UKOPA Pipeline Fault Database and the use of Predictive Failure Modelling

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Why carry out quantitative risk assessments for pipelines?

• Pipeline operators have legal duties to manage risk

• Ensures that expenditure on safety improvements is appropriately allocated

• Can be used to justify deviations to design codes

• Can form the basis for debate with the safety regulator on safety issues including Land Use Planning issues

• Transco has used it to support the uprating of pipelines to higher operating pressures

Risk = Frequency x Consequence

The consequence can be categorised as the number of people (or area affected) which will depend on the calculated hazard range for the failure mode under consideration.

The frequency of failure for MAHPs is usually more difficult to predict because of the sparse data for catastrophic failures.

Traditional Approach For Calculating Failure Frequencies

Look at the number of incidents that have occurred, divide these by the km operating years of experience to generate a likelihood per km year

Disadvantages

In order to generate sufficient operating history then the failures averaged over a range of pipeline diameters, pressures, wall thickness' material strengths etc.

The resulting data does not therefore take account of the actual design parameters for the pipeline under consideration

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Alternative is to use a predictive approach

Step 1 develop a limit state for the pipeline failure mode under consideration.

Step 2 develop statistical distributions for each of the parameters That contribute to pipeline failure.

Step 3 use the statistical distributions in the limit state equation to calculate the likelihood of pipeline failure for the pipeline Under consideration.

Gouge Depth

Gouge Length
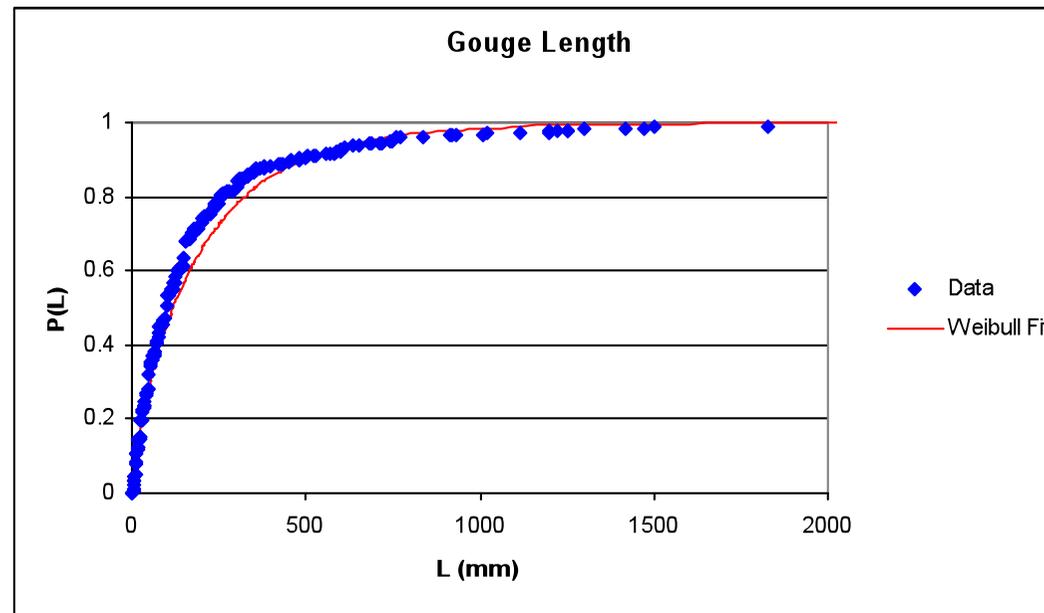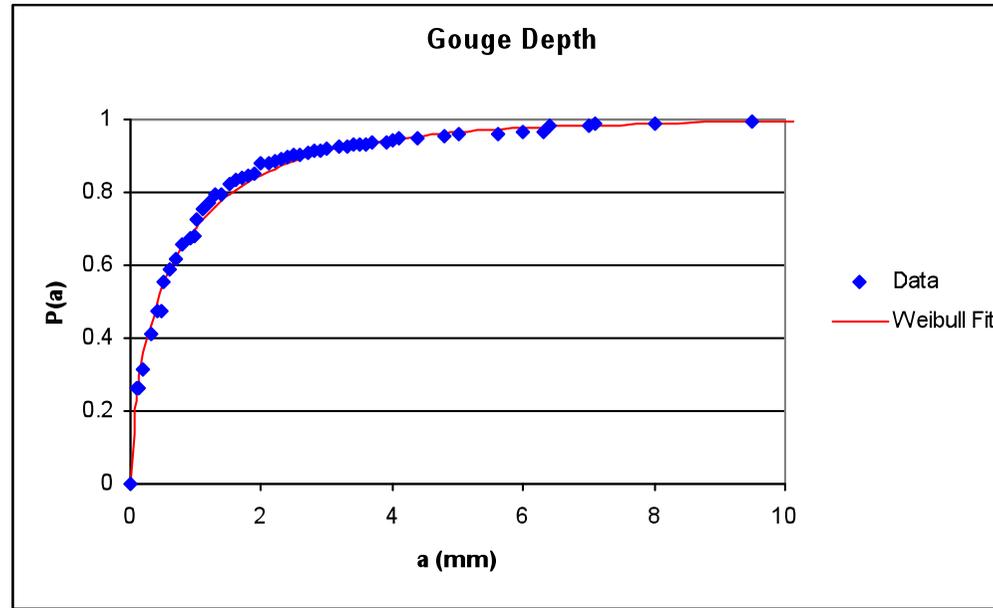
Advantages of the predictive approach

• Can use damage data for the whole pipeline population

• Will allow us to take account of the design parameters for actual pipeline under consideration i.e:
- Diameter
- Pressure
- Material strength
- Wall thickness

• Leads to better risk based decision making

• The HSE accept (and use) this approach

Comparison of Empirical data with predictive modelling results

		Ext Interference 38 bar Incidents/1000 kmyr	Ext Interference 75 bar Incidents/1000 kmyr
EGIG Data (all pipelines)		0.05	0.05
UK Data (all pipelines)		0.01	0.01
Predictive Model Results:			
914mm	19.1mm wt	0.00001	0.00022
	12.7mm wt	0.00184	0.026
609 mm	11.9mm wt	0.0011	0.012
	6.4mm wt	0.191	0.98
457 mm	8.4mm wt	0.00558	0.044
	6.4mm wt	0.119	0.471

Current status

- A data base of damage (occurrences and sizes) has been collected by UKOPA and a summary report for loss of gas incidents

The Way Forward

- Develop predictive models for all failure mechanisms

- Determine the effect of pipeline protection and other risk mitigation measures

- Produce and publish failure frequencies for specific pipeline groups/ conditions