WITNESS STATEMENT **FIRST DRAFT**

I, Richard Anthony Furness of [redacted] shall say the following at the public inquiry.

1. I am a Chartered Engineer of 20 years and an experienced pipeline specialist of nearly 30 years. My career in fluid flow (both liquids and gases) spans almost 40 years. My professional credentials are given in full as appendix RAF1.

2. I am currently the only person to hold professional Fellowships in both UK and US professional Institutions concerned with my discipline of Measurement and Control and one of only 3 people in Europe to hold the highest American accreditation.

3. My experience is both practical and theoretical and I have been responsible for developing and giving courses to senior Professional and Chartered engineers in many parts of the world on gas and other fluid metering.

4. Recent theoretical and experimental work in large diameter pipelines has allowed me to question the assumptions usually made in many standards and in pipeline models. I have detailed knowledge of the historic development of the national transmission system (NTS) that allows a different perspective to be brought to the Inspectors notice.

The proposal to build a pressure reduction installation (PRI) at Corse as part of British infrastructure development is based on some incorrect technical assumptions and statements that are misleading. Consequently it is seriously flawed. I shall address these in the following order.

Historical perspectives

The NTS for natural gas distribution has grown in an essentially random way. The diagrams in appendix RAF2 show the first pipelines from 1967 onwards and how the infrastructure grew, largely piecemeal until the late 1980's. Finally I show the grid as of 2006 where it is clearly seen that the NTS is a complex mix of different diameter pipes running at different pressures. There are very many AGI's – around 150 - built around the UK to ensure connectivity. I shall show this is the consequence of short sighted planning and not of long term strategic thinking. It is the sole reason why this same problem now arises and why this inquiry has been necessary. Historical perspective is a very important factor and failure to learn from past mistakes is at the heart of this current proposal.

In its submission National Grid claims a statutory duty to 'develop and maintain a safe, efficient, co-ordinated and economical pipeline system for conveying natural gas' (Gas Act 1986 as amended) and a related obligation under a Gas Transporter Licence to respond to changes in actual and projected supply and demand (i.e., the new LNG terminals at Milford Haven and its 'forecast' of future gas demand respectively). [(1)]

[(1)] Para. 9-12 David Mercer Witness Statement (WS). See also ss. 2.2.1 and 3.2.1 ES1; National Grid (NG) 'Route corridor investigation overview', South Wales and West Reinforcement Project, September 2005, p.2; see also 2.2 ES2 and NG response 'b' to C Reynolds' email of 29 June 2006 ES2 Addendum (p. 1).

It is evident that the discretion afforded by the terms 'develop and maintain' does not compel National Grid to build the pipeline in question. Its statutory duty therefore provides no obligation to the build the pipeline beyond an appeal to its licence requirement (to respond to changes in demand and supply) and to the ostensible 'national interest' of the proposal. National Grid argues its licence 'compels it to provide new entry requirements when appropriately signalled' by these changes in demand and supply[i] such that not to build the pipeline and associated PRI would render it in breach of its licence. This appeal to licence obligations seems misguided on two accounts. Whilst the licence requires a response of the Appellant, it does not follow that it requires it to propose a pipeline of the type and by the route National Grid has chosen. The choice is subject to National Grid's projection of future UK gas demand and supply and to its commercial interests. In deed Hansard in October 2006 quotes the Tr Hon Malcolm Wicks (then Energy Minister) as saying *"the route and construction are entirely a commercial matter"*. It is important therefore to decide the National interest and the National Grid interest and the clearly differentiate between them. This is an important distinction and the PRI proposal is solely for the latter. I shall show there are better options, albeit at a slightly higher cost, that can be borne by NG without any financial hardships.

Safety

National Grid has been at pains repeatedly state its "exemplary" safety record. I maintain that their record is far from exemplary as shall show the following:

- National Grid failed to disclose a full line fracture in a main feeder pipeline that runs at a far lower pressure than that proposed at Corse. That incident (see appendix RAF3) occurred in Scotland in December 1993; the inquiry subsequently showed the failure was the result of a design error. Failure to disclose this incident has undermined confidence on even the limited amount of information National Grid has given to local residents.
- In 1999, a family of four were killed in Scotland when a high pressure gas line exploded near their home. Failure here was the result of corrosion, exacerbated by NG/Transco's failure to keep adequate records of the pipe in question. Consequently Heath and safety regulations were violated leading to a fine of £15M – a UK record – for breaching these regulations.
- I shall bring other instances for regulatory breaches to the attention of the inquiry to show their record is far from exemplary

It should be borne in mind the standards to which everybody is working are voluntary codes. Many experts contend these are far from complete and my own work in the standards area shows that as one revision is complete, areas for the next revision quickly emerge. I therefore conclude that with this elevated operating pressures, there is a higher possibility of failure, which NG and the Health and Safety Executive fail to acknowledge.

