shown in Figure A2. The approximate population data for the schools identified within the zones are:

Mowlem Primary School	260
Oaklands Secondary School	650
Raines Annexe Secondary School	550
Beatrice Tate Secondary School	90
St Johns Primary School	260
Lawdale Primary School	335
London Fields Primary School	490
Sebright primary School	460

St Joseph's Hospice has an approximate population of 100-120 persons.

The numbers that attend the adult day centres identified appear to be quite low.

Table A1 Residential Population Data

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Borough	Output Area Code	Population within 500m	Total Population	Area within 500m buffer (m2)	Total area (m2)	Fraction within 500m	Weighted population based on area fraction
Tower Hamlets	00BGFW0001	341	341	20037.48	20037.48	1.00	341
Tower Hamlets	00BGFW0002	253	253	82016.10	82016.10	1.00	253
Tower Hamlets	00BGFW0004	252	252	73362.21	73362.26	1.00	252
Tower Hamlets	00BGFW0005	15	245	1076.96	18058.40	0.06	15
Tower Hamlets	00BGFW0006	416	416	14003.02	14003.02	1.00	416
Tower Hamlets	00BGFW0008	196	238	20697.70	25112.64	0.82	196
Tower Hamlets	00BGFW0009	307	307	11116.43	11116.43	1.00	307
Tower Hamlets	00BGFW0010	40	275	1709.77	11882.46	0.14	40
Tower Hamlets	00BGFW0011	303	303	9595.21	9595.21	1.00	303
Tower Hamlets	00BGFW0012	418	418	17555.69	17555.69	1.00	418
Tower Hamlets	00BGFW0013	232	232	12926.50	12926.50	1.00	232
Tower Hamlets	00BGFW0014	414	414	17591.35	17591.35	1.00	414
Tower Hamlets	00BGFW0015	204	204	12799.39	12799.39	1.00	204
Tower Hamlets	00BGFW0016	208	209	23191.21	23267.01	1.00	208
Tower Hamlets	00BGFW0017	330	330	11122.02	11122.02	1.00	330
Tower Hamlets	00BGFW0018	338	338	9994.88	9994.88	1.00	338
Tower Hamlets	00BGFW0019	450	533	24330.55	28788.56	0.85	450
Tower Hamlets	00BGFW0020	194	284	13359.03	19537.74	0.68	194
Tower Hamlets	00BGFW0021	214	320	15074.07	22554.94	0.67	214
Tower Hamlets	00BGFW0022	177	410	6346.00	14669.47	0.43	177
Tower Hamlets	00BGFW0023	64	335	6674.34	35024.60	0.19	64
Tower Hamlets	00BGFW0025	191	276	18822.71	27186.14	0.69	191
Tower Hamlets	00BGFW0026	1	387	28.06	11903.22	0.00	1
Tower Hamlets	00BGFW0028	17	266	1922.80	29794.52	0.06	17
Tower Hamlets	00BGFW0029	445	445	18507.56	18507.58	1.00	445
Tower Hamlets	00BGFW0030	453	453	14194.16	14208.22	1.00	453
Tower Hamlets	00BGFW0031	325	325	39812.43	39812.43	1.00	325
Tower Hamlets	00BGFW0032	46	294	4469.37	28261.16	0.16	46
Tower Hamlets	00BGFW0034	197	197	7785.77	7785.77	1.00	197
Tower Hamlets	00BGFW0035	5	319	772.10	48777.36	0.02	5
Tower Hamlets	00BGFW0036	208	310	10607.66	15831.83	0.67	208
Tower Hamlets	00BGFW0037	462	462	12527.16	12527.16	1.00	462
Tower Hamlets	00BGGA0002	1	347	649.56	443184.41	0.00	1
Tower Hamlets	00BGGE0020	0	249	93.46	47586.03	0.00	0
Tower Hamlets	00BGGM0004	66	300	7674.85	34794.37	0.22	66
Tower Hamlets	00BGGM0028	100	276	4942.32	13701.20	0.36	100
Tower Hamlets	00BGGM0029	7	277	454.63	17076.71	0.03	7
Tower Hamlets	00BGGM0031	9	240	560.93	14723.72	0.04	9
Hackney	00AMGJ0001	196	196	37985.69	37985.74	1.00	196
Hackney	00AMGJ0013	328	328	18083.04	18083.04	1.00	328
Hackney	00AMGJ0014	223	295	34406.25	45443.76	0.76	223
Hackney	00AMGJ0017	310	310	13549.28	13549.28	1.00	310
Hackney	00AMGJ0021	324	324	11778.94	11778.95	1.00	324
Hackney	00AMGJ0025	87	233	30779.62	82040.89	0.38	87
Hackney	00AMGQ0002	221	272	17301.82	21330.96	0.81	221
Hackney	00AMGQ0021	18	264	7204.13	103243.07	0.07	18
Hackney	00AMGQ0025	105	235	13407.66	29922.58	0.45	105
Hackney	00AMGQ0027	98	376	9283.32	35572.78	0.26	98
Hackney	00AMGQ0029	323	323	21543.58	21543.58	1.00	323
Hackney	00AMGQ0030	265	265	14864.65	14864.65	1.00	265
Hackney	00AMGQ0032	222	227	48264.05	49264.94	0.98	222
Hackney	00AMGQ0033	423	423	16906.44	16906.44	1.00	423
Hackney	00AMGQ0034	258	360	11136.81	15557.36	0.72	258
Hackney	00AMGQ0036	279	279	77743.04	77743.06	1.00	279
Hackney	00AMGT0005	28	333	2012.30	23914.24	0.08	28
Hackney	00AMGT0009	222	398	18548.33	33208.00	0.56	222
Hackney	00AMGT0024	241	250	20212.68	20955.43	0.96	241
Hackney	00AMGT0026	53	326	1793.90	10948.41	0.16	53
Hackney	00AMGT0030	164	306	13217.58	24705.32	0.54	164
Hackney	00AMGT0031	282	282	16134.80	16134.80	1.00	282

