Prediction Pipeline Failure Frequencies Due to External Interference

November 2006

Summary of Work Completed

3rd Party Interference:

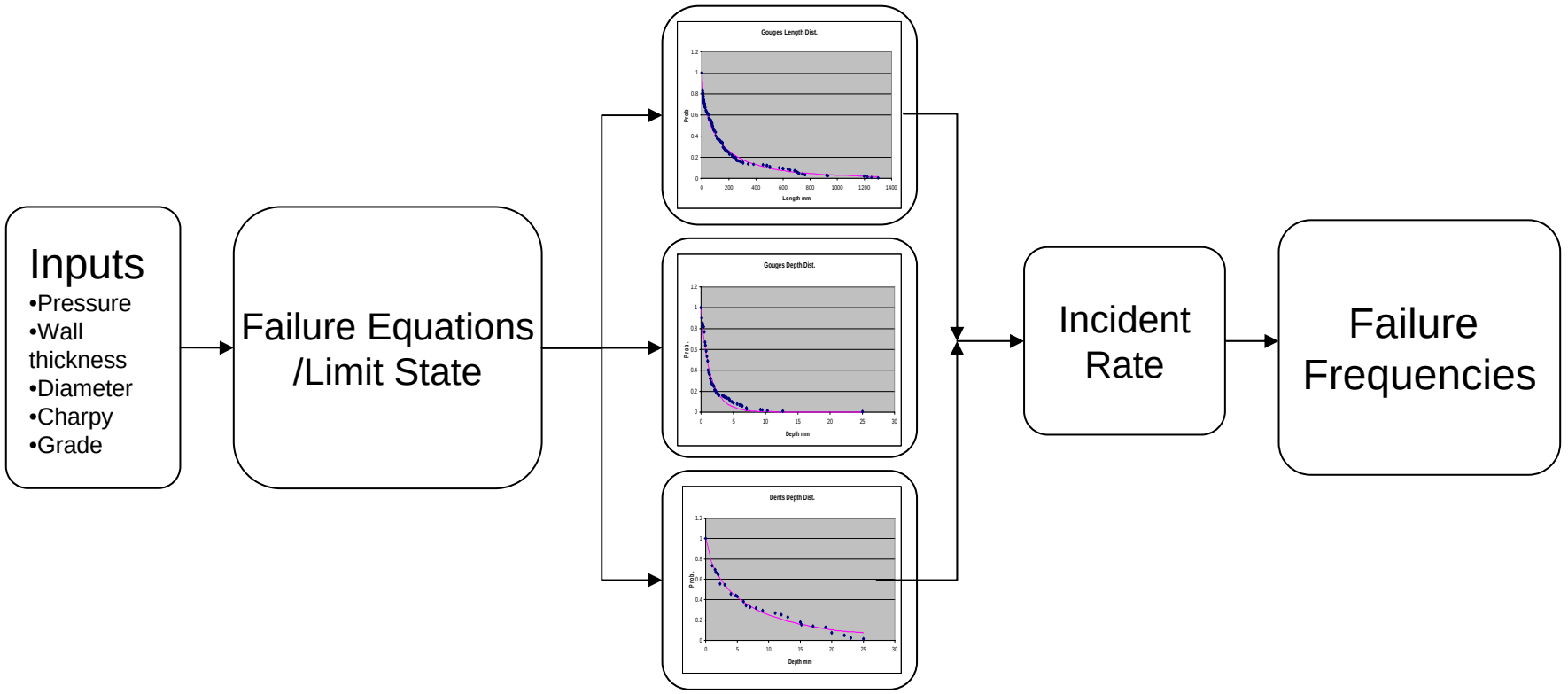
- Detailed review and statistical analysis of UKOPA fault reports:
  - Demonstrated correlation for incident rate between different MAHP pipe groups confirmed
  - Probability of failure depends upon pipeline parameters and size & type of damage
  - Failure frequency depends on incident rate
  - Probabilistic methodology based on published and accepted gas industry work constructed to predict failure frequencies for specific pipelines

Prediction of Failure Frequency due to 3rd Party Damage

- Reconstructed the prediction methodology originally developed by the British Gas Engineering Research Station in the mid 1980's
- Applied model using current UKOPA fault data
- Compared predictions obtained with:
  - recognised expert sources (PIPESAFE – FFREQ)
  - UKOPA failure data
- Used results to prepare generic cases for inclusion in Code Supplements

