



LFG Purification & Blending

Is Pipeline Quality Necessary?



7th Annual LMOP Conference & Project Expo
January 7th, 2004

Overview



Case History / American LF, Canton OH:

Project Partners

- ✓ Dominion
- ✓ Toro Energy
- ✓ Waste Management

Basic Concept

- ✓ Think of Blending as a Manufacturing Process where LFG Quality is Controlled
- ✓ Remove Constituents Detrimental to Pipeline Quality
- ✓ Control the Blending Process for Remaining Constituents so that No Quality Issues Exist
- ✓ Commit to Testing, Monitor & Control



American LF: Canton, OH



Dominion: Risk / Risk Mitigation



Risk: “Non-Spec” Gas Entering our Pipeline Systems

Risk Mitigation Activities:

- + Focus on Day-to-Day Monitoring, Operation and Maintenance of the Blending Process**
- + Utilize Cost-Effective Technologies that Remove or Minimize Gas Components that can be Detrimental (work with project developers to understand, specify and install)**
- + Maintain Commitment for Regular Sampling and Analysis to Identify Changes that May Occur**
- + Assure that Systems & Processes are Designed with Redundant Safety Factors**

Risk / Risk Mitigation, Cont'd.



Risk: Introducing “Non-Spec” Gas Into our Pipelines

- ✚ Stoner Flow & Blending Models
- ✚ CFD Model Utilized to Assure Blending Occurs Within Understood Distances