I have other concerns. Confidence in the safety of a plant or process can only be gained by experience. Despite repeated requests, I have been able to obtain very little statistical information for large diameter pipes working at high pressures. NG claim they have such experience, but they have not quoted this in terms of kilometre years to allow direct comparison with established reference sources. Statistically therefore we are not able to judge the true safety of this in relation to established statistical practices.

One key figure from UKOPA pipeline database (RAF appendix 4) shows that over the past 20 years pipelines have become safer. NG uses this and similar pictures to underpin the assertion that their proposal is safe. Whilst the broad statement that pipelines have become generally safer in the recent past can be made, it cannot be deduced from the foregoing that pipelines which operate at 94 bar have similar standards of safety, since they are not represented in this database in a statistically significant way. Long-term operational data is required to statistically show existing safety standards are adequate at elevated pressures and this does not yet exist.

Using the UKOPA data and extrapolating to the proposed 94 bar pressure has allowed me to conclude that one serious incident could possibly occur somewhere along the pipeline during the life of the pipeline. This possibility is elevated as pressure increases, This calculation has been endorsed by the HSE (at a meeting with them on 2/11/06 at Bootle) but has been rejected by National Grid. Its importance to this inquiry should not be underestimated.

I also question the quality of the welding that is acceptable to NG. Appendix RAF5 shows two pipe welds made in phase 1 of this project. These clearly show the formation of stress risers, the presence of inclusion and the absence of full weld penetration. My concerns are shared by other academic mechanical engineers. I have referred this information to the Health and Safety Executive, but their replies do not satisfy us.

The final safety area regards the site itself. Because remote monitoring of an unmanned site is proposed, the foregoing considerations acquire even greater importance. To date I have been given no assurances that their measures will ensure safe operation nor that adequate safeguards exist to allow a quantitative risk assessment to be made. I have discussed my experience and previous findings with the Health and Safety Executive and shall present a case based on this experience.

Technical environmental factors

When a gas expands due a reduction in pressure, it cools. If the expansion is sufficiently large, it may re-liquefy. To prevent this occurring, heat is required - for which boilers are used. These boilers are usually fired from a proportion of the gas being transported. Calculations based on

data from the boiler manufacturers (Potterton) show that more than a third million tonnes of pollullants (NO_x CO_2) plus 20M cubic metres of excess CH_4 will be emitted during the life of the pipeline. The recent adverse publicity surrounding environmental issues shows this is a pivotal consideration.

Technical data from established sources [(2)] indicates re-heating is only required when the pressure difference exceeds 20-25 Barg. Few NTS pipelines will run at 94 bar and the resulting pressure drop between Felindre and Tirley suggests this re-heating is not necessary. Indeed give the enormous increase in gas supplies publicized (IUK expansions, Langelad, BBL etc.) I contend that there will never be any need for it to operate with such large pressure differences and therefore its need is fundamentally questioned. Given that Government targets for reduction of carbon emissions to 60% of 1990 levels are met, it is most unlikely that full operation will ever materialise.

The proposal has 48" pipes feeding into the PRI and from there into existing 24" and 36" pipes running east. It is the existence and use of these that gives rise to the PRI being needed. A better alternative scenario is to run the 48" line direct to the compressor station at Wormington where upgrades to raise the pressure back to 94 Barg are planned. The environmental impact of this is zero. If the new pipeline is operated at 80-85 bar at Tirley, then no heating and PRI is required at all. Even at 90 bar and above, engineering solutions are possibly to obviate the need for additional heating and therefore for the PRI. Accordingly there are no economic, technical or operational reasons for constructing the PRI now.

