

## ACDS MHSC Working Group on Pipelines

### Notes of WGP HSE HID C15 Technical Seminar 13<sup>th</sup> October 2005 Daniel House, HSE Offices, Bootle

#### Attendance:

##### WGP

G P Walker Chairman  
M Harrison UKOPA/Huntsman  
S Chatfield HSE HID SI3  
N Jackson UKOPA/NGT  
R McConnell Independent Consultant  
J Haswell UKOPA/Secretary

##### HSE

M Wilson, Head of HID C15  
N Riley, Major Hazards Expert, HID C15  
I Hirst HID C15  
G Hawkins HID C15  
S Porter HID C15  
P Harper HSE Operational Policy Unit

##### UKOPA

R Ellis Shell  
P Hall BP  
S Potts UKOPA/NGT Gas  
D Male UKOPA/BPA  
P Baldwin

## 1 Introduction

### 1.1 Purpose of Seminar

G Walker welcomed all to the Seminar, and briefly summarised the background and current position relating the Working Group on Pipelines (WGP). He stated that the WGP had been established to complete a well defined technical agenda, and significant progress had been achieved jointly with HSE up to the end of 2002. However, since that time there had been no real opportunity to review and discuss progress. G Walker confirmed that the main purpose of the current seminar was to review and discuss progress on the WGP/UKOPA and HSE technical work programmes relating to risk assessment and land use planning, discuss how the work can be formalised in the supplements to the pipeline codes IGE/TD/1 and PD 8010, identify areas where joint work can be carried out, and agree a mechanism for achieving this.

G Walker opened this session by explaining that the presentations in the first session were intended to bring attendees up to speed with the work completed to date, current position and current programme for completion of the code supplements.

### 1.2 Review of Previous HSE/UKOPA Discussions Relating to LUP – N Jackson

The overhead used by N Jackson in his presentation is given in attachment 1 to these notes; reference WGP/05/051. The presentation covered summary of:

- The sequence of the key discussions between HSE/UKOPA relating to risk assessment and its application to LUP assessments
- The current position

### 1.3 HSE's Statutory Role – N Riley

The overheads used by N Riley in his presentation are given in attachment 2 to these notes; reference WGP/05/052. The presentation covered:

- HSE's statutory duties regarding LUP
- How these duties are carried out for pipelines and the guidance issued
- Practical application

#### 1.4 HSE's Priorities and Work Programme relating to Pipeline Risk Assessment Methodology and Provision of LUP Advice – I Hirst

The overheads used by I Hirst in his presentation are given in attachment 3 to these notes; reference WGP/05/053. The presentation covered:

- LUP for Pipelines in the 1990s and now
- Significant events
- A summary of the HSE CI5 Work Programme at the end of 2002, and additions to this
- Current HSE CI5 priorities

#### 1.6 Supplements to Pipeline Codes IGE/TD/1 and PD 8010 – N Jackson

The overheads used by N Jackson in his presentation are given in attachment 4 to these notes; reference WGP/05/054. The presentation covered:

- Reason and requirements for carrying out pipeline risk assessments
- The role of pipeline codes and the reasons for a code supplement for site specific risk assessment
- Current status of the review of code supplements
- Outstanding issues and benefits

#### 1.7 Discussion

G Walker asked J Haswell to explain the standards development process. J Haswell explained that the process involved:

- i) Formation of an expert Working Group by the Standards bodies to define, oversee and direct the development work
- ii) Preparation of a draft by the expert Working Group, including solicitation and incorporation of wider comments
- iii) Preparation and submission of a "Committee Draft" or "Draft for Public Comment" version for approval by the Standards bodies
- iv) Issue of the approved committee draft for public consultation process with a defined timescale
- v) Formal review of comments received
- vi) Final approval
- vii) Publication

S Chatfield stated that the key issue was establishing meaningful discussions on the risks and their acceptability, rather than on the calculation process. In this regard, he asked why a risk level of  $0.3 \times 10^{-6} \text{ yr}^{-1}$  was used for LUP, where a risk level of  $1 \times 10^{-6} \text{ yr}^{-1}$  was used for ALARP considerations. It was explained that comparison was complicated by the fact that the risks were of a different nature and applied to different people. The  $1 \times 10^{-6} \text{ yr}^{-1}$  ALARP criterion in R2P2 is based on risk of death, whereas the LUP  $1 \times 10^{-6} \text{ yr}^{-1}$  and  $0.3 \times 10^{-6} \text{ yr}^{-1}$  criteria are based on the risk of receiving a "dangerous dose" or worse. Moreover, the risk in R2P2 is described as being to "workers and the public", whilst the risk calculated in LUP is for a "typical householder". A risk of  $0.3 \times 10^{-6} \text{ yr}^{-1}$  to a typical householder is considered equivalent to a risk of  $1 \times 10^{-6} \text{ yr}^{-1}$  to a vulnerable person.