Figure A1 Census Output Areas

Table A2 Key to Employee Data Areas

Output Area Code	Lower Super Output Area Code	Middle Super Output Area Code	Middle Super Output Area Name	Ward Name	Local Authority
00AMGQ0015	E01001818	E02000367	Hackney 023	Queensbridge	Hackney
00AMGQ0021	E01001818	E02000367	Hackney 023	Queensbridge	Hackney
00AMGQ0025	E01001818	E02000367	Hackney 023	Queensbridge	Hackney
00AMGQ0029	E01001818	E02000367	Hackney 023	Queensbridge	Hackney
00AMGQ0032	E01001818	E02000367	Hackney 023	Queensbridge	Hackney
00AMGQ0036	E01001818	E02000367	Hackney 023	Queensbridge	Hackney
00AMGT0009	E01001837	E02000367	Hackney 023	Victoria	Hackney
00AMGT0024	E01001837	E02000367	Hackney 023	Victoria	Hackney
00AMGT0025	E01001837	E02000367	Hackney 023	Victoria	Hackney
00AMGT0030	E01001837	E02000367	Hackney 023	Victoria	Hackney
00AMGT0031	E01001837	E02000367	Hackney 023	Victoria	Hackney
00AMGT0005	E01001842	E02000367	Hackney 023	Victoria	Hackney
00AMGT0014	E01001842	E02000367	Hackney 023	Victoria	Hackney
00AMGT0020	E01001842	E02000367	Hackney 023	Victoria	Hackney
00AMGT0023	E01001842	E02000367	Hackney 023	Victoria	Hackney
00AMGT0026	E01001842	E02000367	Hackney 023	Victoria	Hackney
00AMGJ0018	E01001774	E02000368	Hackney 024	Haggerston	Hackney
00AMGJ0023	E01001774	E02000368	Hackney 024	Haggerston	Hackney
00AMGJ0024	E01001774	E02000368	Hackney 024	Haggerston	Hackney
00AMGJ0025	E01001774	E02000368	Hackney 024	Haggerston	Hackney
00AMGJ0033	E01001774	E02000368	Hackney 024	Haggerston	Hackney
00AMGJ0001	E01001775	E02000368	Hackney 024	Haggerston	Hackney
00AMGJ0013	E01001775	E02000368	Hackney 024	Haggerston	Hackney
00AMGJ0014	E01001775	E02000368	Hackney 024	Haggerston	Hackney
00AMGJ0017	E01001775	E02000368	Hackney 024	Haggerston	Hackney
00AMGJ0021	E01001775	E02000368	Hackney 024	Haggerston	Hackney
00AMGQ0008	E01001815	E02000368	Hackney 024	Queensbridge	Hackney
00AMGQ0016	E01001815	E02000368	Hackney 024	Queensbridge	Hackney
00AMGQ0022	E01001815	E02000368	Hackney 024	Queensbridge	Hackney
00AMGQ0024	E01001815	E02000368	Hackney 024	Queensbridge	Hackney
00AMGQ0027	E01001815	E02000368	Hackney 024	Queensbridge	Hackney
00AMGQ0002	E01001821	E02000368	Hackney 024	Queensbridge	Hackney
00AMGQ0030	E01001821	E02000368	Hackney 024	Queensbridge	Hackney
00AMGQ0033	E01001821	E02000368	Hackney 024	Queensbridge	Hackney
00AMGQ0034	E01001821	E02000368	Hackney 024	Queensbridge	Hackney
00BGFW0002	E01004197	E02000865	Tower Hamlets 002	Bethnal Green North	Tower Hamlets
00BGFW0005	E01004197	E02000865	Tower Hamlets 002	Bethnal Green North	Tower Hamlets
00BGFW0030	E01004197	E02000865	Tower Hamlets 002	Bethnal Green North	Tower Hamlets
00BGFW0031	E01004197	E02000865	Tower Hamlets 002	Bethnal Green North	Tower Hamlets
00BGFW0036	E01004197	E02000865	Tower Hamlets 002	Bethnal Green North	Tower Hamlets
00BGFW0001	E01004198	E02000865	Tower Hamlets 002	Bethnal Green North	Tower Hamlets
00BGFW0008	E01004198	E02000865	Tower Hamlets 002	Bethnal Green North	Tower Hamlets
00BGFW0010	E01004198	E02000865	Tower Hamlets 002	Bethnal Green North	Tower Hamlets
00BGFW0016	E01004198	E02000865	Tower Hamlets 002	Bethnal Green North	Tower Hamlets
00BGFW0022	E01004198	E02000865	Tower Hamlets 002	Bethnal Green North	Tower Hamlets
00BGFW0009	E01004199	E02000865	Tower Hamlets 002	Bethnal Green North	Tower Hamlets
00BGFW0011	E01004199	E02000865	Tower Hamlets 002	Bethnal Green North	Tower Hamlets
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00BGFW0003	E01004201	E02000865	Tower Hamlets 002	Bethnal Green North	Tower Hamlets
00BGFW0007	E01004201	E02000865	Tower Hamlets 002	Bethnal Green North	Tower Hamlets
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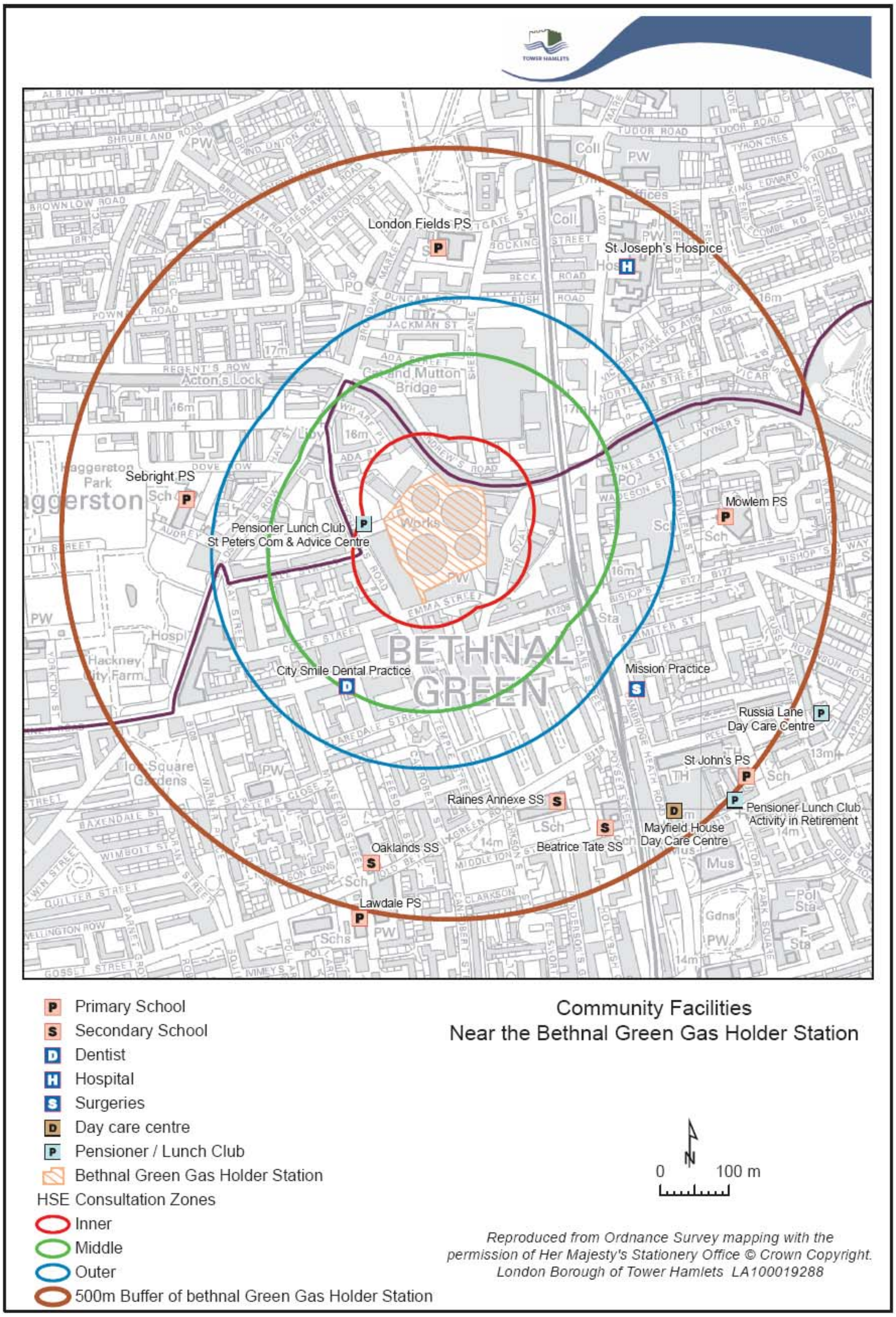
00BGFW0033	E01004201	E02000865	Tower Hamlets 002	Bethnal Green North	Tower Hamlets
00BGFW0035	E01004201	E02000865	Tower Hamlets 002	Bethnal Green North	Tower Hamlets
00BGGA0002	E01004234	E02000866	Tower Hamlets 003	Bow West	Tower Hamlets
00BGGA0003	E01004234	E02000866	Tower Hamlets 003	Bow West	Tower Hamlets
00BGGA0019	E01004234	E02000866	Tower Hamlets 003	Bow West	Tower Hamlets
00BGGA0020	E01004234	E02000866	Tower Hamlets 003	Bow West	Tower Hamlets
00BGGA0021	E01004234	E02000866	Tower Hamlets 003	Bow West	Tower Hamlets
00BGGA0024	E01004234	E02000866	Tower Hamlets 003	Bow West	Tower Hamlets
00BGFW0006	E01004200	E02000868	Tower Hamlets 005	Bethnal Green North	Tower Hamlets
00BGFW0013	E01004200	E02000868	Tower Hamlets 005	Bethnal Green North	Tower Hamlets
00BGFW0014	E01004200	E02000868	Tower Hamlets 005	Bethnal Green North	Tower Hamlets
00BGFW0015	E01004200	E02000868	Tower Hamlets 005	Bethnal Green North	Tower Hamlets
00BGFW0004	E01004202	E02000868	Tower Hamlets 005	Bethnal Green North	Tower Hamlets
00BGFW0029	E01004202	E02000868	Tower Hamlets 005	Bethnal Green North	Tower Hamlets
00BGFW0034	E01004202	E02000868	Tower Hamlets 005	Bethnal Green North	Tower Hamlets
00BGFW0037	E01004202	E02000868	Tower Hamlets 005	Bethnal Green North	Tower Hamlets
00BGFW0020	E01004203	E02000868	Tower Hamlets 005	Bethnal Green North	Tower Hamlets
00BGFW0021	E01004203	E02000868	Tower Hamlets 005	Bethnal Green North	Tower Hamlets
00BGFW0026	E01004203	E02000868	Tower Hamlets 005	Bethnal Green North	Tower Hamlets

Table A3 Employee Data

LSOA_CODE	500m Radius Area	SOA_Area	Proportional_Area	TOTAL	Emp_Ratio
E01001774	30779.65	179566.03	0.17	843	143.31
E01001775	115803.09	126840.61	0.91	108	98.28
E01001815	9283.19	108964.77	0.09	57	5.13
E01001818	168162.46	381334.22	0.44	2176	957.44
E01001821	60209.99	68659.75	0.88	58	51.04
E01001837	68114.08	111400.39	0.61	395	240.95
E01001842	3806.04	64684.66	0.06	67	4.02
E01004197	147707.28	169927.33	0.87	1074	934.38
E01004198	71981.77	94968.93	0.76	557	423.32
E01004199	60650.32	69013.60	0.88	68	59.84
E01004200	57320.64	57320.64	1.00	159	159.00
E01004201	5241.46	129814.16	0.04	644	25.76
E01004202	112182.91	112182.91	1.00	527	527.00
E01004203	30384.15	105158.20	0.29	954	276.66
E01004204	48560.82	84457.98	0.57	421	239.97
E01004234	649.69	573205.32	0.00	250	0.00
E01004259	93.47	133233.23	0.00	1792	0.00
E01004314	8235.71	83243.71	0.10	260	26.00
E01004318	5397.00	58667.01	0.09	229	20.61

Figure A2 Locations of Sensitive Populations



APPENDIX B

Excerpt from PADHI Sensitivity Table

Development type	Examples	Development detail and size	Justification
DT2.1 - Housing	Houses, flats, retirement flats/ bungalows, residential caravans, mobile homes.	Developments up to and including 30 dwelling units **and** at a density of no more than 40 per hectare – **Level 2**	Development where people live or are temporarily resident. It may be difficult to organise people in the event of an emergency.

