NYSEARCH
R&D PROGRAM HIGHLIGHTS

2018 NEW ENGLAND PIPELINE SAFETY REPRESENTATIVES (NEPSR) SEMINAR
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Northeast GAS ASSOCIATION   NYSEARCH
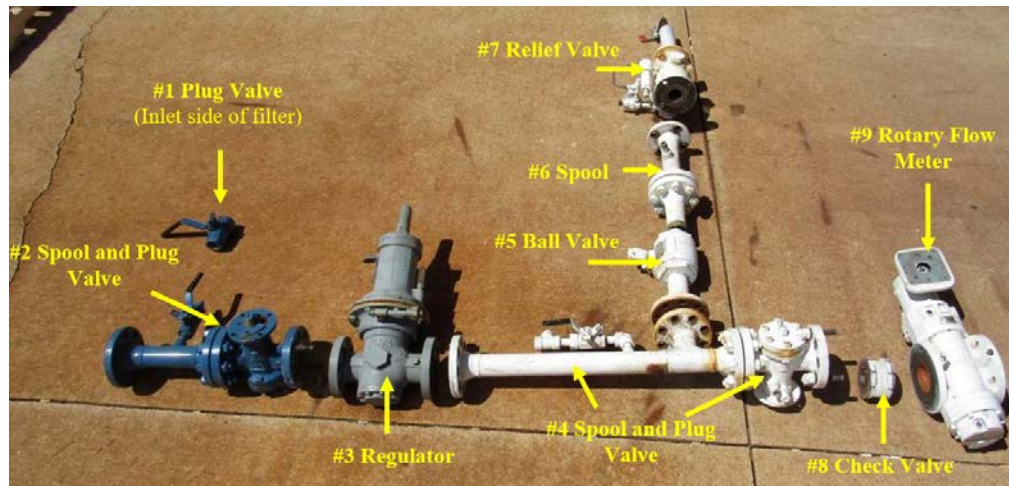
PRESENTATION TOPICS

- Introduction to NYSEARCH

- R & D Program Areas & Examples

  - Improving the Environment/Reducing GHG Emissions

  - Real-time Sensing & Inspection for Distribution

  - Leak Detection

  - Pipe Location

  - Damage Prevention

  - Pipeline Integrity & Inspection - Direct & Remote Assessment

  - Technology to Enhance Installation, Maintenance & Repair

INTRODUCTION TO NYSEARCH RD&D PROGRAM

- NYSEARCH is a sub-organization of NGA that conducts voluntary RD&D on behalf a consortium of utilities located in North America.

- We focus on technologies that advance safety, improve cost effectiveness and productivity, and improve the environment.

- Our program areas reflect the benefits that our members are seeking. NYSEARCH members work to implement R & D products in their companies.

BIOMETHANE DATA COLLECTION PROJECT

- Evaluate the effects of processed biomethane from Renewable Natural Gas (RNG) on distribution system components.

  - Sample select piping components and materials part of the downstream system at the Hamilton Ontario Wastewater Treatment Plant

- Based on several years of operation, gain and share information about the impact of RNG on gas distribution infrastructure and advance understanding of benefits of using RNG.

BIOMETHANE DATA COLLECTION PROJECT

- The wastewater treatment plant's anaerobic digesters produce about 350,000 cubic feet of biogas per day.

- Raw biogas from the digesters is sent to the following systems:

  - A1.6 MW Caterpillar reciprocating engine for co-generation of electricity and heat.

  - A water scrubbing system for upgrading to RNG by removing CO_2, Hydrogen Sulfide, and Siloxanes.

- Operates between 80 – 150 psi; maximum flowrate is 18,000 SCFH

- Pressure reduced to 60 psi for injection into distribution system

- Continuous measurement of CO_2, H_2O, O_2, CO, H_2, H_2S

- Periodic sampling for hydrocarbons, siloxanes, bacteria, ammonia, and mercury.

ENVIRONMENT/REDUCING GHG EMISSIONS — BIOMETHANE DATA COLLECTION PROJECT

Chemical Monitoring

- Sample raw biogas and biomethane (RNG) simultaneously

- Test per CAB 1900 – Siloxanes, Mercaptans, Mercury, Sulphur, Carbon Dioxide, Hydrogen Sulfide, etc.

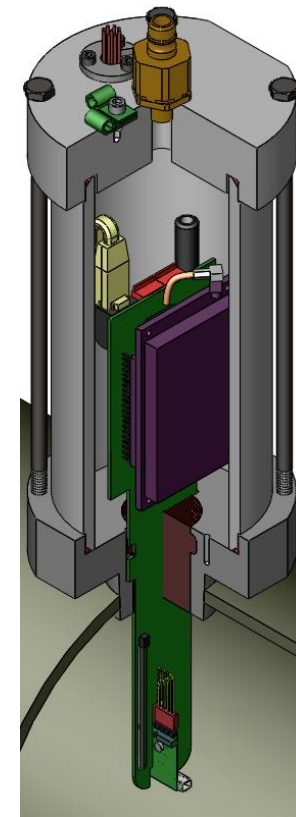- Analyzed metrics – biogas production and gas clean-up system performance

Materials Evaluation

- During plant down time, common distribution components (i.e. piping, fittings, valves, orifices, regulators, etc.) have been removed and replaced. These materials tested to understand long term impacts of RNG.