[Post meeting note – an explanatory note provided by N Riley is given in Attachment 1 to these notes].

In discussion it was also noted that the Inner Zone could be set using some other criteria where uncertainty exists in the risk methodology being used or where the consequences of some events are extremely severe. I Hirst stated that the reason that 1 BPD is used for natural gas pipelines inner zones is because some effects are not accounted for in the methodology (e.g. debris throw, non-vertical jet flames) or are poorly calculated (thermal radiation from a vertical jet flame when very close to the pipeline). He noted that for this reason, an equivalent distance for non-natural gas pipelines would have been useful and consideration was to be given to the use of MDOB (minimum

distance to occupied buildings) as specified in PD 8010, but J Haswell had informed HSE at an earlier meeting that investigation into the basis for this had indicated this may not be appropriate. J Haswell explained that Roger King of A D Little, who had been involved in the original work, had provided some background for the Standards Working Group involved in the development of the code supplement. The MDOB relationships had been developed using QRA results for various pipelines available in industry and HSE in 1989, curve fitting to the  $10^{-6}$  yr<sup>-1</sup> risk contour informed by the existing TD/1 BPD curves, and development of hazard factors based on the consequences from different substances. Roger Hill had strongly recommended that this work should be revisited and updated if it was to be used for anything other than broad and conservative design guidance.

N Jackson requested confirmation that for LUP advice, HSE sought to apply a “broadly acceptable” risk level, and noted that as the HSE LUP requirements specified in PADHI are less onerous than code requirements for ALARP, it may be feasible to revise code requirements to align with PADHI and move towards a generally accepted level of risk for all situations. This would allow certain developments within the 1 BPD distance.

N Riley stated that this required careful interpretation. He stated that HSE were not the controlling body with respect to LUP decisions, and other factors may be significant for local decisions. He noted that the potential population densities implied by the current Government policy for development of brown field sites in the SE of England were extremely high.

R McConnell referred to the comments received from HSE relating to the code supplement from which he inferred that a number of the areas covered by the draft supplements described a new methodology, whereas the presentation given by I Hirst indicated that HSE had made or were working on developments in these areas.

M Wilson confirmed that HSE were working on a number of areas where the need for model development had been identified by the IFRLUP. She noted that 80% of the technical areas relating to risk assessment methodology referred to by N Jackson and I Hirst, were common, and proposed that as money was available for revision of MISHAP, HSE and UKOPA should identify how they could work together to identify and prioritise gaps.

G Walker agreed with M Wilson stating that her proposal was entirely in line with the original WGP philosophy, in which HSE and industry developed the technical agenda jointly. He reiterated that WGP had continued with this agenda over the 2003/4 period, and it may be feasible that joint funding for developments in some areas may be possible.

R Ellis referred to the need for the joint work to address the two different situations covered by pipeline codes, first routeing, design and construction of new pipelines, and second the management of pipeline risks during operation. He stated that in this respect, it was essential that joint work ensured that the use of risk mitigation during operation is addressed by the codes.

## **2 UKOPA Technical Presentations**

### **2.1 Risk Assessment Methodology – R McConnell**

R McConnell explained that the approach taken by UKOPA is to generate models which replicate HSE’s published methodology so that:

- i) Assumptions relating to failure rate, event trees and consequence models can be understood
- ii) Changes reflecting current best practice proposals can be tested to determine the effects on risk levels
- iii) Mitigation methods can be factored into risk assessments
- iv) Advice on application of the methodology can be factored into risk assessments

The overheads used by R McConnell in his presentation are given in attachment 5 to these notes; reference WGP/05/055. The presentation covered:

- Risk assessment methodology and key results for:

- Natural Gas
- Ethylene
- Spiked Crude
- NGL
- Risk assessment methodology and review of CONCAWE failure data, to be published

In discussion during and after R McConnell's presentation, it was agreed that:

I Hirst would provide details of HSE's jet fire model, PIPEFIRE.