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(2) Kempes Engineers Year book 2002 edition page 2317

Site selection

1. National Grid claims to have investigated a number of possible sites to connect the new pipeline to the existing infrastructure. Under the planning regulations 1999, it has a legal obligation to consider and present alternative options. The alternatives sites presented in the environmental statement are nothing more than alternative fields. If this appeal fails, it is unlikely that one of the alternatives sites suggested will be proposed for the PRI. This in my view does not make them real alternatives.

2. There is no technical reason why the PRI should be alongside any existing AGI, wherever that AGI is located. This is only a matter of convenience and cost within due consideration of any environmental consequences. The proposed site has only been selected because of economic consideration in favour of the Appellant. Commercial factors do not constitute a valid consideration in planning decisions.

3. The recent consent given by the Secretary of State shows National Grid has by default been allowed to play the defining role in route selection and assessment of alternatives without challenge or debate. This surely is far from democratic and allows full underscoring of financial motives, to the exclusion of all other factors. Under planning law, as I understand it, cost is not a legitimate consideration. National Grid's failure to appraise and openly present technically feasible alternatives renders its case as less than adequate and shows a complete failure to fairly consider alternative options. The consequence of the technical approach taken and area chosen means unnecessary destruction and pollution of the environment is a natural result. I shall present full information to expose these flaws and give counter arguments to show other more suitable options have been discarded unreasonably.

APPENDIX RAF1 Witness's Curriculum Vitae

NAME: **Dr. Richard Anthony Furness**

ADDRESS: Private Office

[redacted]

TELEPHONE NO: [redacted]

EMAIL:

EMPLOYER: JDF + Associates Ltd.

POSITION: Owner and Director

EDUCATION:

Wellington Grammar School, Shropshire	1959-1965
University College of Technology, Huddersfield	1966-1969
University of Southampton	1969-1973

QUALIFICATIONS: **DipChemE PhD CEng FInstMC ISA Fellow MInstPet**

(a) Academic

HND (Chem.Eng.) (Graduated 1st in Class)	Huddersfield College of Technology (Distinction in fluid mechanics)	1968
CEI Part II	Huddersfield College of Technology	1969
College Associateship in Chemical Engineering		1969
PhD (Mech.Eng)	University of Southampton	1973

(b) Professional

Elected Member, Institute of Measurement & Control	1980
Elected Senior Member, Instrument Society of America	1980
Elected Chartered Engineer (Reg. No. 363287)	1986
Elected Member, Institute of Petroleum	1987
Elected Fellow, Institute of Measurement & Control (UK)	1990
Elected Fellow, International Society for Measurement & Automation (USA) (former name the ISA)	1995

EXPERIENCE:

Scientific Assistant, UKAEA Harwell, Oxfordshire	1965-1966
Research Fellow, University of Southampton, Hampshire	1972-1973
Research Officer, CEGB Berkeley Laboratories, Gloucestershire	1973-1976
R&D Manager, GEC-Marconi Process Control, Sussex	1976-1978
Technical Director, Rhodes & Son, Romford, Essex	1978-1981
Senior Flow Technologist, Union Carbide (Charleston, USA) (Senior Staff Engineer and Chief Flow Technologist in 1984)	1981-1984
Senior Lecturer and Centre Director, Cranfield University, Bedford	1984-1988
Chief Flow Technologist, SGS Redwood, Ellesmere Port	1988-1990
Business Director & Corporate VP, ABB Instrumentation (UK & USA)	1990-1999
Endress + Hauser, Business Director (Indianapolis USA)	2000-2001
JDF + Associates Ltd, Gloucestershire: Owner/Director	2001- present

HONOURS:

Awarded **Callendar Silver Medal**	1996
(Institute of Measurement and Control, London UK)	
Visiting Lecturer, Imperial College, London University	1994-1999
Appointed Visiting Fellow in Engineering at the University of Sussex UK	1999-
Appointed Business Faculty Associate at North Dakota State University, USA	2001-

OTHER DATA:

