SOME ASPECTS OF OPERATIONAL RISK MANAGEMENT IN OIL AND GAS FIELD PIPELINES

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Abstract

Field technological pipelines - capital engineering structures designed for long-term operation and intended for the uninterrupted transport of well products (oil, gas, condensates, water and their mixtures) to the treatment complex.
Negative risk events accompanying the operation of field process pipelines, including failure, total or partial loss of serviceability may occur during operation and are related to several factors.
This paper outlines the risk factors, the main adverse impacts and threats to oil and gas field pipelines, and the rules for operational risk mitigation for oil and gas field pipelines.

Keywords: risk, field pipelines, risk management, reliability, loss of serviceability

I. Introduction

It is known that with the purpose of acceptance and performance of the administrative decisions directed on decrease of probability of appearance of an unfavorable result and minimization of possible losses it is necessary to classify operational risks at functioning of field oil and gas pipelines with allocation of the basic risk forming events and definition of ecological risk for them [1, 5].

The operational risks of oil and gas pipelines are managed by the following types of strategies:

- "Take note". This strategy does not provide for the development and implementation of additional solutions and measures during the operation of the pipelines.
- "Monitoring". This strategy does not provide for the development of additional basic design solutions, but obliges such adjustments and requirements that ensure: the technical capability to diagnose defects or other deviations from design parameters; and the maintainability of the pipelines in the event of failure due to the realization of a risk-generating event.
- "Reduction". This strategy obliges the choice of materials, equipment, masterplan solutions, method of laying, instrumentation system, protection against various influences, etc. to be included in the selection.
- "Elimination". This strategy requires the revision and inclusion of design and operating requirements for the pipelines which move them into a lower risk category.

Risk management strategies are selected separately for each risk-generating event depending on the risk category and magnitude. The correlation between the risk category and the chosen risk management strategy is presented in Table 1 [2, 3].

Table 1: *Risk management strategy*

№	Risk management strategy	Risk category	The magnitude of the risk (as a result of the scoring)
1	"Eliminate" by repeating no less than ½ of the design decision to eliminate the risk	1-Very high	25 and over
2	"Elimination".	2-High	20 to 25
3	"Reduction".	3-Middle	15 to 20
4	"Monitoring".	4-Lower than average	10 to 15
5	"Take note".	5-Low	0 to 10

For each risk factor that could lead to failure of the designed pipeline, design solutions and operational requirements must be provided to eliminate/reduce adverse effects and/or to reduce the likelihood of compromising its integrity.

For a list of risk factors and technical solutions to minimize risk, see [3,6].

In the operation of oil and gas field pipelines, the operating organization carries out inspection, maintenance, diagnostics, corrosion, capacity reduction and other negative influences, repairs and overhauls. The content and frequency of inspection, maintenance and diagnostic work shall be determined on the basis of an assessment of the operational risks associated with the risk-generating events. An important aspect of operational risk management is the identification, assessment and prioritisation of risks.

The identification of the operational risks is carried out in 2 stages:

- At the first stage, the oil and gas pipeline is divided into separate sections for which the operating conditions, environmental conditions along the route, design and ancillary systems are not significantly different.

- In the second stage, each site is analyzed for the possibility of realization of risk-forming events.

The result of the operational risk identification is recorded in the form of a table of identified risks, see Table 2 for a sample.

Table 2: *List of identified risk forming events*

№	Risk forming event	Site -1	Site -2	....	....	Site - N
1	Event 1	yes	yes	....	....	yes
2	Event 1	yes	no	....	....	no
3	Event 1	no	yes	....	....	yes
....	....	....	....	....	....	
N	Event N	yes	yes	....	....	no

The assessment of operational risks of oil and gas pipelines is carried out by expert determination of the probability of occurrence of risk forming events. The probability is determined in accordance with Table 3.

Table 3: *Description of the scale for estimating the probability of failure of oil and gas field pipelines*

Probability	Description in terms of frequency of the risk-generating event	Assessment, points
Low	For this type of oil and gas field pipelines, failure is not possible or not more often than once every 10 years with the application of preliminary design solutions	1-5
Probably	For this type of oil and gas field pipeline, 2 to 3 failures over 10 years of operation are likely with the application of preliminary design solutions	6-10
Medium	For this type of oil and gas field pipeline, up to 2 failures can occur during the 3 years of operation using preliminary design solutions	11-15
High	For this type of oil and gas field pipeline, more than 2 failures over 3 years of operation are possible with the application of preliminary design solutions	16-20
Very High	For this type of oil and gas field pipelines, using preliminary design solutions, failure is already possible within the 1st year of operation	21-25

The results of the assessment and prioritization of operational risks of oil and gas pipelines are summarized in Table 4 [6].

Table 4: *Results of the assessment and prioritization of operational risks of oil and gas field pipelines*

Risk	Site - 1			
	Probability, points	Conclusions, points	The magnitude of risk	Adopted Risk management strategy
Event 1 (R1)	6	10	11,7	"Monitoring"
Event 1 (R2)	20	6	20,1	"Elimination"
Event 3 (R1)	-	-		"Take note"
Event 3 (R2)	-	-		"Monitoring"
.....				
Event N (R1)	18	22	28,4	"Monitoring"
Event N (R2)	18	22	28,4	"Eliminate" by repeating at least ½ of project decisions to eliminate risk

Risk	Site - N			
	Probability, points	Conclusions, points	The magnitude of risk	Adopted Risk management strategy
Event 1 (R1)	12	22	17,0	"Reduction".
Event 1 (R2)	-	-		"Take note".
Event 2 (R1)	3	6	6,7	"Take note".
Event 2 (R2)	3	6	6,7	"Monitoring".
.....				
Event N (R1)	4	24	24,3	"Eliminate"
Event N (R2)	4	24	24,3	"Monitoring"

II. Results

In the operation of oilfield pipelines, the content, frequency of inspection and performance of work on non-critical factors should be determined on the basis of an assessment of the operational risks associated with risk-generating events.

The identification, assessment and prioritization of risks are important aspects of operational risk management.

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