

PIPELINE SYSTEMS - SAFETY FOR ASSETS AND TRANSPORT REGULARITY

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Introduction

According to regulation concerning safety, the definition of the word "safety" means operational, technical and emergency preparations, significant for protection of people, environment and the assets that installations and vessels represent. The succession given here reflects the priority within the term "safety": safety for people is priority no 1, safety for the environment is priority no 2, and safety for the assets is priority no 3.

This presentation will focus on safety for assets and financial interests for pipeline systems, and the safety legislation will be referenced to highlight how requirements are reflected in different regulations.

Safety for assets has priority below safety for people and safety for the environment, but this does not mean that it shall be neglected or given low priority. The pipeline system itself represents large values, and the value of installations connected to pipeline systems will normally represent even larger values.

However, for pipeline systems, the value of transported products will in many cases be most significant, and this should be reflected in the analyse carried out. The time involved in a shut down will of course be very important, and in many cases lost values can be considerable. Other important factors involved in evaluation regarding transport regularity are the market situation as well as how a low regularity will influence on reputation and ongoing and future deliverables.

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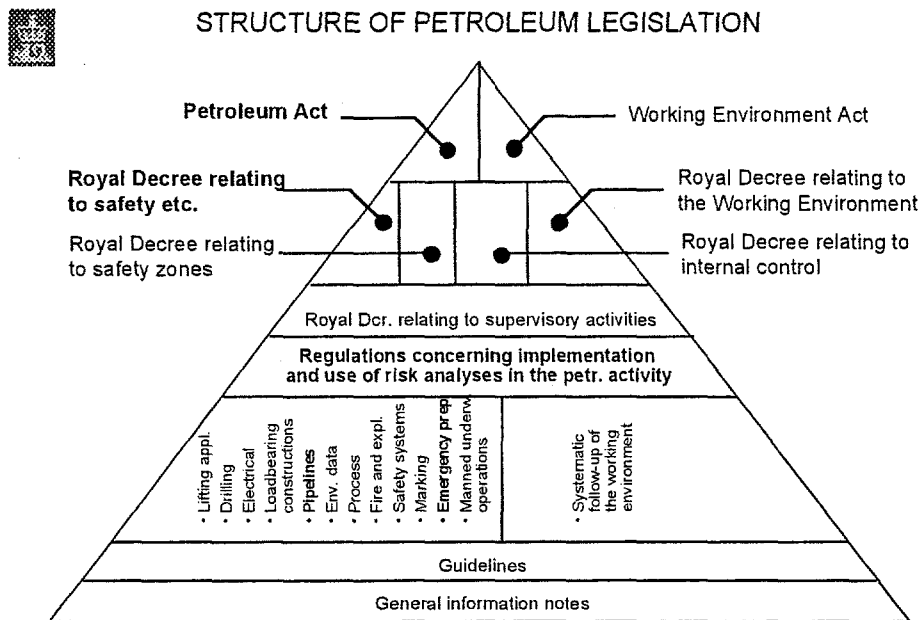
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NPD have the last two years performed a supervisory activity where focus was set on transport regularity for gas transportation from the Norwegian sector. The idea behind this activity was to establish an overview of the analysis performed for existing and future gas transport system for Europe. The approach and the result of this work will be presented briefly.

Relevant legislation

The triangle below gives the overall structure of the Norwegian Petroleum legislation.



Through this triangle I will try to show how some of the acts and regulations cover the safety issue with respect to assets and financial interests. Some of the sections in relevant regulations will be referenced with respect to this issue.

The overall economical interest from a national point of view is stated in sec 3 in the petroleum act: "The petroleum deposits shall be administered for the benefit of the Norwegian society as a whole".

The general purpose of the regulations concerning safety etc., is to establish, maintain and further develop an acceptable level of safety in the petroleum activity. In this regulation, the

word "safety" is defined as "*operational, technical and emergency preparations, significant for protection of people, environment and the assets installations and vessels represent.*" The word installations means pipeline systems etc. for transportation and utilisation of petroleum, as well as platforms etc. which are used for production of petroleum. This definition of the word installation is according to section 23 and 24 in the petroleum act.

According to the regulations concerning implementation and use of risk analyses the purpose of the regulation is to "through requirements with regard to risk analyses, to contribute to establishing and maintaining a fully satisfactory level of safety for people, for the environment and for assets and financial interests in the petroleum activities". The specific requirement related to risk analyses is given in section 12 in the regulations: "Risk analyses shall be carried out in order to identify the accidental events that may occur in the activities and the consequences of such accidental events for people, for the environment and for assets and financial interests. The results of risk analyses shall be included as part of the basis for the decision-making process in the course of ensuring that the activities are in accordance with requirements laid down by or by virtue of law or regulations, with the operator's safety objectives and acceptance criteria."

