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.

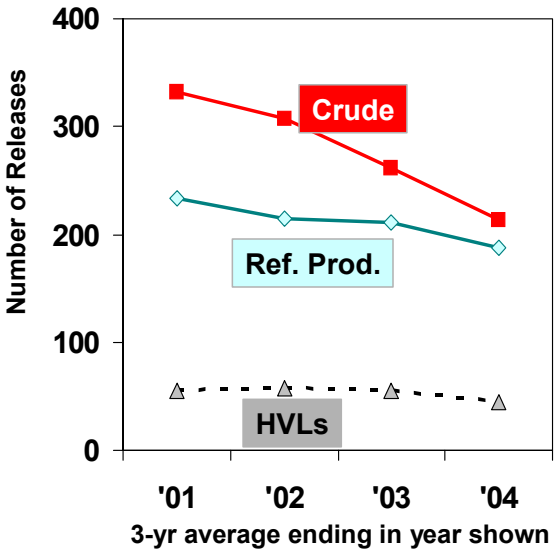
PPTS OPERATOR ADVISORY: CRUDE OIL RELEASES, 1999-2004

Crude Oil Spills Fell Significantly between 1999 and 2004

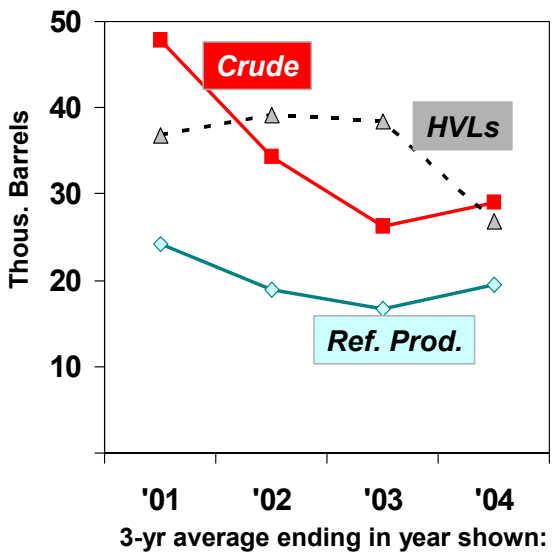
Crude oil spills have dropped significantly over the period from 1999 through 2004, the period that PPTS has been tracking data.[1] They accounted for 54% of spills reported to PPTS in 1999 and their share had dropped to 43 % of the total by 2004. Similarly, crude oil's share of the volume spilled fell from 54% of the PPTS total in 1999 to 38% of the total in 2004. (Crude oil mileage accounts for approximately 28% of the PPTS total.)

As discussed throughout this Advisory, the reduction of corrosion-related spills from onshore pipe has been the major factor in the improvement of crude oil systems; this improvement has also dominated the record for the entire oil pipeline industry. These corrosion-related spills tend to be small. Larger crude oil spills have not declined at the same rate, so challenges remain for operators to improve other aspects of performance. (Larger spills are also a challenge for other commodities' systems.) The most important step an operator can take is to continue to analyze the threats to their system and take measures to neutralize those threats.

Number of Releases, 1999-2004, in 3-Year Averages, by Commodity



Volume Released, 1999-2004, in 3-Year Averages, by Commodity



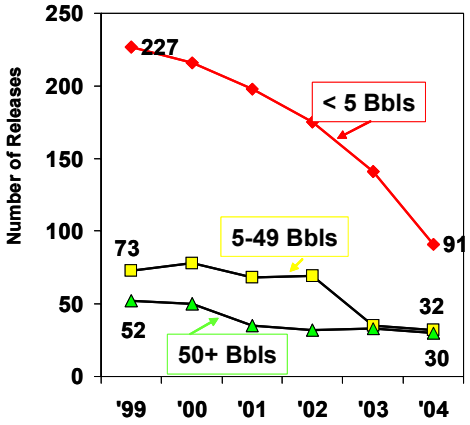
[1] Data for spills occurring in 2005 are not yet available for analysis.