[Post-meeting note:- The details are contained in HSE Research Report RR036, 2002. R McConnell said he would incorporate the model into an update of his calculations before meeting I Hirst and G Hawkins for further discussions.]

I Hirst and G Hawkins will provide details of the failure frequencies used by HSE

[Post-meeting note – I Hirst has sent a spreadsheet to R McConnell giving failure frequencies for all four hole sizes and all Transco natural gas pipelines.]

I Hirst will provide details of the HSE ethylene methodology

[Post-meeting note – Details are given in PCAG Chapter 06P, sent shortly after the meeting.]

### **Action 1 - R McConnell/I Hirst/G Hawkins**

#### **2.2 Justification for Changes to Existing Pipeline LUP Zones – R McConnell**

R McConnell explained that this presentation addressed the key areas of the technical work programme, and evaluated each with respect to the criteria set by M Wilson at the WGP meeting held in April, i.e.:

- Is a cautious approach demonstrated?
- Is the work technically valid and supportable?
- Does the proposed change make a significant difference to LUP zones?
- Are the models readily useable by HSE?

The overheads used by R McConnell in his presentation are given in attachment 6 to these notes; reference WGP/05/056. The presentation covered:

- Failure rate contribution from ground movement
- 3<sup>rd</sup> Party damage prediction model
- Mitigation, specifically risk reduction factors for physical protection of pipelines
- Ethylene pipelines – prediction of LUP zones
- Spiked crude
- Gasoline – risk assessment

During R McConnell's presentation, G Walker requested M Wilson to confirm whether or not she considered the issues presented met the criteria she had set.

M Wilson confirmed that:

Failure frequency due to ground movement - HSE will consider incorporation of changes in the failure rate due to ground movement when the work commissioned by NGT is available.

### **Action 2 - R McConnell/G Hawkins**

Mechanical damage model - HSE will give consideration to use of the new mechanical damage model, although independent validation may be needed. In addition, it was agreed HSE would review the failure rates for smaller diameter pipelines where an apparent divergence from UKOPA data had been identified by R McConnell.

### **Action 3 - R McConnell/I Hirst/G Hawkins**

Mitigation – HSE will require further detail regarding justification of the risk reductions proposed for mitigation, this will be discussed when details of UKOPA work are available. HSE indicated it was unlikely that some of the mitigation measures e.g. safety management would be appropriate for LUP uses as they had been intended for a different purpose.

#### **Action 4 – UKOPA RAWG (N Jackson)**

Ethylene – HSE will discuss this with R McConnell.

#### **Action 5 - R McConnell/I Hirst/G Hawkins**

Spiked crude – The current discussions relating to the Bo'ness development cannot be used as the basis for agreeing a generic approach.

NGL – HSE will discuss this with R McConnell.

#### **Action 6 - R McConnell/I Hirst/G Hawkins**

The following points were covered in discussion:

R Ellis noted that as R McConnell believed he had where possible used HSE's approach, and as HSE have agreed to discuss outstanding issues and differences, is it possible that a single model/methodologies can be agreed, or is it anticipated that HSE will continue to have their own approach?

I Hirst said that whilst a single model had some attractions there was also merit in having two largely independent models that gave similar results. He expected that HSE would continue to provide full details of their methodology, but continue to use in-house software. This is of particular importance in situations where HSE decisions may be scrutinised at a Public Inquiry or Appeal.

R Ellis asked what could be done to avoid future divergence of methodologies?

J Haswell stated that methodologies included in the code supplements would be subject to regular, 5 yearly reviews and updates, this will provide an ongoing process to ensure the expert best practice methodology remains current and transparent. S Chatfield and G Hawkins agreed that where best available technical methods were available externally in other fields of engineering (e.g. Finite Element Stress Analysis), these had been used to good effect. But I Hirst cautioned that bulk updating of LUP zones was a massive task that could not be undertaken frequently. M Harrison stated that it was understood and appreciated by all parties that while agreement on the modelling and calculation approach was essential, interpretation and application of the results may differ for policy reasons. He emphasised the key objective was to agree the approach to numerical calculations, so that discussion can concentrate on understanding policy issues. N Jackson gave an illustration of this in application of ALARP models, in that the approach was agreed, but operators apply models using a conservative assessment of cost benefit, whereas HSE apply the models using a conservative assessment of safety benefit.

