SAFETY ISSUES FOR FELINDRE-TIRLEY PIPELINE PROJECT AND PRI's

Dr. Richard Furness
DipChemE CEng FInstMC ISA Fellow MInstPet

Fluid Dynamics Consultant
Consultant to United Nations on Metrology
Tirley, Gloucestershire UK

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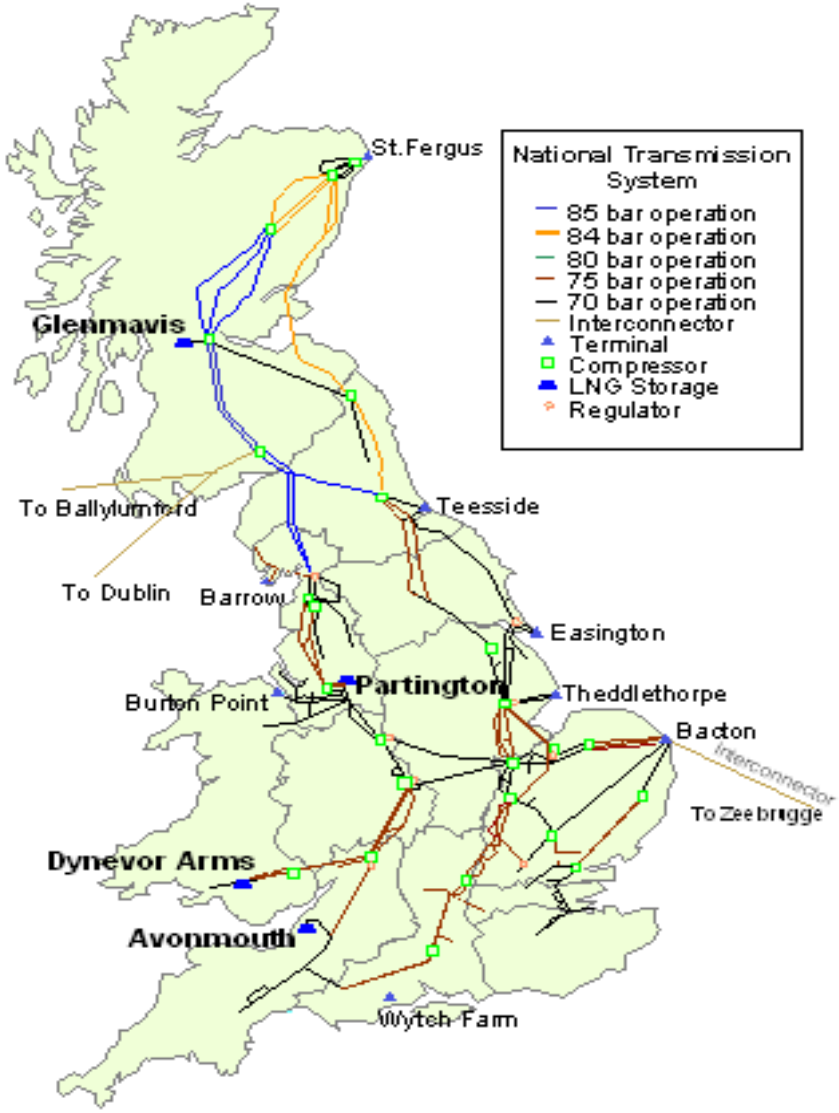
JDF + Associates Ltd.

Presentation outline

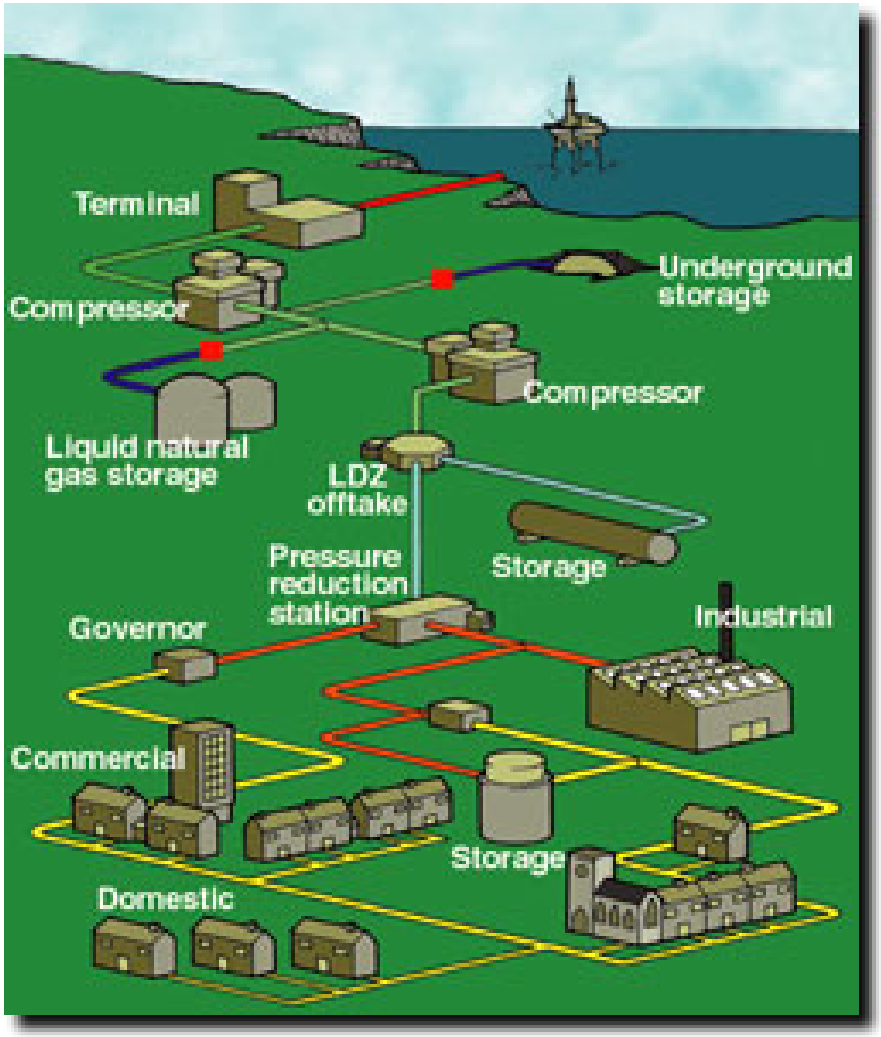
- Overview of the National Grid Transmission system
- Major factors in pipeline accidents worldwide
- Examples of accidents in high pressure pipelines
- The Felindre to Tirley Pipeline proposal
- The safety case and our concerns
- Questions to be answered
- The present position