Here we also see the connection to safety objectives and acceptance criteria for the activities. The operator's responsibility in this respect is described in section 10 and 11 in the regulation. In brief, the operator shall define safety objectives to manage the activities. Acceptance criteria shall be defined before a risk analysis is carried out and used during assessment of identified risks.

In the regulations relating to emergency preparedness, section 16 cover establishment of emergency preparedness, and in the guideline to this section, requirements with regard to operational accessibility are mentioned. These requirements "shall be included in the basis for defining the specific emergency preparedness requirements for the activity in question, cf. the definition of safety in section 3 of the Safety Regulations. The specific emergency preparedness requirements for the activity must be defined on the basis of, inter alia, the acceptance criteria for risk related to the activity, cf. the Risk Analyses Regulations. This means that among other

things delivery agreements for petroleum products will be of importance for the definition of some of the specific emergency preparedness requirements for the activity in question."

The link between the safety regulation and the risk analyses regulation mentioned above is clear from this quotation.

In the guideline to the same regulation, section 16 also clarify operational accessibility for installations which play the role of a junction in transportation systems: "Furthermore special requirements to operational accessibility will have to apply to an installation which is part of a larger production and transportation system, among other things in consideration of the other participants in the system. This in order that a situation of hazard and accident on one installation shall not entail serious consequences for the activities on the other installations. Depending on how they are interlinked, e.g. through a common pipeline system, it may consequently be necessary to define certain specific emergency preparedness requirements on the basis of operational accessibility for other petroleum activities."

The term "normalization" is defined in section 25 in the same regulation. Normalization is measures necessary to bring people, the environment and material goods back to state of normal conditions. Normalization of assets and financial interests may include replacement and repair of damaged parts, depending on the result of cost/benefit evaluations. According to section 15, Action Plan, normalization shall be a part of the action plan which describes the emergency preparedness measures established for the activity.

The purpose of the pipeline regulations is to stipulate requirements to pipeline systems in order to ensure an adequate safety level. The scope of this regulation covers all phases of a pipeline project; planning, engineering, fabrication, installation and operation of the pipeline system. The pipeline regulations are therefore important and relevant for all safety evaluations performed for a pipeline system. This is reflected in section 15, Safety objectives, which specifies that "To the extent it is practically feasible, the construction and design of pipeline systems shall be such as to ensure that no single failure during operation shall lead to lifethreatening situations for any person, or to unacceptable damage to material or to the

environment." Further, this section also require that equipment and operations are subject to risk analysis, in order to detect possible critical failure conditions.

The most important phases for evaluation of safety for assets and financial interests will probably be the early planning phase and the operational phase. Focus on this aspect in the planning phase will make the licencees able to evaluate different concepts more thoroughly with respect to risk for asset and financial interests. Such an evaluation is important for decision making.

The operational phase will have the same priority with respect to safety as reflected in the safety regulation, but due to several transportation systems being "main arteries", evaluations regarding assets and financial interests will be very important. This is also reflected in the actual part of the pipeline regulation where f ex section 41 specify that in the case of pipeline systems where possible damage may lead to significant economic loss, the need for internal inspection shall be considered and normally be carried out. Further, section 43 specify that "the need for plans and contingency preparedness with regard to repairs of damage to pipeline systems shall be considered". These examples highlight that focus on safety for assets and financial interests, including the value of the transported petroleum products is very important.

Assets and financial interests

Safety for assets has priority below safety for people and safety for the environment, but for pipeline systems, the asset and financial interest is of specific importance. The pipeline system itself represent large values, and the value of other installations connected to pipeline systems will normally represent even larger values. However, the most important issue is probably that the pipeline systems normally represent the "main artery" for several fields and partners. This makes the system unique, and makes a major difference between pipeline systems and other installations.

From a national, economical point of view, main oil- and gas pipelines will normally be the most important transportation systems. However, inter-field pipelines connecting several fields,

will play the same key-role for the actual partner group as the main pipeline further downstream the system. The "safety for asset" aspect for inter-field pipelines is an important issue in a relevant project, and should be properly assessed during the different phases.

According to the risk analyses regulation the operator shall define acceptance criteria for risk in the activities, which includes acceptance criteria for assets and financial interests. It is often more difficult to establish relevant criteria for assets, compared to criteria for people and the environment. Normally, internal business economy based on cost/benefit analyses is the basis for establishing criteria for assets and financial interests. For transportation systems this could be misleading and will normally not be sufficient for a complete analysis. The reason for this are third party's interests and national interest which could be overlooked when such narrow criteria are used. It is therefore very important that the acceptance criteria and performed risk analyses, reflect the importance and value of the system with respect to these interests. Necessary attention has to be paid to these interest throughout the entire process.