Finally, it was agreed that the primary intent is to achieve full agreement on the methods, inputs, assumptions and benchmark solutions, and in doing so allow all stakeholders the flexibility to develop and apply their preferred software.

### **2.3 Updated Mechanical Damage Limit State Model – J Haswell**

The overheads used by J Haswell in her presentation are given in attachment 7 to these notes; reference WGP/05/057. The presentation provided a brief summary of the basis of the mechanical damage limit state model developed for UKOPA by Advantica.

G Hawkins confirmed that the Advantica report and published paper provided by UKOPA were being reviewed. It was agreed that a formal comparison of the HSE mechanical damage prediction model and the UKOPA mechanical damage limit state should be carried out.

## **Action 7 - G Hawkins/J Haswell**

### **2.4 Use of the Mechanical Damage Limit State Model to Derive Factors for the Influence of Pipeline Design Factor and Pipe Geometry of Pipeline Failure due to 3<sup>rd</sup> Party Interference – J Haswell**

The overheads used by J Haswell in her presentation are given in attachment 8 to these notes; reference WGP/05/058. The presentation covered:

- The method of application and an overview of the studies carried out
- Results showing the influence of design factor and pipe geometry

N Riley asked what further work was needed to complete the studies. J Haswell stated that further work was needed to understand the influence of diameter and the correlation of results with failure data.

### **2.5 Risk Mitigation Measures – J Haswell**

The overheads used by J Haswell in her presentation are given in attachment 9 to these notes; reference WGP/05/059. The presentation covered:

- Mitigation measures which influence i) the likelihood of impact and ii) the likelihood of rupture once impact has occurred
- The mitigation measures being considered for incorporation on the code supplements, and the recommended risk reduction factors
- Practical application and outstanding work

Following the presentation the following points were raised:

S Chatfield stated that in considering pipeline risk levels, HID SI4 only considered mitigation measures which physically affect the pipeline.

M Wilson confirmed that this was in line with HID CI5 policy, which in addition does not take into account protection.

I Hirst stated that when dealing with a second-bite consultation HSE considers only changes in wall thickness and grade of steel, making allowance for the consequent changes in pipeline failure frequencies, in the different sections of the pipeline. HSE do not take into account any benefit due to depth of cover beyond 1.1 metres or due to the presence of pipeline protection, but would be prepared to consider any justification evidence provided to them.

J Haswell stated that with regard to depth of cover, the most recent consideration was that given by the PD 8010 Standards Working Group, which had considered the need to retain a recommended depth of cover of 1.1 m vs the international and European recommended 0.8 m. In terms of pipeline protection, she stated that the Standards Working Group would consider work carried out by Rod McConnell and N Jackson, who had reviewed previous research into the effect of pipeline protection and marker tape, and were developing a fault tree approach taking into account the type and size of machinery used for different activities, where such activities occurred and what controls they were subject to. In discussion HSE noted that that the current types and size/power of excavating machinery available to cause 3<sup>rd</sup> party damage required review and analysis. In addition, even in rural areas, it is likely that construction machinery will be present when land development is taking place, so the distinction between agricultural and construction machinery is not a clear one.

It was agreed that the UKOPA RAWG would provide further justification in relation to the effect of depth of cover on pipeline risk assessment.

## **Ref Action 4 – UKOPA RAWG (N Jackson)**

M Wilson stated that HSE consider that pipeline protection is likely to be beneficial, and would therefore consider any technical justification provided.

#### **Ref Action 4 – UKOPA RAWG (N Jackson)**

#### **2.6 Proposed Approach to Societal Risk – J Haswell**

The overheads used by J Haswell in her presentation are given in attachment 10 to these notes; reference WGP/05/060. J Haswell stated that the presentation was based on a paper prepared by R McConnell for UKOPA, and covered:

- The existing IGE/TD/1 FN criterion recommended for Natural Gas pipelines
- An FN criterion derived from HSE publications proposed for other MAHPs
- The approach for applying FN criterion to different pipeline diameters and pressures

G Walker stated that WGP were aware that HSE work on societal risk was currently on hold while wider issues were considered by Government, but stated that HSE comment on the proposals would be appreciated.