Member UK Standards Committee PCL/2/6	1979-1981
Member UK Standards Committee PCL/2/7	1979-1981
Member ISO Standards Committee ISO/TC30/SC8	1980-1981
Member USA Standards Committee MMFC/8	1982-1984
Member USA Standards Committee MMFC/15	1982-1984
Main Author, BSI Standard BS7405 on Flowmeters, 280 pp	1987-1989
Chairman IP Standards Committee PMD/5	1987-1990
Visiting Lecturer at Imperial College, London University	1986-1996
Consultant to United Nations on Flow Technology (UNDP)	1987-1999
Member, IMC Journal Executive Committee	1988-1999
Member UK Petroleum Measurement Committee	1988-1995
Member UK Standards Committee PCL/2	1988-
Member ISO Mass Meter Committee ISO/TC30/SC12	1988-
Chairman ISO Standards Committee ISO/TC30/SC2/WG7	1989-
Member UK Standards Committee PCL/2/9	1989-
Chairman UK Standards Committee PCL/2/107	1993-
Contributor to ISA Handbook of Flow Measurement	2000-
Lead Author: E+H Handbook of Flow Measurement	2004

Over 130 papers & reports on flow measurement
More than 220 site audits all over the world, including internal inspections (1m to 4m)
Inspections relate to both closed pipes and open channels

WRITTEN PROFILE

Dr. Richard (Dick) Furness has been involved with fluid flow for more than 35 years. He is internationally known as a leading expert in the field. A graduate in both chemical and mechanical engineering and a Chartered Engineer, he has been involved on the theoretical and practical side of flow metering, having spent time in R&D, in industry and in academic worlds. He has been invited to serve on numerous International and National Flow committees, both in the UK and the USA, and is currently the Convener/chairman of two panels. He is the author of three books and more than 130 papers and reports on all aspects of the subject. He has contributed to many reference texts in the past five years.

Dr. Furness currently runs his own consulting business, with clients all over the world. He has managed multi million dollar businesses at ABB Instrumentation and Endress + Hauser in the past ten years, both in the United States and in Europe. He has been Head of a UKAS flow laboratory for 10 years, has considerable experience in quality control procedures, auditing, traceability, uncertainty assessment and measurement. He has vast field experience, especially pipelines (water and gas) and in water supply & wastewater treatment. This auditing and diagnostic experience extends to both closed pipe and open channel systems on all five continents. He has also undertaken network analysis and UFW studies for several municipal water authorities in India, Latin and South America, Africa and the USA as well as laying down principles for network distribution analysis in the UK. Considerable work has also been done on pipeline dynamics, leakage, safety and balancing. This includes alarm availability analysis and risk factor determination on hazardous gas lines in the USA. He is currently working with EcoPetrol in Colombia to upgrade refinery metering and cut losses for both oil and gas imports and exports.

He has taught fluid mechanics and flow measurement throughout the world and is a former UNDP consultant to the United Nations (New York) on metrology. Technical interests include uncertainty, flowmeter installation influences, magnetic, turbine & mass meters and calibration techniques. His specialty is fluid flow in large diameter pipes and water flow in open channels. In 1995 he was honoured with Fellowship of the ISA (USA) for his work in instrumentation calibration and measurement uncertainty, making him the only person to currently hold Fellowships in Instrumentation in both the UK and USA professional Institutes. In

recognition, the Institution of Measurement & Control awarded the Callendar Silver Medal in June 1996. This is the highest National award in the United Kingdom and is given for life-long distinguished service to the Control and Automation Industry. Few of these have been previously awarded.

CLIENTS

These are based all over the world, but work has been undertaken in the past 5 years for:

United Nations: (UN Consultant for India)	CWPRS Flow Laboratory design, Pune (100 tonne gravimetric system) Open channel audits in Maharastra, Kerala, Gujarat, Rajasthan and Andhra Pradesh Water Network Studies in Mumbai, Pune, Chennai, Nagpur, Jaipur, Delhi, Bangalore, Baroda, Jamshedpur, Cochin and Hyderabad 2300mm pipeline studies for Bombay Municipal Corporation
Mexico:	Water supply studies for Acapulco, Veracruz, Puebla and Hermosillo Wastewater plant assessments in Mexicali, Tijuana, Guanajuato, Irapuato
Brazil:	Network studies in Curitiba, Brasilia, Belo Horizonte and Rio de Janeiro Wastewater plant design for Petrobras Pipeline modeling and measurements in 1500 and 1800mm lines
Colombia:	City of Medellin, EcoPetrol refinery at Barrancabermeja (oil and gas imports)
Ecuador:	Cities of Quito and Ibarra
Libya:	Great Man-made River Authority: Tripoli and Benghazi
USA:	1 Day Training course in water and gas flow measurement for Instrument Testing Association of America, Las Vegas Nevada: Day courses for main Consulting Firms in USA Audit of open channel meters in Redington Beach, Florida Audits and studies on flowmeters in Tampa, Boston, Las Vegas and St. Louis
Canada:	Development of open channel audit and wastewater allocation procedures for Greater Vancouver Regional Authority
Philippines:	Network analysis for Manila Water: Currently undertaking design work for main reservoir and headworks meters, Quezon City
UK:	RPS Water Services plc, Welsh Water, Thames Water, Anglian Water LPG storage and metering studies at the Humber facility