The UK National Grid System

- Pressure in UK is 85bar
- In our area it is 75 bar
- Why build at 94 bar?
- Note high pressure (94 bar) infrastructure does not currently exist in Wales or anywhere else in Europe or N. America



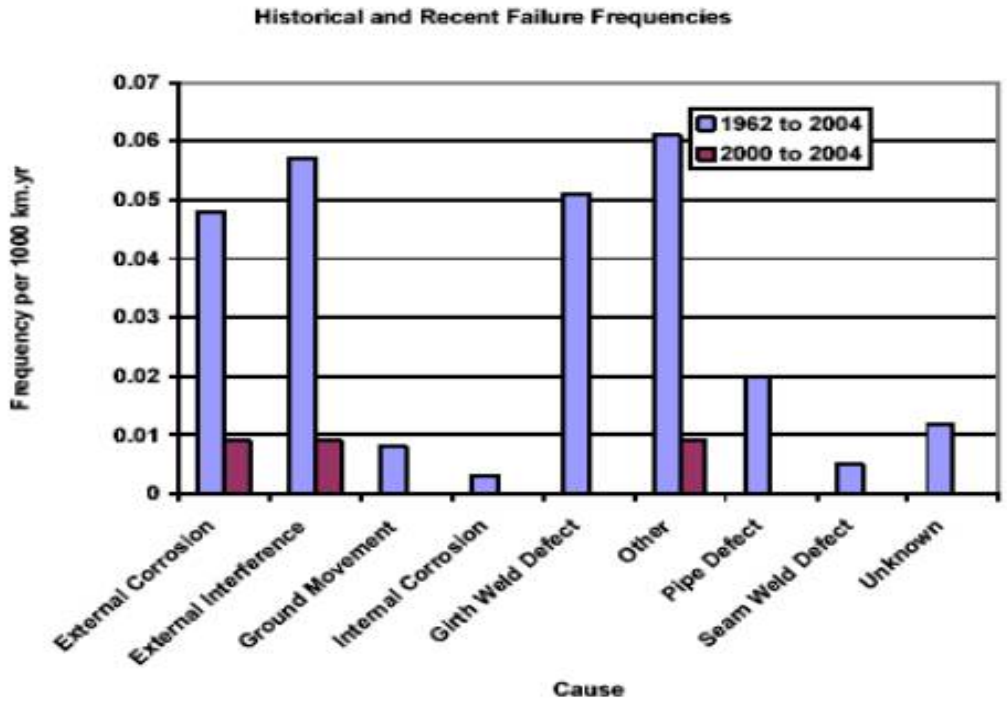
Typical gas distribution system



- High Pressure allows easier transmission but uses energy
- Low pressure is required for end-users
- PRI is a key element within the system

Accident causes (From HSE Website)

- Major failure modes are external corrosion, third party acts and other; What is in other?
- Where are constructional defects, stress corrosion, pipeline dynamics, or inadequate integrity monitoring?



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Causes of Pipeline accidents: The facts

Third party[1] damage (such as gouges and dents) and corrosion have consistently been the major cause of pipeline failures in the developed world (13); for example, Table 3 (14). This means that the safety of our pipeline is critically dependent on how we manage its condition during its life.

	Causes of Pipeline Faults (%)	Causes of Gas Loss (%)	Causes of Pipeline Faults Detected by In line inspection (%)
External Corrosion	25	23	41
External Interference	30	19	1
Pipe Defects	21	5	45
Girth Welds	4	13	2
Ground Movement	1	3	0.4
'Other'	19*	37**	11***
Total Incidents	1768	239	561

Notes for Table:
'Faults' are part wall defects with no gas loss.
*''Other' are minor construction damage such as arc strikes or small gouges, or coating damage.
**''Other' are small leaks from valve stems and other fittings.
***''Other' are eccentric casings, objects in backfill and minor construction damage.

[1] First party is the pipeline operator. Second party is a contractor or agent allowed to work on the pipeline, e.g. for scheduled maintenance. Third party is any person/organization without authority to work on the line, e.g. a farmer ploughing a field and damaging the line.

Source: Prof. Philip Hopkins Univ. of Newcastle upon Tyne

Pipeline & PRI Safety: Codes Applicable

- IGE/TD/1: First developed in 1965: now published as 4th edition 2001: 5th is planned
- BS EN 1594 2000: First European code for gas pipelines covers high pressures over 16 bar: recognised as incomplete
- ISO 13623: for liquid and gas pipelines: not used in Europe as said to be less conservative
- BS 8010: covering onshore oil and gas lines based largely on TD/1
- ASME B31.B (USA) oldest code (1931 with revisions).