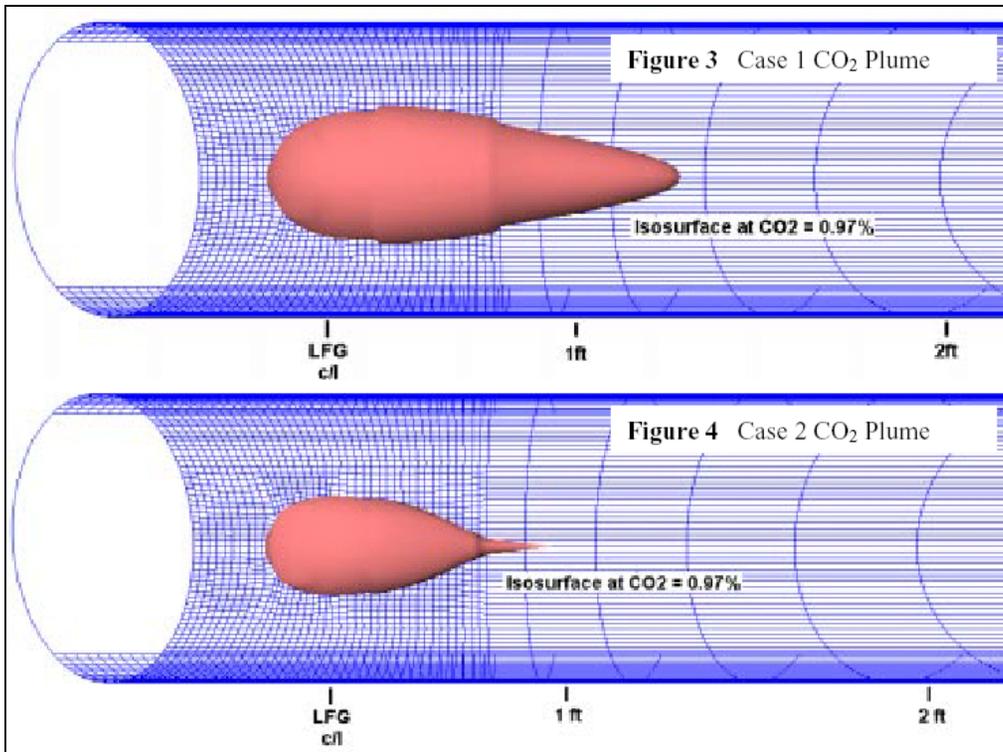


Table 3A: Mean, Minimum, Maximum Values Downstream

Case	CO ₂ %											
	Mean (%)	+/- Range downstream			Mean (%)	+/- Range downstream			Mean (%)	+/- Range downstream		
		50'	100'	150'		50'	100'	150'		50'	100'	150'
1	0.389	0.343	0.379	0.387	1.029	0.994	1.021	1.027	0.120	0.104	0.116	0.119
2	0.207	0.436	0.399	0.391	0.891	1.064	1.036	1.031	0.058	0.135	0.123	0.121
		0.183	0.201	0.206		0.871	0.887	0.890		0.050	0.056	0.058
3	0.483	0.232	0.212	0.208	1.099	0.910	0.895	0.892	0.151	0.067	0.060	0.058
		0.439	0.473	0.481		1.037	1.092	1.098		0.137	0.148	0.150
4	0.483	0.526	0.492	0.485	1.817	1.132	1.107	1.101	0.101	0.166	0.154	0.152
		0.439	0.473	0.481		1.711	1.792	1.811		0.091	0.099	0.100
		0.526	0.492	0.485		1.924	1.840	1.822		0.110	0.103	0.101

Case	HHV			
	Mean	High/Low downstream		
		50'	100'	150'
1	1,034	1,035	1,034	1,034
		1,032	1,033	1,034
2	1,040	1,041	1,040	1,040
		1,039	1,040	1,040
3	1,030	1,032	1,031	1,030
		1,029	1,030	1,030
4	1,024	1,026	1,024	1,024
		1,021	1,023	1,023

Toro Energy



Key Points:

- ✦ Point 1** Project Needs to be Site Specific. LFG May be Blended into Pipelines that Meet Very Specific Criteria, Limiting LFG Pipeline Blending Opportunities.
- ✦ Point 2** Increased Capital and Operating Costs Versus Traditional Medium Btu Projects
- ✦ Point 3** Allows Project to Capture Fossil Fuel Pricing. Increased Capital and Operating Costs Must be Considered.
- ✦ Point 4** Reduces Risk of Catastrophic Loss of Project that can be Associated with Medium Btu Projects (i.e.; plant closing). Reduced Delivery Swings (seasonal and weekend) that can Accompany Traditional Single Source Medium Btu Projects.