Small Spills Plummet; Large Spills Still a Challenge

Excluding 2004's hurricane-related incidents[2], the total crude oil volume that was released dropped from a high of 74K barrels in 1999 to 9K barrels in 2004. As noted earlier, however, large spills are still a challenge for operators. For instance, while the number of small spills has plummeted, the number of spills of 50 barrels and more has been essentially unchanged for four years.

The number of spills in the largest 5% of all crude oil releases (i.e., 400 barrels or more) has shown an uneven record, with year-to-year fluctuations suggesting that improvements or lessons are not yet consolidated for continuous improvement. As shown in the table, these 84 very large releases accounted for 88% of the total volume spilled.

Number of Crude Oil Releases, 1999-2004, by Spill Size



These very large spills also have a different pattern of causes, an examination of which can aid in risk analysis. For example, corrosion caused 44% of the spills smaller than 400 barrels, but only 20% of the spills of 400 barrels or more. In contrast, third party damage (TPD) caused just 5% of the spills less than 400 barrels, and caused 20% of the spills of 400 barrels or more. Thus, the low overall share of TPD spills presents a misleading picture of its role; it causes just 6% of the number of all spills, but results in 19% of the volume released. Similarly, the high frequency of corrosion spills gives a false sense of their relative severity.

Crude Oil Releases, 1999-2004

		<400 Bbls	>=400 Bbls	Total
Number of Incidents		**1551**	**84**	**1635**
Share of Number (%)	Corrosion	43.8	20.2	42.6
	Equip/non-pipe	27.9	19.1	27.5
	Operator Error	9.7	8.3	9.7
	All Other Causes	6.5	14.3	6.9
	Third Party	4.9	20.2	5.7
	Pipe/tank material/seam	4.8	10.7	5.1
	Natural Forces	2.4	7.1	2.6
Thousand Barrels Released		**28.1**	**203.2**	**231.3**
Share of Volume (%)	Corrosion	45.7	20.1	23.2
	Equip/non-pipe	15.7	18.7	18.4
	Operator Error	7.5	10.3	10.0
	All Other Causes	9.7	7.7	7.9
	Third Party	16.1	19.7	19.3
	Pipe/tank material/seam	3.6	14.9	13.6
	Natural Forces	1.6	8.5	7.7

"All Other Causes" includes "other" and miscellaneous tank failures.

There is a further discussion of the primary causes of releases in the sections below on onshore pipe and facilities piping. Addressing these relatively rare very large spills, however, will likely require a closer root cause analysis than PPTS alone can provide.

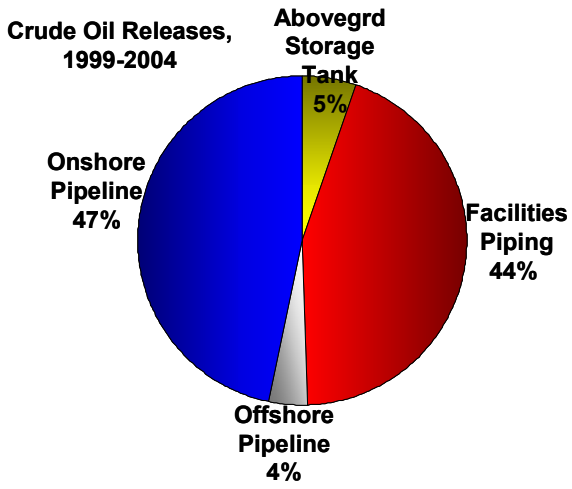
Location Matters

The location of a release on the system is another important aspect of ranking the threats to the pipeline. On the right-of-way, the public and the community are more at risk, while inside the

[2] All graphs *in*clude hurricane-related spills and volumes.

facility fence, the people at risk are likely to be the operator's employees or its contractors. Furthermore, spills along the right-of-way tend to be larger than spills inside facilities.