N Riley suggested that HSE may consider submitting the UKOPA paper to the Cabinet Office for consideration as part of the review of societal risk issues, M Wilson agreed to discuss this internally.

#### **Action 8 – M Wilson/N Riley**

P Harper stated that the application of the casualty criterion needed careful consideration to ensure the basis for the FN curves was equivalent. In addition, he asked how the single event referred to in the application of the FN criterion was defined. R McConnell explained the single event included the summation of all possible consequences and their associated frequencies, occurring at any point along the length defining the interaction of the pipeline hazard with the adjacent population.

M Wilson confirmed that HSE work was on hold and therefore formal engagement on the development of a societal risk methodology was not appropriate. However, she stated that as the IGE/TD/1 FN criterion was published in the existing code, and the Standards Working Group were addressing the issue for justified reasons, HSE would be prepared to provide technical comment, but separate from the process to be applied to the joint technical agenda on risk assessment.

#### **Action 9 – N Riley/P Harper/R McConnell**

Finally, it was agreed that while societal risk presented technical and political difficulties, the individual risk levels of pipelines were invariably low, societal risks associated with encroachments and developments were an ongoing issue and operators needed a robust methodology.

### **3 MSDU Technical Presentations**

#### **3.1 Update on MISHAP methodology – I Hirst**

The overheads used by I Hirst in his presentation are given in attachment 11 to these notes; reference WGP/05/061. The presentation covered:

- Update of MISHAP for pipelines transporting i) natural gas and ii) other flammables pipelines
- Developments in User Documentation (which is available on request) and failure frequency modelling
- Studies into updated release rate models
- Review of the jet fire model and revision of the flash fire model
- Improvements to the software architecture and robustness

In discussion following the presentation, I Hirst again stated that while HSE HID CI5 were not planning any work on depth of cover or pipeline protection, external work would be reviewed if provided, and changes may be recommended if the evidence was sufficiently strong.

#### **Action 10 – UKOPA RAWG (N Jackson)**

##### **3.3 Update on Failure Frequencies – G Hawkins**

The overheads used by G Hawkins in his presentation are given in attachment 12 to these notes; reference WGP/05/062. The presentation covered:

- Update of failure frequencies applied to natural gas pipelines (synthesised from mechanical, natural and 3<sup>rd</sup> party failure frequency rates derived from the UKOPA database, and corrosion failure rates based on EGIG)
- Failure frequencies for other flammables – mechanical (requires a comparison of UKOPA, EGIG and CONCAWE databases for mechanical failures and an assessment of code differences), natural failures (assumptions for gas pipelines should apply), corrosion (UKOPA and CONCAWE to be considered) and 3<sup>rd</sup> party interference (UKOPA to be considered but it may also be necessary to carry out a limited validation of the PIPIN model against CONCAWE data)

In discussion following the presentation, it was noted that UKOPA had completed work which reviewed the application of the UKOPA pipeline failure database to all pipelines, and reviewed and compared CONCAWE data with UKOPA data. It was agreed relevant reports would be formally submitted to HSE. G Hawkins noted that HSE would need to look at the differences in how data should be applied, in particular the justification for applying the trend in reducing failure rates for old pipelines (e.g. 30 years) vs new pipelines, and also how code differences, particularly with respect to hydrotest levels and improvements in NDT and welding, may affect failure rate due to mechanical defects.

#### **Action 11 -UKOPA RAWG (N Jackson)/G Hawkins**

##### **3.5 Update on IFRLUP P6 Work Programme – S Porter**

S Porter reported that while there had been some slippage in the planned programme, a list of required enhancements to HSE models and methodologies had been agreed through IFRLUP P5, and resources were being made available to address these in P6. In many cases, the required enhancements involved updating of software architecture and operating systems; this was being carried out in-house.

#### **4 Discussion**

G Walker summarised the key issues and actions which had been covered and requested agreement for the following:

- i) A number of issues for technical clarification and confirmation had been identified in relation to UKOPA and HSE modelling, and discussions had confirmed that these could be addressed by direct discussion between Rod McConnell, I Hirst and G Hawkins. G Walker proposed that these discussions should be held as soon as possible. This was agreed.