EXCLUSIONS

Infill, backland development.	**DT2.1 x1** Developments of 1 or 2 dwelling units - **Level 1**	Minimal increase in numbers at risk.
Larger housing developments.	**DT2.1 x2** Larger developments for more than 30 dwelling units – **Level 3**	Substantial increase in numbers at risk.
	DT2.1 x3 Any developments (for more than 2 dwelling units) at a density of more than 40 dwelling units per hectare - **Level 3**	High-density developments.

DT2.2 - Hotel/Hostel/ Holiday Accommodation	Hotels, motels, guest houses, hostels, youth hostels, holiday camps, holiday homes, halls of residence, dormitories, accommodation centres, holiday caravan sites, camping sites.	Accommodation up to 100 beds or 33 caravan / tent pitches – **Level 2**	Development where people are temporarily resident. It may be difficult to organise people in the event of an emergency.

EXCLUSIONS

Smaller - guest houses, hostels, youth hostels, holiday homes, halls of residence, dormitories, holiday caravan sites, camping sites.	**DT2.2 x1** Accommodation of less than 10 beds or 3 caravan / tent pitches - **Level 1**	Minimal increase in numbers at risk.
Larger – hotels, motels, hostels, youth hostels, holiday camps, holiday homes, halls of residence, dormitories, holiday caravan sites,	**DT2.2 x2** Accommodation of more than 100 beds or 33 caravan / tent pitches–	Substantial increase in numbers at risk.

camping sites.	**Level 3**		
DT2.3 - Transport Links	Motorway, dual carriageway.	Major transport links in their own right; i.e. not as an integral part of other developments – **Level 2**	Prime purpose is as a transport link. Potentially large numbers exposed to risk, but exposure of an individual is only for a short period.
	EXCLUSIONS		
Estate roads, access roads.	**DT2.3 x1** Single carriageway roads – **Level 1**	Minimal numbers present and mostly a small period of time exposed to risk. Associated with other development.	

APPENDIX C

Assessment of Accident Statistics for Water Sealed Gas Holders

C1 DATA AND ASSUMPTIONS

The following data were available for the study:

1) Information on major accidents occurring between 1912 and 1930 and causing total decoupling of seals, with or without gas ignition and total collapse of the gas holder (Ref. 1).
2) Database of accidents involving gas leaks, with or without ignition, between 1970 and 2000 (Appendix 1 of Ref. 1). These are derived from Transco records. It is important to note that some information related to the above holder accidents has not been disclosed by HSE. In addition, because stations are generally un-staffed, Reference 1 presumes that reliance is made by Transco on reports from the public and analyses of post-accident damage for an estimate of mass of release and causes. Furthermore, it is noted that some inconsistencies in the dataset were observed; these are described in Section C2.
3) Information on the gas holder population and industry development from 1910 (Ref. 1).

In order to use the available information for the derivation of statistical accident frequencies, the following assumptions and refinements on the above data were made. Figures for the number of gas holders active in the United Kingdom over the years, from 1970 were derived from 3). In particular, Reference 1 reports that until the end of the 60s the estimate of water-sealed gasholders in operation in the UK was between 5000 and 6000; hence a constant population of 5500 gasholders was assumed for those years. Information on the subsequent decreases in the number of gas holders in use is given in Reference 1. It is reported that between 1970 and 1980 the gasholder population diminished from 5500 to 1000, between 1980 and 1995 from 1000 to 500 and between 1995 and 2002 from 500 to 400.

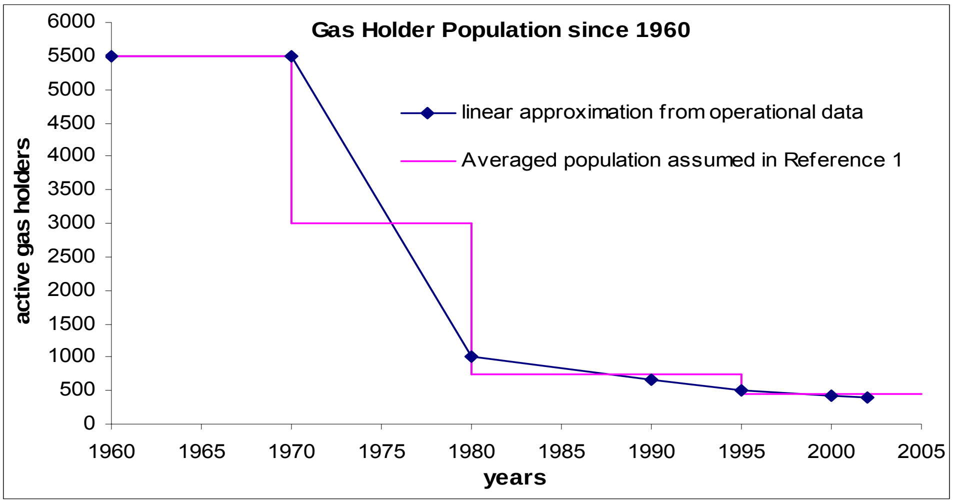


Figure C1 Reduction of gas holder population over time since 1960

From these figures the approximate numbers for the population of gas holders active each year between 1910 and 2002 could be obtained, assuming linear reductions of active gas holder numbers, as shown in Figure C1. The diagram depicts the linear approximations derived for the present analysis and the average values used in Reference 1 for comparison.

C2 EVENT FREQUENCY ANALYSIS

C2.1 Analysis of Large Historical Events

Only 6 major accidents have been reported where decoupling and / or collapse of gas holders have occurred. Three of these, i.e. 50% of the incidents, involved the ignition of the gas which had escaped and two resulted in a total collapse of the holders; all of them happened between 1910 and 1930. Reference 1 derives frequencies for major accidents by dividing the number of accidents by the total number of gas holder operational years (3.76 x 10^5), treating these as a single dataset. In this analysis, data have been treated statistically slightly differently and the specific holder population in operation during the decade when the accident(s) occurred was applied to derive a ten-year frequency and the frequencies obtained during all decades (non-null only for the first two decades) were averaged over the entire period covered. The results are reported in Table C1.

Years		**Events**			**Frequency (events / holder / yr)**		
Period	Holder years	Total collapse	De-coupled seals with ignition	De-coupled seals all	Total collapse	De-coupled seals with ignition	De-coupled seals all
1910 - 1920	55000	1	1	3	$1.82x10^{-5}$	$1.82x10^{-5}$	$5.45x10^{-5}$
1920 - 1930	55000	1	2	3	$1.82x10^{-5}$	$3.64x10^{-5}$	$5.45x10^{-5}$
1930 - 1940	55000	0	0	0	0	0	0
1940 - 1950	55000	0	0	0	0	0	0
1950 - 1960	55000	0	0	0	0	0	0
1960 - 1970	55000	0	0	0	0	0	0
1970 - 1980	32500	0	0	0	0	0	0
1980 - 1990	8330	0	0	0	0	0	0
1990 - 2000	5480	0	0	0	0	0	0
2000 - 2005	2030	0	0	0	0	0	0
Average					$3.83x10^{-6}$	$5.74x10^{-6}$	$1.15x10^{-5}$

Table C1 Frequencies of accidents involving total collapse and seal de-couplement, averaged over periods of 10 years.

Table C2 compares the average probabilities obtained as described above with those reported in Reference 1. It can be seen that the estimates calculated through this study are to be slightly lower than those reported in Reference 1.

Accidents involving total collapse and seal de-couplement	**Frequency (cpm / holder / year)**	
	Calculated	From Reference 1
All	11.5	~15
Decoupled seal (or worse) with ignition	5.7	~10
Total collapse with ignition	3.8	~5

Table C2 Comparison between calculated frequencies of accidents involving total collapse and seal de-couplement and corresponding figures obtained in Reference1.

C2.2 ALTERNATIVE ESTIMATION

Because the only major accidents recorded in the industry have occurred several decades ago and no other accidents have been reported since, Reference 2 derives an estimate of expected frequency, excluding the past events, through the application of the Poisson distribution model.

If:

x is the level of confidence of the estimate in percentage

n is the period (in holder years) without accidents

then the expected frequency F_x can be calculated by applying the following formula:

$$F_x = \frac{-\ln(1 - x/100)}{n}$$

Taking a 90% confidence interval and considering an approximate number of gasholder years of 1 x 10^5 since nationalisation, Reference 2 estimates a frequency F_{90} of 2.1 x 10^{-5} events per holder per year. Furthermore, a 50% ignition probability for major accidents is assumed, which leads to a prediction of about 10 x 10^{-6} ignited decoupled seal accidents / holder / year with a 90% confidence. Of these, 10% are assumed to be as a result of total collapse, with a resulting estimated frequency of 1 x 10^{-6}.

