

## Meeting with HSE to discuss QRA for Gasoline Pipelines to assess Land Use Planning Zones held on 2 November 2007 at Bootle

**DRAFT 01 DATED 5 NOVEMBER 2007**

**RAWG/07/022**

Present:-

Nigel Riley	-	HSE
Ian Hirst	-	HSE
Peter Harper	-	HSE
Glyn Hawkins	-	HSE
Shane Turner	-	HSL Buxton
Deborah Keeley	-	HSL Buxton
Rod McConnell	-	UKOPA

### Background and Purpose of the Meeting

HSE are planning to include gasoline as a "prescribed dangerous fluid" under the Pipeline Safety Regulations 1996 (PSR) by incorporating PSR amendments, probably during 2008. In the past, the hazards from gasoline have been considered a marginal case and though amendments to include gasoline were brought forward in 2003, they were subsequently dropped in July 2004.

Gasoline operators have been aware that a possible European Directive could eventually be implemented which will require the inclusion of gasoline as a dangerous fluid (on safety and environmental grounds), but a higher HSE priority has arisen resulting from the Buncefield incident in December 2005. HSE pipeline group (Steve Wing) have submitted proposals to their management and they expect that changes to PSR might be implemented in autumn 2008 at the earliest.

One of the main implications of including gasoline as a dangerous fluid is that Land Use Planning zones will be applied by HSE. Previous efforts by HSE to apply risk assessment methodologies generated several difficulties and this was one of the main reasons for dropping plans to incorporate gasoline in 2003-4.

The purpose of this meeting was for UKOPA to have the opportunity to share aspects of QRA work carried out on several pipelines in the UK and to put forward ideas as to how LUP zones could be calculated for consideration by HSE. Details of the proposed UKOPA approach were issued prior to the meeting (Ref 1) and a summary of the slides presented at the meeting have also been issued (Ref 2).

HSL Buxton have been engaged by HSE to update aspects of pipeline risk assessment incorporated in HSE models such as MISHAP and produce a Pipeline RISKAT (RISK Assessment Technique) to cover all "prescribed fluids". The first

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priority is natural gas, but gasoline will become high priority when plans are confirmed for the timing of the PSR amendments.

Peter Harper commented that HSE have not progressed their proposed approach since ~1998, and since the issue of RR036 in 2002 (Ref 3)

### **Proposed Methodology for assessing Land Use Planning Zones**

Since 2004, work has continued by UKOPA to generate a credible risk assessment methodology based on existing data and previous work done by W S Atkins and others. A UKOPA review of CONCAWE data up to 2003 was carried out for clean products which included an analysis of UK experience for comparison with overall European experience.

In addition, several operators have commissioned work to help develop a credible methodology and approach. Rod McConnell presented the methodology and results from this work describing key factors taken into account.

Most of the methodology is based on work carried out BY WS Atkins in their 1998 Contract Research Report (Ref 4). Main features include:-

- a) Maximum flowrate through a pipeline is a key parameter and may therefore need to be included in notified information to allow HSE to calculate risk levels.
- b) Inner zone distances should be based on equilibrium pool fire radius based on maximum flowrate.
- c) Middle and outer zones should be risk-based applying 3 hazard scenarios, spray fire, immediate ignition pool fire, and delayed ignition pool fire.
- d) Failure rates should be based on UK 3<sup>rd</sup> party and ground movement failure rates and CONCAWE mechanical and corrosion failure rates, adjusted as appropriate. However previous work by UKOPA indicates the HSE predictive model appears to over-predict failure rates for smaller-diameter higher-design factor pipelines when compared to industry models. HSL indicated that they would like to consider aspects of predictive modelling as their first priority.
- e) Leak detection systems should assume 5 minutes detection and shut-off time for calculating effects of delayed ignition pool fires on LUP zones.
- f) Gasoline should be assumed flowing in multi-product pipelines 100% of the time with generalised ignition probabilities when released of 2.5% immediate ignition, 2.5% delayed ignition, and 10% for spray fires.
- g) Spray fires are assumed to occur for 16% of releases with maximum range in metres = 2 x pressure in bar. Fore ellipses of equal probability are modelled, 100%, 75%, 50% and 25% of maximum range, each with width equal to 80% of length.
- h) No ground soak on impervious surfaces such as concrete or clay, or waterlogged or frozen soil is assumed to occur for 50% of the time, and soak-n resulting in a pool diameter 70% of the impervious surface diameter is assumed to occur for the other 50% of the time.
- i) Impact on population is assumed to result is 100% risk of "dangerous dose or worse" within the fire zone and out to 14.7 kW/m<sup>2</sup> for pool fires, and within the spray zone for spray fires

