Road Mapping Idea Overview

March 22, 2005

Houston, Texas

American Public Gas Association Research Foundation Idea Generation Session

10 November 2004

Philadelphia, PA

Brainstorming Research Needs

- Installation, Operations and Maintenance
- End Use, Residential and Commercial Appliances

Topical Areas of Brainstorming Session

- Operations and Maintenance
- Excavation and Restoration
- Integrity Management
- Metering
- Pipe Materials, Locating, Maintenance, Rehabilitation
- Damage Prevention
- Corrosion Control
- Leak Search and Investigation
- Safety
- Environmental
- Long Term Research

Topical Areas of Brainstorming Session

- Residential
- Commercial
- Natural Gas Prices
- Load Retention and Education
- Comfort and Outdoor Appliances
- Power Generation
- Absorption Cooling

Operations and Maintenance

1. Processing improvements to meet natural gas interchangeability issues with high BTU LNG and heavy end hydrocarbons (safety equipment, processing and system maintenance issues) – 6 Dots
2. Gas/liquid condensation and effect on system disposal – 6 Dots
   a) Systems to monitor and reprocess
   b) Prevention of the presence of liquids
   c) Specification Enforcement
   d) Low Cost removal
3. GPS, Cheap and simple to use – 5 Dots
4. GIS, common language between gas & electric – 3 Dots

Excavation and Restoration

1. Micro Excavation Technology (tools for six-inch opening) – 4 Dots
   a) Robotics
   b) Long handle tools
   c) Clamp, sealing, anode, disconnects and valve installation
   d) Laser cutting
2. One-Step Pavement Restoration – 2 Dots
3. Rapid/Silent Pavement Cutting – 0 Dots
4. Low-cost Shoring – 0 Dots

Integrity Management

- Testing capability of distribution gas mains to locate leaks or potential pipe integrity problems- - 9 Dots
  - Help in prescriptive planning
  - Easy to understand CP protocols for field staff
  - Computer software to aid in IM
  - Enhanced keyhole technology

Metering

1. Way to test gas meters without taking out of service or blowing gas – 5 Dots
2. Meter calibration and testing from office – 0 Dots
3. Automated Meter Reading – solve battery replacement problem. Shoot for 8-12 year life – 0 Dots

Pipe Materials

1. Traceable Plastic Pipe (internal tracer wire; spray-on or post extrusion applied) – 3 Dots
2. Coated plastic pipe to resist abrasion during burial – 2 Dots
3. “Smart” pipe that alerts operators before failure – 1 Dot
4. High Pressure Plastic Pipe – 0 Dots

Pipe Location

1. Locating Tools and Equipment to accurately find non-metallic pipe must be portable (hand-held), easy to use and accurate– 7 Dots
2. Sound generating system to locate mains and services without tracer wire – 0 Dots

Pipe Maintenance

1. Live cut-off and reconnect to reduce costs – 2 Dots
2. Equipment and methods for detecting and control of alternating current on gas piping – 0 Dots

Pipe Rehabilitation

1. Rehabilitation of large diameter cast iron pipe – 5 Dots
2. Replace/Rehabilitate small diameter cast iron pipe – 5 Dots
   a) Develop a predictive risk model that is not only based on historical date, such as breaks
   b) Cost effective replacement and rehabilitation methods
   c) Alternatives to replacement of undermined cast iron.
3. Develop materials and equipment for “live” internal sealing of cast iron pope joints – 0 Dots

Third-Party Damage Prevention

1. Sensors for equipment operating close to natural gas mains – 2 Dots
2. Continuous remote monitoring of third-party activity at all facilities – 1 Dot
3. GPR detector head for gas bore cutting head (alerts operator they are about to strike an underground facility – 1 Dot
4. Automatic shutdown for tear outs on mains. Not an EFV. – 0 Dots
5. Sensor to shut down directional drilling equipment before striking underground facility – 1 Dot

Corrosion

1. Instrument for non-intrusive (pipe in ground) direct assessment of corrosion – 1 Dot
2. Improved methods for performing cathodic protections surveys – 1 Dot
3. Develop an internal corrosion protection device – 0 Dots

