Norwegian Perspective on Integrity Management of Unbonded Flexibles

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Kjell Arild Anfinsen
Petroleum Safety Authority Norway
Flexible Pipelines and Risers

PSA (NPD) arranged a flexible pipe seminar in January 2001:

From the introduction:

“Experience from operation of flexible pipes indicates that the learning curve is still steep. The use of flexible pipes moves towards fields with higher pressures and higher temperatures. This provides extra challenges during the manufacturing phase, and need for comprehensive qualification to prove the lifetime of the product.”

Still valid?
In December 2007 we hosted a new seminar. The following challenges were highlighted:

- Qualification
- Verification
- Manufacturing
- Installation
- Integrity Management
- Ageing and lifetime extension
- Experience transfer

What is relevant from Norwegian Petr. Reg. for these challenges?

But first:

- Who is responsible according to Norwegian Petr. Reg.?
The party responsible

Responsibility according to Norwegian Petroleum regulations:

FRAMEWORK REG. Sec 5

Responsibility according to these regulations
The operator and others participating in the petroleum activities are responsible according to these regulations and regulations issued pursuant to these regulations. The party responsible shall ensure that requirements specified by the legislation relating to health, environment and safety are complied with. The operator shall see to it that everyone carrying out work for him, either personally, by employees, contractors or sub-contractors, complies with requirements contained in the health, environment and safety legislation.
Flexible Pipelines and Risers
Qualification

Qualification of new materials and new prototypes need patience and awareness. Flexible pipes are complex of nature.

FACILITIES REG. Sec. 8

Qualification and use of new technology and new methods
Where the petroleum activities involve use of new technology or new methods, criteria shall be prepared with regard to development, testing and use in order to fulfil the requirements to health, environment and safety. The criteria shall be representative of the relevant operational conditions, and the technology or the methods shall be adapted to already accepted solutions. Qualification or testing shall demonstrate that applicable requirements can be fulfilled by use of the relevant new technology or new methods.
Flexible Pipelines and Risers Verification

Independent verification is an important tool for the design phase, and should not be interrupted by lack of openness.

FRAMEWORK REG. Sec. 15

Verifications

The party responsible shall decide on the extent of verifications, the method to be used in and the degree of independence of the verification in order to document that the requirements of the legislation relating to health, environment and safety have been met. When it has been decided that verifications are to be carried out, such verifications shall be carried out according to an overall and unambiguous verification programme and verification basis.
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Manufacturing

Strong attention is needed to maintain quality during manufacturing when demand for flexibles is all time high.

MANAGEMENT REG. Sec. 11

Manning and competence
The party responsible shall ensure adequate manning and competence in all phases of the petroleum activities, cf. the Framework Regulations Section 10 on organisation and competence. There shall be set minimum requirements to manning and competence in respect of functions a) where mistakes may have serious consequences in relation to health, environment and safety, b) which shall reduce the probability of failures and situations of hazard and accident developing further, cf. Section 1 on risk reduction and Section 10 on work processes.
Flexible Pipelines and Risers
Installation

Installation phase is critical for flexible pipes. They are vulnerable for external loads, and must be handled with care.

ACTIVITIES REG. Sec 14

Installation and commissioning
During installation of facilities and parts thereof it shall be ensured that the loads to which they are subjected do not exceed the loads as mentioned in the Facilities Regulations Section 10: Loads, load effects and resistance.

The technical condition of plants, systems and equipment shall be maintained until the plants, systems and equipment are taken into service.
Flexible Pipelines and Risers
Installation

Installation phase is critical for flexible pipes. They are vulnerable for external loads, and must be handled with care.

ACTIVITIES REG. Sec 28

**Actions during conduct of activities**

Planned activities shall be safety cleared before they are conducted. The safety clearance shall show which conditions have to be met, including the actions required to be taken before, during and after the work so that those who participate in or may be affected by the activities are not injured, and so that the probability of mistakes that can result in situations of hazard and accident is reduced.
Flexible Pipelines and Risers
Integrity Management

Development within Integrity Management has not been satisfactory for flexible pipes. The goal for the Industry must be to develop tools to check the pipe wall integrity.

