Overview of pipelines in Europe – advantages and disadvantages

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A recently laid 36 inch gas pipeline

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UN/ECE Workshop on the Prevention of Water Pollution due to Pipeline Accidents
Berlin, 8-9 June 2005

Gas pipeline networks in Europe are growing rapidly !

- Natural Gas: the total length of European High Pressure networks was approximately 200,000 km in 2003, compared to ~180,000 km in 1996.
- Natural Gas grid in US: The length of onshore gas transmission and gathering pipelines in US remained practically constant since 1984: ~500,000 km.
- The total consumption of natural gas in Europe in 2004 amounted to 458,3 billion cubic meters; it increased by 3.3 % in comparison with 2003 (Source: Eurogas*, February 2005).

* Eurogas is the European Union of the Natural Gas Industry – www.eurogas.org

Natural Gas Pipeline length in the EU

(Marcogaz*, 2003)

Total Gas Transmission Pipeline length: 203.085 km

Germany	73.600
France	35.751
Italy	30.120
United Kingdom	19.000
Netherlands	11.600
Spain	7.666
Slovak Republic	6.196
Hungary	5.270
Belgium	3.730
Czech Republic	3.637
Austria	2.488
Greece	970
Denmark	852

*** Marcogaz is the Technical Association of the European Natural Gas Industry – www.marcogaz.org**

Cross-country oil pipelines in the EU (CONCAWE*, 2005)

- The EU has an extensive network of on-shore pipelines with a total length of nearly 40,000 km in 2004, compared with ~12,000 km in 1971 and ~30,000 in 2000.
- The largest portion of the lines are used for transporting refined products (gasoline, diesel and jet fuel) and heating oil. These pipelines are usually "multi-product" with the ability to transport several different products in separate batches.
- The combined traffic volume in the CONCAWE system in 2001 was 131 billion cubic meters/km, of which ~70 % was crude-oil (16 % higher than in 1994).

***CONCAWE is the oil companies´ European association for environment, health and safety in refining and distribution – www.concawe.be**

Other chemicals conveyed in EU pipelines

- A network of ~10, 000 km pipelines convey more than 150 different hazardous materials such as: Ethylene, Propylene, Chlorine, Ammonia, Hydrogen, Oxygen, Butadiene and Styrene.
- Ethylene and Propylene are conveyed in the main part of those networks.

Around the world are many old pipelines that have been laid and put into service a long time ago. Pipelines that are still in service …

ing in 20-in. line in 1916 near Clendenin, W.Va. Pipe was attached to wooden horses by several turns of manila rope. Men using mope pole as tise the pipe for removing skids before lowering in by loosening the ropes.

