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: FACILITIES PIPING AND EQUIPMENT: FOCUS ON ITEMS INVOLVED AND CAUSES OF INCIDENTS

Facilities Piping/Equipment: Many Releases, Diverse Factors

The releases that take place in facilities tend to be small and to have relatively few public safety impacts. These releases, however, are numerous, accounting for more than half of the incidents reported to the Pipeline Performance Tracking System over the 1999-2003 period. As discussed in this Advisory, these releases result from diverse hazards and diverse causes, requiring a multi-faceted approach for prevention.

The incidents under discussion are those occurring on "pump/meter station; terminal/tank farm piping & equipment, including sumps" (facilities releases) over the 1999-2003 period. These releases 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. This Advisory addresses a subset of facilities releases – those from pipe, valves, pumps, sumps, and scraper traps – where operators may be able most effectively to focus for improvement.

An adjunct Advisory, PPTS Operator Advisory 2005-3, gives an overview of facilities releases, their size characteristics, commodities involved and environmental and safety consequences.

Item Involved: The Road Map to Facilities

PPTS release reporting captures the item involved – the asset – for incidents filed on the Long Form[1], or 359 out of the 1,464 total facilities releases from 1999-2003. The compilation of incidents by item demonstrates 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 the most frequently involved item, at 20%, followed closely by valves, "other" items, pumps, and threaded/other fittings. These five items account for 83% of all of the facilities releases. The more frequent causes of facilities releases are equipment/non-pipe failures,

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

[1] "Long Form" releases are those involving a release of 5 barrels or more, or death, injury, fire or explosion.

corrosion, and operator error. As shown in the Appendix to this Advisory, each of the items is strongly associated with one or two of these causes. Corrosion causes almost 80% of the pipe failures. Valve failures were associated with equipment/non-pipe failures (66%) and operator error (26%). "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 Data Mining Team is revising the PPTS release reporting form to add item categories, to reduce the reliance on the "Other." The first of these additional items, "flange," was added in early 2005.

About 75% of the facilities releases occur on equipment or components that are aboveground. The belowground items tend to be pipes, sumps, and separators. See Appendix Table.

The sections below address the items most frequently involved and selected others that may provide opportunities for operators to improve the record.

Pipe Failures: Internal Corrosion, Dead Legs

Pipe is the item most commonly involved with facilities releases resulting in 73 incidents over the 1999-2003 period, accounting for 20% of the incidents. (While the item category is "pipe or pipe seam," there were no seam failures in facilities over the period.) Of these, corrosion is by far the dominant cause, responsible for 57 or 78% of the incidents. Crude oil systems account for 45 of the 57, or nearly 80%, including one release of 10.5K and another of 5K barrels.

Internal corrosion accounts for three-quarters of all the corrosion incidents involving facilities pipe, and for 87% of the crude incidents, including the two very large ones. While a much smaller number, internal corrosion accounted for 40% of the refined products incidents, an unusually high share in comparison to experience with mainline pipe. While the data do not specify, operator experience suggests that "dead legs" with no or low flow are major contributors to these internal corrosion incidents.

Pipe Failures Due to Corrosion

	External	Internal	Total
Crude	6	39	45
HVLs	2		2
Ref. Prod.	6	4	10
Total	14	43	57

According to the release record, operators reported affirmatively that they had used internal corrosion mitigation procedures -- injecting inhibitors, running dewatering pigs, or employing other internal corrosion mitigation systems or procedures -- in only 6 of the 39 crude oil incidents and in none of the refined product incidents. (Some reported "I don't know," including the 10.5K crude oil incident.) It may be worthwhile to note that there are another 9 internal corrosion incidents that occurred on facilities items other than pipe. Only one of these was employing mitigation measures.

Valves: Equipment/Non-Pipe failures, Operator Error

Valve failures account for 61, or 17%, of the facilities releases, the second-ranked item overall. Refined products systems, where valves cause 60% of the facilities releases, tend to have more valves, enabling them to manage complicated batching operations. Thus, a focus on valves by refined product systems – operations, procedures, material – is likely to improve their release record.