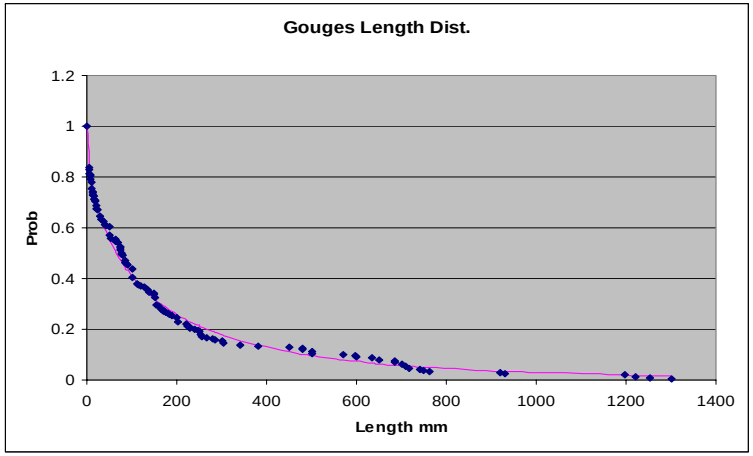
Predictive Models

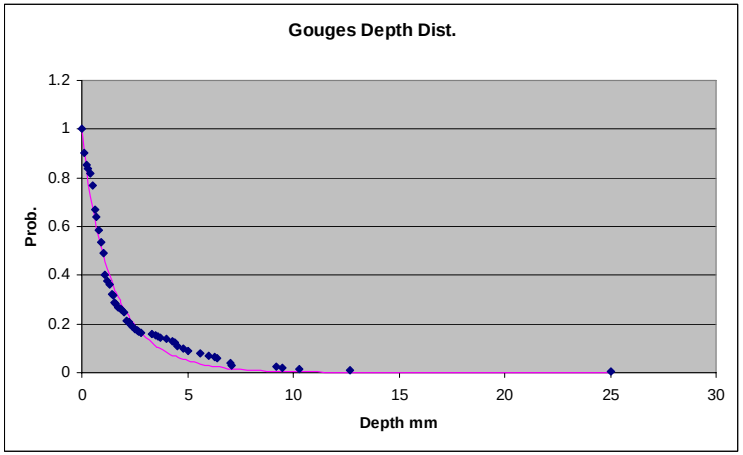
1. 2. 3.

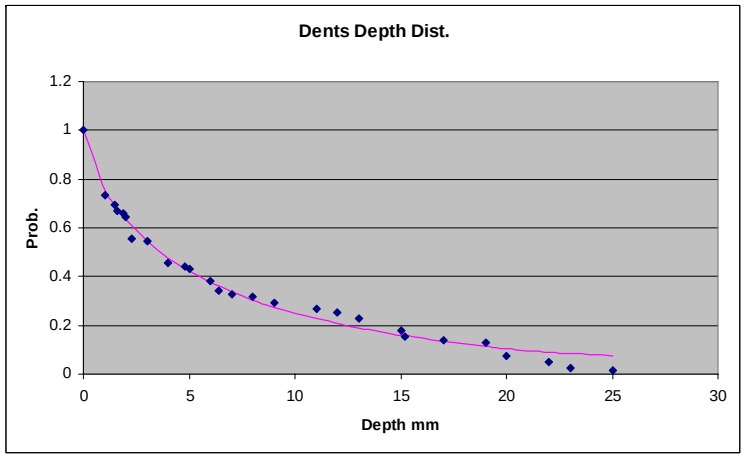


Failure:- 1 – Conditions 2 – Probability 3 - Frequency

Weibull Probability Distributions







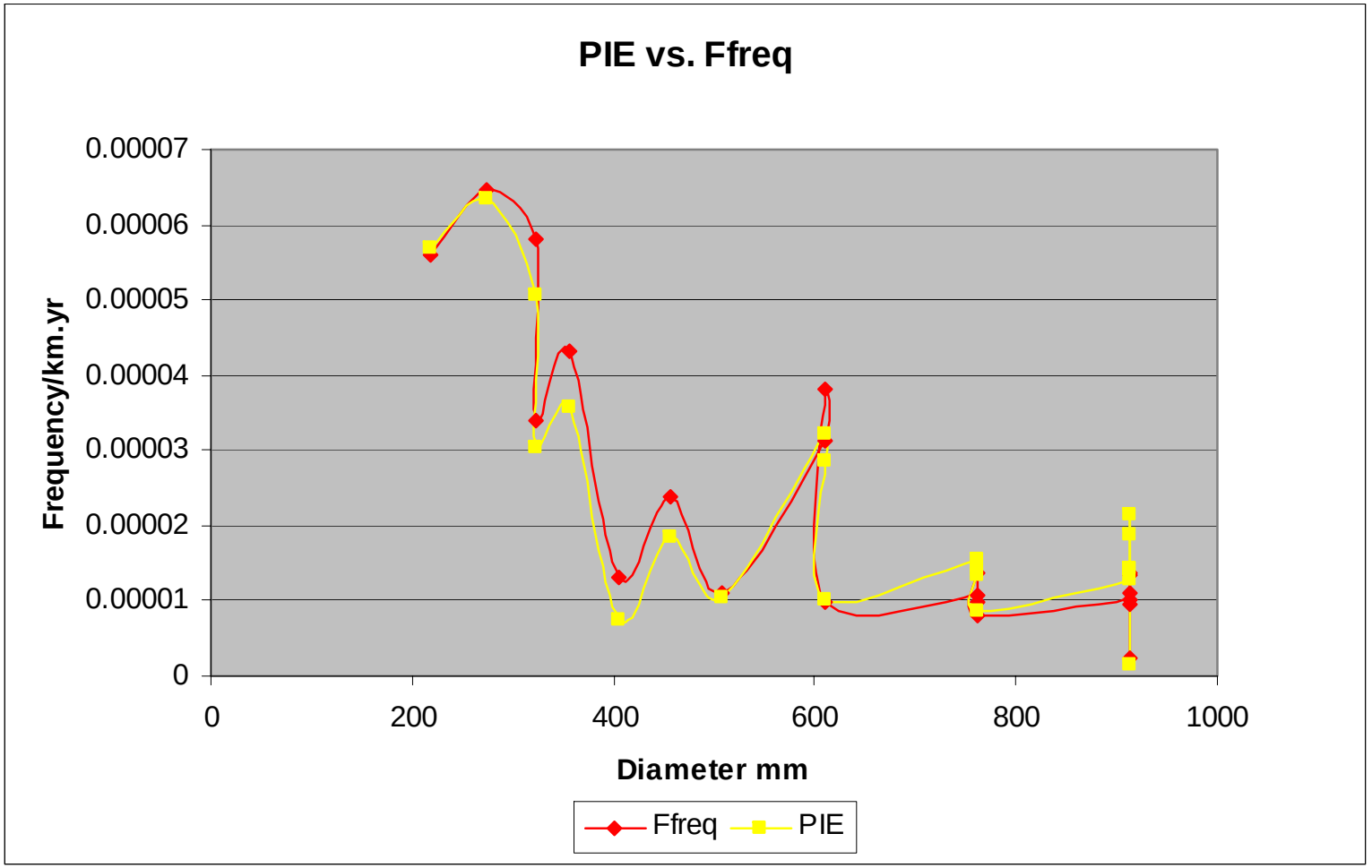
- Prob. of getting fault of certain size
- Curves derived from individual data points

