Directed Inspection & Maintenance Programs for Reducing Methane Emissions

Modern Technologies of Detection and Elimination
of Methane Leakages from Natural Gas Systems
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Leak Characteristics

- **Contribute significantly to total VOC and GHG emissions at UOG facilities.**
- **Only a few percent of the components at a site actually leak.**
- **Most of the leakage is usually from just a few big leakers.**
- **Big leakers often go unnoticed because they occur in difficult-to-access, low-traffic, crowded or noisy areas, or the amount of leakage is not fully appreciated.**
- **Big leakers may also occur due to demanding applications coupled with the high cost or difficulty of repairs.**
- **Leakage is mostly from components in gas/vapour service.**

Key Principles of DI&M

- **Minimize the potential for big leakers and provide early detection and repair of these when they occur.**
- **Focus efforts on the areas most likely to offer the greatest impact and benefit, with coarse or less frequent screening of other areas.**
- **Only repair a component if it poses a health, safety, environmental or operability concern or is economical to repair.**
- **Implement repairs as soon as possible, or at the next facility turnaround if a major shutdown is required.**
- **Consider leakage directly to the atmosphere as well as into vent, flare, drain and blowdown systems.**

Noteworthy Leak Trends

- **Most likely sources of big leaks:**
  - Compressor seals.
  - Open-ended lines and blowdown systems.
  - Pressure relief valves.
  - Pressure-vacuum safety valves.
  - Tank hatches.

- **Least likely sources of big leaks:**
  - Valve stem packings.
  - Connectors.

- **Components in thermal cycling, vibration or cryogenic service have increased leakage.**

- **Fuel gas systems are leak prone.**

- **Components in odorized or H_2S service leak less than those in non-odorized or non-toxic service.**

Important Benefits of DI&M

- **Attractive payback (often <6 months).**
- **Reduced maintenance costs.**
- **Reduced downtime.**
- **Improved process efficiency.**
- **Safer work environment.**
- **Cleaner environment.**
- **Resource conservation.**

Fugitive Equipment Leaks

Facility Type	Facility ID	Number of Components Surveyed	Leak Frequency	Emissions From All Leaking Sources				Contribution to THC Emissions	
				THC	Methane	GHG	Value	Top 10 Sources	Top 5 Sources
			[%]	[$10^3 m^3$/ year]	[tonnes/ year]	[tonnes CO_2E/year]	[$/year]	[%]	[%]
Gas Plant	GP-1	56 461	1.7	1 973	997	20 934	500 253	35	23
	GP-2	16 050	3.5	1 264	471	9 907	320 608	36	23
	GP-3	14 424	3.0	2 203	1 412	29 670	558 665	64	54
	GP-4	14 174	4.0	2 182	1 376	28 894	553 248	36	23
	GP-5	11 556	3.3	2 113	1 215	25 521	621 061	33	20
	GP-6	13 133	2.5	739	186	3 918	386 538	57	40
	GP-7	13 471	1.2	542	299	6 283	178 744	93	88
	GP-8	3 672	10.3	4 063	2 334	49 186	1 262 874	77	71
	GP-9	5 979	0.6	43	29	610	11 863	93	71
TOTAL		**148 920**		**15 123**	**8 320**	**174 923**	**4 393 854**		
AVERAGE		**16 547**	**2.5**	**1 680**	**924**	**19 436**	**488 206**	**54**	**43**
Compressor Station	CS-1	608	5.1	198	110	2 312	61 572	90	66
	CS-2	4 626	1.1	166	98	2 053	49 184	83	71
	CS-3	3 084	0.7	310	169	3 551	98 802	95	79
	CS-4	6 168	1.0	340	194	4 069	103 508	64	48
	CS-5	1 568	4.2	123	80	1 672	33 552	80	59
	CS-6	224	1.3	1	0	7	189	100	100
	CS-7	1 391	1.9	8	4	94	2 367	88	73
	CS-8	2 115	1.8	103	67	1 414	27 855	89	61
	CS-9	2 516	1.1	70	45	960	18 901	91	69
TOTAL		**22 300**		**1 317**	**767**	**16 131**	**395 928**		
AVERAGE		**2 478**	**1.5**	**146**	**85**	**1 792**	**43 992**	**83**	**64**
Well Sites	WS-1 to 3	1 474	0.2	2	1	18	501	100	100
	WS-4 to 8	1 617	1.5	1	1	13	351	88	66
	WS-9 to 12	1 797	0.4	2	1	30	585	100	99
TOTAL		**4 888**		**5**	**3**	**61**	**1 437**		
AVREAGE		**407**	**0.7**	**0**	**0**	**5**	**120**	**97**	**92**

Residual Flaring

Facility	Residual THC Flaring Rate [$10^3 m^3$/day]	THC Emissions [$103 m^3$/year]	Methane Emissions [$103 m^3$/year]	GHG Emission tonnes CO_2E/year	Value of Flared Gas [$/year]
Gas Plant #1	0.56	4	3	540	53 765
Gas Plant #2	NA	NA	NA	NA	NA
Gas Plant #3	5.28	39	28	5 136	227 445
Gas Plant #4	3.43	29	18	3 336	342 272
Gas Plant #5	NA	NA	NA	NA	NA
Gas Plant #6	2.83	21	14	5 590	219 000
Gas Plant #7	NA	NA	NA	NA	NA
Gas Plant #8	10.99	80	66	10 266	1 249 588
Gas Plant #9	NA	NA	NA	NA	NA
TOTAL	**23.09**	**172**	**130**	**24 868**	**2 092 070**
AVERAGE	**2.57**	**19**	**14**	**2 763**	**232 452**

Useful Tools

- **Leak Detection**
  - Bubble Tests
  - Handheld Vapor Sensors
  - Ultrasonic Leak Detectors
  - IR Cameras
- **Leak Quantification**
  - Bagging
  - Hi-Flow Sampler
  - Stack Testing Methods (Velocity Probes)
  - Total Capture and Flow Measurement
  - Tracer Tests
  - Remote Sensing (e.g., DIAL)

Conclusions

- **DI&M is a rational approach to managing fugitive emissions.**
  - Effective means of achieving significant cost-effective reductions in methane emissions.
  - An environmentally responsible choice.

- **A BMP for fugitive emissions management is currently being developed in Canada (CAPP, SEPAC, EC and EUB) and is expected to become a regulatory requirement (End of 2005).**

- **A multi-year study for US EPA/GRI/KSU will also be producing an DI&M BMP (Fall 2005).**