

The oil pipeline industry has undertaken a voluntary environmental performance tracking initiative, recording detailed information about spills and releases, their causes and consequences.

The pipeline members of the American Petroleum Institute and the Association of Oil Pipe Lines believe that tracking and learning from spills will improve performance, thus demonstrating the industry's firm commitment to safety and environmental protection by its results.

This is one of a series of fact sheets and industry advisories drawn from the data compilations of the Pipeline Performance Tracking System, PPTS.

PPTS ADVISORY: AN EXPANDED VIEW OF OPERATOR ERROR

A Worker Safety Issue

PPTS participants reported four Operator Error incidents with injuries from 1999 thru 2001. None resulted in injuries to the public, but they were significant as a cause of employee/contractor injuries. Incidents caused by Operator Error accounted for 14% of all incidents reported to PPTS over the 1999-2001 period, but accounted for 31% of all the incidents involving an injury to any party, and for 57% of the incidents that involved an injury to operator employees or contractors.

In PPTS, Operator Error includes a wide range of tasks, from the actions of control room personnel to maintenance activities by field personnel including excavation by an operator employee or a contractor. As used in PPTS and most incident reporting systems, Operator Error relates to tasks completed by an individual. The individual's performance of a task is a reflection of the operating company's culture, policies and procedures that drive performance. Thus

operating companies need to look inwardly, using tools such as root cause analysis, to identify the true driver for incidents identified as directly or indirectly related to Operator Error. Two additional factors underscore the need for this introspective examination: 1) issues related to Operator Error are more directly under the operating company's control, and 2) some form of Operator Error is a contributing factor somewhere along the chain of events in many (perhaps even most) pipeline failures.

Operator Error Basics

Over the 1999-2001 period, there were 263 incidents caused by Operator Error, equal to 14% of all of the incidents reported to PPTS. As shown in the table at the right, 66% of Operator Error incidents occur on Facilities Piping & Equipment, a particularly high share, and 20% occur on Onshore Pipe, a particularly low share. While incidents involving Aboveground Storage Tanks are few, they account for 11% of Operator Error incidents, while they account for only 7% of incidents due to other causes. (Throughout this Advisory, the phrase "Operator Error" reflects an expanded view of the term, and includes traditional operator error as well as tank overfills due to operator error and excavation damage caused by an operator or its contractor.)

Share (%)	Location of Incidents (System Part)		
	Operator Error	All Other Causes	All Incidents
Aboveground storage tank	11.0%	6.6%	7.2
Belowground cavern	0.4%	0.1%	0.2
Facilities piping & equip	66.2%	44.5%	47.6
Offshore pipe	2.3%	1.7%	1.8
Onshore pipe	20.2%	47.1%	43.3
Total	100.0%	100.0%	100.0

Of the 263 Operator Error incidents, 89 met the criteria of the PPTS Long Form (involved a spill of 5 barrels or more or involved a death, injury, fire or explosion), requiring detailed information. The volume spilled in these Operator Error incidents accounted for about 10% of all barrels reported to PPTS. However, a single incident accounts for 46% of the total Operator Error volume.

As shown in the table below, the most common type of operator error was “valve left or placed in wrong position,” (“Valve” in the table) accounting for 30% of the incidents. None of these incidents, however, involved injuries. Some 70% of valve position errors take place in Facilities Piping & Equipment, suggesting that these failures are related to equipment isolation for maintenance. (Tank overfills or overpressurization, two other issues where a valve position may be important, are separately recorded). “Excavation damage or physical damage to facility or pipeline” (“Excavation” in the table) is the second-ranked type of error. One of these excavation incidents involved an injury. These incidents tend to be larger, with a median spill size almost twice that of the category as a whole. “Other human error” accounts for 20% of the incidents, three of which involved injuries, and includes the 15,000-barrel spill, one of the largest among all PPTS incidents. The size of these “other human error” spills is generally small, however, as indicated by the low median spill size. Tank overfills, which account for 17% of the Operator Error incidents, tend to be larger, in contrast; at 90 barrels, the category has the highest median spill size among the types of operator error.

