

# DECISION-MAKING ON ASSESSMENT OF HIGH PRESSURE GAS TRANSMISSION PIPELINES

*Steve Chatfield*  
*HM Principal Inspector of Health and Safety*  
*Head of Operational Policy, Gas & Pipelines Unit*  
*Hazardous Installations Directorate*  
*Health & Safety Executive*  
*United Kingdom*

## ABSTRACT

In the United Kingdom [UK], the management of pipeline safety is governed by the Pipelines Safety Regulations 1996<sup>1</sup> [PSR]. These Regulations are goal setting and encompass a risk-based approach to safety. They require pipeline operators to design, build and operate pipelines to ensure that they are safe, so far as is reasonably practicable [SFAIRP]. Operators of major accident hazard pipelines, including gas transmission pipelines above 7 bar g, are required to notify the Health and Safety Executive [HSE] before construction, use and significant modification, providing details of the design of the pipeline and operating conditions.

This paper discusses HSE's decision-making process in determining whether the design and operation of a high pressure gas transmission pipeline complies with PSR and includes HSE's approach to deciding whether risks have been reduced SFAIRP.

## INTRODUCTION

The UK's approach to the regulation of major hazards [which includes hazards from high pressure gas transmission and other pipelines, chemical plants, the nuclear industry and offshore oil & gas industry] has evolved over many years. In a densely populated country like the UK, the government and public want assurance that the risks are being controlled and a safety regime has developed to meet this need. While the detail of the major hazard regimes varies across the different industry sectors, all require duty holders, in one way or another, to demonstrate that the risks are being controlled. HSE has therefore developed a framework to inform its decisions about whether this has been achieved.

## LEGAL BACKGROUND

### *Health and Safety at Work etc. Act 1974*

The principal health and safety legislation in the UK is the Health and Safety at Work etc. Act 1974 [HSW Act]<sup>2</sup>. It requires risks to employees, and others, to be reduced SFAIRP. Regulations are made under HSW Act to cover a wide range of health and safety risks.

HSW Act section 1(2) requires safety standards to be maintained or improved, and when considering options for controlling risk, does not allow for a lowering of safety standards. This principle permeates HSE's approach to the regulation and management of risks.

### *SFAIRP/As Low as reasonably practicable [ALARP]*

UK legislation uses both terms SRAIRP and ALARP. While it would ultimately be for the Courts to decide, HSE considers that duties to ensure health and safety SFAIRP and duties to reduce risks ALARP call for the same set of tests to be applied.

Of particular importance in the interpretation of SFAIRP is the case of *Edwards v. The National Coal*

Board (1949)<sup>3</sup>. The case established that a computation must be made in which the quantum of risk is placed on one scale and the sacrifice, whether in money, time or trouble, involved in the measures necessary to avert the risk is placed in the other; and that, if it can be shown that there is a gross disproportion between them, the risk being insignificant in relation to the sacrifice, the person upon whom the duty is laid discharges the burden of proving that compliance was not reasonably practicable.

HSE expects duty holders to make this gross disproportion test to determine if further risk reduction measures are reasonably practicable.

### ***The Pipelines Safety Regulations 1996 [PSR]***

The Pipelines Safety Regulations 1996 [PSR] were made under the HSW Act and are the principal health and safety legislation in the UK concerning the safety of pipelines. The overall aim is to ensure pipelines are designed and constructed properly and operated safely. The Regulations cover both onshore and offshore pipelines, are goal setting [i.e. they set out the objectives to be achieved but leave freedom on how these objectives are to be met], and allow risk-based approaches that have to satisfy the principles of SFAIRP.

PSR covers:

- Design of the pipeline;
- Safety Systems;
- Construction and installation;
- Examination and maintenance.

Part III of the Regulations define certain pipelines as ‘major accident hazard pipelines’ [MAHPs]. This includes high pressure gas transmission pipelines conveying gas at pressures > 7 bar g. Operators of MAHPs are required to notify HSE before:

- Construction;
- Use;
- Certain modifications.

These notifications provide HSE with the opportunity to assess compliance with PSR. However, the onus remains with the duty holder to justify that their pipelines are safe.

HSE has published guidance<sup>4</sup> on complying with PSR, which while not law, gives advice on measures available and what is good practice.

## **UK REGULATORY AUTHORITY AND ITS ROLE**

HSE’s Hazardous Installations Directorate is responsible for enforcing PSR. This is carried by:

- Assessing PSR pipeline notifications;
- Inspecting pipelines throughout their construction, operation and decommissioning lifecycle;
- Investigating incidents.

