The petroleum 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 about the Pipeline Performance Tracking System, "PPTS," its evolution and its lessons.

PPTS OPERATOR ADVISORY: OVERVIEW OF INCIDENTS OCCURRING ON FACILITIES PIPING AND EQUIPMENT

Facilities Piping/Equipment: Many Releases, Diverse Factors

Incidents occurring on Facilities Piping and Equipment ("facilities releases") are important because they account for 52% of all releases and they are the primary factor in the many small spills, accounting for 60% of all releases less than 5 barrels. Furthermore, while the number of spills on the pipeline right-of-way has fallen substantially over the last five years, the number of facilities spills has stayed relatively stable. Thus, in spite of the fact that these incidents generally have relatively low consequences, they must be addressed in order to continue to improve the release record. Compounding the challenge of improving the record is the fact that they result from diverse hazards, requiring a multi-faceted approach for prevention.

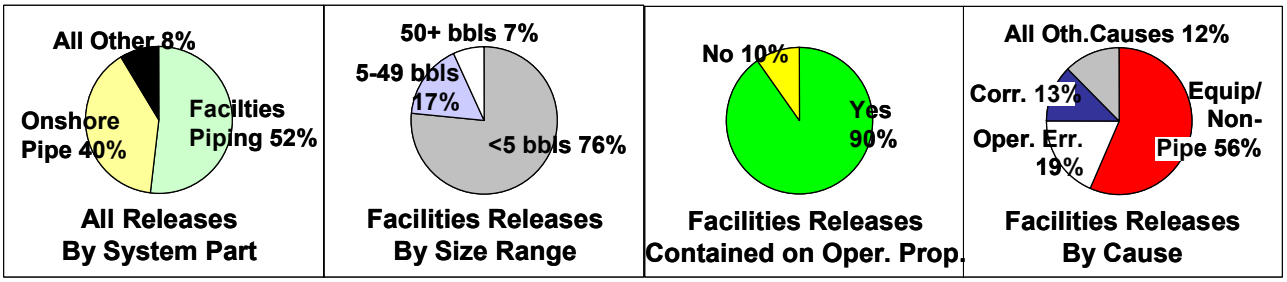
This Advisory will discuss the overview of facilities spills. These are releases or incidents occurring on "pump/meter station; terminal/tank farm piping & equipment, including sumps." They exclude those occurring from aboveground storage tanks or belowground caverns or their appurtenances, or from onshore pipe and related locations along the right-of-way, such as valve sites.

An adjunct Advisory, PPTS Operator Advisory 2005-4, addresses a subset of facilities releases – those from pipe, valves, pumps, sumps, and scraper traps – where operators may be able to implement targeted strategies for improvement.

Facilities Releases: High Numbers, Low Public Safety Consequences

This Advisory confirms many of the findings of an earlier one on the same subject. As illustrated in the pie charts below, these releases are:

- Numerous: 293 annually from 1999-2003, accounting for 52% of all PPTS releases;
- Generally small: 76% are less than 5 barrels (onshore pipe: 32% less than 5 bbls);
- Generally contained on company property (90%) and have low consequences;
- Caused most commonly by "equipment malfunction or failure of non-pipe component," which may involve gaskets, seal/packing failures, threads, couplings, or malfunctions of valves, alarms or other control equipment.



Commodities

Facilities releases are approximately evenly divided between refined product and crude oil, with a relatively small share from HVL. Refined products systems have a greater share of their releases in facilities (62%), the flip side of having a lower share of their releases on onshore pipe. For crude oil and HVLs, the share of the commodity's releases that occur in facilities is 45% and 48% respectively. Thus, while HVL releases account for just 8% of facilities releases, this is not a particular under-representation: HVLs account for 9% of all releases in all locations.

Facilities Releases by Commodity, 1999-2003

	Crude Oil	Ref. Prod.	HVLs	Total
Number of Incidents	659	682	123	1,464
Facilities Share of Commodity	45%	62%	48%	52%
Commodity Share of Facilities	45%	47%	8%	100%
Volume Released (000 Barrels)	74.9	15.2	1.7	91.8
Facilities Share Commodity	37%	13%	1%	19%
Commodity Share Facilities	82%	17%	2%	100%

In general, releases in facilities tend to be small – 52% of all releases occur in facilities, but these releases account for just 19% of the total volume released. Crude oil systems had some very large spills in facilities, including six releases of 4,500 barrels or more, two of which were 15K. These incidents are among the largest occurring over the 1999-2003 period on any part of a PPTS operator's pipeline system. These six releases account for a total of 55K barrels out of crude oil's facilities total of 75K barrels. While these incidents push the crude oil average spill size to 425 barrels, versus 53 barrels for HVLs and 106 for refined product, they are not the only factor arguing for a focus on crude facilities. The median spill size is also larger for crude oil, at 25 barrels, versus 18 for each of the other commodities.

