

An Evaluation of the Causes of Oil Pipeline Incidents in Oil and Gas Industries in Niger Delta Region of Nigeria

A. Adebayo and A.S. Dada

Department of Mechanical Engineering, University of Ado-Ekiti,
Ado-Ekiti, Nigeria

Abstract: Pipeline industry's challenges and change are becoming diverse in the light of security, performance and profitability and they are vital issues for planning and decision-making. The study was designed to examine the cause of pipeline incidents in oil and gas industries in Nigeria. The data for the study were collected from pipeline operators in the oil and gas industries in the Niger Delta area of Nigeria. Thirteen causes of pipeline incidents were identified, the analysis of the respondents ranking shows that sabotage ranks top, followed by corrosion, equipment failure and mechanical impact.

Key words: Pipeline incidents, oil and gas, accident, crude oil, natural gas, Failure

INTRODUCTION

Pipeline is the method that can be used to guarantee a sure, continual and economical means of transport of bulk loads of crude oil and natural gas, so that the need for the evaluation of the causes of pipeline incidents in Nigeria is necessary (Schatzl, 1969).

The risk associated with pipeline in terms of safety of people, damage to the environment and loss of income has been major concern to pipeline integrity managers.

A summary of United States oil pipeline spills for duration of 31 year (1968-199) revealed that, there was 7487 incidents, 383.6 mg or nearly 12 mg annually. Structural problem (40%), operator error (6%), other (25%), outside forcer damage 27% and lastly control problems 2%. Hence, corrosion takes the lead in the structural problems of pipeline in the United States (Pipeline and gas journal, 2003).

Journal of SPDC (1996) put the economic impact of corrosion into perspective, corrosion costs the U.S. economy \$276 billion annually, which is equivalent to approximately 3% of the annual GDP. Investigation into the cause of the failure of a portion of 647-mile, 20 inch diameter Nor Andino natural gas pipeline and traced it to Seismic activity in the area, accompanied by very unstable rock soil conditions. He decided that the failed line would have to be replaced by drilling through the mountain, which is made up of folded sandstone, siltstone, claystone, mudstone and alluvial materials to overcome the adverse geological conditions.

According to information supplied by the Pipeline and Products Marketing Company (PPMC) in Nigeria, it is reported that in spite of security measures; statistics on oil pipeline showed that vandalization effect remain staggeringly high. In 1999 rupture, 27 of which were due to natural cause, namely wear tear from corrosion while the rest, 497, were due to vandalization.

In 2000, shell's oil pipeline records on environmental performance showed that sabotage remains a significant problem and accounted for 40% of the incident and 57% of the volume of oil spilled (2000 people and the environment annual report).

Ajayi (2003) shared their view on how to improve pipeline Integrity Management, opining that Pipeline operator can realize many benefits by implementing a data integration approach that enables integrity managers, risk assessment specialist and pigging engineers to view and analyze combined information form disparate surveys and to increase the value of data by shaving it across the entire corporation.

Hence, the aim of the study is to rank the oil pipeline incident from data collected from oil and gas industry, so that pipeline managers can priotize their strategies for managing the risk involves. This will further upgrade recodes on pipeline risk.

MATERIALS AND METHODS

Questionnaires were administered in a leading dealer of oil Pipelines Company in Nigeria as a representation of the oil and gas industries and the company responded within the time limit.

The population for this was limited to the pipeline safety department called PIM (Pipeline Integrity Management) of shell petroleum Development Company SPDC East, Port Harcourt in Nigeria.

RESULTS AND DISCUSSION

The result obtained from the questionnaire were analysed below to determine the cause of oil pipeline incident that inhibits productivity.

Pipeline risk/cause of pipeline failure: The ranking to the main cause of oil pipeline incidents that inhibits productivity in a selected oil gas industry was assessed as in Table 1.

Mean rating scores: Table 1 shows the ranking produced by using the mean of scores for each as means of ranking the causes.

As shown in Table 1, the following are first top 5 causes listed:

- Rank 1: Sabotage (vandalization).
- Rank 2: External corrosion.
- Rank 3: Internal corrosion.
- Rank 4: Mechanical Impact .
- Rank 5: Equipment failures.

Evaluation of findings: The study is geared toward aiding the tops executive of oil and gas industrial find solution to the problems that hinders or inhibits productivity. It is worth nothing that all the top factors are external to the companies and the rest are direct interaction with the company.

Sabotage (vandalization) can be traced to the long history of neglect, marginalization and repression of the host communities. The cumulative effect has been lack of development and widespread property and discontent among the people.