Equipment malfunction or failure of a non-pipe component was the largest cause of valve failures, at 66%. This cause category accounted for 27 of the 36 – or 75% – of the refined product incidents involving valves. As shown in the following table, the remaining refined products valve incidents are spread among a variety of failure types: gasket or O-ring, malfunction of control or relief equipment, "other" equipment/non-pipe failure (the largest factor,

at 8 incidents), and seal or packing failures. Crude oil system releases are more difficult to categorize as "other" equipment/non-pipe failure accounted for half of the incidents.

Valve Failures Due to Equipment/Non-Pipe Component				
Type of Failure	**Crude**	**HVL**	**Ref. Prod.**	**Total**
Gasket or O-ring	3		7	10
Malfunction of control/relief	1	2	6	9
Other equip/non-pipe failure	5	1	8	14
Seal or packing			5	5
Stripped threads, etc.	1		1	2
Total	10	3	27	40

The other important cause of facilities releases involving valves is operator error, which accounts for 26%. Operator error is a more important cause for crude oil systems, where it accounts for 42% of the crude valve incidents. (It accounts for 19% of the refined products incidents.) "Valve left or placed in the wrong position" was by far the most prevalent type of error, accounting for 12 of the 16 operator error incidents involving valves, including 5 of the 8 occurring on crude oil systems, 6 of the 7 occurring on refined product systems, and the only HVL system incident. It is also useful to recognize that one of the operator error incidents involved excavation damage, and another involved overpressuring equipment.

Pumps: Equipment/Non-Pipe failures, Fires, Operator Error

Pumps are the lifeblood of pipeline operations, and releases or other failures that require pumps to be shut down have an impact on system efficiency and utilization. There are far fewer pumps on a system than valves. The data thus suggest that pump failures, at 58 incidents, are over-represented (occur at a greater rate per item count) than valve failures. Thus, attention to pumps, their packing and other equipment, and sources of ignition in their vicinity would appear to be warranted.

Pumps are over-represented in incidents with fires, accounting for 6 out the 15 total fire-related facility incidents. However, volumes released were negligible. In fact, these incidents were all required to file the detailed "Long Form" solely because they involved fires. With respect to commodity, 3 of the fire-related incidents that involved pumps occurred on refined product systems, 2 on HVL systems, and 1 on a crude oil system. (The pump fires accounted for 60% of the refined product fires, for 28% of the HVL fires and for one-third of the crude oil fires that occurred during facilities incidents.) With respect to cause, 4 were due to equipment/non-pipe failure, 1 due to operator error, and 1 "other" cause.

The 58 incidents involving pump failures were attributed to equipment/non-pipe failures in about 80% of incidents, a total of 47. Of these, 28 were due to pump or seal packing failure and 14 were due to "other equipment or non-pipe failure." In addition, operator error accounted for about 10% of the incidents involving pumps, a total of 6. Of these, 2 incidents were due to "valve placed or left in the wrong position" and 4 were due to "other human error." (The next largest factor was "stripped threads, defective or loose fitting or tubing," with just 3 incidents.)

Sumps: Operator Error

Sumps were involved in 26 of the facilities releases, or 7%. While not the most common item, sumps may be another opportunity for improvement.

Sump/Separator Due to Operator Error			
	Crude	**Ref. Prod.**	**Total**
Motor vehicle	2	1	3
Other human error		1	1
Tank overfilled		1	1
Valve position	7	4	11
Grand Total	9	7	16

More than 60% of the sump incidents involved operator error. As shown in the table, 11 of the 16 operator error incidents involved a valve left or placed in the wrong position, including 7 out of the 9 crude oil system incidents. In addition, 3 of the

operator error incidents involved a motor vehicle; it is useful to note that there were only 6 motor vehicle-related incidents reported to PPTS over the period (excluding excavation damage). There was 1 tank overrun/overfill among the operator error sump incidents. After operator error, the next leading cause of sump/separator incidents was equipment and non-pipe failure, accounting for 7 or 28%. Of these, 4 were malfunction of control or relief equipment, 2 were "other" equipment failure, and 1 was stripped threads.

It is interesting to note that 13 of the 26 sump incidents involved aboveground equipment; 11 belowground, and 2 at the above/belowground transition.