Leak Location & Detection

1. Laser detector for leak survey (capable to 100 ft or more) – 5 Dots
2. Leak survey utilizing vehicles and hand-held equipment (beyond optical methane detection) – 0 Dots
3. Make the product visible – 0 Dots
4. Methods for determining the presence of gas in buildings without entering the building – 0 Dots

Safety

1. Improved protective clothing/equipment for first responders – 0 Dots
2. Improved Carbon Monoxide detection capability – 0 Dots
3. Technologies to deal with and control blowing gas conditions in lieu of SCBA – 0 Dots

Pipe Installation

1. Joint trench technology to serve gas, electric, telephone and water – 3 Dots
2. Camera technology to route camera up cleanout wye on sewer lateral to check house lines after gas service is bored in place – 0 Dots

Environmental

- Remediation (in situ and bio) of former manufactured gas plant sites while leaving structure in place – 0 Dots

General Improvements

- Perfect hydro-heat water heater – 2 Dots
- Outdoor natural gas patio heater – 3 Dots
- National efficiency rating for gas appliances – 6 Dots
- Venting solutions that are easy and cost-effective – 4 Dots
- Address BTU fluctuations causing appliance problems – 0 Dots
- Transport natural gas by tanks – 1 DOT
- Design dielectric non-conductive nipples to protect water heaters against corrosion shortened life – 1 Dot

Longer Term

- Retrofit natural gas appliances to burn hydrogen – 2 Dots
- Blend H2 with other molecules to transport (bigger molecule=less permeation – 1 Dot
- Make natural gas inert for shipping, reform at appliance – 0 Dot
- Non meter installations – Smart appliances send info back on their use – 3 Dots
- Natural gas stored in solid form as hydrates or hydrides– 0 Dots

Residential

- Return pulse furnaces to the marketplace – 4 Dots
- Return outside water heaters to the marketplace – 9 Dots
- Develop a natural gas equivalent of a propane mosquito magnet – 3 Dots
- Residential gas reformers for all residential appliances – 4 Dots

Fuel

- Affordable natural gas (address market greed) – 2 Dots

Load Retention/Government and Customer Education

- Integrate technologies such as Evaporative Coolers and desiccants – 0 Dots
- Load Retention – 7 Dots
- Smart appliances (software providing consumers with efficiency feedback) to compete with electrics – 7 Dots
- Government/Consumer education on total cycle efficiencies of natural gas and electricity – 4 Dots
- Educate architects on benefits of natural gas appliances – 2 Dots
- Educate architects and engineers on value engineering – 7 Dots

Comfort – Air and Water

- Gas A/C and Ambian gas heat pump – 20 Dots
- Micro water heating and heating unit – 5 Dots
- Real cost effective dehumidifier for residential and commercial applications – 7 Dots
- Combined water heating and heating – 4 Dots
- Evaporative Cooler for both wet and dry areas (gas-fired A/C with dessicant) – 3 Dots
- Use of dessicants to improve air-conditioning – 4 Dots
- Ease cleaning of commercial natural gas appliances (gas under glass) – 6 Dots
- Minimize heat loss in commercial cooking through heat recovery in exhaust hood – 4 Dots

Outdoor Appliances

- Excessive heat shutdowns in gas lights and barbeques – 1 Dot
- Increase light output of natural gas lamps – 3 Dots
- Increase the variety of outdoor appliances – 2 Dots
- Improve gas logs – 0 Dots
- Ventless fireplace – eliminate water on windows – 0 Dots

Power

- Affordable distributed power for residential and commercial customers – 2 Dots
- Low pressure gas generator – 11 Dots

Absorption Storage

- Residential natural gas storage (absorption medium) – 7 Dots
- Availability of CNG vehicles – 1 Dot
- Natural gas fueled vehicles – 0 Dots
- Methane storage for vehicular use – 0 Dots
- Fuel cell operated crew truck and heavy equipment – 0 Dots