The TD/1 Code: Used to justify safety in Tirley PRI

- Code talks about maximum pressure of 100 bar but uses design factors to assess risk
  - Design factor is hoop stress/specified minimum yield strength
- Design factors of 0.72 and 0.8 are discussed analysis is via probability, supported by operation over time: no supporting experimental data (i.e. code is not rigorously quantified)
- Data for 94 bar not provided, assumed non-existent
- Does not consider stress corrosion even though it has been shown to be the cause for some past accidents
- Does not consider elevation momentum and fluid dynamic effects which can cause uneven hoop stress.
- No probability analysis yet published for high design factors

- BOTTOM LINE IS CODE DOES NOT PROVE SAFETY CASE AT TIRLEY AS IT STANDS AT PRESENT

Stress corrosion dynamics

- Stress corrosion cracking (SCC) is major cause of pipeline rupture: Ref. NTSB reports in USA
- It is at micro-level within the grain boundaries of the pipe material
- Cracks form and propagate at right angles to direction of applied stress at stress levels much lower than those needed to fracture
- Many defects are caused during construction
- Higher pressures significantly increase the risks and erode safety margins
- At 94 bar and with almost no margins of safety based on the TD/1 code who is looking at the risk assessment for this proposed pipeline and associated PRI's?
- University of Loughborough calls for this to be studied and modelled further

Crater left by 30” gas pipeline explosion

Carlsbad pipeline explosion, New Mexico USA in August 2000

Crater was 86 feet long 46 feet wide and more than 20 feet deep

At 94 bar and in 48” pipes, any similar crater anywhere along the line will be larger

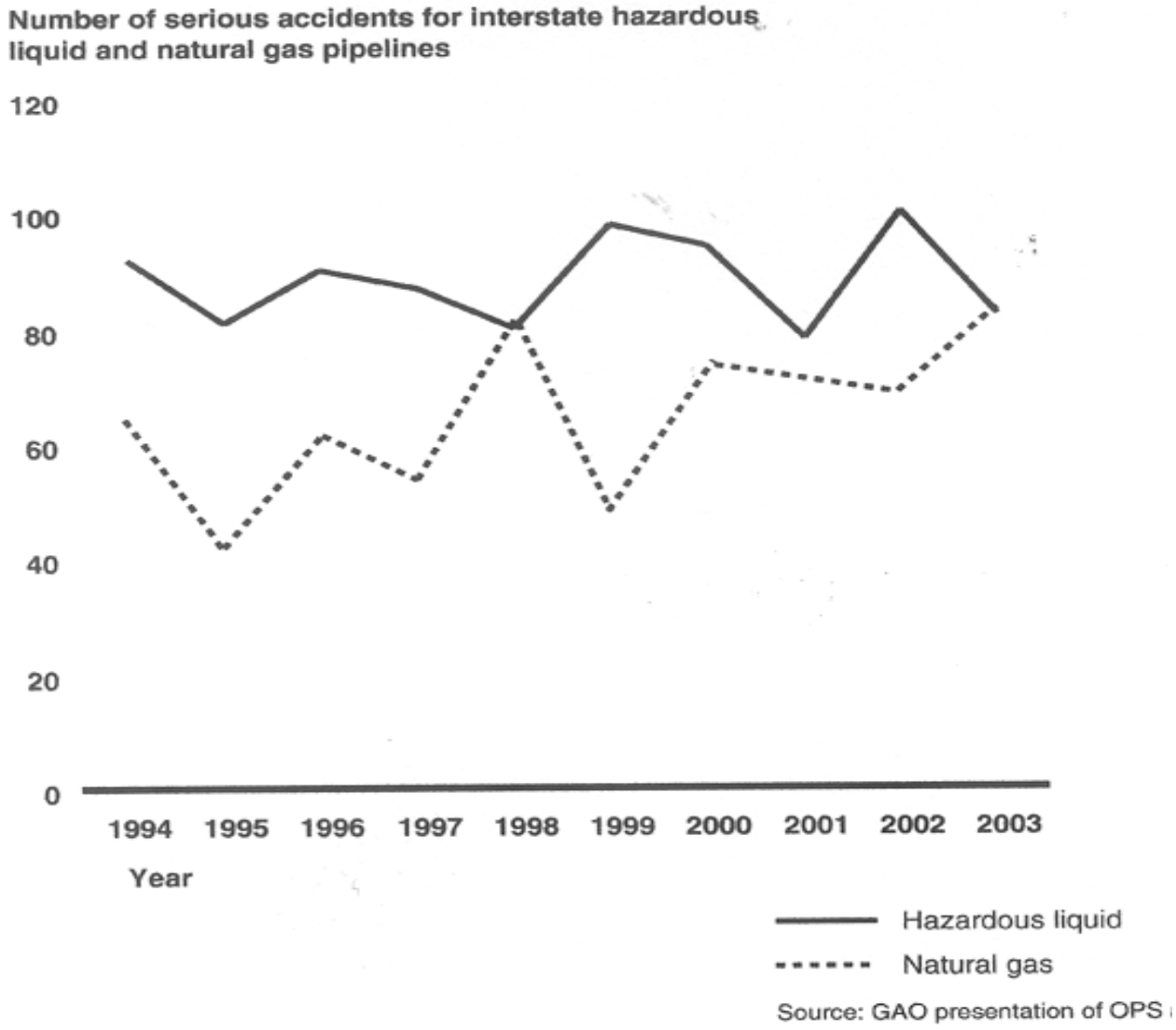
55 bar, 26” line Explosion in USA in 2003

- **Williams Pipeline Toledo Washington State: Pipeline tested a year previously hydrostatically but the stress corrosion which was the cause of this accident was not detected by such testing NG proposes this method**

Ghislenghien accident 30th July 2004

- Caused by third party action – local excavation: gas smelt but not acted quickly upon: explosion within 37 minutes of detection Emergency procedures MUST be written for such eventualities
- Operating pressure 71 bar: 24 died 131 injured including firemen
- It can happen any time and anywhere!
- Belgium had perfect safety record up to this accident

Gas pipeline accident data from US 1994-2003



Gas pipeline explosions in US pipelines are now more than 1 each week: their occurrence has steadily increased in past decade

Pipeline Accident examples

- Edison NJ 1994: Pipeline deterioration: no remote valves: 1500 residents evacuated
- San Juan PR: 1996: LNG line explosion 33 deaths: poor leak response and action
- Ufa Russia 1989: LNG line explosion 645 deaths in two trains: leak not detected
- Ghislenghien, Belgium 2004: 24 deaths: leak not detected and acted upon quickly enough

- TODAY IS NOT REAL THE WORRY: TIME AFFECTS
- Aerial inspection as proposed by NG cannot reveal leaks in buried lines. How will they check the PRI from the air?