However, the total number of holder years derived in Reference 1 over the accident free period (since 1930) and since nationalisation (1950) is respectively 2.5 x 10^5 and 1.5 x 10^5. If these values are used in the application of the Poisson formula, for a 90% confidence interval, the following estimates are obtained:

Since 1930 $$F_{90} = \frac{-\ln(1-90/100)}{2.5\times10^5} = 9.2\times10^{-6}$$ events/holder/year

Since 1950 $$F_{90} = \frac{-\ln(1-90/100)}{1.5\times10^5} = 1.5\times10^{-5}$$ events/holder/year

The table below compares these figures to those obtained in Reference 2 together with frequencies for ignited decoupled seal accidents and total collapse accidents derived by applying the same factors assumed in Reference 2.

Accidents involving total collapse and decoupled seal (or worse) with ignition	Frequency (cpm / holder / year)		
	From Reference 1	Calculated since 1950	Calculated since 1930
All	21	15	~9
Decoupled seal (or worse) with ignition	10	~7.5	~4.5
Total collapse with ignition	~1	~0.75	~0.45

Table C3 Comparison between predicted frequencies for accidents involving total collapse and decoupled seal (or worse) assuming a 50% probability of ignition.

C3 ANALYSIS OF RECENT INCIDENT DATA

C3.1 BACKGROUND

A review has been carried out for gas holder incidents occurring between 1970 and 2000, details of which are provided in Appendix 1 of Reference 1. One hundred and twenty nine events are reported to have occurred during the period and involved gas leaks of various magnitudes from water-sealed gas holders. Because the data reported were obtained only through partial disclosure of information and through public report and post-accident analysis, they often lack details in terms of quantities released and accident causes. In particular, for approximately 55% of the cases, the gas leak has not been quantified.

In reviewing the dataset, it was also noted that for two pairs of entries reported separately in the dataset the details given appear remarkably similar, suggesting that each pair actually refers to the same event. For the purpose of this review, each pair will be considered as representative of a single incident. (It is noted that the events in the dataset of Reference 1 are reported in chronological order, with the exception of the two spurious duplicate entries, which, therefore, appear to be recorded erroneously). The total number of events used in the present analysis from Reference 1 is therefore 127. Although ‘major releases’ have been recorded in several instances, it is not suggested that any of these accidents have produced a full seal de-couplement or holder collapse.

Figure C2 shows the event distribution between 1970 and 2000. Over the period covered, with the exception of isolated peaks, the accident trend shows a fairly random and reasonably uniform spread with an average of 4-5 accidents per year. However, if the number of events per year is normalised with respect to the actual holder number in operation during the year, the resulting frequency appears to be increasing steadily (with the sporadic superimposed peaks), as shown in Figure C3. This might be attributable to the fact that, whilst the population of holders has decreased significantly over the last 30 years, it is likely that the holders being decommissioned are actually those that in recent years have not been in operation (full utilisation). Whereas before decommissioning these holders might have been considered as part of the total populations, they would not have been equally susceptible to accidents (hence the apparent lower accident probability). The resulting total average probability is 5.4×10^{-3}. This is calculated as the average of the annual frequency obtained by dividing the number of events per year by the gas holder population in the same year and averaging the annual frequencies obtained over the three decades 1970 -2000. If the gasholder operational years were treated as a single dataset, the total frequency would be obtained by dividing the number of events (127) by the integrated gas holder population over the 30 years of operation considered (48950), giving rise to more optimistic predictions (2.6×10^{-3}).

Of the accidents recorded, 13% are reported in Appendix 1 of Reference 1 to have caused releases greater than 30te (major releases), all attributable to seal failure, except one case of overfilling. The resulting yearly probability for major releases is, therefore, $5.4 \times 10^{-3} \times 0.13 = 7.1 \times 10^{-4}$ per holder per year.

It is interesting to note that in only four instances did the accidental gas leaks ignite, and none of these cases were explicitly related to major releases (Ref.1). In three cases ignition was attributed to faulty electrical antifreeze equipment and in one instance to spark generated from a hand grinder. None of the events occurred after 1985. Ignited leaks therefore represent approximately only 3% of the totality of accidents which occurred in the period under review, with a resulting probability of $5.4 \times 10^{-3} \times 0.03 \approx 1.7 \times 10^{-4}$.

C3.2 Cause Analysis

A review of potential causes was undertaken for the set of events reported in Appendix 1 of Reference 1 for the period 1970 – 2000. Gas holder accidents were grouped under the categories indicated in Table C4, and a pie chart of the causal distribution given above is given in Figure C4.

Cause	Number of events	Percentage
Corrosion in water seal	24	19%
High winds	9	7%
Snow load	3	2%
Overfilling	13	10%
Low temperatures	1	1%
Evaporation	3	2%
Equipment / Mechanical Failure	34	27%
Human error	6	5%
Ignited seal	4	3%
N/R / other / unknown	30	24%

Table C4 Causal distribution of gas holder accidents for the period 1970 – 2000.

For a large percentage of accidents (24%), the cause was not reported or was reported as unknown. For the remaining cases, the two predominant accident roots are mechanical / equipment failures (38%), with a distinct high contribution of water seals failing due to corrosion (19%) and a substantial single contribution from failure of the antifreeze system. It is interesting to note that, out of the four instances resulting in fire, in three cases ignition was attributed to faulty electrical antifreeze equipment. The next most significant source of releases is overfilling (due to mechanical problems or human error).

Factors such as low temperatures, snow load and evaporation, identified in Reference 1 as potential causes for major accidents (de-couplement and holder collapse), have been recognised as the possible origin of a small number of releases (1 instance due to low temperatures, 3 due to snow load and 3 due to evaporation over 30 years). However, in none of these events were large releases reported and the overall contribution, compared to the total number of accidents, is of little significance. On the other hand, in Reference 1, a greater number of events (9) are attributed to (or were recorded as occurring in the presence of) high winds, also recognised as a potential cause for major accidents.

The following initiators are of particular interest for gas holder safety assessments and hence have been considered separately:

- Split crown
- Overfilling
- Seal failure

Table C5 below summarises statistical data and frequencies related to the three initiators. Frequencies have been calculated as fractions of the total average frequency derived above (5.4×10^{-3}).

Initiator	Number of events	Percentage over total number of events	Frequency
Split crown	7	5.5%	3.0×10^{-4}
Overfilling	13	10.2%	5.6×10^{-4}
Seal Failure	33	25.9%	1.4×10^{-3}

Table C5 Statistical data and frequencies related to accident caused by: split crown, overfilling, and seal failure.

Whereas release quantities were not specified for any of the split crown events, a number of overfilling and seal failure accidents were reported to have resulted in leaks of different severity, including major releases.

C3.3 Release Size Assessment

A classification of accidental releases from gas holders reported in Reference 1 for the period 1970 – 2000 was carried out on the basis of the mass of gas. When considering the quantification of releases, there is an even greater percentage of cases (55%) for which the amounts of gas released are not specified. If the same severity distribution from quantified releases (45% of events) is applied to the 55% un-quantified events, reasonably conservative release percentages can be estimated. Actual and projected figures are summarised in Table C6 below, and the release distributions given in the table are represented in Figures C5 and C6 through pie charts.

Quantity of gas released [te]	Number of actual events	Percentage	
		Reported	Projected
0 – 10	30	24%	53%
10 – 20	8	6%	14%
20 – 30	3	2%	5%
30 – 40	4	3%	7%
40 – 50	11	9%	19%
> 50	1	1%	2%
NR	70	55%	

Table C6 Release distribution of gas holder accidents for the period 1970 – 2000.

The majority of recorded releases (24% reported, 53% projected) were relatively small. A small number of reported accidents (11) gave rise to gas leaks between 40te and 50te. These were all attributable to mechanical / equipment failure, including corrosion in the water seal. In total, 16 'major releases' which gave rise to discharges greater than 30te are reported in Reference 1, i.e. 13% of the total number of accidents considered. However, if same the severity distribution from quantified releases is also applied to un-quantified events, a considerably greater contribution of major release would be obtained, corresponding to an estimated percentage of 28%. It is evident how crucial would be the knowledge of the effective distribution of events for which information is undisclosed or partial.

C4 DISCUSSION

The causal distribution of accidental leaks recorded for the period 1970 – 2000 was derived, as reported in Section C.3.2. The analysis showed that the predominant causes for gas holder accidents are mechanical / equipment failures including corrosion of seals, followed by overfilling. Extreme weather conditions (snow loading, extreme temperatures and high winds) have been identified in Reference 1 as potential causes of de-couplement or total collapse of gas holders. However the recorded experience shows that only in very sporadic instances did snow loading and extreme temperatures result in minor releases (3 and 1 incidents respectively). A greater number of incidences (9) were attributed to high winds.

It is interesting to note that only 4 cases of ignited leaks were recorded, over 127 accidents. None of the accidents recorded to have caused major releases ignited. Recent historical data demonstrate that the percentage of all accidents escalating in the ignition of leaks is very small – 3%. It may be argued that, in past years (e.g. 1920s – 30s), the ignition sources in the vicinity of gas holder installations would be many more. On the other hand, however, electrical antifreeze equipment, which appears to have been the cause for three out of four ignited releases and a number of further non-ignited leaks, was not used at the time. For ignited releases from total collapse / de-couplement accidents, the mechanisms of ignition could be different. Sources such as metal / metal sparking during collapse could be intrinsic to the accident modality and very local to the leak, causing ignition to be nearly instantaneous and more probable.