Operator Error by Type of Error							
	Excavation	Motor vehicle	Other human error	Over-pressured	Tank overfill	Valve	Grand Total
Number of Incidents	20	4	18	5	15	27	89
% of Number	22%	4%	20%	6%	17%	30%	100%
Barrels	8,981	109	15,410	259	3,929	3,946	32,634
% of Barrels	28%	0%	47%	1%	12%	12%	100%
Avg. Size (Bbls)	449	27	1,027	52	262	146	379
Median Size (Bbls)	78	22	14	50	90	30	40
Involving a Death	0	0	0	0	0	0	0
Involving an Injury	1	0	3	0	0	0	4
Involving a Fire/Explosion	0	0	3	0	0	1	4

“Long Form” spills: 5 barrels or more, or involving a death, injury, fire or explosion.

Operator Error is a Significant Contributor to Oil Pipeline Worker Injuries

Operator error causes 14% of all incidents, but caused 31% of the few incidents with injury over the 1999-2001 period, and 57% of the incidents involving an injury to pipeline employees or contractors. The four Operator Error incidents involved six injuries, four employees and two contractors. None involved an injury to a member of the general public. One of the incidents involved operator excavation damage (one injury); the other three involved “other human error.” While pipeline operations in general have a good worker safety record, threats to worker safety should be constantly re-evaluated and the subject of training from the control room to the field.

Operator Error as a Contributing Cause of Incidents

Neither the RSPA Form 7000-1 Accident Report nor the PPTS release record addresses contributing factors during a pipeline incident because focusing data collection on the primary cause simplifies reporting and ensures that these primary causes are understood and addressed. Incident causation, however, is usually not simple. Frequently a chain of contributing actions or circumstances can be identified and if the chain could have been broken at one of the intermediate stages, the incident would not have occurred or the consequences may have been mitigated. Many operators conduct in-depth incident investigations or root-cause analyses to reveal contributing factors, as well as potential actions an operator could have taken. These actions might include better recognition of the incipient stages of failure, or necessary system-wide changes in training, engineering or administration.

Another source of information for operators to use in improving performance is in-depth incident investigations conducted and published by the National Transportation Safety Board. The NTSB conducts such in-depth investigations of significant, large or unique pipeline incidents, but not all pipeline incidents. NTSB also periodically conducts safety studies encompassing a number of accidents with similar causes or related factors that may have played a role in multiple accidents even if these causes are not necessarily related.

In recent years (1990s), NTSB has been focusing on certain types of contributing causes and factors, that it believes are not yet well understood as contributing factors in pipeline incidents, including:

- Human factors: Was information presented to control center personnel in a way that hindered understanding or resulted in mistakes? Were control center personnel overwhelmed by incoming data? Were personnel who were involved in a set of events unable to perform at optimum capacity due to fatigue?
- Qualification: Did pipeline operator personnel have the necessary facts or training to interpret information about abnormal operating conditions accurately? Did the operating company act on concerns by operating personnel about potential abnormal conditions?
- SCADA Systems: How is operational information displayed in control centers? How and when is SCADA data updated or reconfigured?

These are only a few examples from recent NTSB reports.

Considerations for Operators

Operators are addressing operator error on a number of fronts. For example, the Office of Pipeline Safety's Operator Qualification requirements apply to maintenance and operational tasks that have the greatest risk of causing or contributing to significant incidents. Individual operators have a regimen of large scope pre-job meetings, task-specific tailgate meetings, and documented procedures. The items that follow are some other considerations that may be of use.

- Some Operator Error incidents involving excavation damage (those caused by an operator or its contractor, 1st or 2nd parties) have been entered into the PPTS database as Third Party Damage. A spill from an Aboveground Storage Tank may involve Operator Error in a tank overfill. Where this is the case, we will request that the PPTS operator revise the record to reclassify the incidents and thus provide a more accurate view of Operator Error as a primary cause.
- Operators should pay special attention to maintaining and using documented procedures, even for one-time events.
- Operators should review pipeline accident investigation reports and special reports published by the National Transportation Safety Board and have a means of evaluating those reports and studies against company operating practices, procedures, documentation, and accident reporting.
- Operators should consider the rigorous application of root cause analysis. Only through root cause analysis will an operator identify cultural, policy and procedural factors that *contributed* to an incident, regardless of its primary cause. And only with this understanding can the operator determine the necessary changes in training, engineering or administration that will prevent future incidents.
- Operators should consider setting volume or consequence-related thresholds (at a minimum, death or injury) for conducting full-scale accident investigations with formal, documented root cause analyses. While investigations of incidents below this threshold may be smaller and less formal, understanding the true root cause should be the underlying purpose of any incident investigation.