In contrast, 48% of the HVL total releases account for just 1% of the commodity's total volume. (See further discussion of the HVL record in PPTS Operator Advisory 2005-2.) Refined products also have a mismatch between the number of spills in facilities and the volume released, with the 62% of refined products' spills that occur in facilities accounting for just 13% of the total volume of refined product released. Crude oil has a closer match, with facilities releases accounting for 45% of crude oil's total spills, and 37% of its volume.

Causes: Equipment Malfunction or Failure of Non-Pipe Component

The data previously shown on causes of releases were based on all facilities incidents, while the data below are drawn from the most significant subset of the 359 incidents filing the detailed Long Form.[1] The most important cause in terms of the number of spills remains "equipment malfunction or failure of non-pipe component;" at 47%, it accounts for more than twice the number of incidents as the next greatest cause. The largest volumes, however, are spread among equipment/non-pipe, corrosion, operator error, and pipe material/seam failures. Each of these causes is associated with at least one of the large crude oil spills. The crude oil share of volume released in each of these categories reflects the role of these large releases.

It is interesting to note that of the 54 crude oil incidents caused by corrosion, 45 involve internal corrosion. There is a discussion of dead legs in the adjunct Advisory, 2005-4, which addresses incidents involving pipe, valves, pumps, sumps, scraper traps.

[1] Long Form: Releases of 5 barrels or more, or ones involving death , injury, fire or explosion.

Long Form Facilities Releases by Cause by Commodity, 1999-2003									
		Number of Incidents				000 Barrels Released			
Data	Cause	Crude	HVL	Ref. Prod.	Total	Crude	HVL	Ref. Prod.	Total
Value	Equipment/non-pipe	73	13	81	167	13.7	0.7	4.4	18.8
	Corrosion	54	4	14	72	22.0	.	0.9	23.0
	Operator error	29	4	36	69	17.0	0.1	6.5	23.6
	Other	6	14	7	27	0.9	0.2	0.1	1.2
	Pipe material/seam	8		3	11	20.8		0.9	21.7
	Natural Forces	4	2	4	10	0.3	0.6	2.3	3.2
	Third party damage	3			3	0.1			0.1
	Total	177	37	145	359	74.8	1.7	15.1	91.6
Share of Commod (Read Down)	Equipment/non-pipe	41%	35%	56%	47%	18%	44%	29%	21%
	Corrosion	31%	11%	10%	20%	29%	3%	6%	25%
	Operator error	16%	11%	25%	19%	23%	5%	43%	26%
	Other	3%	38%	5%	8%	1%	13%	1%	1%
	Pipe material/seam	5%	0%	2%	3%	28%	0%	6%	24%
	Natural Forces	2%	5%	3%	3%	0%	35%	15%	4%
	Third party damage	2%	0%	0%	1%	0%	0%	0%	0%
	Total	100%	100%	100%	100%	100%	100%	100%	100%
Share of Cause (Read Across)	Equipment/non-pipe	44%	8%	49%	100%	73%	4%	23%	100%
	Corrosion	75%	6%	19%	100%	96%	0%	4%	100%
	Operator error	42%	6%	52%	100%	72%	0%	27%	100%
	Other	22%	52%	26%	100%	75%	19%	7%	100%
	Pipe material/seam	73%	0%	27%	100%	96%	0%	4%	100%
	Natural Forces	40%	20%	40%	100%	9%	19%	72%	100%
	Third party damage	100%	0%	0%	100%	100%	0%	0%	100%
	Total	49%	10%	40%	100%	82%	2%	16%	100%

"Long Form": Releases of 5 barrels or more, or ones involving death, injury, fire or explosion

Item Involved: The Road Map to Facilities Hazards

PPTS release reporting on the Long Form captures the asset ("item") involved in incidents. The variety of items involved demonstrates the diversity of hazards faced in a facility and therefore the challenge in improving the release record. Each affected item undergoes different maintenance and operations procedures and schedules, and each item category represents a variety of specifications and materials for individual parts and pieces of equipment.

As shown in the table, pipe is still the most frequently involved piece, at 20%, followed closely by valves, "other" items, pumps, and threaded/other fittings. These five items account for 84% of all of the facilities releases. As noted earlier, the most frequent causes of facilities releases are equipment and non-pipe failures, corrosion, and operator error. As expected, each of the items is associated with one or two of these causes. Corrosion causes almost 80% of the pipe seam

Long Form Facilities Releases, by Item, 1999-2003		
Item Involved	**Number**	**Share**
Pipe	73	20%
Valve	61	17%
Other	59	16%
Pump	58	16%
Threaded/Other Fitting	50	14%
Sump/Separator	26	7%
Meter/Prover	10	3%
Scraper Trap	10	3%
Weld Fitting	7	2%
Weld, incl. HAZ*	4	1%
Repair Fitting	1	0%
Total	359	100%

*HAZ: heat-affected zone

failures. Valve failures were associated with equipment/non-pipe failures (66%) and operator error (26%). Pump failures were attributed to equipment/non-pipe failures in about 80% of incidents, and to operator error in another 10%. "Other" items were attributed to equipment/non-pipe failures in 48% of the cases, and to operator error in 24%. "Other" item failures were also attributed to "other" causes in 21% of the incidents.