Release distributions were also derived for the same set of recent accidents. The majority of recorded releases (23%) were smaller than 10te. Only a small number of accidents (12), all due to mechanical / equipment failures, gave rise to gas leaks greater than 40te. These represent 10% of the reported events. However, if the severity distribution from quantified releases (45% of events) is applied to the 55% un-quantified events, the percentage of releases greater than 40te would go up to 21%.

C5 CONSIDERATION OF IGNITION PROBABILITY

Since the molecular weight of methane is 16, its density is only 55% of that of air, ie. 0.678kg/m^3, and any release of natural gas will experience a significant buoyancy force. This will lift it up, and hence away from the ground where most likely ignition sources will be present. The effects of this buoyancy can be approximately assessed by assuming that any large volume of gas which is released will form a sphere, which will accelerate until it rises through the air with a terminal velocity.

Mass released = M kg

Volume release = $\frac{M}{0.678}$ m^3

Radius of Sphere = $\left(\frac{3}{4\pi} x \frac{M}{0.678}\right)^{1/3} = 0.71M^{1/3} \qquad (m)$

Downward force on sphere = Mg

Upward buoyancy force = $\frac{M}{0.678} x 1.225 g$

Hence, net upward force = $Mg\left(\frac{1.225 - 0.678}{0.678}\right)$

= 0.81Mg

If this bubble moves upwards at v m/s, the drag force = $\frac{1}{2}\rho A V^2 C_D$, where

ρ = density of air

C_D = drag coefficient (=2 for a sphere)

A = cross sectional area of bubble

= πr^2 = 1.58 $M^{2/3}$

The terminal velocity is attained when the net upward force is equal to the drag force: 0.81Mg = $\frac{1}{2} x 1.225 x 1.58 M^{2/3} x V^2 x 2$

ie. $$V^2 = \frac{0.81gM^{1/3}}{1.225x1.58} = 4.08M^{1/3}$$

Hence $V = 2.02M^{1/6}$

For M=78,000kg (78t), this gives a terminal velocity of around 13m/s. It can be shown that 95% of this velocity is attained within the first 3 seconds, at which time the gas 'bubble' will have risen around 24m. Clearly, the gas will begin to disperse, forming a slightly less buoyant but larger cloud, for which the buoyancy force will be reduced, and the radius (and therefore the drag force) increased. However, the release mechanism is such that there is unlikely to be rapid initial mixing, which implies that the other calculations given above will apply to first order.

Although the HSE assessment of the 6 major releases in the early 20th century implied an ignition probability of 50%, this is considered to be overly conservative for the following reasons:

a.) The greater ignitability of town gas (predominantly hydrogen) than that of the currently used natural gas (predominantly methane).

b.) The potential under-reporting of large unignited releases. (It is unlikely that large ignited releases would go unreported.)

c.) The size of the buoyancy effects noted above.

d.) The historical record for 1970-2000, which shows an ignition probability of 3% overall and of zero for large releases.

On the basis of this information, it is proposed that an ignition probability of 10% is used for total collapse and decouplement events.

C6 CONCLUSIONS

Frequencies of accidents involving total collapse and seal de-couplement of gas holders were derived from statistical treatment of historical data. The figures obtained in Section C2.1 are reported in Table C7.

The only accidents involving de-couplement and total collapse with ignition, recorded in the industry, have occurred several decades ago and no other such accidents have been reported since. Hence, estimates of frequency expectancy, excluding the past events have been derived through the application of the Poisson distribution model using the approximate numbers of gas holder years since nationalisation (1950) and for the whole accident free period (since 1930). An ignition probability of 50% for major accidents and a further 10% probability of total collapse were assumed in Reference 2 (these factors were applied in Section C2.2. However, as described in Section C3, the results obtained from recent historical data related to accidents experienced recently in gas holders, show that only 3% of gas leaks resulted in ignitions. Since 1970, 16 events resulting in gas releases greater than 30te were reported, however none of these ignited. This historical evidence suggests that the 50% ignition probability assumed above may be too conservative. Hence, an ignition probability of 10% is considered more realistic and was applied to derive the expected frequencies reported in Table C7. The table summarises frequencies obtained in this study through the analysis of historical data and through the application of the Poisson distribution as well as the corresponding figures derived in References 1 and 2.

Accidents involving total collapse and decoupled seal (or worse) with ignition	**Frequency (cpm / holder / year)**				
	From historical data on accidents		**Estimates from Poisson distribution**		
	Ref. 1	Calculated	Ref. 2 since 1950	Calculated since 1950	Calculated since 1930
All	~15	11.5	21	15	~9
Decoupled seal (or worse) with ignition	~10	5.7	10	~1.5	~0.9
Total collapse with ignition	~5	3.8	~1	~0.15	~0.1

Table C7 Comparison between predicted frequencies for accidents involving total collapse and decoupled seal (or worse).

REFERENCES

1 Revision of HSE's LUP assessment methodology for low pressure, water sealed, natural gas, gas holders. Part 4 – Decoupled seal and holder collapse events.

2 A Revised Three Zone LUP Siting Policy for Low Pressure, Water-Sealed Gas Gasholders Containing Natural Gas – Annex 2.

FIGURE C2 Events involving gas leaks from water-sealed gas holders between 1970 and 2000

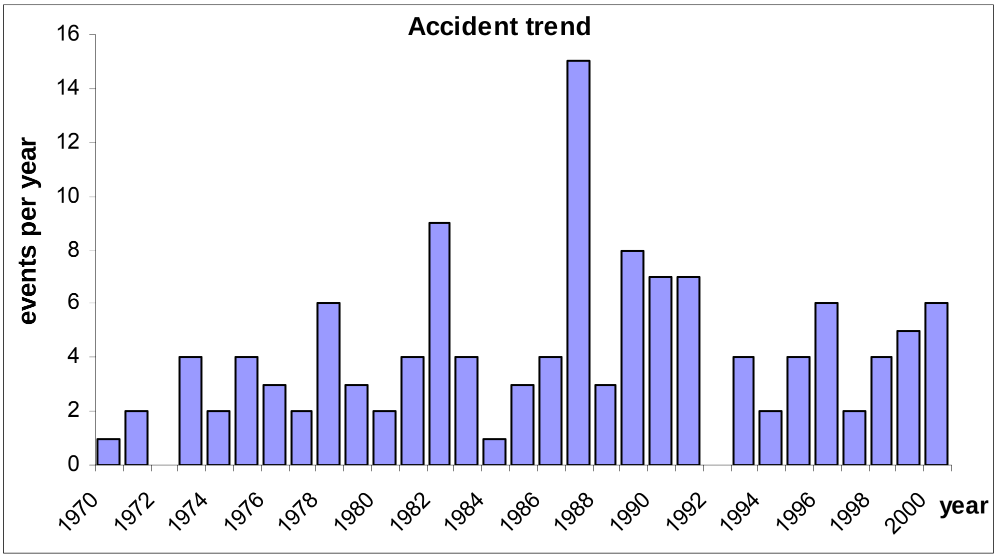


FIGURE C3 Frequency of leak per holder per during the operational years between 1970 and 2000

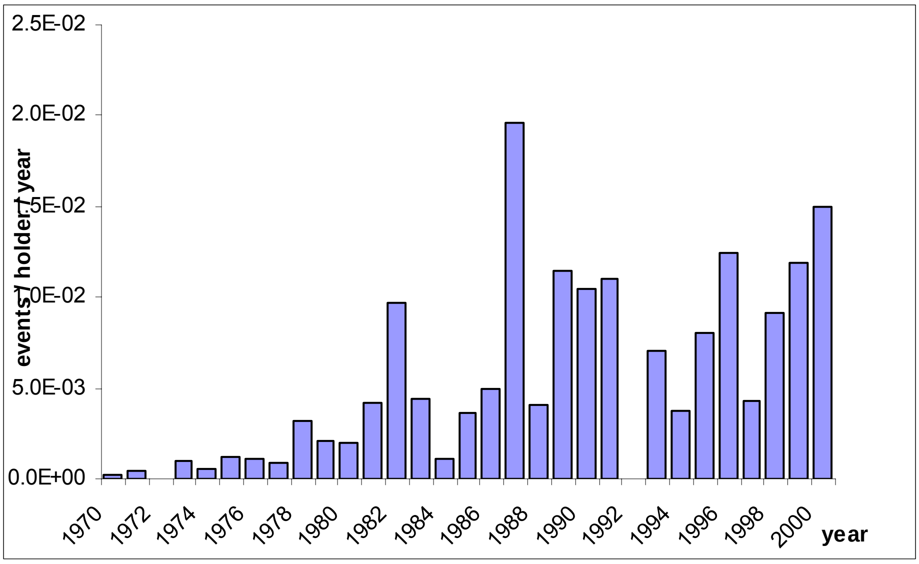


FIGURE C4 Causal distribution for gas holder events occurring between 1970 and 2000