Test Cases

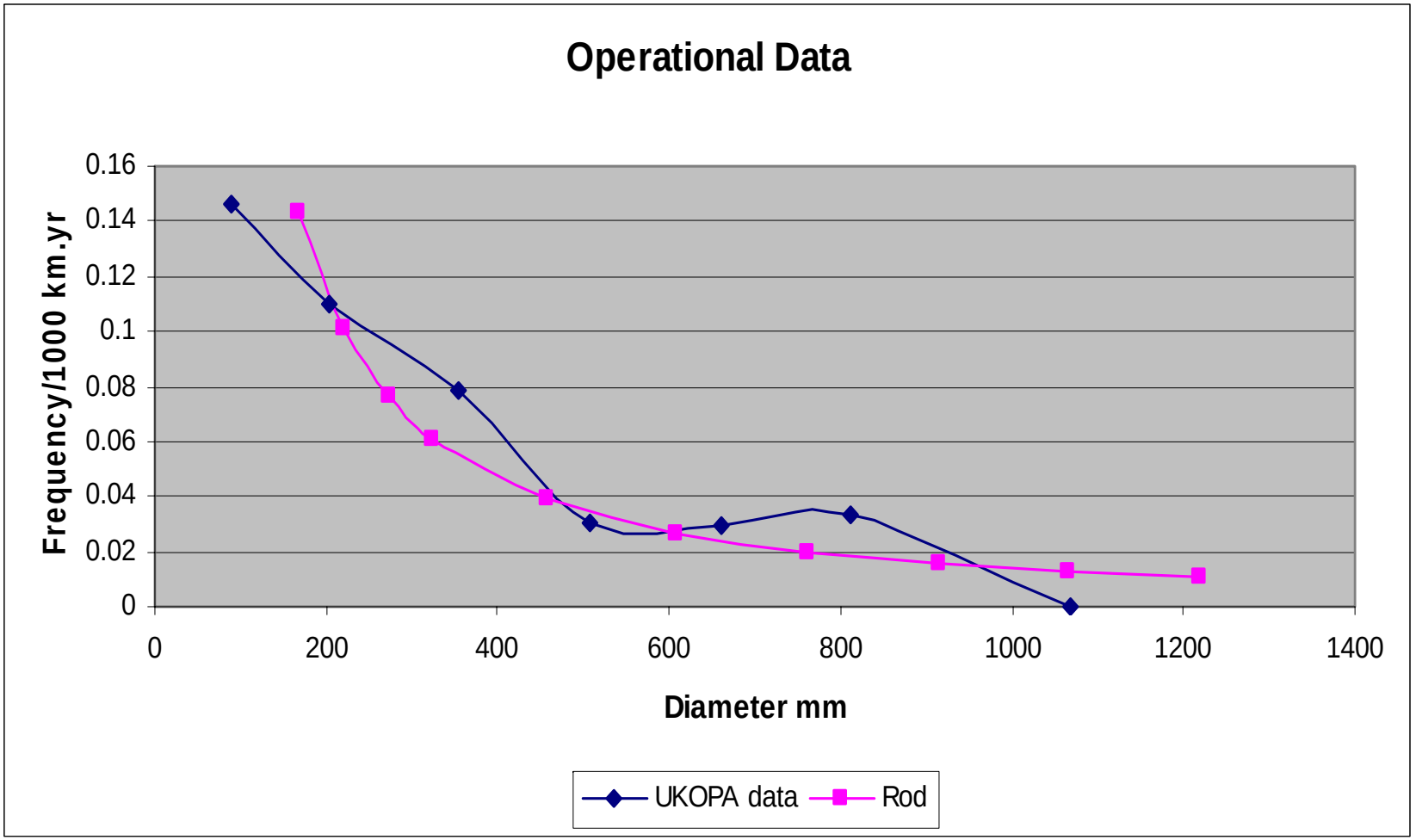
Pressure	Diameter	Wall Thickness	Grade
70	219	6.4	X42
69	273	6.4	X46
70	324	7.1	X46
70	324	7.9	X52
32	406	9.5	X56
70	457	9.5	X52
70	508	11.1	X46
75	610	9.5	X52
75	762	11.9	X52
70	762	12.7	X60
85	914	12.7	X60

- Produced reconstructed model
- Results of test cases generated
- Comparison of test cases with i) existing calculations ii) operational data