#### **Action 12- R McConnell, I Hirst, G Hawkins**

- ii) A number of formal documents had been identified for exchange between HSE and UKOPA. J Haswell was actioned to confirm these in the notes of the meeting.

#### **Action 13 - J Haswell**

- iii) HSE had reviewed the draft code supplements and had been updated on the status of the development. G Walker invited M Wilson for confirmation of HSE's involvement in the process for development, with the caveat that this involvement would exclude societal risk.

- iv) A number of areas of joint interest and work had been acknowledged, G Walker invited all attendees to propose and agree how this may be achieved, for example should the Working Party (Risk Assessment) previously operated by WGP be reconstituted?

G Walker invited open discussion.

With regard to iii), M Wilson confirmed that HSE will support the development of the code supplements, and with regard to societal risk and FN criteria, will provide technical comment on an informal basis.

Regarding iv) M Wilson asked whether the WP (RA) was in fact the best mechanism, or whether a series of informal meetings involving relevant experts would be more efficient. With regard to the areas with the potential for joint working, she stated that:

- HSE will undertake to review the work commissioned by NGT on failure rates due to ground movement with the view to implementing this in the revised and updated version of MISHAP.
- There is a need to explore the validity of predictions for jet fires.
- HSE will compare their existing predictive model for 3<sup>rd</sup> party interference with the UKOPA mechanical damage limit state with a view to applying the UKOPA limit state to the prediction of failure frequency due to 3<sup>rd</sup> party damage. In addition, they will review failure rates for smaller diameter in comparison with UKOPA data.
- There is potential for joint working with regard to the risk assessment methodology for ethylene.
- There is possible potential for joint working on spiked crude and NGL pipelines, although HSE have not decided whether a generic methodology for these pipelines is required. A case by case assessment may be more appropriate due to the small lengths of such pipelines operating in the UK.

I Hirst stated that with regard to predictions from jet fire models, HSE would be keen to receive any empirical data. N Jackson and P Baldwin agreed to review and supply any appropriate material.

**Action 14 - N Jackson/P Baldwin.**

In addition, with regard to methodologies for ethylene, spiked crude and other MAHPs, I Hirst stated that HSE would be interested in any proposals for generating relevant data.

Returning to the issue of technical models for the pipeline inner zone, N Jackson proposed that the technical basis for the TD/1 BPDs be formally reviewed so that a technically equivalent distance can be reliably derived for non-natural gas pipelines. It was agreed that the UKOPA RAWG would progress this and inform HSE of any progress.

**Action 15 - UKOPA RAWG (N Jackson).**

M Wilson stated that in all aspects, HSE and UKOPA should seek to exchange and compare models through the joint programme of work.

The mechanism for the joint programme of work was discussed. It was agreed that a series of expert meetings co-ordinated by R McConnell would be the most appropriate way of progressing the joint work programme.

R McConnell agreed to develop formal terms of reference covering i) the topics for joint working/discussion, ii) the procedure for setting up and recording meetings, and iii) the procedure for agreeing and formalising action programmes and timescales, for approval by WGP. He agreed that where possible, the programme of meeting dates would be circulated for information.

**Action 16 - R McConnell**

## **5 Conclusion**

G Walker concluded the meeting by stating that the agenda had been fully covered and constructively discussed. He thanked M Wilson and N Riley for hosting the meeting, and all for attending.

G Walker stated that as the Advisory Committee on Dangerous Substances had been discontinued, the Working Group on Pipelines in its current guise would also be discontinued. He proposed that the outstanding actions and proposals to address these and the mechanism for overseeing and confirming this should be the subject of a final WGP meeting, to be scheduled in Q1 2006. This was agreed.