Under HSW Act, HSE Inspectors have a range of powers for enforcing PSR. These powers are used in accordance with HSC/E’s enforcement policy<sup>5</sup> which is based on the following principles:

- The targeting of action: focusing on the most serious risks or where hazards are less well controlled;
- Consistency: adopting a similar approach in similar circumstances to achieve similar ends;
- Proportionality; requiring action that is commensurate to the risks;

- Transparency: being open on how decisions are arrived at and what are their implications;
- Accountability: making clear, for all to see, who is accountable when things go wrong.

## HSE's DECISION MAKING PROCESS

### *Introduction*

HSE has published a suite of documents concerning its approach to ALARP and SFAIRP judgements. These are designed to give high-level principles that separate parts of HSE can then use to promulgate sector specific guidance. The main documents are:

- Reducing Risk, Protecting People [R2P2]<sup>6</sup>;
- Principles and guidelines to assist HSE in its judgements that duty-holders have reduced risk as low as reasonably practicable<sup>7</sup>;
- Assessing compliance with the law in individual cases and the use of good practise<sup>8</sup>;
- Policy and guidance on reducing risks as low as reasonably practical in design<sup>9</sup>.

The documents provide the framework under which HSE assesses the safety of pipelines. The framework makes it clear that:

- Both the level of **individual risks and the societal concerns** engendered by an activity or process must be taken into account when deciding whether a risk is **unacceptable, tolerable or broadly acceptable**;
- The decision-making process and criteria adopted are such that action taken is **inherently precautionary**;
- HSE starts from the position that, for every hazard, the law requires that:
  - a suitable and sufficient risk assessment must be undertaken to determine the measures needed to ensure that risks from the hazard are adequately controlled;
  - suitable controls must be in place to address all significant hazards;
  - those controls, at a minimum, must achieve the standards of **relevant good practice precautions**, irrespective of specific risk estimates.
  - Additional?

### *Individual risk and societal concerns*

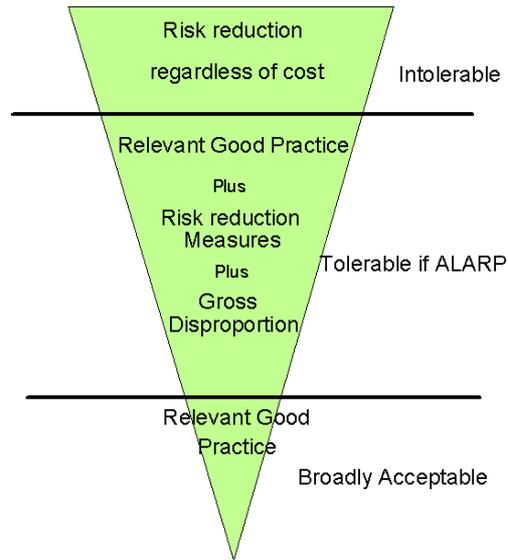
High pressure gas transmission pipelines give rise to hazards which fall into two broad categories:

- Risks to the individual from a particular hazard;
- Societal concerns or the risks or threats from hazards which impact on society. Societal concerns due to the occurrence of multiple fatalities in a single event are known as societal risk.

In regulating and assessing risks from pipelines, HSE consider both individual and societal risks.

In R2P2, HSE has adopted a framework for considering individual risks under its 'tolerability of risk' framework. This is shown diagrammatically in Figure 1.

Figure 1: Types of ALARP Demonstration



Where risks fall in the ‘tolerable if ALARP’ region then duty holders will have to show that further control measures are not justified.

Developing criteria on societal risk is more difficult. Nevertheless HSE has developed criteria for addressing concerns where there is a risk of multiple fatalities occurring in one single event. These were developed through the use of so-called FN-curves (obtained by plotting the frequency at which such events might kill N or more people, against N).

***The precautionary principle and handling uncertainty***

HSE adopts the precautionary principle when assessing risks that are subject to high scientific uncertainty. This may result from knowledge uncertainty (e.g. data based on sparse statistics), modelling uncertainty and limited predictability or indeed unpredictability. This approach is particularly relevant where there are societal risks and where duty holders propose to choose control measures which do not follow relevant good practice precautions.

