Pipeline Pressure Limits - Pipelines Safety Regulations 1996

Scope

This document details how the Pipeline Safety Regulations 1996 (PSR) term Safe Operating Limit (SOL) for pressure and the PSR Guidance document (L82) term Maximum Allowable Operating Pressure (MAOP) translate into the pressure terms used in the recognised standards for the UK sector, both onshore and offshore.

The pipeline's SOLs may be specified in terms of maximum operating pressure and maximum and minimum temperature. In some cases SOLs will also take into account such matters as fluid velocities and any limits set on the composition of the fluid. This document only deals with the pressure SOL.

Also, it is important to note that the determination of a pipeline pressure safe operating limit (SOL) can vary between recognised pipeline standards/codes. This is acceptable so long as the SOL is established in compliance with the recognised design standard/code being adopted for the pipeline and in line with the guidance provided below.

Background - PSR and PSR Guidance

PSR Regulation 11 states the pipeline operator shall ensure that no fluid is conveyed in a pipeline unless the SOLs of the pipeline have been established and that a pipeline is not operated beyond its SOLs.

The guidance document L82 paragraph 52 states that the pipeline operator should ensure that the pipeline is operated within the SOLs.

Schedule 5 of PSR specifies as a notifiable event, changes in the SOLs.

The guidance document L82 paragraph 199 states changes in the MAOP are notifiable. The MAOP is used by the HSE for land use planning purposes.

Note: SOL for pressure and MAOP are not the same

The recognised standards allow short excursions of pressure above MAOP. The pipeline can therefore, for limited periods, see pressures above MAOP and still be in code. The SOL, above which the pressure must not rise under any circumstances, is therefore higher than MAOP.

L82 paragraph 54 can be interpreted to imply that MAOP is the same as SOL. For the reasons stated above this is an incorrect interpretation. It is intended to redraft this paragraph when the guidance is revised.

PSR Notifications

SOL must be notified under PSR regulation 20, schedule 4 and regulation 22, schedule 5.

In addition L82 paragraph 199 states that changes in MAOP are also notifiable under PSR.

PSR SOL and MAOP equivalents in recognised standards

	PSR SOL	PSR MAOP
BS EN 14161	MAOP+10%	MAOP
BS EN 1594	MIP	MOP
BS PD 8010 Part 1	Undefined in spec	MAOP
IGE/TD/1	MIP	MOP
IGE/TD/3	MIP	MOP
IGE/TD/13	MIP	MOP
BS PD 8010 Part 2	Min MAOP+10%	MAOP
DNV-OS-F101	MIP	MAOP
API 17B + API 17J	Undefined in spec	Undefined in spec

Note:

- MAOP - Maximum Allowable Operating Pressure
- MIP - Maximum Incidental Pressure
- MOP - Maximum Operating Pressure

European Harmonised Standard : BS EN 14161 : Petroleum and natural gas industries – Pipeline transportation systems

The standard includes the following definitions

- Maximum allowable operating pressure (MAOP) = maximum pressure at which a pipeline system is allowed to operate. Must not be exceeded in steady state conditions.
- Internal design pressure = maximum internal pressure at which the pipeline is designed. (equal or greater than MAOP)

Incidental pressures above MAOP due to for example surges or failure of pressure control equipment, are allowable provided they are of limited frequency and duration and do not exceed MAOP by more than 10%. This is equivalent to the PSR SOL.

European Harmonised Standard : BS EN 1594 : Gas Supply Systems - Pipelines for maximum operating pressure over 16 bar – Functional requirements

The standard includes the following definitions

- Design pressure - the pressure at which design calculations are based.
- Incidental pressure - the pressure which occurs incidentally within a system at which a safety device becomes operative.
- Maximum incidental pressure (MIP) - the maximum pressure which a gas system can experience during a short time, limited by safety devices.
- Maximum operating pressure (MOP) - maximum pressure at which a system can operate continuously under normal conditions. Operating pressure (OP) - pressure under normal operating conditions.

When operating at or near MOP, MOP may be exceeded by no more than 2.5% to accommodate variations of the pressure regulation devices.

Incidental pressures are acceptable provided systems exist to automatically limit the excess to 15% above MOP. This is MIP. The MOP must not be exceeded for longer than is strictly necessary to check the malfunction and reset to normal operating conditions.

Note: MIP under BS EN 1594 can be a maximum of MOP+15%. Under TD1 it can be a maximum of MOP+10%.