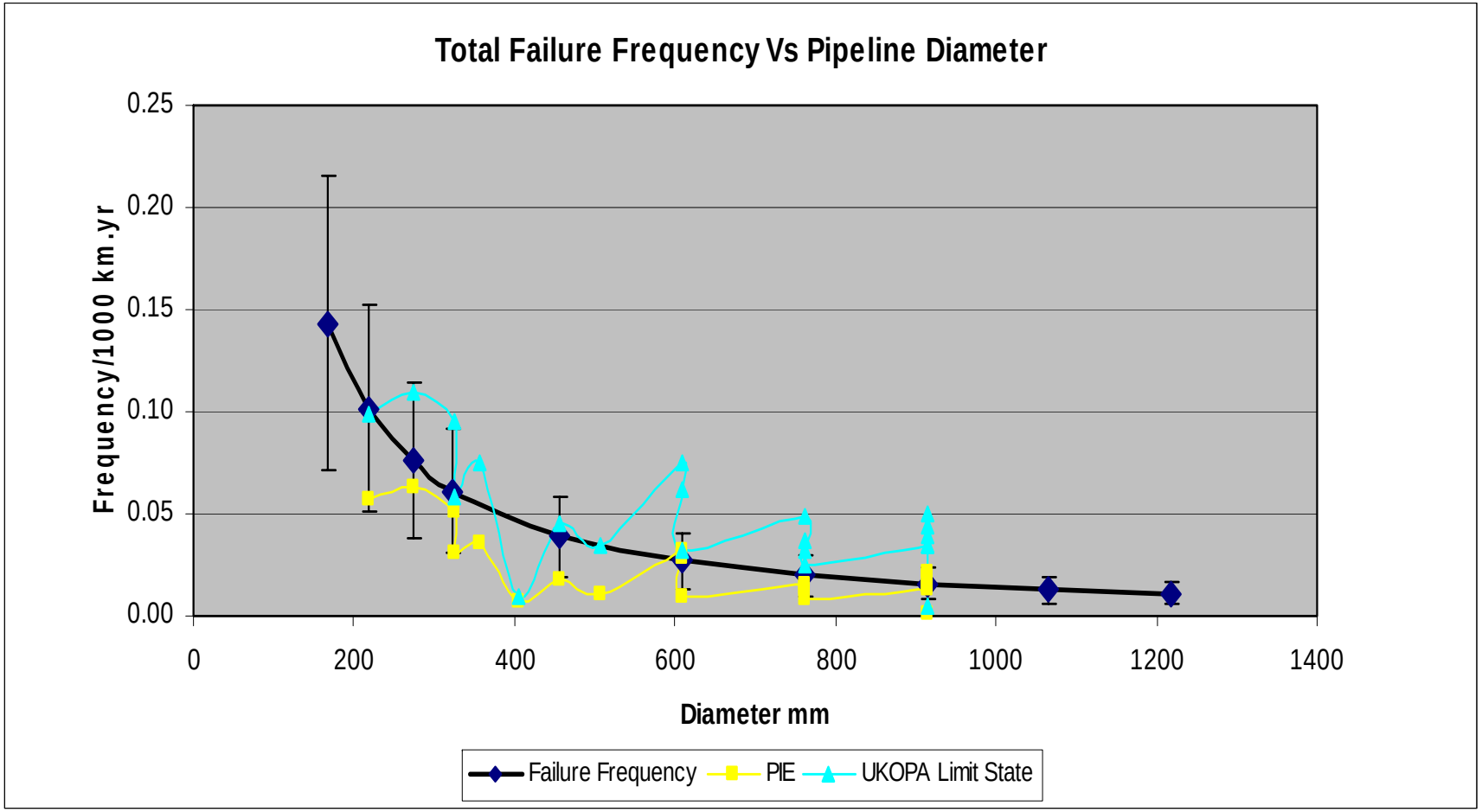
PIE vs. Ffreq


PIE vs. Ffreq
Frequency/km.yr
0.00007
0.00006
0.00005
0.00004
0.00003
0.00002
0.00001
0
0
200
400
600
800
1000
Diameter mm
Ffreq
PIE