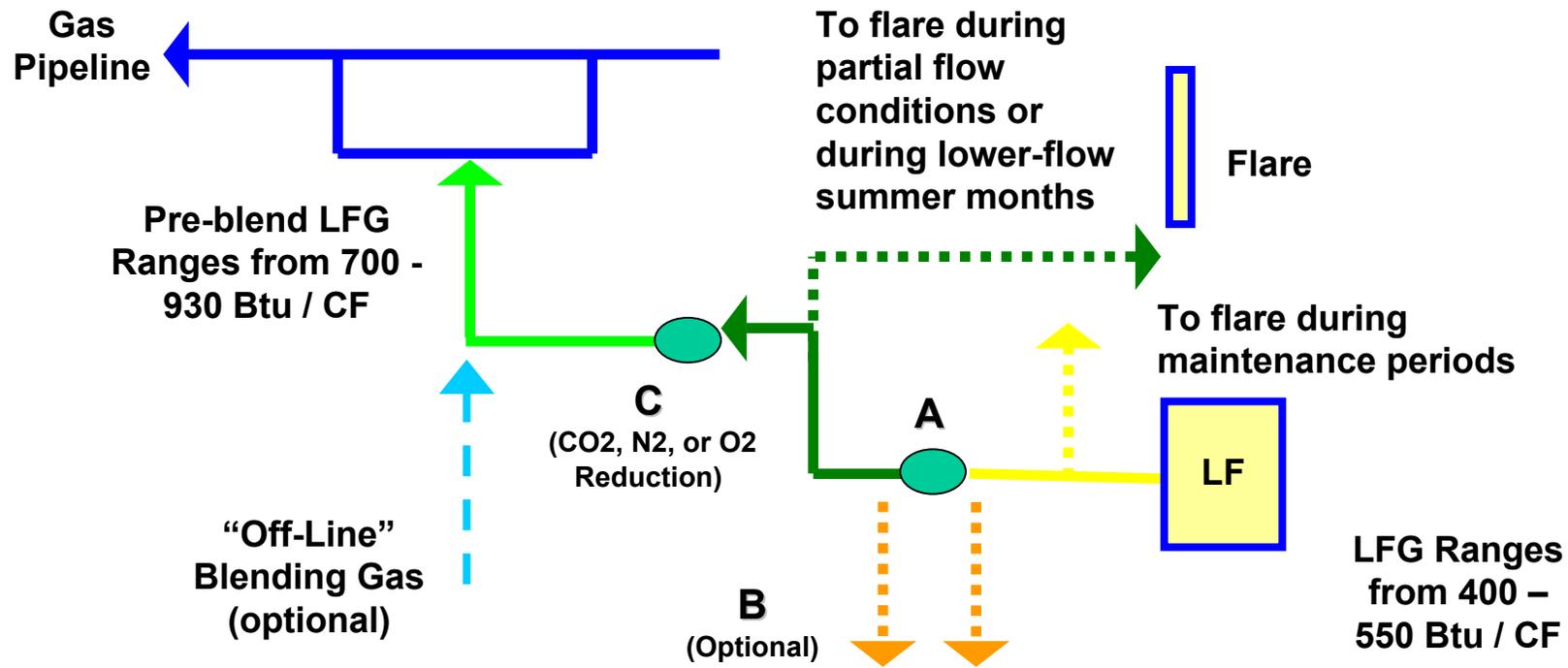
Waste Management



Why this Type of Project is Appealing to the Landfill Owner:

- + Minimal Impact to the Land-Filling Operations**
- + 24/7, Year Round Beneficial Use of Landfill Gas**
- + No Permitting of New Emission Source Required at Landfill**
- + Plant and Pipeline are “Non-Contentious” Facilities, Especially in a Region where Natural Gas is Produced Locally**
- + Smaller Footprint than Power Plant Alternative**
- + Can be Economically Feasible when Other Uses are Not**

Blending Options Schematic



- ✚ Pretreatment, VOC & NMOC Removal at Point A
- ✚ Optional Power Generation at Point B (or other “local” LF use) Power can be Base or Peak (or a combination of both)
- ✚ CO₂ Reduction & Additional Optional Clean-up at Point C (several methods exist)
- ✚ Can Pre-Blend “Off-Pipeline”
- ✚ Greater Numbers of Projects



The Business Case for Participation



Financial Overview:

- + LF Owner Retains Tax Credits**
- + Developer Fees Offset Capital and O&M (one employee usually)**
- + LDC Fees for Metering, Monitoring, Controlling / Blending, Testing, Billing**
- + Emission Credits Usually Split Between LF Owner & Producer (LDC's can participate)**
- + Fees Vary per Project (one recent example, fees are about \$0.35, \$3.00 and \$0.65 respectively)**



Nontraditional Methane Resource Commitment



For Dominion:

- ✚ Formal Project Team**
- ✚ Evaluation Process for Projects**
- ✚ Own & Operate Instrumentation to Monitor and Control Blending Process**
- ✚ Testing & Analysis Schedule for Operating Projects**
- ✚ Can Assist the Process of Securing Fixed-Cost Supply to End-users**

Future Blending Projects

Best Opportunity Sites:

- + Flare Operating**
- + Within Reasonable Distance from Higher Volume Natural Gas Pipeline**
- + 1,500 CFM Raw Gas Flow (+/- ?)**
- + Purification Equipment to Produce Pre-Blend Volumes with:**
 - ✓ 75% to 90% Methane**
 - ✓ ~4% Nitrogen**
 - ✓ < 5 to ~20% Carbon Dioxide**
 - ✓ 1% Oxygen (maximum)**
 - ✓ <7# / Mcf Water**
 - ✓ VOC & Odor Free**
 - ✓ Siloxane at Non-Detect Level**
 - ✓ 4 ppm Hydrogen Sulfide (maximum)**
 - ✓ Additional Specifications Apply**
- + LF Still Receiving Waste (or closed not more than a few years)**



Future State Nontraditional Methane Blending



Project Partner Summary Points:

+ Dominion

- + All Parties Benefit**
- + Blended Gas Can Be Provided to Several End-Users (without special modification to end-user equipment)**

+ Toro

- + Viable in Very Specific Applications**
- + Reduces Market Risks and May Reduce Fluctuation of LFG Deliveries to Single-Source Customers**

+ Waste Management

- + Viable in Locations that Lack Nearby Medium Btu Customers**