The pie chart illustrates that the number of releases on the right-of-way and the number inside the facility fence are similar: 47% on the onshore ROW, and 44% from piping inside facilities such as tank farms and pump stations. These two largest categories account for more than 90% of all crude oil releases. Further discussion focuses on them, below. Spills from tanks – also inside the facility fence – account for 5% of the total. The remaining 4% of crude oil spills over the 1999-2004 period involve offshore pipelines.



All Injury Incidents Were Caused by Operator Error

Crude oil systems had 16 incidents over the period that involved a "public safety impact": death, injury, fire, explosion, evacuation. Five of the incidents involve only evacuations. PPTS compilations include evacuations, even precautionary ones initiated at the operator's discretion (as 3 of the 5 were), as public safety impacts because even the *threat* of an unsafe condition has its own impact. Also, evacuations that involve local emergency responders utilize the community's infrastructure and impose a cost.

First, it is important to emphasize that no fatalities were associated with crude oil system incidents over the period. Of the 16 "public safety" incidents, 5 involved an evacuation only, 3 incidents involved injuries to operators/contractors and 13 involved a fire or explosion, some in combination with an evacuation.

A total of 8 people, 3 operator employees and 5 contractors hired by the operator, were injured in the incidents. (No members of the general public were injured.) Two of the incidents occurred inside facilities, and one along the right-of-way. All of the incidents involving injuries were caused by operator error.

Greatest Environmental Impact from Large Spills and Spills from Onshore Pipe

Both spill size and system location are important in describing environmental consequences: large spills and onshore pipe spills have consequences more frequently, as shown in the table in Appendix I. These characteristics underscore the importance of careful risk-ranking in addressing spill prevention.

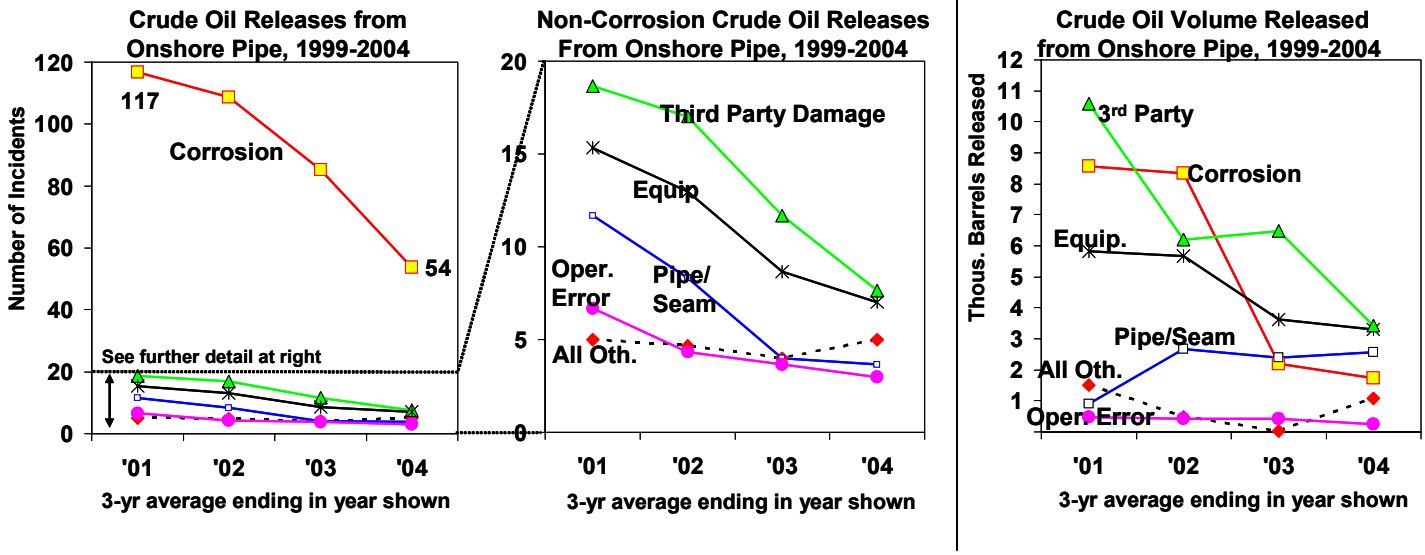
The PPTS report form captures impacts to water (surface water, groundwater, ocean, drinking water and the special subset of drinking water sources classified as "unusually sensitive areas," as well as the shutdown of water intakes for surface water and groundwater wells), impacts to ecology (vegetation, fish, birds, other ecology), and impacts to soils.[3] It also records information on remediation activities.