The Upgrade of the National Grid

Main import sites will be St. Fergus, Bacton and Milford Haven

PROJECTS AFFECTING THE AREA

D = Milford Haven to Aberdulais

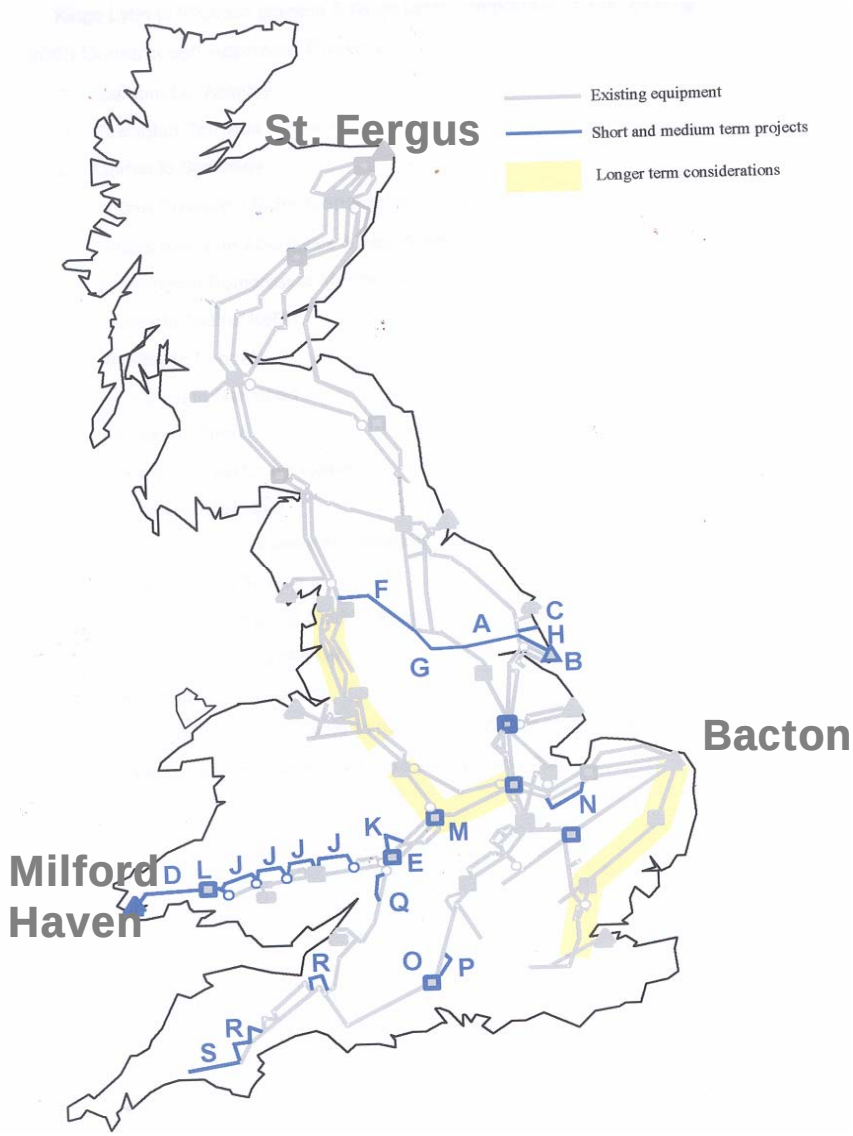
E = Wormington compressor

J = Felindre to Tirley

K = Wormington to Honeybourne
(this will also be 94 bar)