The relationship of item involved and cause is explored in more detail in Advisory 2005-4.

Environmental and Safety Consequences

As noted at the outset, the area affected by facilities releases is contained on company property in 90% of the incidents, substantially reducing the risk of personal or environmental harm to the public. Nonetheless, facilities incidents do involve undesired consequences.

Fatalities and Injuries. Facilities releases did not involve any fatalities over the 1999-2003 period. Three incidents however injured two operators and six contractors. Operator error caused the incident that released 15K barrels. The other two injury incidents (one caused by operator error and the other by "other" cause) involved a release of less than 5 barrels. Two of them involved large diameter pipe (a 20-inch pipe and 26-inch pipe).

Fires. There were 15 incidents involving fires. Most released little volume, and six incidents are "Long Form" solely because a fire occurred. One 15K-barrel release involving a fire accounts for 94% of all the volumes released in incidents involving fires.

HVLs are significantly over-represented, with 7 of the 15 fire-related incidents; HVLs account for just 8% of all facilities incidents, but 47% of the incidents involving a fire. Crude oil (20% of the fire-related incidents) and refined products (33%) are involved in the remaining fire-related incidents.

Pumps should be a particular focus as pumps are the item most frequently involved in fire-related incidents, accounting 6 out of the 15 (or 40% of the incidents with fires) and 14% of the facilities incidents overall. None of these incidents involved a release of 5 barrels or more. Scraper traps, which account for 8 incidents overall, are also over-represented in the fire-related incidents, with two; however, two is too few to draw strong conclusions for prevention strategies.

Environmental consequences. As noted, environmental consequences from facilities releases are lower than line pipe. For instance, there was an impact to water in about 12% of facilities releases (contrast 24% for line pipe releases), an impact to ecology in 17% of facilities releases (22% for line pipe), an impact to soils in 74% of facilities releases

Environmental Impacts of Long Form Facilities Releases on Crude Oil and Refined Product Systems, 1999-2003

		Crude + Refined	Crude	Ref. Prod.
Number	**Total**	322.0	177.0	145.0
Water Impact %	**No Impact**	88	94	82
	Some Impact	12	6	18
	Surface Water	9	5	15
	Groundwater	3	1	6
Ecology Impact %	**No Impact**	93	93	94
	Some Impact	7	7	6
	Vegetation	6	7	5
	Fish	1	0	1
Soils Impact %	**No Impact**	26	24	28
	Some Impact	74	76	72
Remediation %	**None/None Needed**	27	22	34
	Remediation	73	78	66
	Vegetation	5	6	5
	Soils	71	76	64
	Surface Water	7	3	12
	Groundwater	3	1	5

Impacts amounting to less than 0.5% of incidents not shown.
Shares expressed as percent of total incidents (first row in table).
Because some incidents have more than one impact, detail may not add to share with "some impact."

(82% for line pipe) and a need for remediation in 73% of facilities releases (89% for line pipe).[2] Soils impact is the most common. Refined product releases from facilities impacted some sort of water almost 3x more often than crude oil releases did, and most commonly surface water.

Considerations for Operators

- Facilities releases account for more than half of all releases reported to PPTS. Continuing to improve the overall release record requires that these releases be addressed and their number reduced.
- When conducting risk assessments, the much lower consequences of incidents involving facilities piping and equipment should be factored in, particularly as compared with mainline pipe.
- While consequences are generally low, facilities releases have involved injuries to employees and contractors over the 1999-2003 period.
- The primary causes, or "threats," are generally associated strongly with a particular type of asset, or "item involved" in PPTS terms. By understanding both, operators can create a focused strategy for prevention. Areas for examination will include maintenance and repair procedures, inspection schedules and protocols, even item specifications.
- Safety precautions, such as the posting of procedures at work sites or item locations and safety meetings prior to facility work projects, serve to focus workers (both contractors and employees) on the hazards specific to the item or items involved in that work. In addition, the pressures that the item involved may be subject to or the potential pressures that directly connected items may be subject to, should also be considered in conducting facility-based projects.
- The variety and complexity of a specific operator's facilities will vary significantly from industry-wide averages. Operators should consider evaluating the performance of facilities against industry-wide performance to improve planning and implementation of company and facility specific accident prevention efforts.
- PPTS Advisory 2005-4 provides more detail on these issues, and provides data on item involved and causes by commodity transported.

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[2] These percentages exclude releases of HVL, which seldom have an environmental consequence except to air. (An exception is an ammonia spill to water, which may impact fish.)