The data suggest that improved operational practices will be a key to improving the record with sumps.

Scraper Traps: Increased Opportunities with Increased ILI

Scraper traps -- the staging place where a pig goes into a line or comes out of the line -- present another potential opportunity to improve facility performance, again through a possible combination of operational practice and attention to equipment failure. Controlling these releases is particularly important during this period of IMP implementation and its numerous pig runs.

There were 10 incidents involving scraper traps; one was almost 5,000 barrels. They occurred 50% on crude systems; 30% on refined products systems and 20% on HVL systems. Five of the incidents, including the large one, were caused by equipment/non-pipe failure, and 4 of these 5 involved crude oil systems.

O-rings should be a particular focus in avoiding scraper trap failures; 4 of the 5 crude oil spills involved gasket/O-ring failures. Misalignment at the time of closure of the trap can cause a cut in the seal. More frequent use and the cycle of opening and closing causes wear and tear, and a weakening of the O-ring ensues. There were also 3 scraper trap incidents that were caused by operator error, all of them on refined product systems.

Considerations for Operators

Facilities releases reflect disparate hazards and causes so that compiled data provide only small pockets of information to focus on -- a few incidents, not a clear trend. It is part of the nature of facilities that this should be so. Because facilities involve the interface of people and equipment, there is a greater potential for employee/contractor injury. Thus, the goals of zero releases and zero injuries requires that operators pay special attention to even a few incidents in the separate categories.

While the data do not capture the information specifically, operator experience indicates that the interface between the high pressure maintained in the mainline pipe and the atmospheric pressure more common to facilities operations is an area that requires special vigilance. Given the number of transitions involved in pipeline configurations, the incidents occur at a low rate, but they have potentially high consequences. Establishment of new maintenance schedules and procedures will help to reduce or even eliminate such incidents. These might include:

- *Revised inspection protocols*. A checklist that includes checking the sump when draining down the pig trap would be an example.
- *Administrative changes such as posting information at the equipment*. Examples of information to be posted: operational procedures; flow charts of inflow and outflow; a chart of stop and start levels.

Each item category will require a different strategy, as outlined below.

- *Failures involving **pipe***: internal corrosion is the largest factor in failures of pipe in facilities. Both establishment of internal corrosion mitigation measures and evaluation of dead legs may improve results.
- *Failures involving **valves***: Valves are the most common piece of equipment in facilities and of necessity must be operated often. They are also of varying materials and design, making strict adherence to management of change protocols an important factor. Operators are thus likely to need a multi-faceted program to improve release performance. Valve failure due to malfunction or operators leaving a valve in the wrong position, argue for a review of maintenance schedules and procedures as a first step, targeting the asset (design, material), the procedures and the personnel (operator/operation error).
- *Failures involving **pumps***: incidents involving pumps tend not to be high volume, but affect system efficiency, and because the occurrence of fires is over-represented, operators will likely need to combine preventive maintenance protocols that prevent spillage along with the elimination of ignition sources.

*Errors involving **operators/incorrect operations***: While keeping the public safe requires special attention to line pipe and the right-of-way, in fact there are more people – employees and contractors – directly exposed and in close proximity to equipment in facilities than there are along the right-of-way. Thus keeping people safe and preventing injuries also require attention in facilities. As noted earlier, this may require a procedure-by-procedure review, augmented by posting procedures, diagrams and flow charts at the equipment. While some companies have added level switches for sumps and installed remote control operations, engineering can only mitigate, not replace operator procedures.

Because of the prevalence of the "other" category among the reported "item involved" data, the Data Mining Team will adopt additional subcategories for this reporting field. The Data Mining Team has already added "flange" to the list of item involved on the PPTS release reporting form.

The Appendix to this Advisory includes tables of incidents by item by cause for all commodities, and separately for crude oil, refined products and HVL systems.

