

**ACDS MHSC Working Group on Pipelines**  
**Notes of Technical Meeting held on 25<sup>th</sup> June at Advantica, Loughborough**

**Attendance**

M Harrison	WGP/Huntsman/UKOPA
R Turner	WGP/HSE, MSDU
I Hirst	HSE, MSDU
S Pointer	HSE, MSDU
N Briscoe	HSE, Policy Unit
P Siddals	WGP/Transco/UKOPA
N Jackson	Transco
D McHugh	Transco
P Davis	WGP/BPA/UKOPA
R McConnell	WGP/ABB
R Ellis	UKOPA/Shell UK
R Greenwood	Advantica
A Francis	Advantica
J Haswell	Secretary, WGP

**Apologies**

G P Walker	Chairman, WGP
A Thayne	WGP/HSE, HID
K Thomas	Huntsman/UKOPA RAWG
T Findlay	BP/UKOPA

**1 Introduction**

J Haswell reported that G Walker was unable to attend due to urgent university business. G Walker requested that M Harrison chair the meeting on his behalf, and had confirmed he would be involved as required in any business actioned at the meeting. M Harrison chaired the meeting.

**2 Purpose**

M Harrison invited R Turner to introduce the purpose and subject matter of the meeting.

R Turner stated that as part of a wider change in the way HSE advised on risks in the vicinity of major hazards, HSE were introducing a codified risk-based approach to providing advice on land use planning decisions in the vicinity of high pressure natural gas pipelines. A key objective was to reduce the volume of cases referred to HSE specialists for review. The move to this approach meant the need to establish risk-based inner, middle and outer zones, and a revised decision matrix. The existing HSE methodology was based on IGE TD/1 building proximity distances (BPDs), so a number of technical and modelling issues had been addressed by I Hirst and S Pointer since the decision to move to the new methodology had been made.

R Turner stated that the new methodology had first been presented to the WGP at a technical workshop in November 2001. Since this workshop, a number of technical discussions between HSE, Transco and UKOPA had taken place, and significant progress relating to the use of UKOPA database and failure frequency modelling had been made. However, it was unlikely that all issues would be fully resolved, and progress to date would be implemented on an interim basis, while work continues to allow a phase II to be implemented. R Turner stated that the approach being developed for gas pipelines will be extended to other pipelines as soon as practicable, and invited I Hirst and S Pointer to present the methodology.

### **3 HSE Methodology for Formulating LUP Advice in the Vicinity of Natural Gas Pipelines**

I Hirst and S Pointer presented the risk-based methodology.

NB Presentation material is given in WGP\_TM250602\_Att1.ppt (WGP/02/026).

#### **3.1 Methodology**

I Hirst summarised the key drivers for the development of the new HSE methodology:

- The UK onshore MAHP pipeline population statistics, showing 90% of the population is comprised of natural gas pipelines
- Consultation zones around these pipelines are notified to LAs, who must consult HSE before granting permission for developments in the vicinity of the pipelines.
- Consultation zones are divided into inner, middle and outer land use planning (LUP) zones. The LUP zones for natural gas pipelines are currently based on BPDs, other pipelines have risk-based or partially risk-based zones.
- Standard definitions are used for risks, risk levels, dangerous dose, as given in the 1989 LUP document.
- The HSE methodology uses a version of the software MISHAP (largely as described in Pipes and Pipelines International, 1997) which takes into account four failure modes (rupture, large hole, small hole, pin hole), release rates, fire types (fireball, jet fire, flash fire), event trees and scenarios (probabilities for immediate, subsequent and non ignition).

#### **3.2 Failure Frequency Modelling**

S Pointer presented the approach to failure frequency modelling:

- Predictive modelling approach applied to the prediction of failure frequency due to 3<sup>rd</sup> party damage is similar to the Advantica approach (as used by Transco).
- Verification and validation work has considered the range of operational data and changes in failure frequency with key parameters representing variation within the Transco pipeline population.
- UKOPA data has been used where possible, for failure frequencies derived from operational experience, noting the smaller database, and the fact that

failure data is dominated by smaller holes. It is significant that, for Mechanical and Natural failures, the UKOPA database indicates a bias towards smaller hole size failures whereas the Europe wide EGIG data contains significant numbers of larger hole and rupture failures.

- HSE to uses conservative best estimates. In cases where there are zero failures in the operational experience data, one failure is assumed and this is split between the four failure categories. This gives a confidence of approximately 55% that the true failure frequency will not be higher than that predicted.

### 3.3 Consequence Modelling

I Hirst then presented consequence modelling issues.