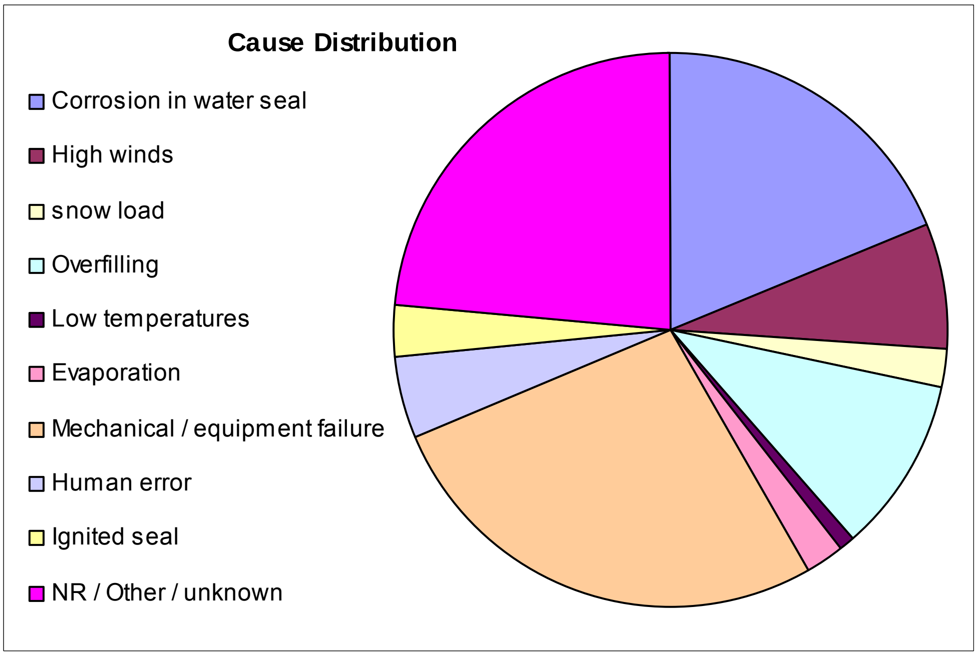


FIGURE C5 Release distribution for gas holder events occurring between 1970 and 2000

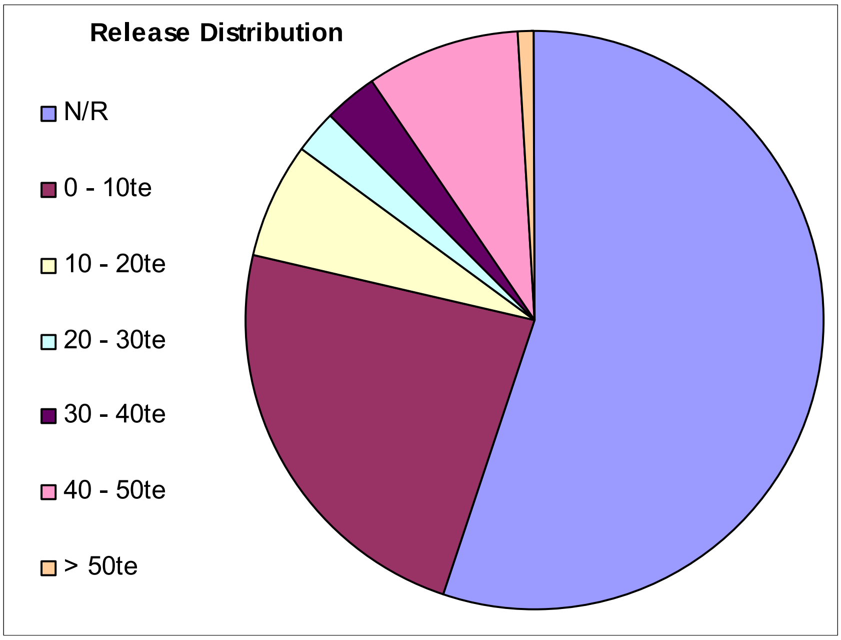
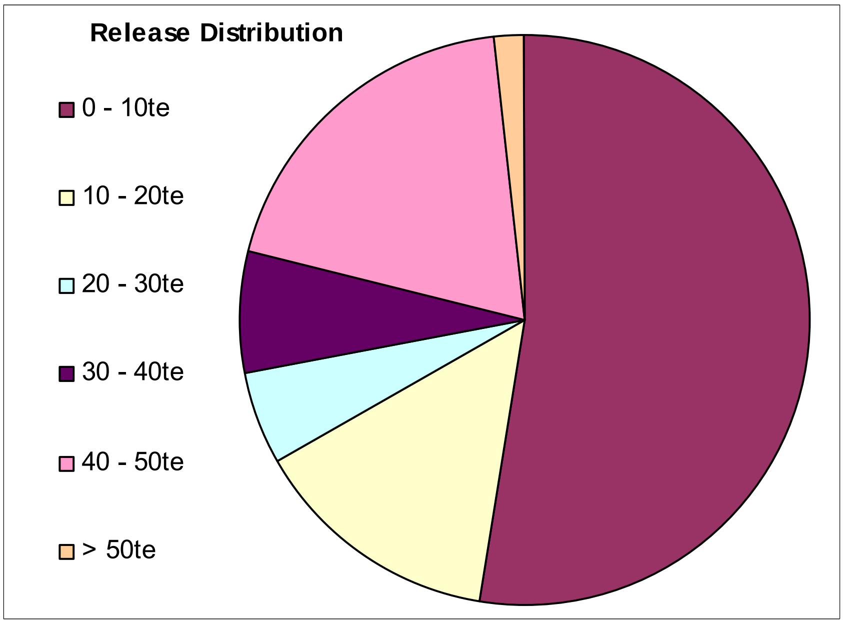


FIGURE C6 Release distribution for gas holder events occurring between 1970 and 2000 obtained by applying the severity distribution from quantified releases to un-quantified events



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Woodcote Grove
Ashley Road
Epsom Surrey
KT18 5BW
England

Phone +44 (0)1372 726140
Fax +44 (0)1372 740055

Clifton House
Clifton Place
Glasgow
G3 7LD
Scotland

Phone +44 (0)141 332 7030
Fax +44 (0)141 332 4428

WS Atkins House
Birchwood Boulevard
Birchwood
Warrington
Cheshire
WA3 7WA

Phone + 44 (0) 1925 828987
Fax + 44 (0) 1925 828153

11 rue la Boetie
75008 Paris
France

Phone +33 (0) 144 51 1703
Fax +33 (0) 144 51 1704

11200 Richmond Avenue
Suite 300
Houston
Texas 77082
United States of America

Phone +1 281 496 1073
Fax +1 281 496 1225

Euston Tower
286 Euston Road
London
NW1 3AT
England

Phone +44 (0)207 121 2000
Fax +44 (0)207 121 2200

6 Golden Square
Aberdeen
AB10 1RD
Scotland

Phone +44 (0)1224 620202
Fax +44 (0)1224 647652

process@atkinsglobal.com
www.atkinsglobal.com/process

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Appendix 1d

Comments on Atkins Oil & Gas assessment by HSE

1. In HSE's opinion, Atkins' assessment methodology for gasholders is not technically robust, and consequently they have significantly underestimated the risks to people at 33-37 The Oval. There is a real and recognised danger in allowing new intensive development, particularly of a multi-storey nature, close to water-sealed gasholders. This is the reason HSE sought and were granted 'call-in' of the application for the amended development even though it would have located slightly further away from the holders than the present, partly-constructed building. Whilst holders are proven storage technology, the additional measures that can be taken to prevent accidental escapes or mitigate their consequences are limited. It is for this reason that maintaining adequate separation from off-site development is crucial for this type of major accident hazard. In our opinion, the 'hardening' of the building in an attempt to reduce the risk is unacceptable where the occupants have no control over their exposure and obtain no direct benefit from it. Furthermore, comparisons of involuntary risk with generalised benchmarks such as annual risk of all deaths (including natural causes) or those where the population benefits in some away (employment) is misleading, particularly for a non-specialist audience, eg. the Council.

2. HSE considers that a gas escape when one or more of the water seals fail is also a serious major accident hazard. Such failures can occur for a number of reasons, including weather effects. There are typically 3 large gas escapes from seal failure each year in the country's holder population: on average at least one of these exceeds 30 tonnes. There were three large seal escapes last year, of which two occurred at holder stations in London. A holder at Bethnal Green suffered a large seal escape in 1986 which closed Liverpool Street Station: its cause was thought to have been vandalism.

3. Historically seal escapes have not resulted in significant harm, probably because of the reasonable separation between most holders and adjacent development, particularly of an high-rise nature. However, there have been five known seal fires (a very tall sheet of highly radiative flame around the holder's circumference) in the last 35 years. At least two of these required the evacuation of neighbouring populations. A seal fire is a potential precursor of a holder decouplement and collapse 'fireball' event.

4. If a seal escape does not ignite immediate, it can result in a flammable gas cloud which does not necessarily disperse upwards as expected. In wind speeds over 5m/s, the wake effect around the holder can cause the gas cloud to extend horizontally and downwards. This has been demonstrated in wind-tunnel and 1/3-scale practical tests. HSE knows of only one 'model' which has been satisfactorily validated for this type of dispersion. Predictions from a general purpose dispersion model such as HGSYSTEM would need very careful interpretation if they are not to mislead, particularly in view of the relatively short distance of interest (~20m).

5. The flammable cloud from a seal escape is predicted to extend out to 80m or more from the side depending on the diameter and type of holder under certain wind speeds. The cloud from a failed upper seal, if not already touching the ground, will descend as the holder empties enveloping anything in its path. There is little that can be done once a seal has failed other than to empty the holder into other available storage, but this can not be done quickly. By coincidence, one recent escape started when a technician was present on a holder station. Even though he was able to initiate prompt emergency emptying, half of the holder's contents still escaped.

