API/ANGA Information on Gas Well Refracture Rate

EPA Stakeholder Workshop
September 13-14, 2012
Washington D.C.

energy API
AMERICAN PETROLEUM INSTITUTE

Background: Workover/ Refracturing Emissions

- A well workover refers to remedial operations on producing natural gas wells to try to increase production.
- EPA's 2009 national GHG inventory split the estimation of emissions from producing gas wells into conventional (i.e., without hydraulic fracturing) and unconventional (i.e., with hydraulic fracturing)
  - Workovers without hydraulic fracturing apply EF of 2,454 scf of CH_4/workover
  - Workovers with hydraulic fracturing apply EF of **7,623,000 scf** CH_4/re-fracture

Existing Refracturing Rate Assumptions

- In the national inventory, EPA assumes the refracturing (workover) rate for unconventional wells is 10% per year
  - In the TSD for Subpart OOOO EPA changed their assumption to 1% per year
- API/ANGA gathered data to assess EPA's assumed refracture rate

Overall emissions will depend on both the emission factor assumed for each completion/workover, the rate of performing such workovers, and the percentage vented vs. flared

API/ANGA Refracturing Rate Results

- The first phase of the API/ANGA survey obtained information from over 91,000 wells
  - Counts of refracturing by well type (conventional, tight, shale, and coal bed methane) and by AAPG basin
  - The frequency of existing wells refracturing was calculated by dividing the reported number of refracturing events by the reported total number of each type of gas well
- Although the inventory refers to these events as Workovers the terminology adopted for Subpart OOOO was changed to "refracture rate" and we recommend that this be used now for the national inventory

Refracturing Events: API/ANGA Survey Data

NEMS Region	Conventional Wells	Unconventional Wells			Unspecified
		Shale	Coal-bed Methane	Tight	
Northeast	-	-	-	-	-
Gulf Coast	-	5	-	38	73
Mid-Continent	8	1	-	73	33
Southwest	60	25	-	8	7
Rocky Mountain	4	-	25	901	-
West Coast	-	-	-	-	-
Unspecified	-	-	-	-	200
Survey TOTAL	72	31	25	1,020	313
		1,076			
Overall Survey Total	1,461				
National Workover Counts (from EPA's 2010 national inventory)	Workovers w/out HF	Workovers with Hydraulic Fracturing			
	21,088	5,044			

Refracturing Rates: API/ANGA Survey Data Phase 1 Results

	Conventional Wells	Unconventional Wells			
		Shale	Coal-bed Methane	Tight	Unspecified
% Workover Rate w/ HF (from ANGA/API Survey)	0.3%	0.3%	0.5%	3.0%	2.4%
Tight w/out AAPG 540				0.5%	
Unconventional Wells		2.2%			
W/out AAPG 540		0.5%			
All Wells	1.6%				
All Wells w/out AAPG 540	0.7%				

API/ANGA Refracturing Rate Phase 1 Results

- For all wells in Phase 1, the overall refracturing rate is 1.6%
- Excluding AAPG 540, the overall refracturing rate involving hydraulic fracturing was 0.7%
- Even when accounting for the high refracturing rates associated with tight gas wells, the workover rate is much less than EPA's assumed 10% of gas wells re-fractured each year

API/ANGA Refracturing Rate Phase 2

- Second phase collected data for 69,000 unconventional gas wells
- Targeted information for "unconventional" gas wells (i.e., those located on shale, coal-bed methane, and tight formation reservoirs), where the formations require fracture stimulation to economically produce gas.
- Re-fracture or workover was defined for this second phase of the survey as a re-completion to a different zone in an existing well or a re-stimulation of the same zone in an existing well.

Refracturing Rates: API/ANGA Survey Data Phase 2

NEMS Region	# Unconventional Operating Gas Wells	# Hydraulic Fracture Workovers on Previously Fracture Stimulated Wells	Regional % Wells re-fractured per year
Northeast	1,976	0	0%
Gulf Coast	4,943	45	0.91%
Mid-Continent	11,738	111	0.95%
Southwest	4,222	44	1.04%
Rocky Mountain without AAPG 540	13,420	40	0.30%
AAPG 540	5,950	866	14.6%
Not Specified	26,025	487	1.87%
Unconventional TOTAL (all wells)	69,034	1,593	2.31%
Unconventional TOTAL (Without AAPG 540 outlier)	**63,084**	**727**	**1.15%**

API/ANGA Refracturing Rate Results: Phase 2

- The refracturing rate obtained from survey
  - **2.31%** - based on the total of 1,593 workovers for the 69,034 wells reporting
  - **1.15%** - based on 727 workovers for 63,084 wells reporting (if excluding AAPG 540)
  - **4.68%** - based on 906 workovers reported for 19,370 wells for the Rocky Mountain Region (with AAPG 540)
    - 0.3% for Rocky Mountain Region without AAPG 540

Gas Well Refracturing Emissions Comparison

NEMS Region	2010 EPA National Inventory # Workovers	Adjusted Refracturing Events	2010 EPA National Inventory		Revised Emissions, tonnes CH_4**	% Difference
		Refrac rates from API/ANGA Survey	Emission Factor, scf CH_4/ workover	Estimated Emissions, tonnes CH_4*	From API/ANGA Survey	
Northeast	0	0	7,694,435	0	0	
Mid-Con	1,328	153	7,672,247	196,191	22,462	-89%
Rocky Mountain	2,342	1,100	7,194,624	324,486	151,432	-53%
Southwest	1,374	158	7,387,499	195,497	22,382	-89%
Gulf Coast	0	0	8,127,942	0	0	
West Coast	0	0	8,429,754	0	0	
TOTAL	5,044	1,411		716,174	196,276	-73%

* EPA Estimated emissions are converted to mass based on 60 F and 14.7 psia

** Revised emissions = Adjusted workovers x Emission Factor, converted to mass based on 60 F and 14.7 psia

This comparison does not address the validity of the EPA emission factor.

energy API AMERICAN PETROLEUM INSTITUTE

Conclusion

- API/ANGA provides a rich database of refracturing rates for the 91,000 wells surveyed
- Even when using the high EPA emission factor for the adjusted regional number of refracturing events (derived from the observed refracturing rates), the total emissions are much lower
- This does not yet address issues with the emission factor per refracturing event
  - We have used the EPA EF since no new emissions data are currently available
- OOOO assumption of 1% refracturing is a more reasonable assumption than 10%