APPENDIX

Long Form Facilities Releases by Item Involved by Location, 1999-2003

Data	Item Involved	Above ground	Transition	Below ground	Total
Number	Pipe	20		53	73
	Valve	51	1	9	61
	Other	53	1	5	59
	Pump	52		6	58
	Threaded or Other Fitting	41		9	50
	Sump/Separator	13	2	11	26
	Meter/Prover	9		1	10
	Scraper Trap	10			10
	Weld Fitting	5		2	7
	Weld, including HAZ			4	4
	Repair Fitting	1			1
	Total	255	4	100	359
% of Location	Pipe	8%	0%	53%	20%
	Valve	20%	25%	9%	17%
	Other	21%	0%	6%	16%
	Pump	20%	25%	5%	16%
	Threaded or Other Fitting	16%	0%	9%	14%
	Sump/Separator	5%	50%	11%	7%
	Meter/Prover	4%	0%	1%	3%
	Scraper Trap	4%	0%	0%	3%
	Weld Fitting	2%	0%	2%	2%
	Weld, including HAZ	0%	0%	4%	1%
	Repair Fitting	0%	0%	0%	0%
	Total	100%	100%	100%	100%
% of Item	Pipe	27%	0%	73%	100%
	Valve	84%	2%	15%	100%
	Other	90%	0%	10%	100%
	Pump	90%	2%	9%	100%
	Threaded or Other Fitting	82%	0%	18%	100%
	Sump/Separator	50%	8%	42%	100%
	Meter/Prover	90%	0%	10%	100%
	Scraper Trap	100%	0%	0%	100%
	Weld Fitting	71%	0%	29%	100%
	Weld, including HAZ*	0%	0%	100%	100%
	Repair Fitting	100%	0%	0%	100%
	Total	71%	1%	28%	100%

*HAZ: heat-affected zone. Long Form: incidents of 5 barrels or more, or involving death, injury, fire, explosion

Incidents in All Systems:
Long Form Facilities Releases by Item Involved by Cause, 1999-2003

		Cause							
	Item Involved	Corro-sion	Equip./ non-pipe	Natural Forces	Operator/ oper'n error	Other	Pipe Mat'l/ seam	Third party dmg.	Grand Total
Number	Pipe	57	1	4	3	3	3	2	73
	Valve	2	40		16	3			61
	Pump	3	47		6	1	2		59
	Other	3	28	1	14	12			58
	Threaded or Other Fitting	4	33	2	7	3		1	50
	Sump/Separator		7	1	16	2			26
	Meter/Prover	1	5		3	1			10
	Scraper Trap		5	1	3	1			10
	Weld Fitting	1	1	1	1	1	2		7
	Weld, incl. HAZ*	1					3		4
	Repair Fitting						1		1
	Total Number	72	167	10	69	27	11	3	359
Number as % of Cause	Pipe	78.1%	1.4%	5.5%	4.1%	4.1%	4.1%	2.7%	100.0%
	Valve	3.3%	65.6%	0.0%	26.2%	4.9%	0.0%	0.0%	100.0%
	Pump	5.1%	79.7%	0.0%	10.2%	1.7%	3.4%	0.0%	100.0%
	Other	5.2%	48.3%	1.7%	24.1%	20.7%	0.0%	0.0%	100.0%
	Threaded or Other Fitting	8.0%	66.0%	4.0%	14.0%	6.0%	0.0%	2.0%	100.0%
	Sump/Separator	0.0%	26.9%	3.8%	61.5%	7.7%	0.0%	0.0%	100.0%
	Meter/Prover	10.0%	50.0%	0.0%	30.0%	10.0%	0.0%	0.0%	100.0%
	Scraper Trap	0.0%	50.0%	10.0%	30.0%	10.0%	0.0%	0.0%	100.0%
	Weld Fitting	14.3%	14.3%	14.3%	14.3%	14.3%	28.6%	0.0%	100.0%
	Weld, incl. HAZ*	25.0%	0.0%	0.0%	0.0%	0.0%	75.0%	0.0%	100.0%
	Repair Fitting	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
	Total % of Cause	20.1%	46.5%	2.8%	19.2%	7.5%	3.1%	0.8%	100.0%
Barrels	Pipe	22,400	7	2,386	168	30	229	33	25,253
	Valve	43	2,878		2,848	29			5,798
	Pump	90	2,000		105		1,347		3,542
	Other	386	4,264	7	18,940	152			23,749
	Threaded or Other Fitting	50	3,604	205	210	101		35	4,204
	Sump/Separator		847	6	443	37			1,333
	Meter/Prover	5	95		58	10			168
	Scraper Trap		5,107	200	772	825			6,904
	Weld Fitting	10	20	404	31	19	26		510
	Weld, incl. HAZ*	8					20,024		20,032
	Repair Fitting						80		80
	Total Barrels	22,992	18,822	3,208	23,575	1,203	21,706	68	91,573