Corrosion (both external and internal) is another problem in the oil and gas industries. Wells pipeline and oil and gas apparatus and equipments are prone mostly to electrochemical corrosion. This types of corrosion is caused by exposure to the atmosphere particularly at an elevated relative humidity, to formation of water containing dissolved salts, to micro -organism (offshore and onshore). Corrosion also occurs from contact between dissimilar metals under live current in narrow silts and gaps e.g threaded and flange joint. If not properly controlled could lead to pipeline leaks.

Table 1: Ranking of cause of oil pipeline incidents that inhibits productivity using mean rating score (x)

S/n	Cause Oil pipeline incidents	Mean rating score (x)	Ranking
1	Sabotage (Vandalization)	5.00	1st
2	Mechanical impact (third party) damage	1.35	4th
3	Materials defect	1.11	8th
4	Equipment failure	1.33	5th
5	Operation errors	1.05	10th
6	Geotechnical forces/hydrodynamic force (Natural forces)	1.11	8th
7	External corrosion	1.88	2nd
8	Internal corrosion and hydrogen induced cracking	1.38	3rd
9	Over-pressurization	1.12	7th
10	Internal expansion forces	1.00	11th
11	Fatigue	1.00	11th
12	Weld crack	1.16	6th
13	Improper repair weld	1.00	11th

Source: Filed survey 2004

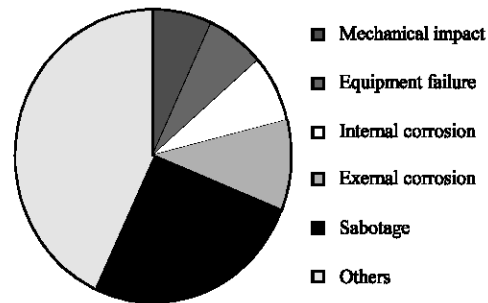


Fig. 1: Percentage distribution of various causes of oil pipeline incident

Mechanical impact occur when on shore pipeline are interfered by mechanical excavator, mostly when there are no pipeline marker sign or warning tapes around the zones. It can also be caused when the dragging of anchors from large ships are not adequately guarded. This can happen in thick regions (bushes grown over, covering the Right-of-Way) ROW, where pipeline inspectors might not be able to visit for a long period of time.

Equipment such as compressor or pumping stations and the incorporation of Emergency-Shut-Down (ESD) valves, may block valves actuators. Therefore, a failure in the operational status of these equipment or facilities leads to a major blowout (explosion 5 outbreak).

Summary of the caused of oil pipeline incident in oil and gas industry: The factors considered as show in Fig. 1 above were obtained from Table 1.

From Fig. 1, the factor termed ‘other’ with 43%, comprises material defect (5.79%), operation error (5.5%), Geotechnical force (5.79%), over pressurization (5.21%), Internal expansion forces (4.63%), fatigue (5.21%) weld crack (6.0%), Improper repaired weld (4.9%).

Now, while 75% of structural problems are due to corrosion in the United State In Nigeria, Sabotage (Vandalisation) remains a significant problem, closely followed by corrosion.

CONCLUSION

The study report the finding of a study conducted late 2004 with pipeline Integrity Management Department using questionnaire. The respondent conclude that Sabotage, Corrosion (external and internal), mechanical impact, equipment failures are the top four factors of the causes of pipeline incident that inhibits productivity. It is noteworthy that only one of the top factor it internal to the company, while the other three are external to the company that have some bearing with the environmental interaction with company. Therefore, to reduce the causes of pipeline incident; pipeline integrity managers should undertaken any or combination of the following:

- Pipeline operators should implement a data integration approach that enables integrity managers, risk assessment specialists and pigging engineers to view and analyze combine information from disparate survey and to increase the value of data by sharing it across the entire company.

- The disastrous effect of some the least rated factor on the long run should be carefully examined; such as the seismic activity in the area; to forestall the likely incident of the Tsunami.
- Concerted efforts to protect then national infrastructures should be put in place in today's volatile climate of disaffected groups and international terrorist.
- The welfare of the host communities to the oil and industries should be paramount in the polices of the pipeline operators.
- Government and pipeline operator should sponsor research programme and development of innovative technology to help ensure safety of the pipeline and environment.

REFERENCES

- Ajayi, A.B., 2003. Pipeliue vandalisation, effects and remedy. Boam Puplishers, pp: 113.
- SPDC, 1999. Journal of Shell Petroleum Development Company, pp: 36-37.
- Pipeline and Gas Journal, 2002. Oildom Publishing Co.of Texas, pp: 14.
- Pipeline and Gas Journa, 2003. Oildom Publishing Co. Texas, pp: 28.
- Shatzl, L.M., 1969. Petroleum in Nigeria. Oxford University Press, pp: 46-51.