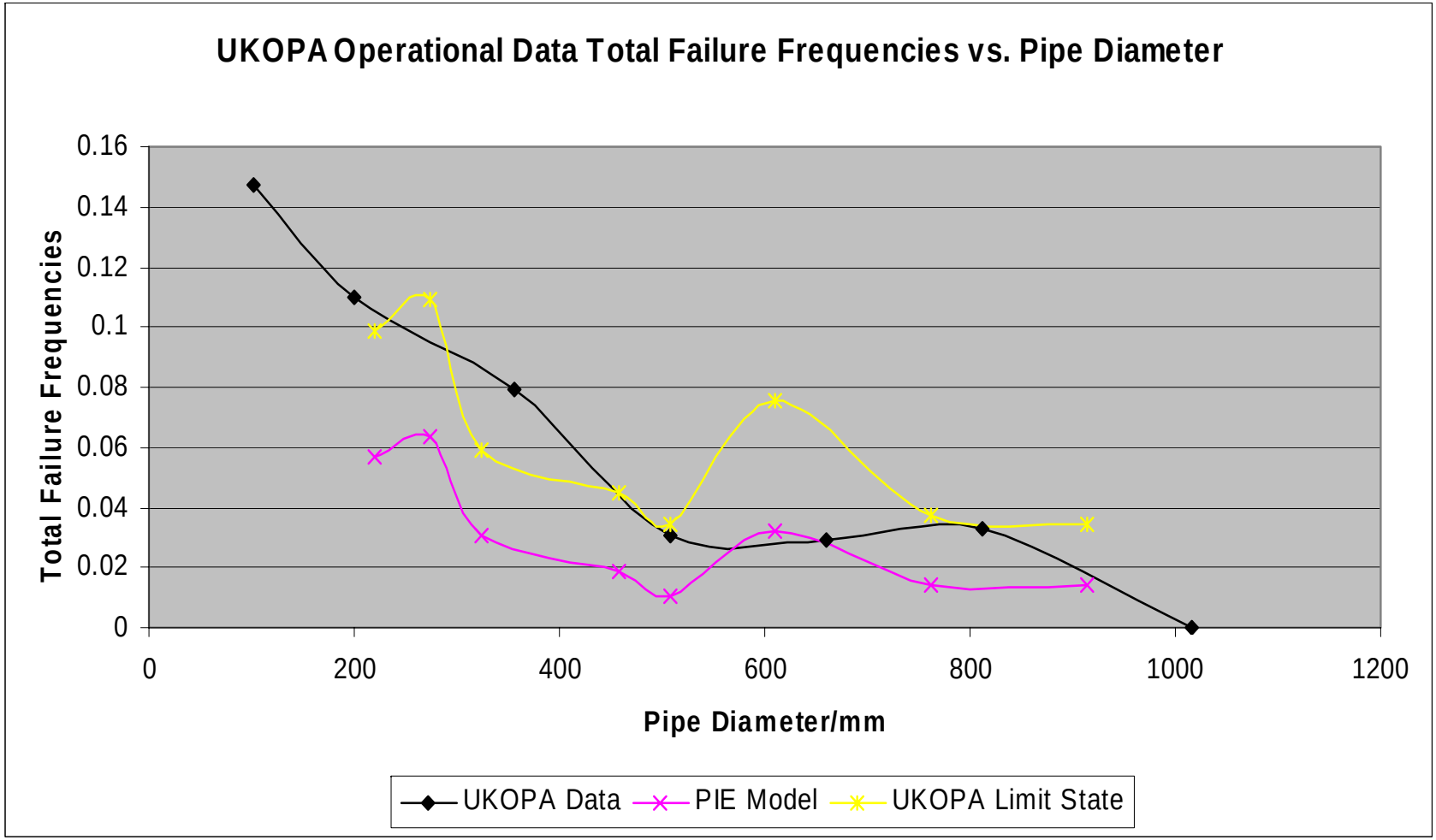
Curves Derived from Operational Data



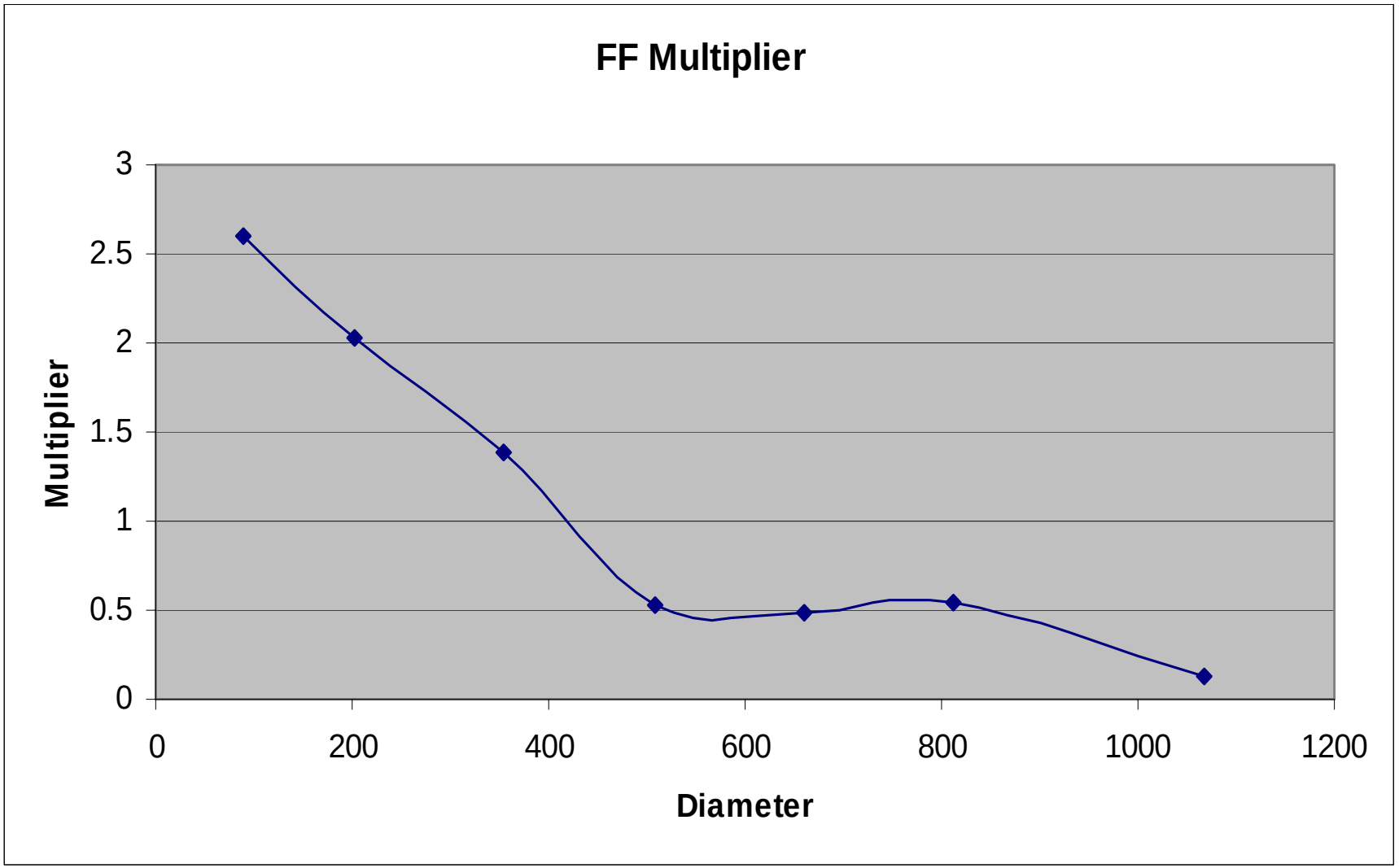
Failure Frequency Predictions vs Operational Data