*HAZ: Heat-affected zone. Long Form: Releases of 5 barrels or more, or involving death, injury, fire, or explosion

Incidents in Crude Oil Systems:
Long Form Facilities Releases by Item Involved by Cause, 1999-2003

		Cause							
	Item Involved	Corro-sion	Equip./ non-pipe	Natural Forces	Operator/ oper'n error	Other	Pipe Mat'l/ seam	Third party dmg.	Grand Total
Number	Pipe or pipe seam	45		1	1	2	2	2	53
	Pump	2	22		3		1		28
	Threaded or Other Fitting	1	18	2	4			1	26
	Valve	1	10		8				19
	Sump/Separator		7	1	9	1			18
	Other	2	10		3	2			17
	Scraper Trap		4			1			5
	Meter/Prover	1	2		1				4
	Weld, including HAZ*	1					3		4
	Weld Fitting	1					2		3
	Total Number	54	73	4	29	6	8	3	177
Number as % of Cause	Pipe or pipe seam	84.9%	0.0%	1.9%	1.9%	3.8%	3.8%	3.8%	100.0%
	Pump	7.1%	78.6%	0.0%	10.7%	0.0%	3.6%	0.0%	100.0%
	Threaded or Other Fitting	3.8%	69.2%	7.7%	15.4%	0.0%	0.0%	3.8%	100.0%
	Valve	5.3%	52.6%	0.0%	42.1%	0.0%	0.0%	0.0%	100.0%
	Sump/Separator	0.0%	38.9%	5.6%	50.0%	5.6%	0.0%	0.0%	100.0%
	Other	11.8%	58.8%	0.0%	17.6%	11.8%	0.0%	0.0%	100.0%
	Scraper Trap	0.0%	80.0%	0.0%	0.0%	20.0%	0.0%	0.0%	100.0%
	Meter/Prover	25.0%	50.0%	0.0%	25.0%	0.0%	0.0%	0.0%	100.0%
	Weld, including HAZ*	25.0%	0.0%	0.0%	0.0%	0.0%	75.0%	0.0%	100.0%
	Weld Fitting	33.3%	0.0%	0.0%	0.0%	0.0%	66.7%	0.0%	100.0%
	Total % of Cause	30.5%	41.2%	2.3%	16.4%	3.4%	4.5%	1.7%	100.0%
Barrels	Pipe or pipe seam	21,548		80	0	30	82	33	21,773
	Pump	55	1,180		20		633		1,888
	Threaded or Other Fitting	20	2,865	205	89			35	3,214
	Valve	10	1,251		1,095				2,356
	Sump/Separator		847	6	323	25			1,201
	Other	364	2,558		15,457	21			18,400
	Scraper Trap		4,968			825			5,793
	Meter/Prover	5	55		30				90
	Weld, including HAZ*	8					20,024		20,032
	Weld Fitting	10					26		36
	Total Barrels	22,020	13,724	291	17,014	901	20,765	68	74,782

*HAZ: Heat-affected zone. Long Form: Releases of 5 barrels or more, or involving death, injury, fire, or explosion
Note: Order of "Item Involved" rows is based on frequency.