ACTIVITIES REG. Sec. 43

Classification
The systems and equipment of facilities shall be classified with regard to the health, environment and safety related consequences of potential functional failures. With regard to functional failures that may entail serious consequences, the party responsible shall identify the different fault modes with associated failure causes and failure mechanisms, and estimate the failure probability in respect of the individual fault mode. The classification shall constitute the basis for the choice of maintenance activities and maintenance frequency, and for the priority of different maintenance activities.
Flexible Pipelines and Risers
Integrity Management

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ACTIVITIES REG. Sec. 44

Maintenance programme
Fault modes which constitute a risk to health, environment or safety, cf. Section 43 on classification, shall be systematically prevented by means of a maintenance programme. The programme shall comprise activities for monitoring of performance and technical condition, which will ensure that fault modes that are developing or have occurred, are identified and corrected.

The programme shall also contain activities for monitoring and control of failure mechanisms that may lead to such fault modes.
Flexible Pipelines and Risers
Integrity Management

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MANAGEMENT REG. Sec. 19

Registration, examination and investigation of situations of hazard and accident
The party responsible shall ensure that situations of hazard and accident that have occurred and that may lead to or has led to injury, harm or pollution, are recorded and examined in order to prevent recurrence.
Situations frequently recurring or representing severe actual or potential consequences, shall be examined closely through investigation.
Criteria shall be set as to which situations are to be recorded, examined and investigated, and requirements shall be set with regard to extent and organisation.
The operator shall keep a complete record of situations of hazard and accident that have occurred.
Flexible Pipelines and Risers
Ageing and lifetime extension

Ageing and lifetime extension has been on the agenda for flexible pipes for years. Original design life was based on assumptions not relevant for operation phase.

FRAMEWORK REG. Sec. 24

**Development concepts**
The design, engineering and manufacturing of the individual facilities comprised by a development concept shall be such as to enable them to be placed, operated and if applicable removed in a safe and prudent manner.

FRAMEWORK REG. Sec. 28

**Use of facilities**
Facilities shall be prepared for the planned use and shall be used and if applicable removed in a safe and proper manner, in accordance with the prerequisites for use on which design, engineering and manufacturing were based.
Flexible Pipelines and Risers
Experience transfer

More openness and transfer of experience will benefit the whole industry and contribute to increased safety level. Still room for improvement!

MANAGEMENT REG. Sec 22

**Improvement**

The party responsible shall continually improve health, environment and safety by identifying the processes, activities and products that need improvement, and implement necessary improvement measures. The measures shall be followed up and their effect shall be evaluated.

Provision shall be made for using knowledge gained through experience from own activities as well as the activities of others in the improvement efforts.
Flexible Pipelines and Risers

Experience transfer

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FRAMEWORK REG. Sec 56

Authorities’ access to facilities and vessels

Representatives of the Ministry of Labour and Social Inclusion, the Ministry of the Environment, the Ministry of Health and Care Services, the Petroleum Safety Authority, the Norwegian Pollution Control Authority, the Norwegian Board of Health or other authority decided by the Petroleum Safety Authority, shall have access at all times to vessels and facilities for petroleum activities, as well as to material and information necessary to carry out supervision, and shall have the right to participate in investigations. Representatives of the authorities shall have the right to stay on vessels and facilities as long as necessary. The operator shall arrange transport of representatives of the authorities to and from vessels and facilities, as well as their stay on board.
Summary:

The learning curve is still steep for flexible pipes.

Continuous and effective Integrity Management is needed to prove the lifetime of flexibles pipes.

The Industry as a whole will gain from more experience transfer and openness.

The operator and others participating in the petroleum activities are responsible according to PSA regulations.

PETROLEUM ACT Section 9-1
Safety

The petroleum activities shall be conducted in such manner as to enable a high level of safety to be maintained and further developed in accordance with the technological development.