A 20 inch gas line laid in 1916

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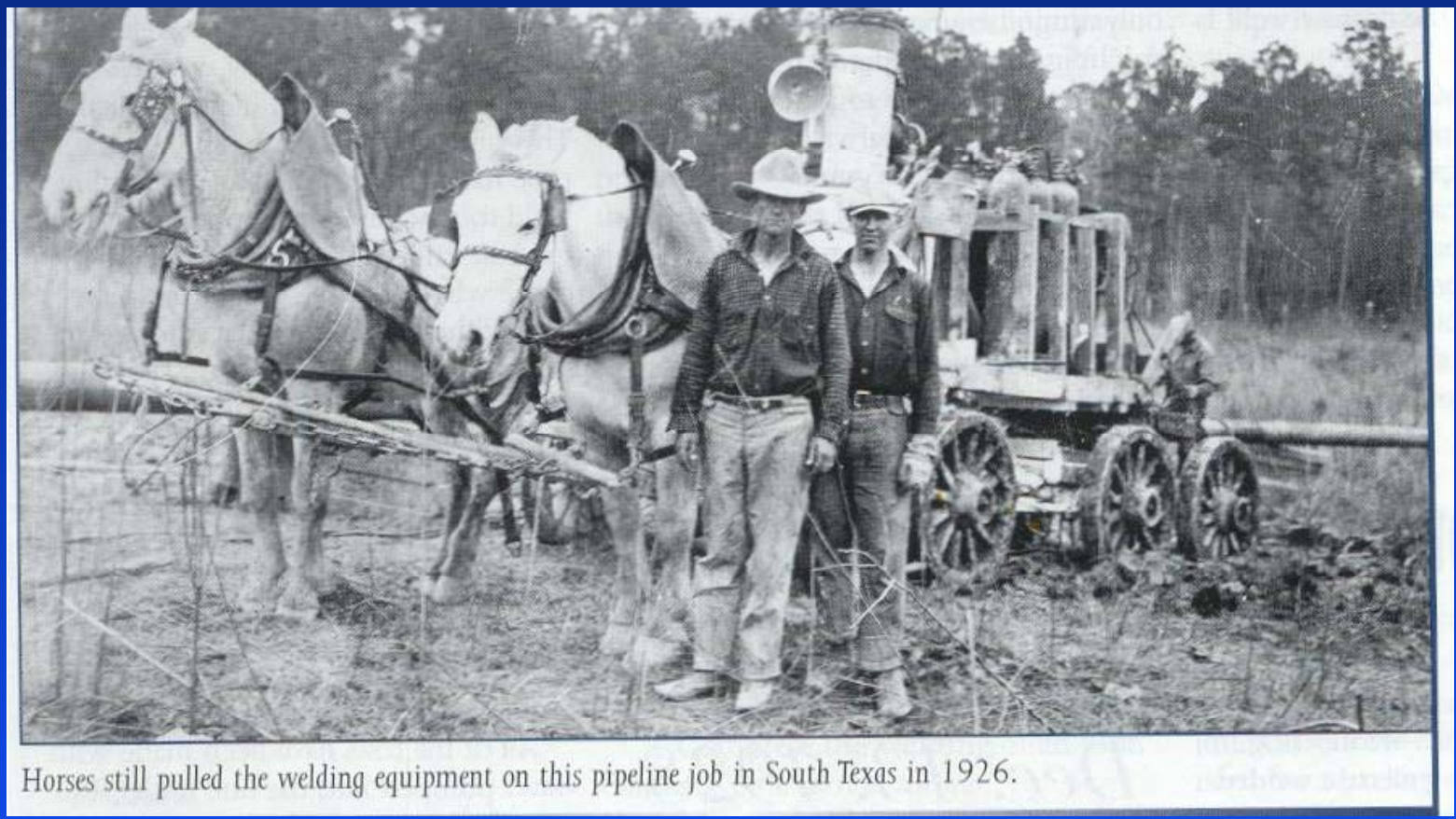
Such pipelines have been welded and laid to historic standards or good workmanship.



Horses still pulled the welding equipment on this pipeline job in South Texas in 1926.

A good pipeline safety record within the Member States (EU-15)

- Most of the 'headline news' pipeline accidents have occurred outside the EU.
- However, accidents world-wide indicate the 'major-accident hazard' potential of pipelines.

European Gas Pipeline Incident Group (EGIG - www.egig.nl)

- EGIG: a co-operation of 12 major gas transmission operators in Western Europe managing 110,000 km of gas pipelines with a cumulative exposure of 2.41 million km/year in the period 1970 to 2001 (in 2003 the exposure is 2.65 million km/year).
- EGIG owns a gas pipeline-incident database with 1,100 incidents: unintentional releases of gas in transmission since 1970.

Gas Transmission Pipelines Performance Records

Natural Gas Europe :

- EGIG incident rate 0.44 incidents per year per 1,000 km (improved by ~25% last decade),
- External Interference is the major cause (in ~ 50% of cases)

Natural Gas US :

- DOT 0.44 incidents per year per 1,000 km (improved by ~8% last decade)
- External interference is the major cause (42% of cases)

However, accidents do occur …

Ghislenghien, Belgium, 30 July 2004

Flames shoot into the air after a gas pipeline explosion at an industrial estate near Ghislenghien, southern Belgium.(AFP/Philippe Schpilka)

External damage with fracture that occurred when the operational pressure in the pipeline was increased.

The cut gas pipeline and the crater it left when it exploded at an industrial estate in Ghiselenghein, southern Belgium.(AFP/Philippe Huguen)

The day after:
20 fatalities
~ 130 wounded
with
33 people severely burned and 2 in critical condition

According to press reports, there was a total of over 100 million € damage.

Gas Accidents consequences

- Natural Gas Europe: rare casualties, with the exception of the latest accident in Belgium in July 2004.
- Until the year 2000, the average casualty rate is estimated at 0.011 per 1,000 km per year.
- Natural Gas US: ~0.067 casualties per 1,000 km per year within reporting period 1986-2002. Improvements until 1996, however, bad records with numerous casualties in the period 1998-2002.