L = Felindre Compressor

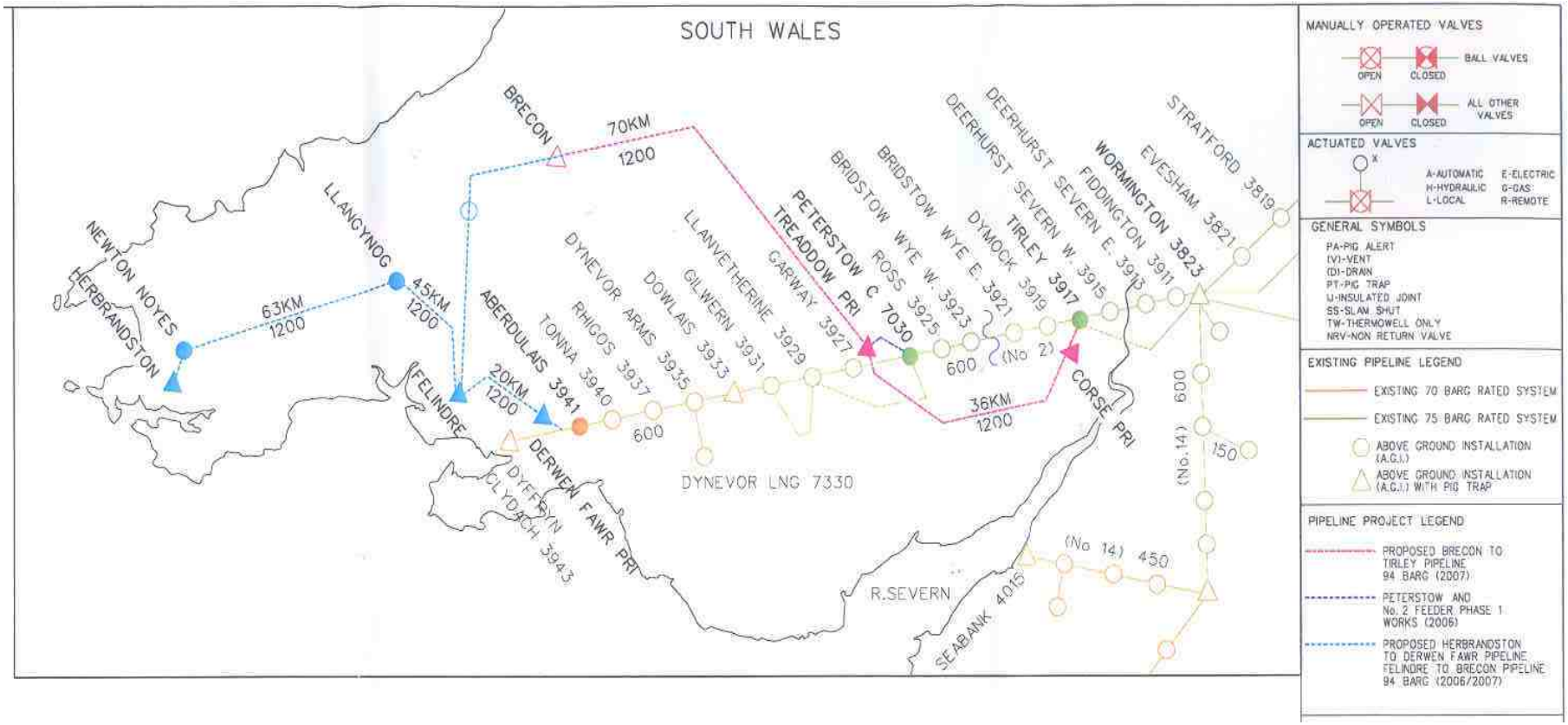
Q = Wormington to Sapperton



Felindre to Tirley 48” pipeline

Schematic of proposed pipeline connections

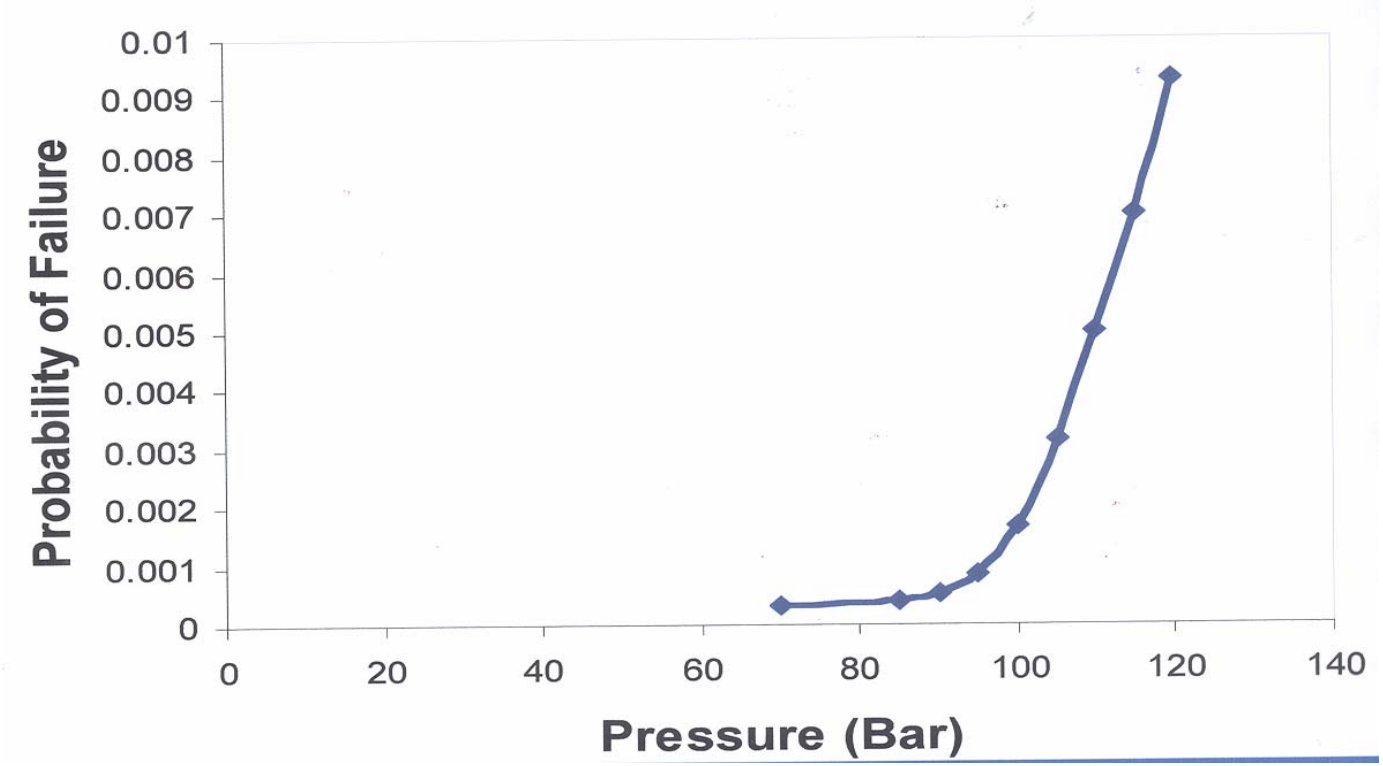
- Diagram shows that Wormington is better option for the PRI. Junction already exists



The issues surrounding the pipeline & Corse PRI

- Safety factors
  - Do NG have any operational experience in pipes and PRI's?
  - Does the pipeline and PRI design fall within the standards?
  - Why this pressure and size? Not yet answered by NG
  - Why is the Corse PRI station not manned: how is security guaranteed?
  - PRI is a very complex installation due to the many components and needs extra care in the design with such new operating conditions
- Noise and exhaust gas emissions
  - What is the local environmental impact: no figures given by NG on 18th July 2006 during their presentation
- The 'blot on the landscape'
  - Is a greenfield site the right place?
  - Landscaping and lighting issues