Incidents in Refined Product Systems:
Long Form Facilities Releases by Item Involved by Cause, 1999-2003

		Cause						
	Item Involved	Corro-sion	Equip./ non-pipe	Natural Forces	Operator/ oper'n error	Other	Pipe Mat'l/ seam	Grand Total
Number	Valve		27		7	2		36
	Other	1	17	1	9			28
	Pump	1	20		3		1	25
	Threaded/Other Fitting	2	13		2	2		19
	Pipe	10	1	3	2	1	1	18
	Sump/Separator				7	1		8
	Meter/Prover		2		2	1		5
	Scraper Trap				3			3
	Weld Fitting		1		1			2
	Repair Fitting						1	1
	Total Number	14	81	4	36	7	3	145
Number as % of Cause	Valve	0.0%	75.0%	0.0%	19.4%	5.6%	0.0%	100.0%
	Other	3.6%	60.7%	3.6%	32.1%	0.0%	0.0%	100.0%
	Pump	4.0%	80.0%	0.0%	12.0%	0.0%	4.0%	100.0%
	Threaded/Other Fitting	10.5%	68.4%	0.0%	10.5%	10.5%	0.0%	100.0%
	Pipe	55.6%	5.6%	16.7%	11.1%	5.6%	5.6%	100.0%
	Sump/Separator	0.0%	0.0%	0.0%	87.5%	12.5%	0.0%	100.0%
	Meter/Prover	0.0%	40.0%	0.0%	40.0%	20.0%	0.0%	100.0%
	Scraper Trap	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	100.0%
	Weld Fitting	0.0%	50.0%	0.0%	50.0%	0.0%	0.0%	100.0%
	Repair Fitting	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	100.0%
	Total % of Cause	9.7%	55.9%	2.8%	24.8%	4.8%	2.1%	100.0%
Barrels	Valve		1,484		1,748	29		3,262
	Other	22	1,486	7	3,415			4,930
	Pump	35	774		85		714	1,608
	Threaded/Other Fitting	20	545		110	28		703
	Pipe	847	7	2,306	168	0	147	3,475
	Sump/Separator				120	12		132
	Meter/Prover		40		28	10		78
	Scraper Trap				772			772
	Weld Fitting		20		31			51
	Repair Fitting						80	80
	Barrels	924	4,356	2,313	6,477	79	941	15,090

Long Form: Releases of 5 barrels or more, or involving death, injury, fire, or explosion. Note: Order of "Item Involved" rows is based on frequency. There were no releases in refined product system facilities involving "weld" as an item or "third party damage" as a cause.

Incidents in HVL Systems:
Long Form Facilities Releases by Item Involved by Cause, 1999-2003

	Item Involved	Cause					
		Corro-sion	Equip./ non-pipe	Natural Forces	Operator/ oper'n error	Other	Grand Total
Number	Other		1		2	10	13
	Valve	1	3		1	1	6
	Pump		5			1	6
	Threaded/Other Fitting	1	2		1	1	5
	Pipe or pipe seam	2					2
	Scraper Trap		1	1			2
	Weld Fitting			1		1	2
	Meter/Prover		1				1
	Total Number	4	13	2	4	14	37
Number as % of Cause	Other	0.0%	7.7%	0.0%	15.4%	76.9%	100.0%
	Valve	16.7%	50.0%	0.0%	16.7%	16.7%	100.0%
	Pump	0.0%	83.3%	0.0%	0.0%	16.7%	100.0%
	Threaded/Other Fitting	20.0%	40.0%	0.0%	20.0%	20.0%	100.0%
	Pipe or pipe seam	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%
	Scraper Trap	0.0%	50.0%	50.0%	0.0%	0.0%	100.0%
	Weld Fitting	0.0%	0.0%	50.0%	0.0%	50.0%	100.0%
	Meter/Prover	0.0%	100.0%	0.0%	0.0%	0.0%	100.0%
	Total % of Cause	10.8%	35.1%	5.4%	10.8%	37.8%	100.0%
Barrels	Other		220		68	131	419
	Valve	33	142		5		180
	Pump		47				47
	Threaded/Other Fitting	10	194		11	73	288
	Pipe or pipe seam	6					6
	Scraper Trap		139	200			339
	Weld Fitting			404		19	423
	Meter/Prover						
	Barrels	49	742	604	84	223	1,701

Long Form: Releases of 5 barrels or more, or involving death, injury, fire, or explosion. Note: Order of "Item Involved" rows is based on frequency. There were no releases in HVL system facilities involving the following items: repair weld, sump/separator, or weld. There were no releases caused by pipe material/ seam failures or by third party damage. The only release involving a meter/prover was less than 5 barrels; PPTS did not record the exact volume for such releases at the time it was reported.