6. Whilst a ground roughness length of 0.3 may be suitable for predicting long distance dispersion over an urban environment, it is unlikely to suitably represent the relatively short and 'open' distance between the two holders and 33-37 The Oval. In view of the 'knock-down' effect the holder has on gas dispersing in its wake, it is unlikely that the holder station perimeter wall will provide any significant mitigation.

7. It is HSE's understanding that the 18m exclusion distance for ignition sources (it is not claimed to be a safe separation distance) in IGEM SR4 was derived from early wind-tunnel tests which indicated a higher degree of buoyancy than was eventually found to be the case. The 2nd edition of the Safety Recommendations is now over 10 years old and when revised will no doubt more accurately reflect current knowledge.

8. Major holder failure (decouplement or collapse) has resulted in flames reaching ground level. At least one early Home Office investigation report describes people running to escape the fire as a holder collapsed.

9. Atkins has calculated the chance of safe dispersion (ie. no ignition) from a seal escape as 93% which appears unreasonably high in view of the short separation to high-rise, mainly residential nature of the 33-37 The Oval development.

10. Atkins' back analysis of the National Grid split crown explosion results is incorrect.

11. HSE disagrees with the event frequency analysis in Annex C. The information on which the analysis is based was obtained from the HSE and was not claimed to be exhaustive. The data was gathered for the specific purpose of determining whether the expected frequencies of decouplement and collapse major accidents exceeded that required to support a protection concept 'siting policy' for providing land use planning advice. When the necessary number of past events had been identified, HSE terminated its search. Other unidentified 'large scale' holder accidents have probably occurred in the past and consequently the Atkins' analysis could significantly underestimate the frequencies of these types of event.

12. As a result of Atkins' misunderstandings they have significantly underestimated the individual and case societal risks at 33-37 The Oval, possibly by more than a factor of five but probably by less than an order of magnitude. This appears to have mostly been caused by their inaccurately short seal escape dispersion distances (resulting from an unsuitable dispersion model, optimistic effect of perimeter wall, inappropriate ground roughness) and, consequently, very low ignition probabilities for this event. However, their very probable underestimation of the frequencies for larger major accident events will also have contributed.

13. The 'call-in request' SRI comparison values of 500,000 and 750,000 should only be used with individual risk values of receiving a dangerous dose or worse. HSE's unpublished comparison values for use with risk of death, as Atkins have used in their SRI calculation, are significantly lower so the comparison is inappropriate.

14. Gasholders are not used for just 6 months of the year. Holders were seen fully inflated in July this year. The current hazardous substances consent for the Bethnal Green Holder Station does not constrain storage to certain times of the year. However HSE notes that the Council, acting as Hazardous Substances Authority, has the power to modify the consent if it wishes, although we understand that compensation may be payable to the operator if they did so.

15. It is noted that Atkins advises that ideally both terraces should be removed or made inaccessible for normal use. In HSE's opinion signage is unacceptable as a way of

ensuring the absence of ignition sources. In view of their underestimated dispersion distances, Atkins' recommendation regarding the occupation of front terraces is unsound. Furthermore, openings further than 18m from the gasholder could result in gas ingress and an internal building explosion under certain weather conditions.

16. A normal construction building is unlikely to withstand the almost 1 bar overpressure predicted by Atkins. Furthermore, the application of film or the provision of shatter-proof windows may at best just result in the blast forces being transferred to the frames and adjacent wall which in turn could result in partial or complete building collapse. The adequate 'hardening' of normal buildings against heat and blast is highly specialised, requires considerable expertise and may be impossible for a partly constructed building.

17. HSE 'tolerability' framework in R2P2 was not designed to judge the incompatibility of proposed land uses close to major accident hazard establishments. Consequently, its attempted use by Atkins to justify the acceptability of the development at 33-37 The Oval is misleading. The substantial level of individual risk to occupants is the reason HSE sought and were granted 'call-in' of the application for the amended development even though it would have located slightly further away from the holders than the present, partly-constructed building.

18. The comparison of the risk to occupants with generalised benchmarks such as annual risk of all deaths (including natural causes) or those where the population benefits in some away (employment) is misleading, particularly for a 'lay' audience, eg. the Council, who are not used to making risk-based decisions.

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Appendix 1e

Response by Atkins Oil & Gas to HSE comments.

E1 General Comments

Atkins has sought to provide a realistic best estimate of the actual risks posed by the gas holders to the proposed development at 33-37 The Oval. In particular, it is recognised that there are always uncertainties in such an approach, and the rather more cautious HSE approach is considered to be entirely appropriate for use in the PADHI screening tool. However, even allowing for the variations in approach, many of the differences between the results are a consequence of the paucity of the data available, together with the uncertainties associated with their interpretation. This is discussed further in the detailed responses below.

E2 Detailed Responses

1) This seems to be a general criticism which is backed up by more detail in the subsequent comments. However, since there are some details here which are not specifically raised elsewhere, the response covers each briefly in turn.

    a. It is generally accepted that an assessment of this nature includes many uncertainties, and these have been noted; on the basis of some of the new information which HSE has now identified, it is possible that there is a potential slight under estimate.

    b. Whilst the building is multi-storey, its vertical cross section only just intersects with the most likely potential dispersion profiles (see Response 12).

    c. Building hardening is a secondary issue, and would mitigate against minor incidents (see Response 16).

    d. Presentation of risk with no comparison would be even more misleading (see Response 18).

    It seems that there are 2 major issues:

    i. Dispersion modelling - this has been shown to give a minor change to the results (see Response 12)

    ii. Ignition probability - HSE have not given a robust rebuttal of the Atkins assessment (see Response 9 & 11).

    It is therefore concluded that, using the currently available information, the results may be a slight underestimate, but are essentially a robust *best estimation* of risk. If HSE, or the gas distribution companies, were able to supply better or more up to date information, the assessment could be refined further.

2) These types of event have been considered, as leading to either seal fires or flash fires. Their modelling has been discussed in more detail in Response 12. The frequency of such events has been based on the information which has been reviewed in Appendix C, covering a 30 year period, which does not seem to bear out the '3 large seal escapes per year' which HSE refer to. Ignition probability is discussed in Response 7, and the general

lack of availability or accessibility of validated historical data is discussed in Responses 10 & 11.

3) Seal fires have been considered, and shown (Table 4.8) to contribute 33% to the risk at the nearest edge of the proposed development; as a result, the requirement for adequate evacuation provision has been recognised within the report. The fact that a seal fire may be a precursor to a larger fireball event does not affect the statistical analysis in Appendix C, since it has considered all large scale release and fireball events from whatever cause. It is also noted that there are existing developments already adjacent to gas holder sites, and that many of them are industrial, which could provide ignition sources, so lack of ignition may not be solely due to separation.

4) As the wind speed increases above 5m/s, so the more rapid mixing due to atmospheric turbulence will reduce the plume length. Results presented in Cleaver & Halford (2004) show that, even for the worst transient release from a 70m gas holder, concentrations above the lower flammable limit (LFL) exist only to 18m downwind at ground level (in extremely rare high wind speeds), although they may extend to around 35m downwind at higher elevations (around 15-20m high) in more common moderate wind speeds (5m/s). Note that further discussion regarding the use of HGSYSTEM has been given in Response 12.

5) The 80m quoted here almost certainly refers to the distance to ½ LFL, at which it is sometimes considered that ignition could occur. In practice, ignition is unlikely to occur at less than 70% of LFL, but the area covered by a flash fire will effectively be restricted to the smaller area covered by the LFL contour, in line with the most common modelling approach of such effects in QRA studies. See further discussion in Response 12.

6) The effective roughness length is determined by upwind fetch, as well as the distance over which the leak disperses. The value of 0.3m is considered appropriate to an urban area. In this particular case, its only effect on the QRA results will be a slight change to the flash fire distances.

7) The reference to IGEM SR4 was primarily for comparison and completeness, and is not critical to the QRA results presented. It is recognised that this may be updated in due course in the light of improved information.

8) Atkins agrees with HSE's comment, and so this point is not an issue, since the QRA has considered major holder failure (both total loss and decouplement). The fireball modelling for these cases allows for flames reaching ground level by taking 100% fatality probability within the area covered by the projection of the fireball radius onto the ground below.

9) This represents an ignition probability of 7%. Given the statistics reviewed in Appendix C, there appears to be at most an overall probability of ignition of any release from a gas holder of around 3-4%. Indeed, if the information was not exhaustive (as noted in HSE's comment 11), this is probably an over-estimate, since releases are much more likely to go unreported if they are unignited than if they are ignited.

10) Atkins cannot comment without further detail. However, it is noted a) that the contribution to risk from such events is small (<10%), and b) that the assessment of risks from Major Hazard sites would be considerably easier if more detail of the predictive aspects of COMAH reports could be made available. In this case, National Grid did supply some information, but it was not complete. Nevertheless, on the basis of a) above, this does not represent a major issue.