***Relevant good practice precautions***

In securing compliance with the law HSE expects duty-holders to apply relevant good practice as a minimum. For new installations, this will mean the application of current good practice. In respect of high pressure gas transmission pipelines, the following are key standards recognised by HSE as being good practice:

- Steel Pipelines for High Pressure Gas Transmission, IGE/TD/1 Edition 4, Institution of Gas Engineers, 2001<sup>10</sup>.
- British Standards Institution, PD 8010-1:2004 ‘Code of practice for pipelines–Part 1:Steel pipelines on land’<sup>11</sup>.
- British Standard Institution, BS EN 1594:2000 ‘Gas supply systems – Pipelines for maximum operating pressure over 16 bar – Functional requirements’<sup>12</sup>

HSE attaches particular importance to reducing risks as a result of appropriate consideration of health and safety in design when there is the maximum potential for reducing risks by application of the principles of inherent safety. Adoption of these principles is particularly important where the consequences of plant or system failure is high. HSE presses for the incorporation of inherently safe

design features, where these are possible, to reduce the reliance on engineered safety systems or operational procedures, to control risk.

The majority of judgements made by HSE in determining whether the risks from a pipeline are reduced SFAIRP will involve comparison of the duty holders actual or proposed practice against relevant good practice as described above. These provide duty holders with generic advice for controlling the risks from the hazards of high pressure gas transmission. In so far as duty-holders adopt this relevant good practice, this relieves them of the need (but not the legal duty) to take account of individual risks, costs, technical feasibility and the acceptability of residual risk, since these will have been considered when the good practice was established. For example, the standards above have been developed over many years with input from all key stakeholders in industry and the regulatory authorities and have stood the test of time.

Individual and societal risk concerns are 'built-in' to these standards. For example the standards consider pipeline routing, population density, proximity to occupied buildings, area classifications and increased design safety factors where pipelines run close to populations or cross roads.

And, while there is no room for complacency, based on these standards, the safety record of the UK high pressure gas transmission pipeline system has been very good.

However, the measures required to comply with PSR are not prescriptive, and duty holders are free to adopt a different approach to controlling risks. Indeed HSE encourages technological advances, provided that they can demonstrate that the risks are no greater than that would have been achieved through adoption of good practice. Where pipeline operators wish to deviate from these codes, they will be required to make a rigorous demonstration that an equivalent or lower risk has been achieved.

Duty holders should also recognise that meeting good practice alone may not be sufficient to comply with PSR. An example may be where the circumstances are not fully within the scope of the good practice. Having complied with good practice, duty holders may ask what more can be done to reduce the risks, whether there are further measures which would be effective in reducing risks further and is it reasonably practicable to implement them.

## **CONCLUSION**

HSE's decision-making on the of high pressure gas transmission pipelines requires operators to comply with PSR. This requires them to design and operate pipelines so that the risks are reduced SFAIRP. HSE's uses a suite of documents that set out its approach to deciding if this objective has been met. HSE expects duty-holders to apply relevant good practice as a minimum.

## **DISCLAIMER**

The views expressed in this paper are those of the author alone and are not necessarily a statement of HSE policy.

## **REFERENCES**

---

<sup>1</sup> HMSO, Statutory Instrument 1996 No. 825 'The Pipelines Safety Regulations 1996'.

<sup>2</sup> HMSO, Health and Safety at Work etc. Act 1974, Chapter 37.

<sup>3</sup> Edwards v. The National Coal Board (1949) 1 ALL ER 743

<sup>4</sup> Health & Safety Executive, 1996, L82, 'A guide to the Pipelines Safety Regulations 1996. Guidance on Regulations', ISBN 0 7176 1182 5.

<sup>5</sup> Health & Safety Executive, 2004, HSC15, 'HSC Enforcement policy statement'. See also <http://www.hse.gov.uk/pubns/hsc15.pdf>.

---

<sup>6</sup> Health & Safety Executive, 2001, 'Reducing Risks, protecting people. HSE's decision-making process. See also <http://www.hse.gov.uk/dst/r2p2.pdf>.

<sup>7</sup> Health & Safety Executive 'Principles and guidelines to assist HSE in its judgements that duty-holders have reduced risk as low as reasonably practicable'. See also <http://www.hse.gov.uk/dst/alarp1.htm>.

<sup>8</sup> Health & Safety Executive 'Assessing compliance with the law in individual cases and the use of good practice'. See also <http://www.hse.gov.uk/dst/alarp2.htm>.

<sup>9</sup> Health & Safety Executive, 'Policy and Guidance on reducing risks as low as reasonably practicable in design'. See also <http://www.hse.gov.uk/dst/alarp3.htm>.

<sup>10</sup> The Institution of Gas Engineers, 2001, 'Steel Pipelines for High Pressure Gas Transmission', IGE/TD/1 Edition 4.

<sup>11</sup> British Standards Institution, PD 8010-1:2004 'Code of practice for pipelines – Part 1:Steel pipelines on land'.

<sup>12</sup> British Standard Institution, BS EN 1594:2000 'Gas supply systems – Pipelines for maximum operating pressure over 16 bar – Functional requirements'.