Appendix E

Response 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. Atkins concedes that dispersion distances determined are potentially underestimated for higher wind speeds. However, the vertical cross section of the building 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 could be 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)

    Although the HSE did not directly query the seal fire modelling methods used, investigations into the comments have led Atkins to refine its modelling of seal failure fire events. These changes have had the effect of slightly increasing the risk results observed at The Oval. Using *all* of the newly available information, it is concluded that the results have been underestimated by *up to* a factor of 2.

2) These types of event have been considered, as leading to either seal fires or flash fires. Atkins concedes that assuming seal failures occur over only a 10m span of seal may underestimate the consequence of some of these events.

   The modelling of flash fires 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. However, as stated above Atkins concedes that it may be appropriate to assume that a small percentage of seal fires will propagate into large seal fires and this has not been accounted for in modelling to date. The effects of this change are included within the overall factor of 2 noted at the end of Response 1.

   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) Atkins concedes that modelling dispersion distances using conventional dispersion models may produce slightly underestimated results *for higher wind speeds*. However, 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, sustained 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 or suburban area, as recommended by the HSE within the Safety Assessment Report Guide for installations of this nature.

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 effectively 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 Cleaver and Halford 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. Furthermore, the maximum dispersion ranges from the adjacent holders, as quoted in the National Grid Bethnal Green gas holder station COMAH report, is 27m. Considering that this distance to LFL would be observed approximately 10-20 meters above ground level (in the worst case release), this underestimate is not considered likely to change the results significantly.

    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 equal to the maximum dispersion distance quoted in the COMAH report, and envelops the nearest edge of the proposed development). This would increase the *outdoor* risk from 11.7 cpm 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.

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.

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. Note also that an increase in R by a factor of 2 (which Atkins now believes may be more representative of the real risk) would result in the SRI still 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

On consideration of HSE's comments, the Atkins assessment gives a slight under-estimation of the risks (approximately by a factor of 2), as discussed in Response 2 and 12 above. This implies that the risks would be relatively high but still 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. If HSE, or the gas distribution companies, were able to supply improved or more up to date information, the overall risk assessment could be refined further.