11) This is the only information which Atkins had available with which to perform such a frequency analysis. Given the current interest in developments close to gas holders, and the amount of potential development which could be affected, it would seem important to ensure that the best possible and fullest information is made available to interested parties so that the real risks can be quantified with greater certainty. It seems that the main difference between Atkins' analysis and HSE's interpretation is the appropriate value of ignition probability. This is discussed in some detail in Section C5, but HSE have made no specific attempt to refute or improve upon the analysis. It is understood that HSE have generally made rather conservative interpretations of the data, in order to decide whether certain major events should be used to set planning zone boundaries. Atkins agrees that this approach is entirely reasonable in the context of deriving a standard methodology for setting such boundaries. The approach taken by Atkins, however, has been to determine best estimate values, whilst remaining conservative, in order to ensure that a realistic understanding of the risks is obtained.

12) It is acknowledged that the dispersion of gas from a seal failure is a complex phenomenon, and may not be adequately modelled by a simple model such as HGSYSTEM. The alternative, as suggested by Cleaver and Halford and discussed in Responses 4 & 5 above, is also a simplification, in that it does not allow for the presence of adjacent gas holders, or the deflection of the flow by downwind obstructions such as walls. Nevertheless, the maximum downwind range to LFL which they give for a transient seal failure from a 70m gas holder (larger than any at Bethnal Green) is, as noted above, around 30-35m. It is important to note, however, that the results show this peak at around 15-20m above ground level. The presence of the boundary wall would deflect this further upwards, so that only a small part of the building would be within the flammable envelope.

    The ignition probability which has been used has been taken from standard models, and is shown to be conservative relative to the historical data analysed in Appendix C. It is independent of the cloud envelope, and this approach is consistent with the level of detail which is used in current QRA modelling. In order to determine the effects of larger flammable envelopes, subsequent sensitivity calculations have been undertaken, in which the cloud footprints calculated from HGSYSTEM have been doubled (giving a *ground level* hazard range of around 27m, which is close to that from Cleaver & Halford, and envelops the nearest edge of the proposed development). This would increase the *outdoor* risk to 14.7 cpm at the nearest location, but would not change it at the furthest location.

    Note that the results presented in the report are for risks to a person who is outdoors for 100% of the time. This is conservative, and was presented since there is little protection for people indoors from the major contributing events. With the modified modelling of flash fires described above, there is a greater difference, and the risk to a *residential* population (indoors 90% of the time) would only be increased from 11.7 cpm to 12.2 cpm. Overall societal risk will be little changed by this increase.

13) In Section 5.4, following the equation for SRI, it is explicitly stated that R is the risk of exceeding dangerous dose. Confusion seems to have arisen because the average R [=(15.4 + 8.9)/2 cpm] is almost identical to the risk of fatality at 'Development nearest' [11.7 cpm]. Hence the comparison *is* appropriate.

    It is noted that Atkins believes that the analysis has potentially *overestimated* the SRI value by using conservative numbers of residents at the development, relative to the way in which HSE would normally calculate SRI. Using an average value of 2.5 people per unit, the number of residents may be calculated as 14 x 2.5 = 35, and the *effective* number of office workers can be reduced by a factor of 4 (16 x 0.25 = 4) in line with the detail given in the paper by Carter (1995).

Taking n = 35 people for 70% of the time and n=39 people (residents + 0.25 x workers) for 30% of the time, R = (15.8+8.8)/2=12.3 cpm, (based on the revised risks calculated as noted in Response 11) and A = 0.056 ha (approximate area), gives:

$$SRI = \frac{(35+35^2)/2 \times 12.3 \times 0.70}{0.056} + \frac{(39+39^2)/2 \times 12.3 \times 0.30}{0.056} \approx 148{,}000$$

This is actually around half of that presented in the report. It is noted that even an increase in R by a factor of 5 (as suggested by HSE) would result in the SRI being close to, but remaining less than, the 750,000 call-in value.

14) When enquiries were made of National Grid, they stated the operational profile which has been reproduced in Section 4.1. Since no account has been taken of this operational profile when determining the event frequencies, any changes to the profile would not change the risk estimates.

15) It is agreed that non-occupation would be better than signage. However, in view of the small difference between outdoor and indoor risks, such a measure may not reduce the risk significantly. The front terraces are more than 35m from either gas holder, and therefore, on the basis of the Cleaver & Halford dispersion results, are extremely unlikely to be within a flammable cloud.

16) It is agreed that building collapse would be the most likely result of the blast effects of the worst cases considered. However, much of the injury potential from lesser events (not specifically modelled in the QRA) would be from flying shards of broken glass, and this could be minimised by use of shatter-proof windows.

17) In no way is Atkins seeking to use R2P2 to justify the acceptability of the development. As stated in the second sentence of Section 5.3, it is used to set the level of risk in the context of typical major hazard risks. It has been acknowledged that the risks are rather higher than the levels which HSE would consider appropriate for a development of this nature, and it has been emphasised that it is Tower Hamlets' responsibility to weigh up these risks before making a final decision.

18) Quoting risks in terms of cpm would mean very little to a lay audience unless they were compared with something to which they could relate. Whilst the occupational risks quoted are at the higher end of such risks, and may not be experienced by many of the likely audience, road accident risks, for example, are events to which most people *can* relate. It is clear that the risks are different, but the list set out in Section 5.2 at least puts the magnitude of the risks at the development into context.

E3 Conclusions

The Atkins assessment potentially gives a slight under-estimation of the risks as discussed in Response 12 above. It is possible that there is a larger underestimate (roughly by a factor of 2) if some of the anecdotal information given in HSE's Comment 2 could be put onto a sound statistical footing. This implies that the risks would be relatively high but not intolerable. It also implies that, because of the relatively small scale of the development, the associated societal risk would be unlikely to exceed the SRI call-in criterion of 750,000.

Appendix 2

LONDON BOROUGH OF TOWER HAMLETS

Agenda Item number:	8.1
Reference number:	PA/05/00421
Location:	33-37 The Oval E2 9DT
Proposal:	Demolition of existing building and redevelopment to provide a five storey building comprising 3 Use Class B1 (business) units on the ground floor with 14 flats above (6 one bedroom, 6 two bedroom and 2 three bedroom).

1. ADDITIONAL VIEWS FROM HSE

1.1 The HSE believe that the Council's consultants (Atkins Oil and Gas) have had to make judgements in lieu of the Safety Report information that, because of security considerations, it did not have when producing its work. This has resulted in the risk predictions being lower than HSE would consider appropriate. This is covered in more detail in the next section (Report amendments). The HSE have also provided the following as further examples:

> The 'Maximum Horizontal Downwind Dispersion Distances to LFL' should have been interpreted as at close to ground level, unless otherwise described. Consequently the advice that flammable gas escapes would exist only 10-20m above ground level, and would mostly pass over the proposed multi-storey development is incorrect.
>
> Recent information from gasholder operators is that evidence has now been discovered that a small gasholder 'decoupled' in 1979. This would revise further upwards the risk predictions, particularly as the original report indicates the values to be very sensitive to increased fireball frequency (Table 4.9). Also, the operator's revised thermal radiation predictions for the Bethnal Green holders nearest to 33-37 The Oval indicate that the whole of the development site would be within the ranges at which most people would be expected to be killed (1800 thermal dose units) from a seal fire.

1.2 HSE remain of the opinion that Atkins Oil and Gas's revised risk estimate still underestimates the risks to people at the development should it be occupied and they repeat their concerns set out in para 8.12 of the main report.

2. REPORT AMENDMENTS

2.1 As mentioned above, in commenting on our report HSE have provided additional information to our consultants that was previously not available to them. A fuller review of the comments from HSE on the Atkins risk assessment has led Atkins to believe that some of the risks may have been underestimated by a factor of around 2 (this is reflected in appendix E in the report) rather than a factor of 5 as suggested by HSE. The following changes have been made to the report as a consequence, but these were too late to include before the agenda had to be published:

> 8.12 Add: Review against HSE's comments suggests that the risks could be around a factor of 2 higher than the original predictions (i.e. 25cpm; once in 40,000 years). This remains high but not intolerable.

8.13 Comparison now puts ‘The development’ above ‘Manufacturing industry’

8.14 Add: Revised risk results give the increase in risk of 0.25%.

8.15 Note that IR may be up to 25cpm

8.23 Line 1 should include reference to latest estimate of 25cpm

2.2 The table on page 225 of the report is reproduced below with the amended data from both Atkins and HSE plus HSE’s “broadly acceptable” and the “intolerable” risk level definitions:

Risks of fatality	Risk as annual experience per million	Risk as annual experience
Annual risk of death (entire population)	10,309 cpm	1 in 97
Annual risk of cancer	2,584 cpm	1 in 387
Annual risk from all types of accident	246 cpm	1 in 4,064
HSE intolerable level of risk	**100 cpm**	**1 in 10,000**
Annual risk from all forms of road accident	60 cpm	1 in 16,800
The development (HSE view)	**60 cpm**	**1 in 16,800**
Construction	59 cpm	1 in 17,000
Agriculture, hunting, forestry and fishing	58 cpm	1 in 17,200
The development (Atkins view)	**25 cpm**	**1 in 40,000**
Manufacturing industry	13 cpm	1 in 77,000
HSE broadly acceptable level of risk	**1 cpm**	**1 in 1,000,000**

2.3 These amendments do not alter the fundamental conclusions about risk nor the balance of considerations against the other material planning considerations in the report.

3. RECOMMENDATION

3.1 My recommendation is unchanged.