British Standard Code of Practice for Pipelines: BS PD 8010 Part 1: Steel Pipelines on Land

The standard includes the following definitions

- Design pressure (DP) = pressure on which design criteria is based
- Incidental pressure = level of pressure that occurs incidentally at which safety devices operate
- Maximum allowable operating pressure (MAOP).
- Operating pressure (OP).
- Surge pressure = surge pressure caused by pumps, valve operation etc for liquid or multi phase lines,.

The incidental pressure is defined as the level of pressure that occurs incidentally at which safety devices operate. It is therefore likely to be exceeded when the safety device operates so is less than the maximum incidental pressure defined by the IGEM recommendations. It is therefore less than the SOL required by PSR.

The surge pressure is the maximum pressure caused by maximum pressure caused by:

a. rapid closure of valves during pipeline operation;
b. pump trips and re-start operations;
c. vacuum cavities in the pipeline;
d. reverse flow operations;
e. a combination of the above usually caused by mal-operation

Surge pressure is applied to liquid lines and multi-phased lines. Uninhibited surge pressure is the maximum of the combination of liquid surge pressure at maximum operation conditions and the pump shut-in head pressure.

Surge pressure is broadly similar to transient pressure defined in PD BS 8010 Part 2. So it can be taken that the minimum value of the PSR SOL is MAOP+10% as per PD BS 8010 Part 2.

IGE/TD/1 : Steel Pipelines for High Pressure Gas Transmission- (Pipelines exceeding 16 bar)

The standard includes the following definitions

- MIP - maximum incidental pressure
- PLOP - peak level operating pressure
- MOP - maximum operating pressure

MIP is usually MOP+10%. Excursions between PLOP and MOP are allowed if they do not last for more than 5 hours in excess of MOP at any one time or for more than a total of 20 hours in any rolling year.

If MOP is greater than or equal to 75 barg then for National Grid systems MIP is MOP+6%.

PLOP is MOP+2.5% and covers the pressure fluctuations for pressure controlled systems with a set point of MOP.

IGE/TD/3 : Steel and PE Pipelines for Gas Distribution - (Pipelines not exceeding16 bar)

The standard includes the following definitions:

- MIP - maximum incidental pressure
- PLOP - peak level operating pressure
- MOP - maximum operating pressure

These are the same as the definitions in TD1 and TD 13.

IGE/TD/13 : Pressure Regulating Installations for Transmission and Distribution Systems

The standard includes the following definitions:

- STP - strength test pressure
- MIP - maximum incidental pressure
- SP Nom 3 - slam shut set point
- TOP - temporary operating pressure
- SP Nom 2 - set point monitor regulator
- PLOP - peak level operating pressure
- MOP - maximum operating pressure.
- SP Nom 1 - active regulator set point can equal MOP
- OP - operating pressure

If MOP >7 barg then

PLOP - MOP+2.5%

TOP - MOP+5%

MIP - MOP+10%

The pressure gap SP Nom 2 to TOP is the regulator accuracy class (AC)

The pressure gap SP Nom 3 to MIP is slam shut accuracy group (AG)

British Standard Code of Practice for Pipelines: BS PD 8010 Part 2: Subsea Pipelines

The standard includes the same definitions as BS PD 8010 Part 1 with the addition of

- Transient pressure = pressure fluctuation created by an upset in the steady state flow

Transient pressure is defined as the pressure fluctuation created by an upset in the steady state flow conditions in a pipeline. It is stated that transient pressure is normally caused by valve operation, pump start or trip-out, or by the fluctuation of a control valve and inaccuracies of instrument set points and that transient pressure may exceed the MAOP but by not more than 10 %.. This gives a minimum value for the PSR SOL as MAOP+10%.

Norwegian Offshore Standard: DNV-OS-F101 : Submarine Pipeline Systems

The standard includes the following definitions:

- MIP - Maximum incidental pressure
- MAIP - Maximum allowable incidental pressure
- MAOP - Maximum allowable operating pressure

The MAIP is the maximum pressure at which the pipeline system shall operate during incidental (i.e., transient) operation. The maximum allowable incidental pressure is defined as the maximum incidental pressure less the positive tolerance of the pressure safety system. MIP is therefore the PSR SOL.

API 17B: Recommended Practice for Flexible Pipe & API 17J: Specification for Unbonded Flexible Pipe

These standards do not include pressure definitions for PSR SOL or PSR MAOP.

The API specifications do mention, design pressure, maximum operating pressure and operating pressure.

The maximum operating pressure can be taken to be the PSR MAOP. The PSR SOL will have to be specified explicitly by the operator.

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