**Notes: The following items are included below:**

**An explanatory note provided by N Riley in relation to risk levels and criteria (ref Item 1.7)**

**An Action List**

**A List of attachments**

**A list of documents to be exchanged**

## **Explanatory Note provided by N Riley Relating to ALARP and LUP Risk levels and Risk Criteria**

Further to the discussion at 1.7, the difference between the 'risk of death' and 'dangerous dose' was addressed in the HSE document "Risk criteria for land use planning in the vicinity of major industrial hazards" published in 1989 (ISBN 0 11 885491 7) at paragraphs 54 & 55, under the heading "Suggested Individual Risk Criteria":

- 54 "The RSSG (Royal Society Study Group) and HSE's document 'The tolerability of risk from nuclear power stations', suggested that most people would regard as trivial a hazard whose risk was below about one in a million per year chance of death. It is not clear from RSSG whether this figure should be related to a typical individual in a group at risk or whether it should be related to the most exposed or vulnerable member. For the present purpose (land use planning) HSE will use the figure of 1 in a million per year for the lower bound, but in relation to the risk of receiving a 'dangerous dose' or worse, for a typical pattern of user behaviour in a development. As discussed above, a cross-section of the population contains a proportion of highly vulnerable people for whom a 'dangerous' dose would likely result in death. Thus this criterion equates to about 1 in a million per year chance of death for such people. For the majority of the population, assessments done by HSE suggest that it corresponds to a risk of 1/3 in a million per year of death, since this is the risk of receiving a somewhat higher dose which would be expected to result in the death of 50% of the population.
- 55 For developments where there would clearly be a high proportion of highly susceptible people, a more stringent criterion might be appropriate. HSE suggests that a level of 1/3 in a million per year of a 'dangerous' dose or worse would be trivial even for such cases as homes for the elderly, caring institutions, long-stay hospitals etc."

The above explains the origin of the 1 in a million risk of death as the ALARP criterion i.e. the boundary, described as 'trivial' at the time of publication that has now become the boundary between 'ALARP' and "broadly acceptable' for the installation /pipeline in a safety report.

For land use planning purposes where the intention is to provide a worthwhile measure of protection from major incidents for people who are typical users of developments in the vicinity, a level of 1 in a million per year risk of dangerous dose for the general population sets the middle zone boundary. And for a highly vulnerable population, a level of risk of 1 in a million per year of dangerous dose sets the outer zone boundary.

As the intention is to include both of the above assessment criteria in the same document in due course, it is of fundamental importance that the definition of risk and the appropriate criteria referred to be absolutely clear.

**WGP HSE HID CI5 Technical Seminar 13<sup>th</sup> October 2005  
Action List**

<b>Action No</b>	<b>Action</b>	<b>Owner(s)</b>
<b>1</b>	I Hirst would provide details of HSE's jet fire model, PIPEFIRE to R McConnell I Hirst and G Hawkins will provide details of the failure frequencies used by HSE to R McConnell I Hirst will provide details of the HSE ethylene methodology to R McConnell	<b>R McConnell I Hirst G Hawkins</b>
<b>2</b>	HSE will consider incorporation of changes in the failure rate due to ground movement when the work commissioned by NGT is available.	<b>R McConnell G Hawkins</b>
<b>3</b>	HSE i) to consider use of the new mechanical damage model, and ii) review the failure rates for smaller diameter pipelines where an apparent divergence from UKOPA data had been identified by R McConnell.	<b>R McConnell G Hawkins</b>
<b>4</b>	HSE require further detail regarding justification of the risk reductions proposed for mitigation. This will be discussed when details of UKOPA work are available.	<b>UKOPA RAWG (N Jackson)</b>
<b>5</b>	HSE will discuss the risk assessment methodology for ethylene with R McConnell.	<b>R McConnell I Hirst G Hawkins</b>
<b>6</b>	HSE will discuss the risk assessment methodology for NGL with R McConnell.	<b>R McConnell I Hirst G Hawkins</b>
<b>7</b>	A formal comparison of the HSE mechanical damage prediction model and the UKOPA mechanical damage limit state is to be carried out.	<b>G Hawkins J Haswell</b>
<b>8</b>	HSE to give internal consideration to submitting the UKOPA paper to the Cabinet Office for consideration as part of the current review of societal risk issues.	<b>M Wilson N Riley</b>
<b>9</b>	HSE HID CI5 to provide technical comment on societal risk methodology/FN criteria, separate from the process to be applied to the joint technical agenda on risk assessment.	<b>N Riley P Harper R McConnell</b>
<b>10</b>	HSE HID CI5 will review external work on depth of cover or pipeline protection, external work would be reviewed, and may recommend changes to the HSE methodology if the evidence was sufficiently strong.	<b>UKOPA RAWG (N Jackson)</b>
<b>11</b>	UKOPA to provide reports on application of the UKOPA Pipeline Fault Database to all pipelines and review of CONCAWE data to HSE, and discuss with HSE application of data to new and old pipelines.	<b>UKOPA RAWG (N Jackson) G Hawkins</b>