## HSE Comments on the Proposed Methodology

The following comments were made by HSE:-

a) The previous methodology by HSE had used the delayed ignition pool fire distance as the Inner Zone – this had resulted in a standard inner zone for gasoline pipelines of 50 metres. HSE questioned the justification for adopting the immediate ignition equilibrium pool fire as the basis for inner zone distance.

The argument was put forward that:

- (i) The immediate ignition pool fire is based on a single parameter – this being the pumping rate through the pipeline, whereas the delayed ignition pool fire is based on pumping rate and delay time to pump shutoff – these is dependent on leak detection and pump shutoff times.
- (ii) Delayed ignition pool fires are more dependent on local topography and therefore more uncertain to affect the whole 100 metre diameter delayed pool than the immediate ignition pool fires.
- (iii) The 100 metre diameter pool was based on bunded areas around storage tanks and is less relevant to the dynamic release situation from a pipeline. The original HSE approach of including small hole (10 mm) in this analysis was not supported by UKOPA.
- (iv) Different pipelines have different pumping rates ranging from 150 to 1200 m<sup>3</sup>/hour – the inner zone should reflect the potential difference in consequences from a release.

b) The HSE approach had been to base Middle and Outer zones on risk of immediate and delayed pool fires – middle zones had sometimes been smaller than inner zone, and outer zone extended to a maximum of ~ 80 metres. HSE had not included spray fires, although a report had recommended that HSE should include this scenario.

c) HSE had reservations about using 5 minutes as the shutoff time for delayed pool fires. In the past the operators had apparently declared an average of 38 minutes for detection and shutoff time. The WS Atkins report (Table 3.14 page 11) reports times of 1 to 20 minutes for detection (average 5 minutes), and 1 to 38 minutes (average 10 minutes) for pump shutoff.

The argument was put forward that:

- (i) Modern leak detection systems have improved the leak detection capability considerably such that all but minor leaks were rapidly detected.
- (ii) Pipeline control centres have the manning, alarms, systems and procedures for shutting down pipeline pumps rapidly when the leak detection alarms.
- (iii) Several incidents reported by WS Atkins indicated times of ~ 5 minutes for liquid fuel releases.
- (iv) In addition, 3<sup>rd</sup> party activities resulting in leaks are also likely to communicate to the control centre to shut down the pumps.

d) HSE have not included ground soak-in in their previous assessments on the basis that gasoline releases in populated areas were likely to spread on impervious surfaces such as roads and pavements. The argument was put forward that such areas do also have gardens and open ground areas through which pipelines are mostly routed, and that roads are graded to drains which would reduce the pool size.

**Next Steps**

HSE and HSL Buxton will be considering the approach further in due course. HSE commented that they would expect further justification for some of the proposed aspects in the methodology.

Any further information or data from UKOPA to support the proposed approach would be welcomed by HSE.

R A McConnell  
5 November 2007

**References**

- 1 Gasoline Pipelines – Possible inclusion as MAHPs in PSR 1996 Proposed Methodology to Determine Land Use Planning Zones, R A McConnell, 14 February 2007
- 2 Gasoline Meeting HSE 2 Nov 07 RMcC Presentation.pdf Adobe document containing summary of slides presented to meeting on 2 Nov 07
- 3 "Report on a second study of pipeline accidents using the Health and Safety Executive's risk assessment programs MISHAP and PIPERS", Prepared by Casella Scientific Consultants for the Health and Safety Executive 2002 RESEARCH REPORT 036
- 4 "Assessing risks from Gasoline Pipelines in the UK based on historical experience", Prepared by W S Atkins Safety & Reliability for the Health and Safety Executive 1999, CONTRACT RESEARCH REPORT CRR 210/1999

Copies to:-  
Those present  
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