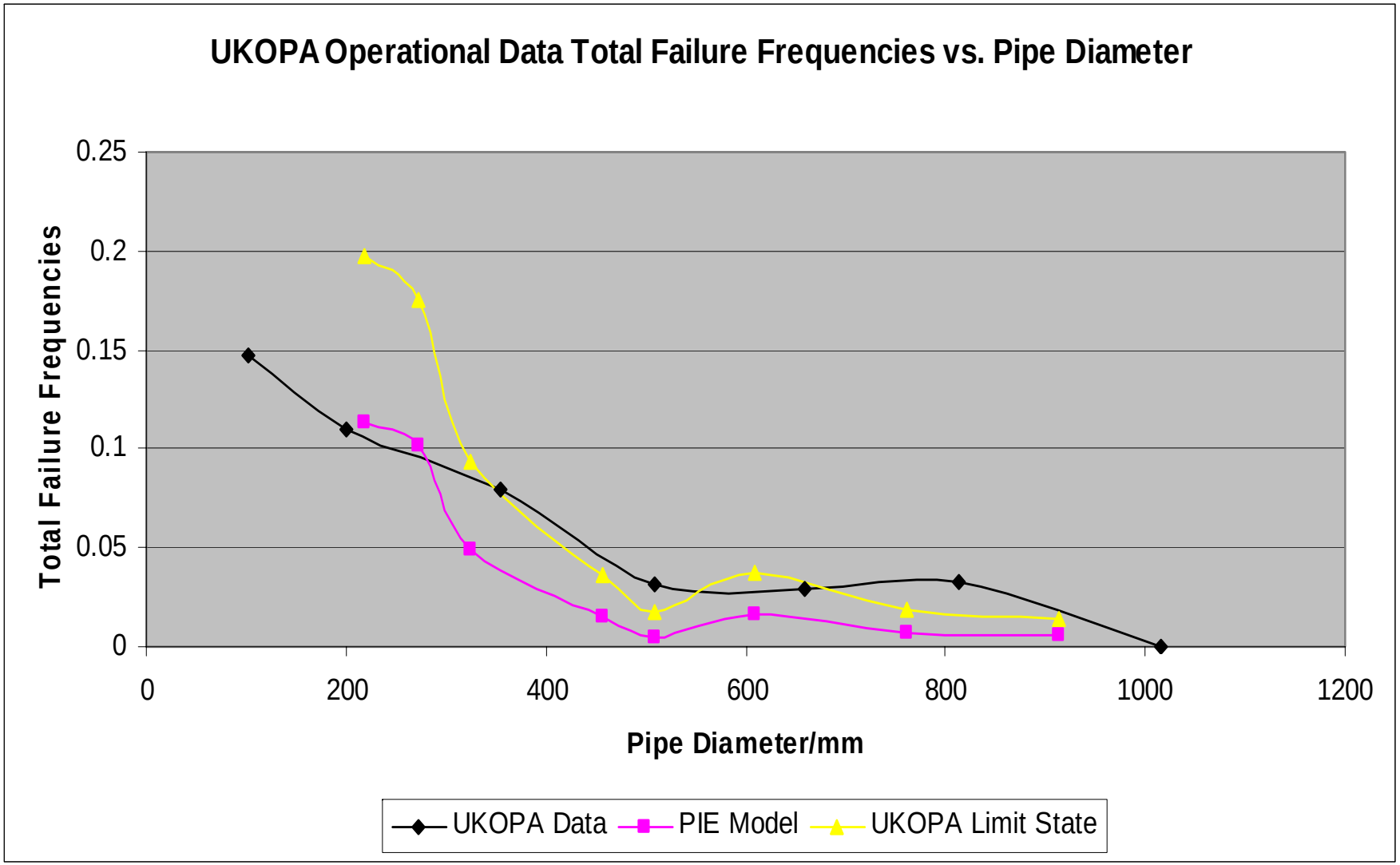
Failure Frequency Predictions vs Operational Data – Simplified Data Set