He stated that predictions from MISHAP98 and from the newer MISHAP01, which has a replacement jet-fire model for natural gas, have been compared to real failure data (predominantly American), to data from experiments and to results from Transco's calculations, and the following conclusions have been drawn by HSE:

- Release rate predictions for the first twenty seconds following rupture appear too high, indicating too large a fireball, but they are reasonable thereafter.
- But HSE's fireball model was originally developed for propane predictions, in which rain out can occur, and probably has a surface emissive power that is too low for natural gas. On balance the fireball model is conservative.
- The replacement jet fire model for natural gas gives heat fluxes in reasonable agreement with the empirical data, but there is a tendency towards nonconservatism closer to the pipeline.

I Hirst continued by saying that some phenomena that may contribute to risks near to the pipeline were not included in the model; e.g. no blast overpressure, no debris, no horizontal or shallow-angled jetfires.

However, based on the work carried out, HSE have concluded that MISHAP01 is broadly fit for the purpose of defining the size of the LUP zones, but would not be trusted entirely very near to the pipeline. In the scheme to be adopted the zones would be the distances given by MISHAP01, subject to a minimum inner zone equal to the Building Proximity Distance given by the IGE TD/1 Code.

Application of the new scheme required a proposed development to be placed into one of four "sensitivity levels" (SL), defined broadly as:-

SL-1- normal working population

SL-2 - general public at home and involved in normal activities

SL-3 - vulnerable members of the public

SL-4 - large examples of 3 and large outdoor examples of 2.

HSE would not advise against an SL-1 development anywhere, would advise against SL-2 in the inner zone, would advise against SL-3 in the inner and middle zones, and would advise against SL-4 anywhere within the consultation zone.

## 4 Transco Comment

N Jackson stated that Transco had appreciated HSE's sharing of information and predictions, which had enabled Transco to consider in detail the pipeline population used to undertake sensitivity studies, and to investigate some of the parameter modelling issues involved. D McHugh then presented the results of these considerations.

NB Presentation material is given in WGP\_TM250602\_Att2.ppt (WGP/02/027).

D McHugh presented a graph comparing HSE risk based outer zones with current outer zones based on multiples of BPDs for the same pipeline parameters for R and S area pipelines. The comparison showed significant increases in outer zones for S area pipelines. A graph of the ratio of HSE to Transco predictions for failure frequency due to third party damage indicated that while HSE failure frequency predictions were generally higher than equivalent Transco predictions, the ratio was significantly higher in cases where the design factor was low (ie less than 0.2). D McHugh then presented the comparison of risk-based outer zones with current multiple BPD outer zones, but with the HSE third party damage component replaced with an equivalent Transco prediction. This showed a significant improvement in the S area/low df predictions, but still showed greater risk-based outer zones for S area pipelines. D McHugh stated that this was due to the contribution due to natural causes (ie ground movement, land slip etc) which are included in the HSE failure frequency model, but not in the Transco model. S Pointer confirmed that the HSE model applied the failure statistics in the UKOPA database (one rupture due to ground movement, Bushey Heath) which gave an operational failure frequency of  $2.10^{-6}$  to all pipelines. D McHugh and N Jackson concluded the comparison between HSE and Transco predictions highlighted two issues for resolution:

- i) the prediction of Third Party failure frequencies for S area pipelines (with low design factors) and
- ii) the prediction of failure frequency due to natural causes.

These issues were then discussed in detail.

## 5 Discussion

### 5.1 Failure Frequency Predictions for 3<sup>rd</sup> Party Damage

Regarding the prediction of failure frequency for pipelines with low design factors, A Francis noted that the numerical integration solution techniques (FORM and SORM) were sensitive to the type of function. Convergent solutions required that the limit state function was smooth and continuous (and that in addition FORM routines required the function to be a minimum of once differentiable at the solution point, SORM routines required the function to be twice differentiable at the solution point). S Pointer agreed that the numerical solutions were non-convergent, and appeared to be conservative in this region, and stated that this would be resolved in due course.

### 5.2 Failure Frequency Due to Natural Causes

HSE considered that the prediction of failure frequency due to natural causes to be of greater significance. N Jackson stated that the view taken by Transco, based on previous work, was that natural causes such as ground movement affected a small proportion of the pipeline network only (2-4%), and in most cases the issues affecting the pipeline were location specific, so the global application of a failure rate calculated using location specific failure data was not reasonable. Transco's approach was therefore to use management procedures (involving monitoring, analysis and excavation to relieve applied loading) to deal with issues when they arose.

S Pointer stated that HSE must take a cautious approach which demonstrates that assumptions used are conservative. HSE would therefore require a robust rationale and additional data in order to justify non-consideration of the contribution of natural causes to pipeline failure rates. He also noted that HSE recognised that IGE TD/1 recommendations include controls for areas where land movement can occur, and that the operational failure data in the UKOPA database used by HSE gives a very low failure rate, so it is difficult to envisage how this can be reduced further without considerable work. R Turner supported this position, and stated in generating risk based consultation zones, HSE could only use notified information, and that any such rationale for non consideration of the contribution of natural causes to pipeline failure frequency predictions presented by a pipeline operator would require publication and consideration by an expert peer group.