Risks rise as pressure rises



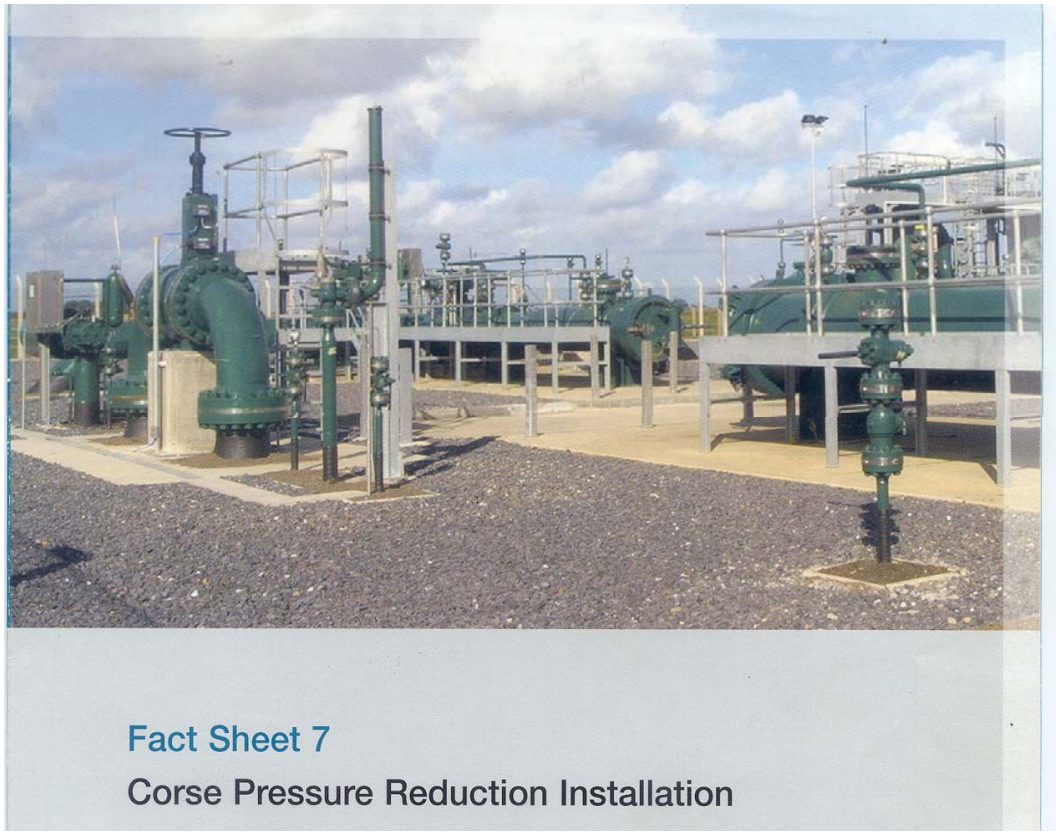
Raising the line pressure from 75 bar to 100 bar (code limit), the makes the probability of failure more than double. Source Dr. Jane Haswell: Safety expert

This is theory and has not been verified experimentally for gas lines and PRI's

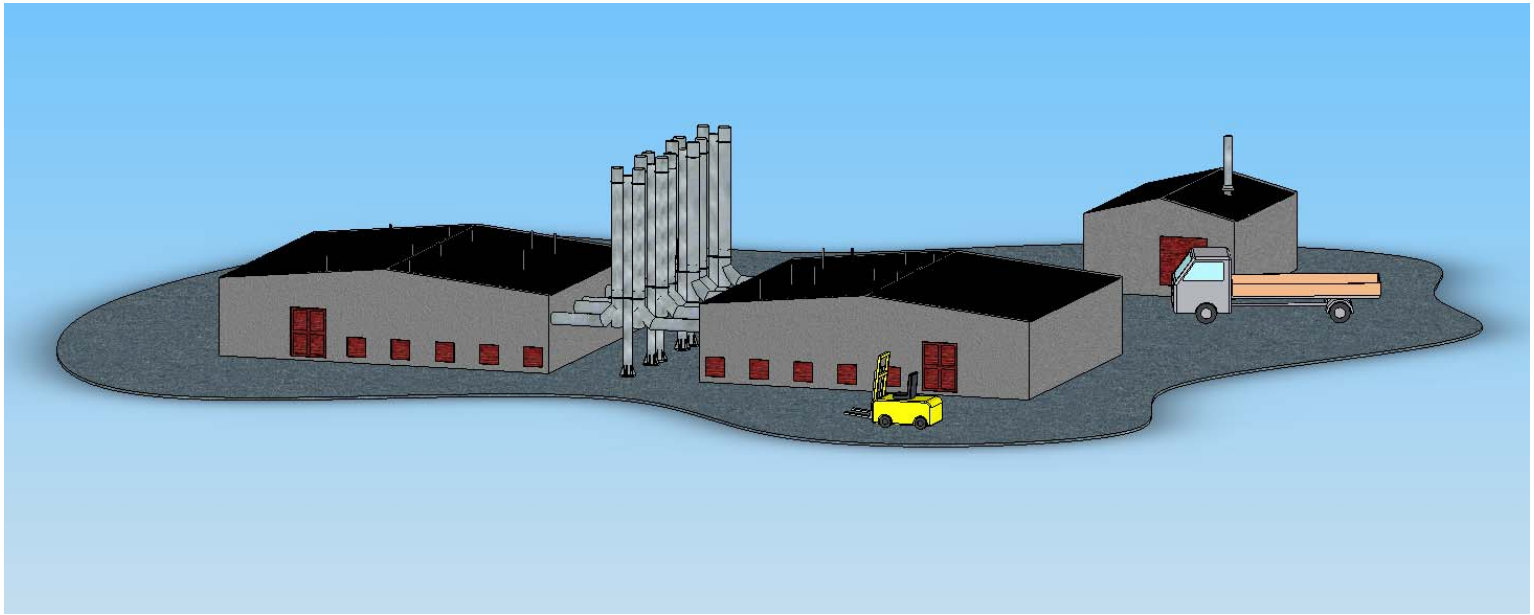
Largest experiments with gas were in 36" pipe at 60 bar pressure (Canada 2000)