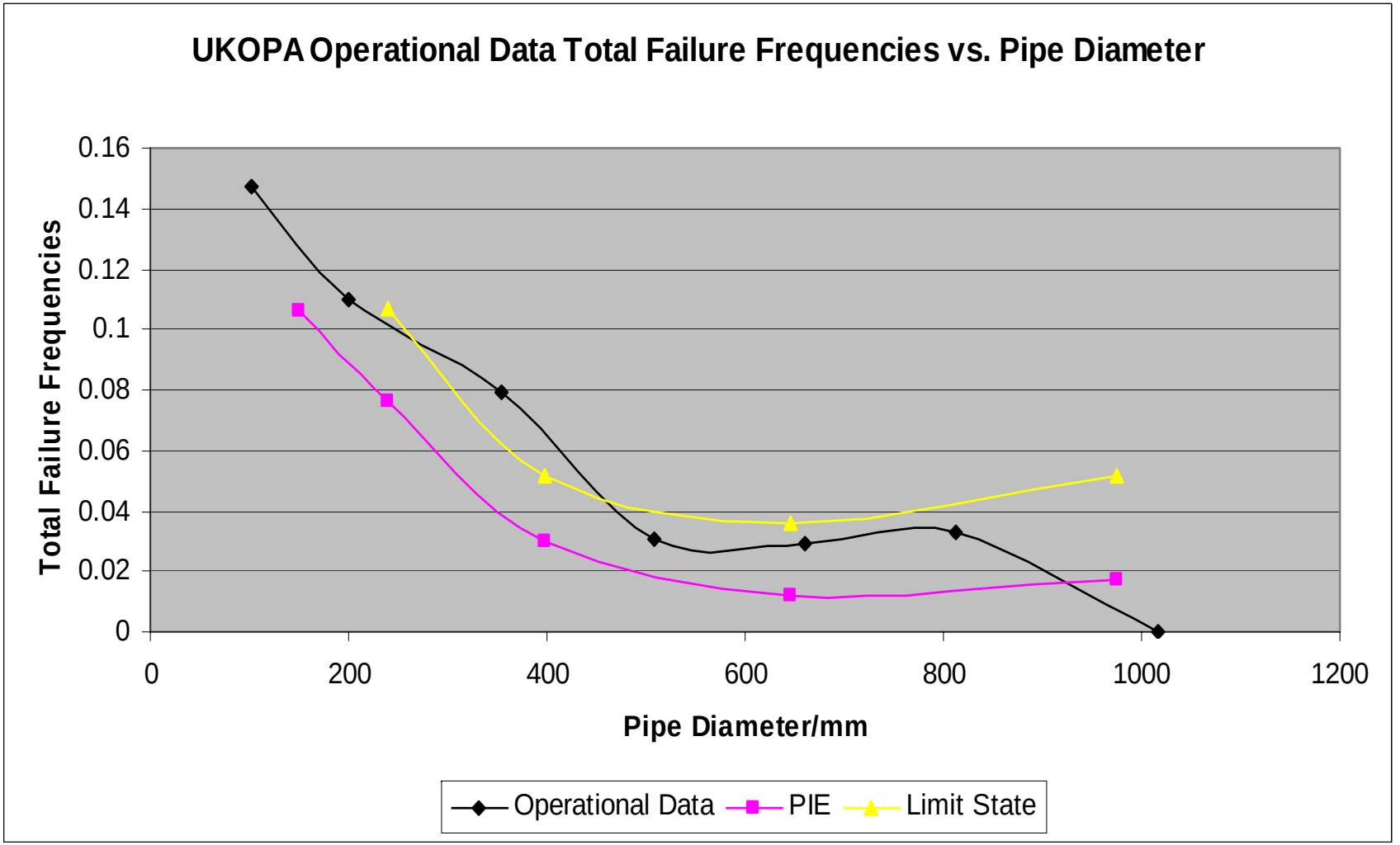
Variation in Failure Frequency with Pipe Diameter Derived from Operational Data



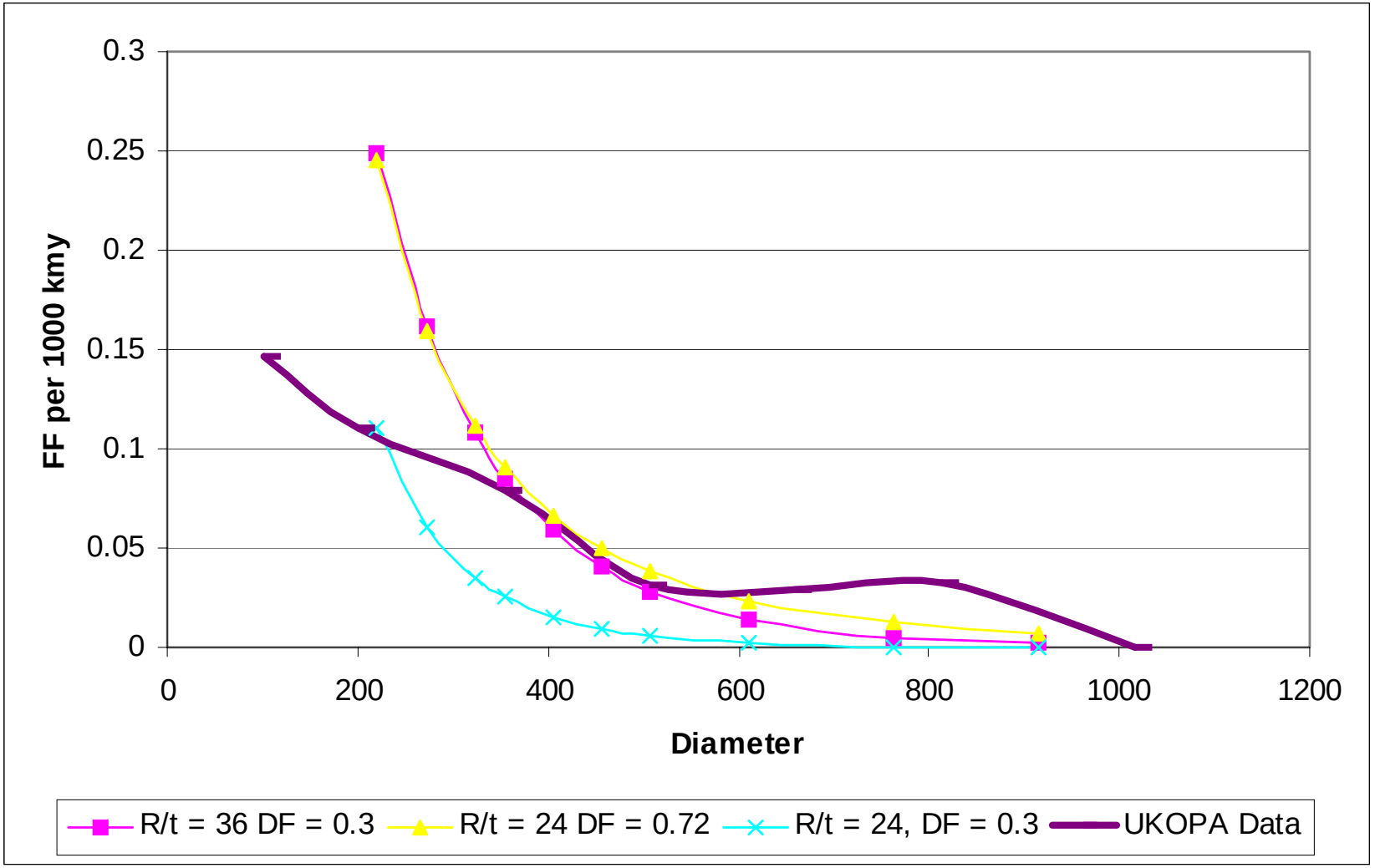
Failure Frequency Predictions Taking into account variation in Incident Rate with Diameter