[3] The PPTS report form does not capture air emissions.

As shown in the table in Appendix 1, the most common environmental impact of crude oil spills is to soils, which rises to more than 90% for onshore pipeline incidents. Virtually all of these are addressed either with soil haul-off or, if necessary, with longer term remediation programs such as a pump-and-treat system. Ecology was impacted in 16% of the incidents overall, and in 25% of the releases of 50 barrels or more occurring on the right-of-way. The most common ecology impact, by far, is to vegetation; impacts to wildlife occur in only 1% of crude oil spills, even along the right-of-way. Almost one-third of releases of 50 barrels or more along the right-of-way have some type of water impact. Importantly, however, there were no impacts to drinking water. The most common water impact is to surface water (11% of all Long Form incidents, and 23% of incidents on the right-of-way of 50 barrels or more), followed by groundwater (3% of all Long Form incidents, and 9% of large incidents on the ROW).

Onshore Pipe: 75% Reduction in Corrosion Spills, but Challenges Remain

The greatest improvement in the onshore pipe record has been in the number of corrosion-related spills: a reduction of 75% on a year-to-year basis from 1999 to 2004, and a reduction of more than 50% on the basis of the three-year average from 1999-2001 compared to the three-year average from 2002-2004. This reduction in the number of corrosion spills can be attributed to the Integrity Management requirement of running internal inspection tools that target metal loss, a sign of corrosion. Using the additional detail available in PPTS for spills of 5 barrels or more, we see that internal and external corrosion failures occur at similar rates and tracked downward in approximately the same pattern from year-to-year.

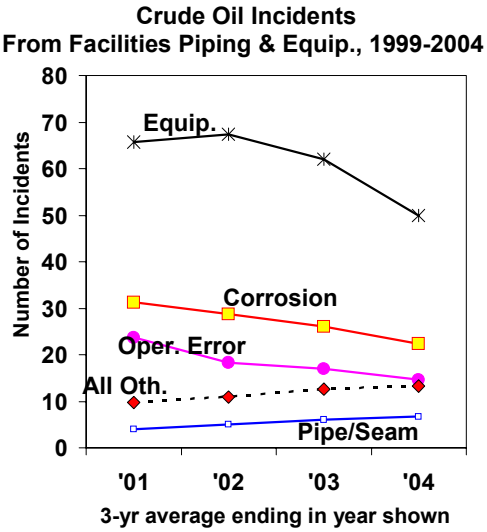


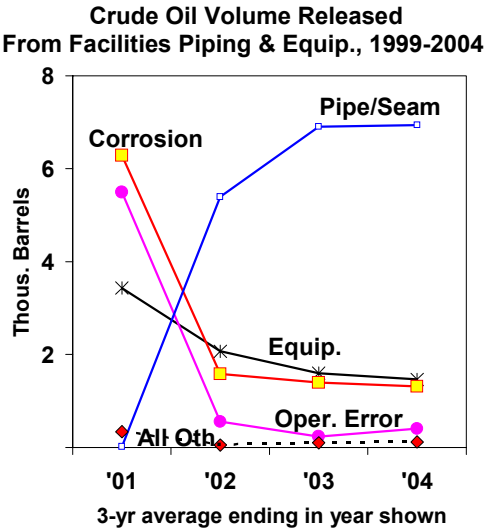
The high number of corrosion-related releases in the early part of the period necessitates a scale on the graph that masks the improvement in the other major causes. Above, the graph on the left and the graph in the center both show the number of incidents. The one in the center ("Non-Corrosion Crude Oil Releases") excludes the corrosion releases to allow an expanded scale. Third party damage, equipment-related failures, pipe/seam failures, operator error and other causes each result in fewer than 10 incidents per year. Third party damage fell by 59% from the first three-year average to the last, equipment failures fell by 54%, pipe material/seam failures fell by 69% and operator error fell by 35%. Nonetheless, large isolated events in these categories keep them on the radar screen for performance improvement (graph, top right, and earlier discussion).