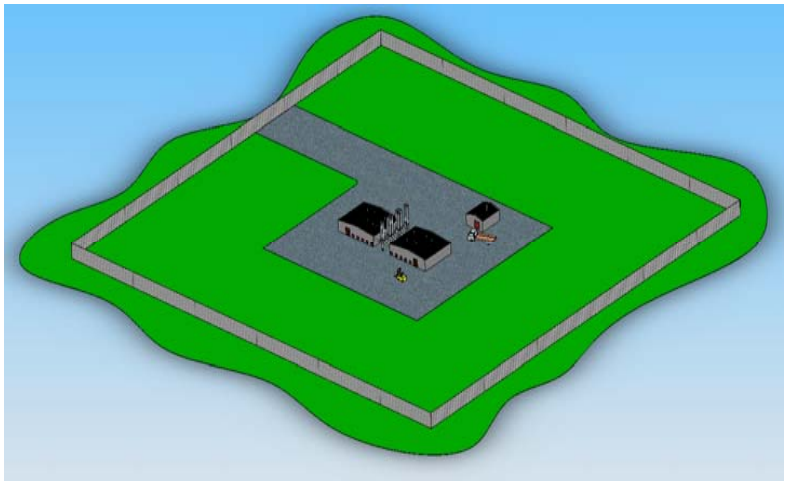
NG Fact Sheet 7 - The Corse PRI

- Fact Sheet 7 is misleading and incomplete
- Why are the 14m square buildings and other site structures not mentioned?
- Why are no pictures or sizes given for stack heights (8.5M)?
- Picture on page 3 is not correct for this type of installation



The Corse PRI; Artistic impression





In addition there will be tanks, valves, and other equipment similar to that shown on front of Fact sheet 7 on site.

It is a true industrial site in the middle of undeveloped rural countryside. The proposed location is not appropriate and certainly not necessary: Wormington is better and the logical place.

NG replies to some of our questions

- NG have admitted no experience of operating pipelines + PRI's at 94 bar
- NG have not answered questions on remote monitoring for line or PRI
- There are no official safety documents yet supporting the application.
- NG have stated there are no brownfield sites available: Have they looked and where?
- NG have stated that INITIALLY 20% of the total UK demand would pass through the Corse PRI. Future expansion will be needed.
- RADIO 4 program on Milford Haven this week said *"Eventually 80% of the total requirement will pass along this line"* **quote by John Constable of National Grid**
- NG have stated that emissions will be mostly water vapour, carbon dioxide and small quantities of nitrous oxide. This is NOT correct. Emissions will contain Nitrogen oxide variants (called NOx), which are pollutants
- NG have yet to provide any documentation on emergency response procedures for other sites
- Many technical, operational and safety queries from previous public meetings still remain unanswered despite their statement on 18/7/06 that questions would be answered in 2/3 weeks. This presentation will add others

Basic questions - 1

- Why 94 bar when rest of network is much lower?
- The TD/1 code permits pressures up to 100 bar: why is 94 bar proposed here and not the maximum stated?
- Why 48” (1219 mm) when rest of network is smaller?
- Why make a pipeline weak point by building a PRI at Tirley where none exists today? A PRI is a complex installation
- With the higher design factors, have fracture control and integrity management plans been written by NG?
- Why not run the larger pipe line to Wormington where a major junction already exists, where the compressor is to be upgraded to 94 bar and where logistics and control would be easier?
- What are the margins of safety for the 15.9mm and 22.2mm pipe already purchased?
- Has the existing pipe been subject to any testing and/or full inspection? Is this equal to or above max design factor + micro-radiography for defect detection?

Basic questions - 2

- Can we see the risk assessments for 0.8+ design factors?
- What blast and dispersion models have been used?
- How is pressure control to be guaranteed? Does the pipeline have instrument redundancy for added safety
- What SCADA and instruments are to be used for full integrity monitoring? What pipeline model is used?
- What is response time to shut off in event of major rupture? How long is the depressurized time?
- What mass of gas would be released by a full pipe rupture at 94 bar and in a smaller leak? HSE computer models suggest more than 25tonnes/s. Where are the block valves located?
- Has NG calculated the distance debris would be thrown? How about size profile of this debris?