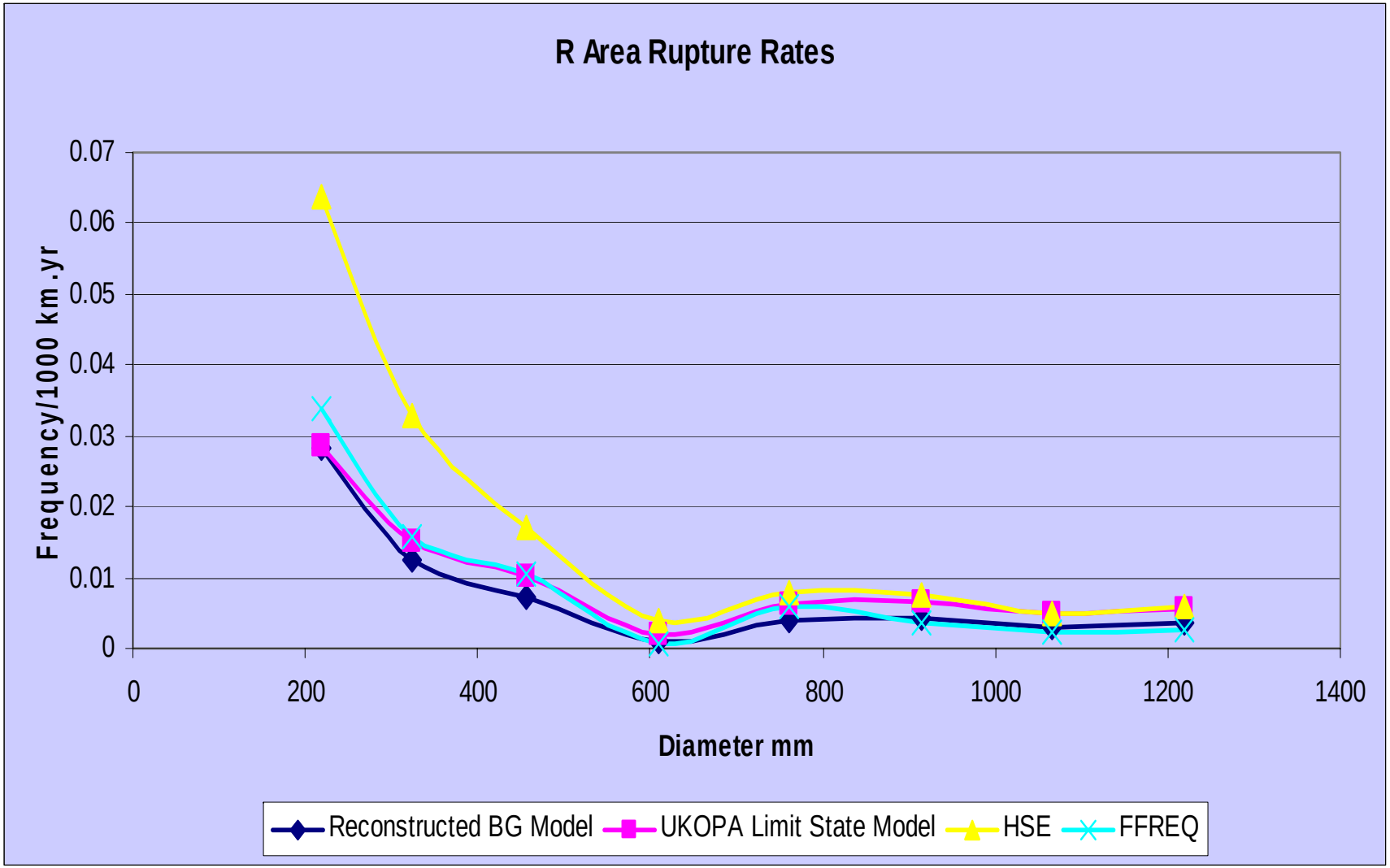
Failure Frequency Predictions based on Weighted Average Pipeline Population Statistics



Effect of Variation in Pipeline Parameters



Comparison of Predicted Failure Frequencies



Comparison with Generic Curves and UKOPA Failure Data