Risk related to loss of capability to handle delivery obligations and loss of reputation for future markets should also be included in analyses for assets and financial interests as well as the risk for physical parts of the total system. This is an area which is of vital importance to the risk picture for transportation systems, and this fact is also reflected in the requirements to operational accessibility referenced in the regulations relating to emergency preparedness mentioned above.

Economy and consequence

Obviously, investments will vary a lot from an 8" infield pipeline of 5 km length to an 800 km long, 42" pipeline. There are on the other hand several other factors in addition to pipeline dimensions and length which have influence on the investments.

When it comes to the operational phase and possible damage which leads to repair, evaluation regarding cost consequences will be different. Several factors, such as complexity of the work, mobilization cost, duration etc will be important, and the cost-difference between repair of

pipelines with different dimensions will not necessarily be considerable. The consequence of lost petroleum transport for bigger pipelines makes it important to keep downtime as low as possible, and the cost of the actual repair will in many cases be of "minor" interest.

As mentioned earlier, so called trunk-lines transporting oil or gas from several fields will normally be of the greatest importance, both from several companies' point of view, and from a national point of view. Inter-field pipelines will have the "main artery" function for licences involved in the field, and they should also have the necessary attention on this part of the safety issue.

To give a picture of the magnitude of value of transported petroleum products, the table below show some typical transport capacities and values for medium size inter-field pipelines, and bigger trunk-lines. Remember that these values are not exact, they are just numbers meant to give an idea about possible economical values involved.

	<u>Capacity</u>	<u>Price estimate</u>	<u>Value pr day</u>	<u>Value pr week</u>
Gas	10 MSm ³ /d	0,5 NOK/Sm ³	5 MNOK	35 MNOK
	40 MSm ³ /d	0,5 NOK/Sm ³	20 MNOK	140 MNOK
Oil	80 000 bbl/d	140 NOK/bbl	11 MNOK	77 MNOK
	600 000 bbl/d	140 NOK/bbl	84 MNOK	588 MNOK

To give an example of consequence of a repair situation, let me use the damage on the Ekofisk -Teesside pipeline in 1977. The pipeline was hooked by an anchor in march 1977 and suffered damage during the attempts to retrieve the anchor. The damage was discovered during annual survey of the pipeline in september 1977. A detailed inspection of the damage was performed immediatly, and it was found that the concrete coating was missing over a distance of 65 metres. In the central 10 meter length of this part, four dents were observed. The deepest dent was estimated to be 5", and this was confirmed by a caliper pig in october 1977. Analysis

showed that if preventative measures were taken, the operation could continue until summer 1978, when the repair was performed. Hyperbaric welding was chosen as the best repair method, and it was decided to replace a 45 meter long section. The replacement took place from 9 of June to 12 of July 1978, and resulted in more than 30 days lost transport-capacity in the pipeline.

Transport regularity

During 1995 and 1996, NPD performed a supervisory activity where focus was set on safety for transported product in Norwegian gas transport systems. The aim of the activity was to establish a general overview of the analysis performed for existing and future gas transport systems and the following aspects were identified as important for the scope:

- risk analyses performed for existing and planned gas transportation system
- analysis performed to highlight safety for transport of gas to the continent
- emergency preparedness plans for longer shut-downs in systems for gas transport

Evaluation of present safety regulations with regard to their relevance for transportation regularity, acceptance criteria for transport regularity and clarification of terminology were important issues for the activity.

The activity was performed through meetings with the operator and review of relevant documentation. Briefly the observations from the activity can be summarised as follows:

- existing studies seemed to be too narrow, and there was a potential for improvement with respect to performing global analysis covering the total transportation system, including relevant platforms.
- primarily, the analysis performed focused on incidents leading to damage for people, environment and material goods. Improvement could be made by focusing more also on incidents leading to stops in the transport of gas, without causing

damage to people and environment. Further, incidents with very low probability should in some cases be evaluated when very large economical consequences are involved.

- there is an improvement in clarifying how assumptions are used in risk analysis and to give priority to the communication regarding the analysis with respect to personnel involved in operation.
- it may be possible that established acceptance criteria for assets and financial interest can be improved to satisfy other interests in a better way
- it may be possible to improve existing plans for normalisation to cover the the whole system, including platforms etc.
- the terminology in the different analysis was not consistent.
- responsibility for performing this type of analysis should be clarified. Guidelines for methodology to be used for the different analyses could provide improvement.

The operators work within this area will be followed up from NPD, also in 1997.

Summary

This review regarding safety for assets and financial interests for pipeline systems has showed how this aspect has been taken care of in the existing petroleum legislation. It has been demonstrated that the integrity of pipeline systems with respect to maintaining petroleum transport is important for all parties involved, including third party's interest and national interests. Examples have been given to provide a picture of the value of transported petroleum products. Finally, the scope of work for as well as observations after a supervisory activity related to safety for the transported product, have been referenced.