Oil & Liquid Transmission Pipelines Performance records

Records for oil in Europe

- CONCAWE : 0.65 incidents per year per 1,000 km oil pipeline (improved by ~15% in last decade)
- External interference is the major cause (35% of cases).

Hazardous liquid pipelines in US :

- US DOT records ~0.85 incidents per year per 1000 km (~6% higher in last decade)
- Corrosion is the major cause (30% of cases).

Liquid Accidents consequences

Oil spills in Europe

- CONCAWE: 0.023 casualties per 1,000 km per year in the period 1971-2000.
- During the last 17 years, the average casualty rate has greatly improved to 0.014 casualties per 1,000 km per year.

- Hazardous liquid pipelines in US show higher casualty rates than European oil pipelines.

Environmental consequences from oil spillages

- Environmental consequences of oil releases within the EU cannot be accurately estimated.
- A number of accidents were of record scale; in 1993 and 1994, the cost of oil spillages in Western Europe was estimated to be higher than 16 million €.
- The annual net spillage volumes per kilometer of oil transmission pipelines in EU did not show any improvement in the period 1975 to 1993.

Pipeline Studies (EU Commission, JRC*)
(carried out 1996 plus reviews in 1999 and 2003)

Main Contents of the two studies:

- Review of transmission pipeline accidents: causes, frequencies of occurrence, types of consequences
- Analysis of existing legislation on pipelines within the EU (safety requirements, emergency planning, accident reporting etc.), including a Benchmark on national regulatory provisions in the Member States (EU-15)

* JRC the Joint Research Centre of the European Commission – www.jrc.cec.eu.int (for the two studies go to: mahbsrv.jrc.it)

Main conclusions on pipeline accidents

- Substances frequently involved: natural gas, crude oil and oil products
- Oil spillages are mostly linked to environmental damage, while …
- Gas releases can be linked to health damage.

Accident reporting

- The "Seveso II" Directive (96/82/EC) introduced comprehensive reporting requirements for EU Member States for the collection and analysis of major accidents in industrial installations (Directive excludes pipelines).
- EU-MARS (Major Accident Reporting System) contains ~500 cases to date.
- In the absence of any formal reporting requirements at European level, similar official records on major pipeline accidents are not available.
- The review of accidents has shown that the existence of legislation on the control of hazards arising from pipelines in other parts of the world, for example in the U.S., contributes to better knowledge about accidents and their consequences.