In the more distant past projects have included work in:

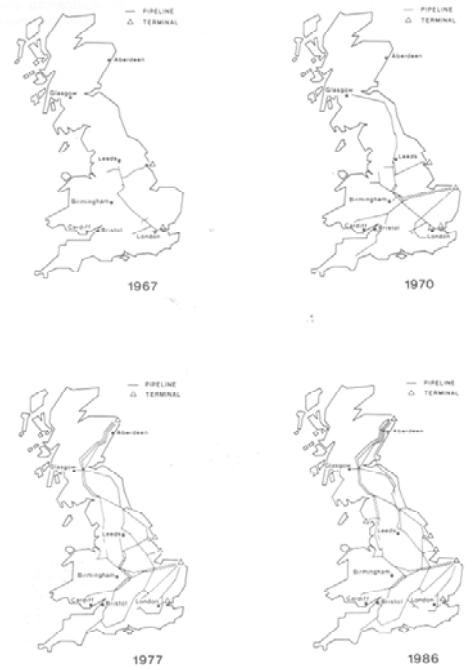
Jamaica, South Africa, Australia, New Zealand and the throughout the USA and the United Kingdom (Severn Trent, United Utilities and Anglian Water).

This included main consultant on the first MIG project in the United Kingdom for United Utilities plc. (This set the current standard of water metering for UK nationwide in 1990)
Hazardous pipeline theoretical and experimental work in USA
Operational experience, Leak detection and mass balancing in carbon monoxide and natural gas pipelines in USA

References can be provided as required

Historical Development

- First line built 1963 - Canvey Is.
- First offshore mid 60s
- Bacton terminal added by 1970
- Feeder to Wales built late 60s
- Morecambe discovered late 80's
- N. Sea Gas slows 2001:
- Milford LNG planned from 2003

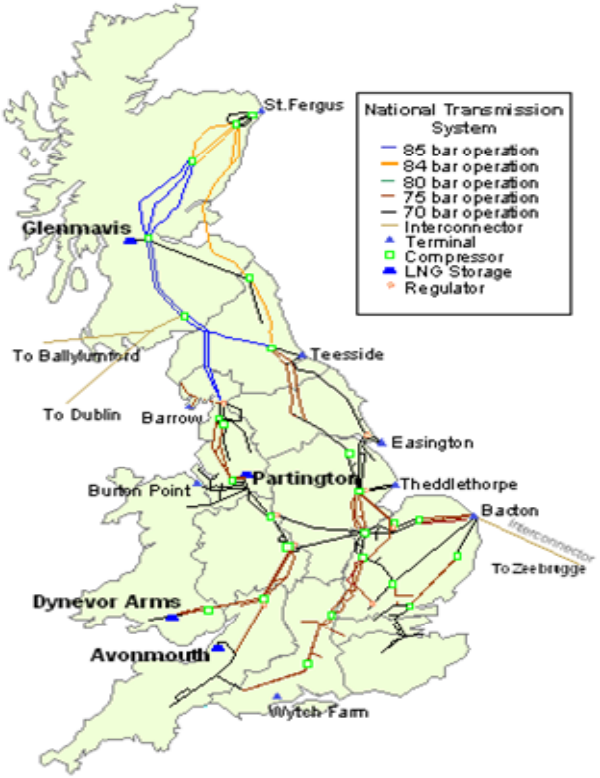


- System developed piecemeal

27/02/2007 5

The UK National Grid System in 2006

- NG says it has 94 bar operational experience in 48" pipes: exactly where and for how long?