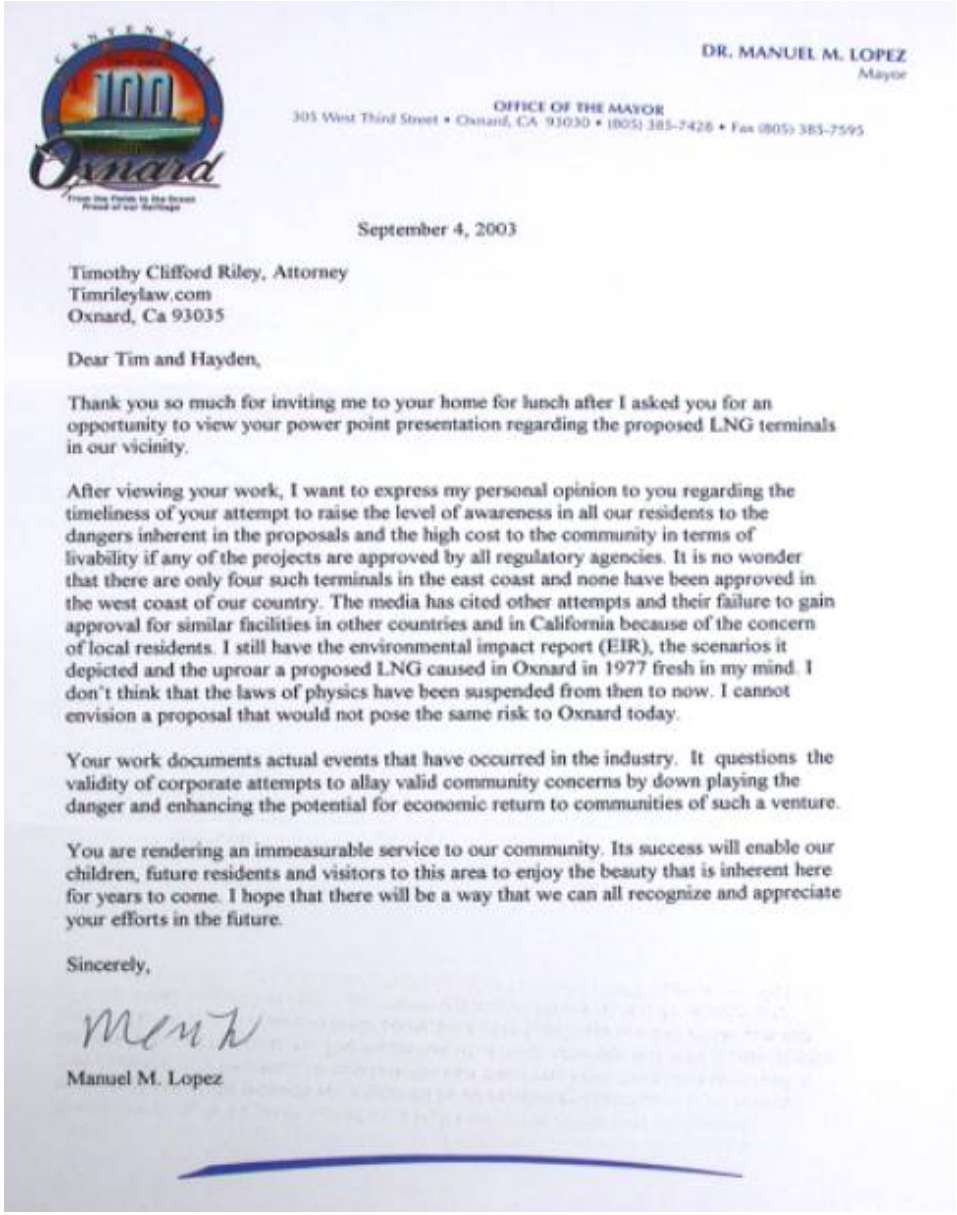
Basic questions - 3

- Why is the station not manned? Is it to be designed for special security?
- Has NG considered gas momentum effects within the pipe? This will give uneven pipe stresses, especially at bends. What is the maximum flow?
- It seems the pipeline is storage as well as transmission: Is this the case? What is the total mass within the Milford Haven to Tirley section?
- What HSE licences and approvals will be required to cover the design and operation? Are they available or issued?
- Given that hydrostatic testing becomes less effective with age, how does NG intend to eliminate the possibility of SSC affecting overall safety over time? (Ignored in TD/1)

US Resident concerns mirror ours

- Please check out
- www.timrileylaw.com

Note this paragraph



DR. MANUEL M. LOPEZ
Mayor

OFFICE OF THE MAYOR
305 West Third Street • Oxnard, CA 93030 • (805) 385-7428 • Fax (805) 385-7595

September 4, 2003

Timothy Clifford Riley, Attorney
Timrileylaw.com
Oxnard, Ca 93035

Dear Tim and Hayden,

Thank you so much for inviting me to your home for lunch after I asked you for an opportunity to view your power point presentation regarding the proposed LNG terminals in our vicinity.

After viewing your work, I want to express my personal opinion to you regarding the timeliness of your attempt to raise the level of awareness in all our residents to the dangers inherent in the proposals and the high cost to the community in terms of livability if any of the projects are approved by all regulatory agencies. It is no wonder that there are only four such terminals in the east coast and none have been approved in the west coast of our country. The media has cited other attempts and their failure to gain approval for similar facilities in other countries and in California because of the concern of local residents. I still have the environmental impact report (EIR), the scenarios it depicted and the uproar a proposed LNG caused in Oxnard in 1977 fresh in my mind. I don't think that the laws of physics have been suspended from then to now. I cannot envision a proposal that would not pose the same risk to Oxnard today.

Your work documents actual events that have occurred in the industry. It questions the validity of corporate attempts to allay valid community concerns by down playing the danger and enhancing the potential for economic return to communities of such a venture.

You are rendering an immeasurable service to our community. Its success will enable our children, future residents and visitors to this area to enjoy the beauty that is inherent here for years to come. I hope that there will be a way that we can all recognize and appreciate your efforts in the future.

Sincerely,

Manuel M. Lopez

UK practice versus US experiences

- National Grid says the US data is not relevant
- Since 1995 British Gas has been involved with the US, purchasing several companies
- UK experience and practice plus the adoption of the IGE/TD/1 code (2001) in some US projects has not reduced US accident rate
- ALL pipeline incidents are relevant to the evaluation of risk, especially where new operational conditions or technology is involved (as with this application)

The present CAPRI position

- The Application was first made with minimum of public exposure: immediate local affected people were not fully aware
- There is currently no safety case proven as the margin of safety appears to be zero using the IGE/TD/1 code.
- We have not been able to review any safety documents and do not know if a QRA has been lodged as part of the application.
- I have made a formal request to the HSE for overall technical review of TD/1 standard in light of proposed operational conditions: Now invited to meet HSE
- Reference number for this is BCRN-6S8HH5
- We have informed the press of our safety concerns
- Application will be heard by Forest of Dean at later date

Brief Summary

- There are no pipelines in Europe that operate at 94 bar. The Dutch Authorities will not even allow pressures above 75 bar anywhere in their network
- The Environmental Statement does not even mention 94 bar and National Grid do not attempt to explain their operational reasons for this reasons let alone justify it
- Risk rises with significantly with pressure. The probability of failure doubles if pressure rises from 75 to 94 bar. No experience exists in operating PRI's at these conditions
- With the natural gas being odourless, detection is almost impossible. They have to rely on instrument readings to measure the mass balance.
- Block valves are at extreme distances apart (50kms). Depressurization at Corse will last many minutes and release thousands of tonnes of gas. This has a potentially lethal effect (as Ghislenghien)
- There is no justifiable reason why this pressure should be used. If the pipe were operated at 75 bar the need for the Corse PRI disappears. The pipe could indeed by-pass Corse altogether to be routed direct to Wormington, where site modifications are already planned

Ghislenghien accident 30th July 2004

- Caused by third party action: gas smelt but not acted quickly upon: emergency procedures MUST be written
- Operating pressure 71 bar: 24 died 131 injured
- Belgium had perfect record up to this accident
- It can happen any time and anywhere!

- IT COULD HAPPEN HERE