**Action List (Cont)**

<b>Action No</b>	<b>Action</b>	<b>Owner(s)</b>
<b>12</b>	Arrange meeting(s) to discuss actions 1 – 6.	<b>R McConnell I Hirst G Hawkins</b>
<b>13</b>	List documents to be exchanged between HSE and UKOPA	<b>J Haswell</b>
<b>14</b>	NG/Advantica to review available experimental test data for jet fires and forward any relevant data to HSE	<b>N Jackson P Baldwin I Hirst</b>
<b>15</b>	Formal review of technical basis for the TD/1 BPDs for the purpose of deriving a technically equivalent distance for non-natural gas pipelines.	<b>UKOPA RAWG (N Jackson)</b>
<b>16</b>	Draft and circulate Terms of Reference for Expert UKOPA/HSE Meetings, covering i) the topics for joint working/discussion, ii) the procedure for setting up and recording meetings, and iii) the procedure for agreeing and formalising action programmes and timescales, for approval by WGP.	<b>R McConnell</b>

**WGP HSE HID CI5 Technical Seminar 13<sup>th</sup> October 2005**  
**List of Attachments**

<b>Att No</b>	<b>WGP Ref No</b>	<b>Title</b>	<b>Author</b>
1	WGP/05/051	Review of Previous HSE/ UKOPA Discussions Relating to LUP	N Jackson
2	WGP/05/052	HSE's Statutory Role	N Riley
3	WGP/05/053	HSE's Priorities and Work Programme relating to Pipeline Risk Assessment and Provision of LUP Advice	I Hirst
4	WGP/05/054	Supplements to Pipeline Codes IGE/TD/1 and PD 8010	N Jackson
5	WGP/05/055	Risk Assessment Methodology	R McConnell
6	WGP/05/056	Justification for Changes to Existing Pipeline LUP Zones	R McConnell
7	WGP/05/057	Updated Mechanical Damage Limit State Model	J Haswell
8	WGP/05/058	Use of the Mechanical Damage Limit State Model to Derive Factors for the Influence of Design Factor and Pipe Geometry on Pipeline Failure due to 3 <sup>rd</sup> party Damage	J Haswell
9	WGP/05/059	Risk Mitigation Measures	J Haswell
10	WGP/05/060	Proposed Approach to Societal Risk	J Haswell
11	WGP/05/061	Update on MISHAP Methodology	I Hirst
12	WGP/05/062	Update on Failure Frequencies	G Hawkins

**WGP HSE HID CI5 Technical Seminar 13<sup>th</sup> October 2005**  
**List of Documents to be Exchanged**

**1 Documents Requested from HSE by WGP/UKOPA:**

No	Reference	Title
1	PCAG chp_06c – (30/03/2005)	Chapter 6C: Risk assessment for pipelines conveying natural gas
2	PCAG schp_06c – (29/06/2005)	Chapter 6C: Models within MISHAP01 for risk assessment of pipelines conveying natural gas
3	PCAG chp_06p – (07/09/2005)	Chapter 6P: Risk assessment for pipelines conveying flammable substances other than natural gas

**NOTE: The above documents were supplied by HSE on 14.10.05.**

**1 Documents Requested from UKOPA by HSE:**

No	Reference	Title
1	UKOPA/05/0043	Risk F-N Curves – Possible Requirement for ALARP Demonstration
2	UKOPA/03/0067	UKOPA Pipeline Fault Database – Application to All Pipelines
3	TBC	Review of CONCAWE Data for Product Pipelines Part 1 – W S Atkins 1997 Report for HSE
4	TBC	Review of CONCAWE Data for Product Pipelines Part 2 – Calculation of Failure Rates to end of 2003
5	TBC	Review of CONCAWE Data for Product Pipelines Part 3 – UK Product Pipeline Failure Rates
6	TBC	Review of CONCAWE Data for Crude Oil Pipelines Calculation of Failure Rates to end of 2003