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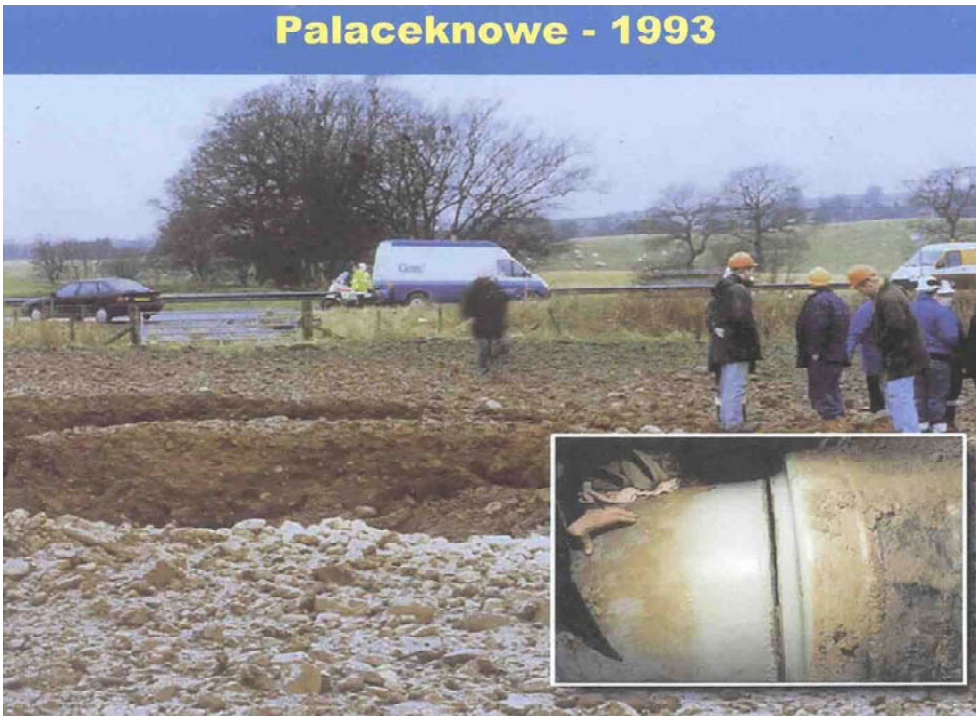
Pipeline failure in the UK

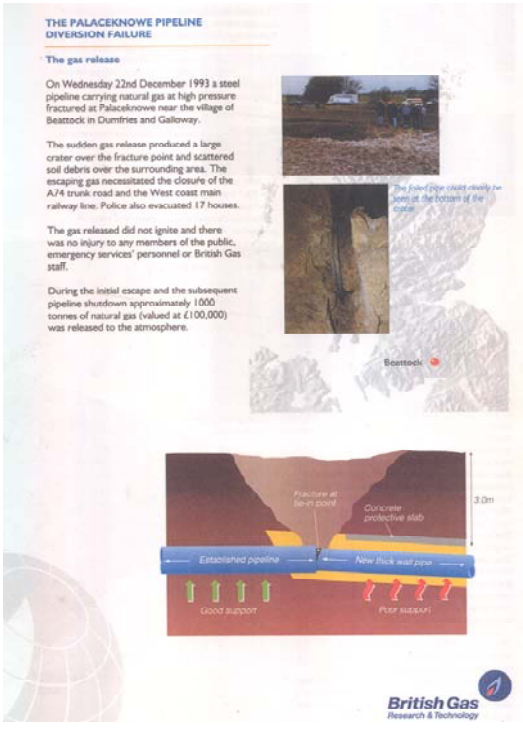


27/02/2007 30

Palaceknowe incident December 1993

- BG description of the incident.
- Loss of gas 1,000 tonnes
- A74 trunk road closed and homes evacuated
- This has not appeared in any NG presentations or project documents until I highlighted it.
- National Grid say they have had no serious incidents for 35 years: What about this? Why was it not disclosed?