P Siddals stated that ground movement was not an issue in the UK, and the locations where increased risk could occur could be identified and notified. He also noted that because the general application of assumptions of ground movement to all S area pipelines resulted in such significant increases in consultation zones, there would be an immediate increase in refused planning permissions which would in turn draw unfavourable public (developer) attention to pipeline locations and a change in HSE's approach to advising on safety implications. S Pointer stated that if it was possible to provide HSE with independently assessed information which confirmed that there was no risk of pipeline failure due to natural causes, this would be taken into account. R Turner drew attention to the rigour that would need to be applied, both to the information and the definition of a 'no' or 'low' risk location, the need for open publication and independent verification and validation.

### **5.3 Ground Movement Risk Levels**

P Siddals stated that Transco had approached the British Geological Survey (BGS) for advice. BGS have developed a database of locations susceptible to ground movement, and this database could be used to provide predictions of risk levels relating to the likelihood of ground movement.

R Ellis asked if the more robust design of S area pipelines was taken into account in applying the natural causes failure rate. S Pointer stated that the failure that had occurred was an S area failure. P Siddals agreed, but stated that the failure was predictable, as it had occurred due to 3<sup>rd</sup> party activity. R Greenwood confirmed that the failure was caused by land slip from an engineered rather than a natural slope, and this sort of activity occurred in a limited number locations only. Ground movement in

such cases occurred with little warning, whereas natural ground movement events were slow, predictable and the effects on the pipeline could be managed. He therefore proposed that the justification to attribute risk on a local basis could be developed. R Turner stated that HSE would consider such justification, but reiterated that HSE make cautious best estimates when giving judgements on risk levels, and the judgement made includes an assessment of uncertainty.

## **6 Actions**

The following actions were agreed:

### **6.1 Failure Frequency Predictions for 3<sup>rd</sup> Party Damage**

S Pointer requested that Transco provide 3<sup>rd</sup> party damage failure frequency predictions for S area pipelines with design factors less than 0.2. HSE will use this data to identify pipelines where significant divergence in predictions occurs. The impact of this on predicted risk levels will be considered, significant overestimates will be screened out and the interim methodology will indicate that enquires relating to these pipelines should be referred to MSDU for advice.

P Siddals agreed that Transco would supply this data as soon as possible.

### **6.2 Failure Frequency due to Natural Causes**

P Siddals confirmed that Transco would obtain HSE advice and agreement regarding a definition of 'no' or 'low' risk, and would place a contract with BGS to identify and report locations on Transco pipeline routes where the risk of ground movement exceeded this risk level. The report would be submitted to HSE for consideration.

## **7 Programme for Implementation**

### **7.1 Programme**

R Turner confirmed that HSE would submit a paper to MHSC for information, noting that Phase I of risk-based codified methodology (which has been previously agreed) was being implemented, the planned date being October 2002. He stated that the paper would highlight that technical issues relating to the prediction of failure frequency for 3<sup>rd</sup> party damage and natural causes were still under consideration, and would note also that the inclusion of protection and reinforcement were still to be addressed in Phase II. N Jackson asked if the WGP would be required to approve or support the paper. R Turner stated that this would not be necessary as the paper was for information, but that G Walker may be asked to make comment.

### **7.2 Process for dealing with Planning Enquiries**

N Jackson asked whether HSE would undertake additional risk assessments during the planning enquiry process. R Turner stated that HSE would give advice based on the codified methodology, which uses notified information. Developers could refer to pipeline operators for more information, and could consider how this would affect the

risk levels. If additional information or factual differences from the standard notified pipeline conditions were identified locally through this, HSE would be prepared to consider carrying out a local risk assessment.

## **8 AOB**

### **8.1 Definition of Population Sensitivity Levels**

R McConnell asked for clarification of the interface between population sensitivity levels 2 and 3. I Hirst explained that the definition used by HSE related to the number of houses and population density, and confirmed the definition used would be transparent in the published methodology.

### **8.2 Programme for Other Pipelines**

R Ellis asked about HSE's plans for extension of the methodology to other pipelines. R Turner confirmed that the plan in order of priority was:

- i) to resolve the immediate outstanding technical issues
- ii) address protection and reinforcement
- iii) to consider other pipelines, commencing with ethylene.

R Turner stated that, with regard to extension of the approach to other pipelines, if projects or studies that were identified and could be progressed without the need for significant HSE resource, HSE will support any work which would inform the future programme.

On completion of the discussion, M Harrison thanked all parties for their contributions and comments, and closed the meeting.