Facilities Piping and Equipment: Spills from the Three Leading Causes Reduced

The number of spills involving facilities piping and equipment has also shown a significant improvement since 1999, notably in 2004. This decrease is believed to be attributable to the increased emphasis by the industry on facility risk assessment and operations. The three major causes of facility spills are: equipment/non-pipe failures, corrosion, and operator error, which together account for 86% of the total number of facilities spills since 1999. The greatest spill reductions have been spread evenly over these causes since 1999.

The total volume spilled continues to be driven by individual events of varying causes for facilities as well as onshore pipe. For instance, operator error's high volume in the first three-year average is due to a single release of 15.5K barrels. The sharp increase in the volume of pipe material/seam failures similarly reflects a 15.5K barrel event in 2002, and a 4.5K barrel incident in 2003. In fact, however, there are only 4 incidents greater than 50 barrels in this pipe material/seam failures category, another example of how the largest spills drive the performance results.





Considerations for Operators

❖ ***Considerations Relating to Onshore Pipe***

- To protect the public, address the issues surrounding high volume, high consequence releases. The very large events carry the heaviest consequence in terms of public safety, environmental impact, and public trust.
- Investigate all failures thoroughly to understand the root causes and prevent reoccurrence in other parts of the system.
- Operators who experience a spill on a segment that had previously been internally inspected should re-evaluate the ILI and data integration process. See also PPTS Advisory 2003-2, "Integrating ILI Use and Lessons" (www.api.org/ppts).
- In spite of improvements in the record, mechanical damage such as that from excavation and farming activity continues to be a significant threat, especially in terms of pollution and potential safety impacts.

❖ ***Mitigation actions at facilities to help reduce spills could include:***

- Reduce amount of unnecessary piping no matter the size;
- Mitigate internal corrosion by identifying and reducing dead-legs and/or low-flow sections;
- Replace auxiliary and instrument piping with wire (transmitter lines, etc.);
- Analyze equipment with a reliability and maintenance program,
  - reduce or eliminate vibration on equipment and piping,
  - focus on sump systems, including installation of fail safe controls and maintenance of related equipment;
- Reduce or eliminate threaded fittings;
- Post instructions and flow diagrams at locally-operated equipment (pig traps, sumps, etc.);
- Improve crude quality with elimination of received water content and use of inhibitors for the stations that are run sporadically.

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For additional information on PPTS and its lessons for the oil pipeline industry, please see www.api.org/ppts/. Click on the "documents" link in the left frame to see other Operator Advisories. A list is included in Appendix 2.

APPENDIX 1: DETAIL ON ENVIRONMENTAL CONSEQUENCES

When assessing the environmental consequence of releases, the PPTS comparison is usually limited to spills of 5 barrels or more, or ones involving death, injury, fire or explosion, because PPTS participants provide vastly more detail on these "Long Form" releases for all aspects of the PPTS questionnaire. For environmental consequence information, the comparison is further limited to 2000 onward; after the first year of PPTS, 1999, it became apparent that certain clarifications to the consequence questions on the form were necessary.

The PPTS report form captures impacts to water (surface water, groundwater, ocean, drinking water and the special subset of drinking water sources classified as "unusually sensitive areas," as well as the shutdown of water intakes for surface water and groundwater wells), impacts to ecology (vegetation, fish, birds, other ecology), and impacts to soils.[4] It also records information on remediation activities.