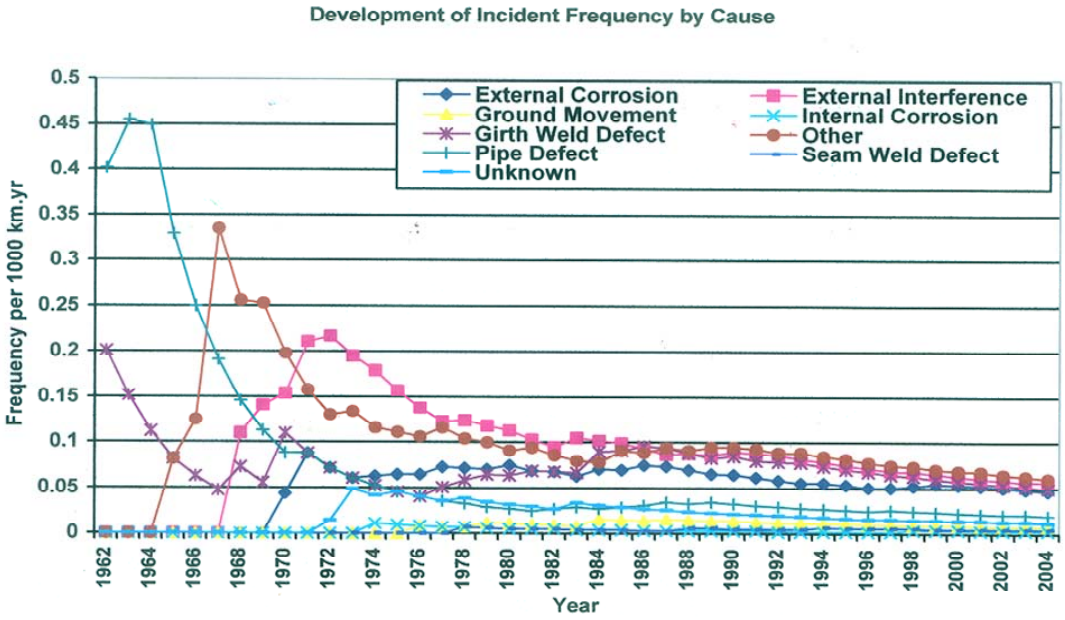
•Welsh Minister has restated NG claims of no serious incidents even after my address to Welsh Assembly



27/02/2007 31

APPENDIX RAF4 UKOPA pipeline accident probability data

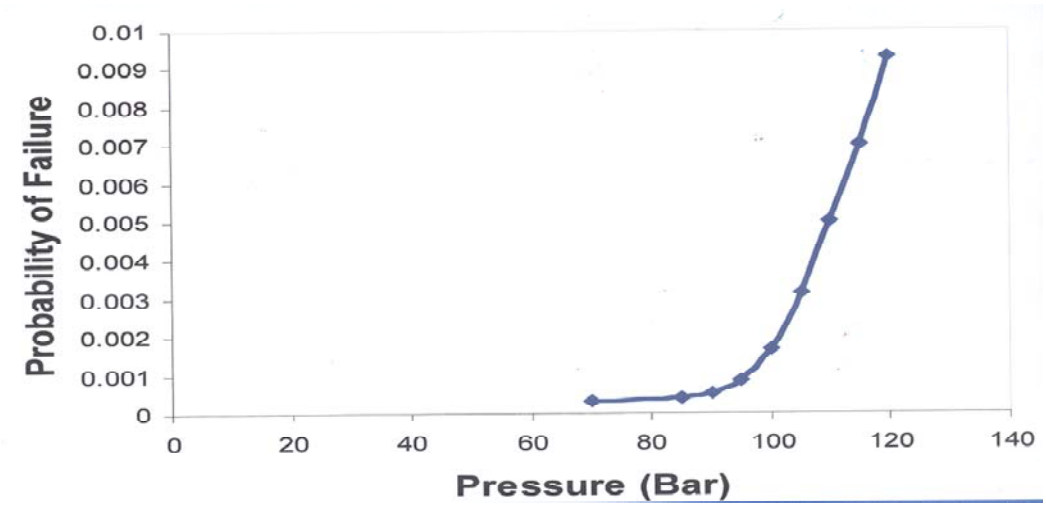
HSE probability data



27/02/2007 23

Data used to calculate the possibility of serious incidents occurring

Risks rise as pressure rises



Raising the line pressure from 75 bar to 100 bar (code limit), the makes the probability of failure more than double. Source Dr. Jane Haswell: Safety expert

This is theory and has not been verified experimentally

Largest experiments with gas were in 36" pipe at 60 bar pressure (Canada 2000)

27/02/2007 22

APPENDIX RAF5 Examples of weld quality from Phase 1 construction

Expert opinion states these are substandard (stress riser formation, inclusions and insufficient weld penetration) and that hydrostatic testing, ultrasonic and x-ray inspection will not lead to the require margins of safety. The welds are made by hand, experts contend they should be made by robotic means. At elevated pressures adequate safety margins require high quality weld integrity.