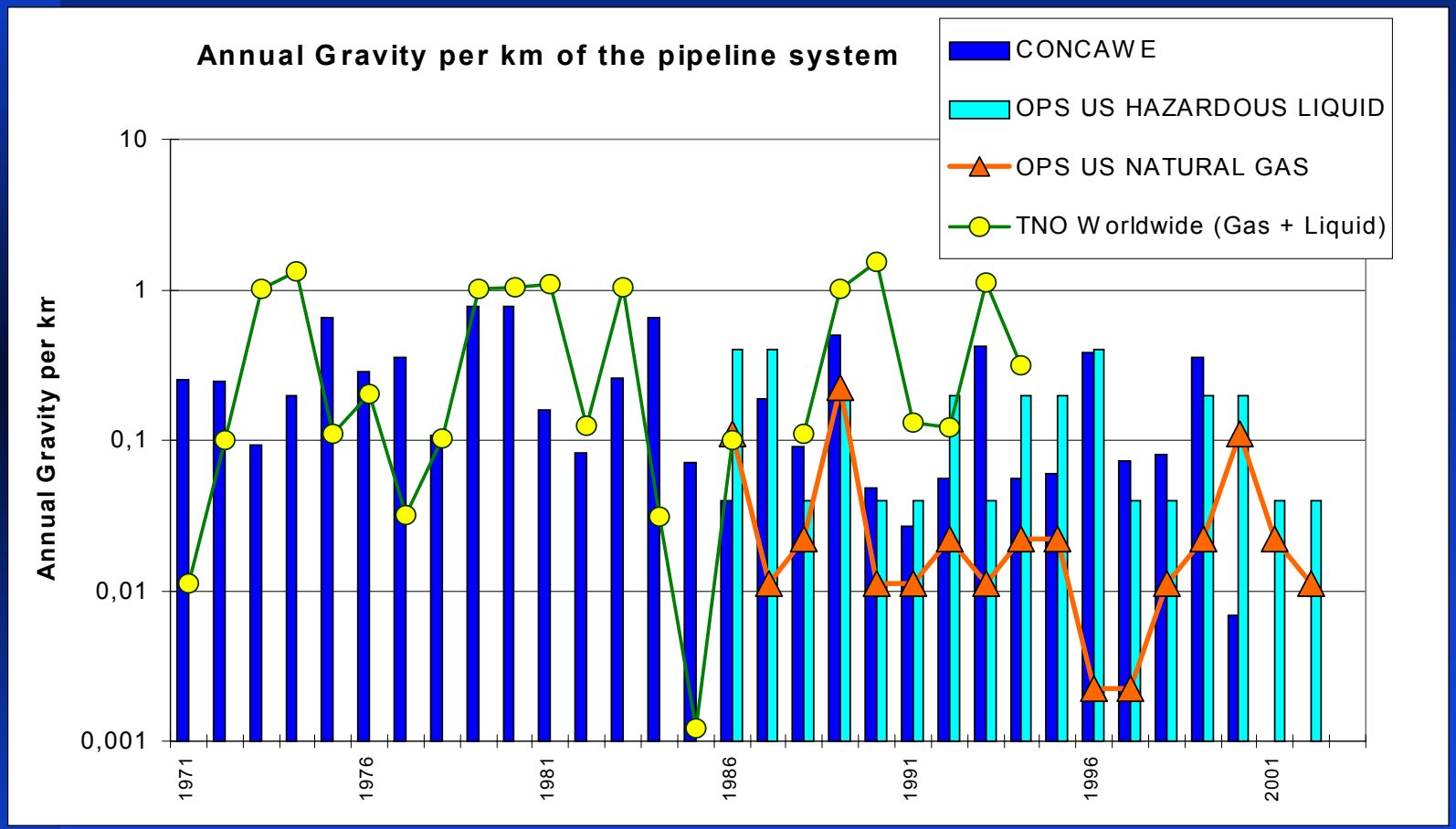
Comparison of records

- The "gravity" of pipeline accidents was compared against that of major accidents in fixed installations in EU member states. The criteria used are the reporting criteria according to "Seveso II" Directive (96/82/EC).

The main conclusions are:

- Gas and oil pipeline accidents around the world are of gravity higher than the gravity level that characterises an accident as "major" according to "Seveso II" Directive.
- Oil pipeline accidents in Europe and US are of "medium gravity" and many of them can be characterised as "major".
- Annual gravity of pipeline accidents (per km of system) was not improved in the period 1971 to 2000 – *see next figure.*

Comparison of records (ctd.)



Some more conclusions from accident analysis …

- In general, major accidents do not occur frequently in pipelines but some accidents have serious consequences.
- Environmental damage such as contamination of soil and water and clean-up are mostly related to oil spills.
- Health damage is mostly related to gas releases when ignited (4% of all cases, up to 25% for gas releases from larger diameter gas lines).
- Comparison of performance of different pipeline networks should be performed with care since data at different pipeline systems and in different periods are collected under different reporting criteria.

Regulatory Benchmark (1999)

MAIN CONCLUSIONS

- Different definitions and exclusions (substances, networks, etc.) in several EU Member States
- General obligations of operator are covered in most countries but major gaps in national provisions are related to :

1. safety management system (missing in most countries),
2. prevention of third-party damage,
3. accident reporting requirements,
4. information to the public,
5. emergency planning,
6. land use planning, etc.

Review Study (2003)
MAIN CONCLUSIONS

- New countries joined the EU that have different control systems for their pipeline networks.
- Certain countries with a high %-age of EU networks reported developments in regulations since 1999:
  - Germany (40% of EU network): major development, new Pipeline Ordinance (RFLV-2002) and technical rules (TRFL-2003) including requirements on safety management system, prevention of third-party damage, etc.
  - UK: New Pipe-Works Regulations in 2000 require Environmental Impact Assessment
- Need for further improvement in the rest of EU and research on the new EU Member States.

Final remarks

- **While pipeline grids in other parts of the world are stagnating, networks within the EU are growing rapidly. Furthermore, existing networks are aging.**
- **Compared to other modes of transport (rail, road, maritime), the transport of dangerous substances in pipelines is "rather" safe and environmentally friendly.**
- **However, the major accident potential of pipelines is proven. While pipeline accidents occur less frequent , their consequences are often more severe than accidents in chemical plants and storages.**