Environmental Consequences of "Long Form"* Crude Oil Releases, 2000-2004

			Impacted Water?		Impacted Ecology?		Impacted Soils?	
Location	**Spill Size**	**Number**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**
All System Parts	<50 Bbls	286	91%	9%	87%	13%	15%	85%
	>=50 Bbls	180	73%	27%	78%	22%	19%	81%
	Total	466	84%	16%	84%	16%	16%	84%
Onshore Pipe	<50 Bbls	165	90%	10%	81%	19%	7%	93%
	>=50 Bbls	107	68%	32%	75%	25%	12%	88%
	Total	272	81%	19%	78%	22%	9%	91%
All Other System Parts	<50 Bbls	121	93%	7%	97%	3%	25%	75%
	>=50 Bbls	73	81%	19%	84%	16%	29%	71%
	Total	194	89%	11%	92%	8%	26%	74%

"Long Form" includes releases of 5 barrels or more, or involving death, injury, fire, explosion. The "Long Form" includes extensive detail not available for smaller spills.

[4] The PPTS report form does not capture air emissions.

APPENDIX 2: PPTS OPERATOR ADVISORIES

PPTS Advisory Number and Dates (www.api.org/ppts)		
Title	**Date**	**Number**
Small Spills: Limited Negative Impact but Many Opportunities to Learn and Thus Prevent	October 2002	[none]
The Pipeline Performance Tracking System: More Detail, More Opportunities to Learn	October 2002	[none]
Learning from PPTS: Illustrating Risks with Decade of Construction Data	October 2002	[none]
Corrosion: Just the Facts	April 2003	2003-1
PPTS Advisory for Operators: Integrating ILI Use and Lessons	March 2003	2003-2
PPTS Advisory for Operators: Internal Corrosion and Crude Oil	April 2003	2003-3
PPTS Advisory for Operators: Public Safety Impacts of Pipeline Incidents	June 2003	2003-4
PPTS Advisory: Facilities Piping & Equipment	June 2003	2003-5
PPTS Advisory for Operators: Building Quality into the Numbers	June 2003	2003-6
PPTS Advisory: An Expanded View of Operator Error	June 2003	2003-7
PPTS Advisory for Operators: General Overview of Third Party Damage	August 2003	2003-8
PPTS Advisory for Operators: Landowner Activity Impact on Third Party Damage	September 2003	2003-9
PPTS Advisory for Operators: Impact of Commercial and Industrial Activities on Third Party Damage	September 2003	2003-10
PPTS Operator Advisory: Reporting Oil Pipeline Releases in High Consequence Areas	April 2004	2004-1
PPTS Advisory: Industry Performance Data [Password]	April 2004	2004-2
The Pipeline Performance Tracking System: Committed to Reliability and Performance	April 2004	2004-3
PPTS Operator Advisory: Reporting Integrity Management Program Activity in the Infrastructure Survey	November 2004	2004-4
PPTS Operator Advisory: Environmental Impacts of Crude and Refined Product Pipeline Releases	January 2005	2005-1
PPTS Advisory for Operators: HVLs: Handle With Care	April 2005	2005-2
PPTS Operator Advisory: Overview of Incidents Occurring on Facilities Piping and Equipment	June 2005	2005-3
PPTS Operator Advisory: Facilities Piping and Equipment: Focus on Items Involved and Causes of Incidents	June 2005	2005-4
PPTS Operator Advisory: Industry Performance Data [Password]	February 2006	2006-1
PPTS Operator Advisory: Highlights of Findings, 1999-2004	February 2006	2006-2
PPTS Operator Advisory: Refined Product Releases Require New Strategies for Continued Improvement	July 2006 [pending]	2006-3
PPTS Operator Advisory: Crude Oil Releases, 1999-2004	July 2006 [pending]	2006-4