- No indications of corrosion, microbially induced damage or any other degradation from RNG service in over 5 years of operation.
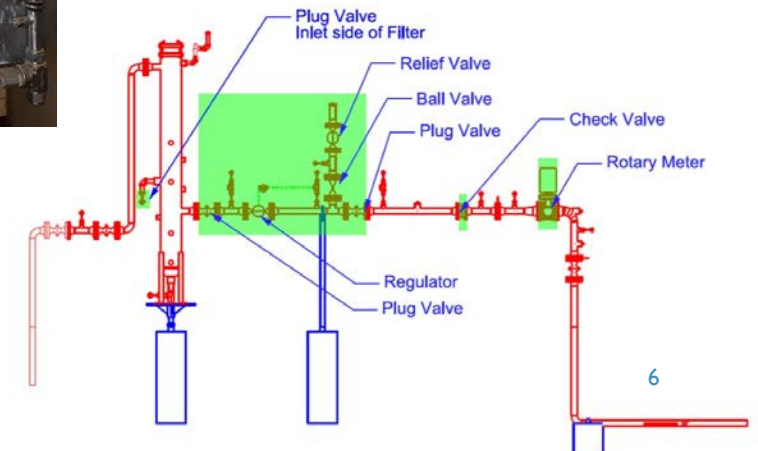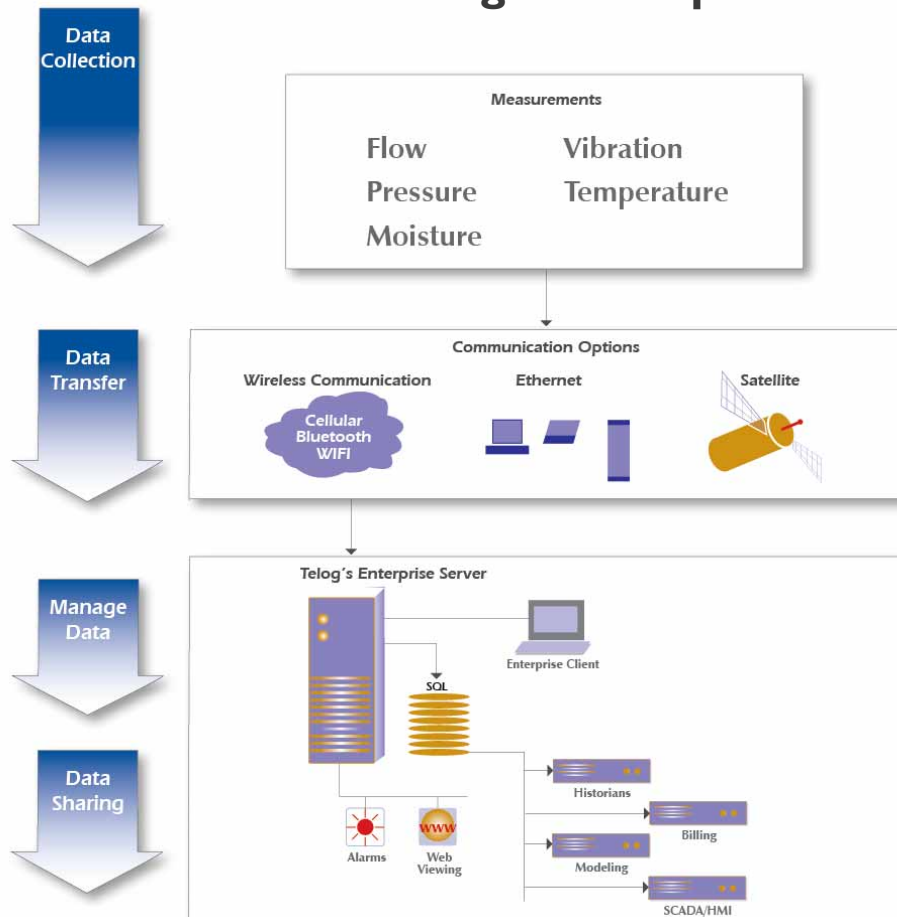
REALTIME SENSING & INSPECTION OF DISTRIBUTION –
GASCOMM™ SENSOR NETWORK

- Develop a wireless distributed network of sensors that can measure and monitor the following parameters in gas distribution:

  - Pressure

  - Temperature

  - Humidity

  - Flow volume rate

  - Flow direction in pipe

  - Vibration

- Communication between sensors will be cellular (for testing purposes) or can be designed for radio, modem, utility specific.
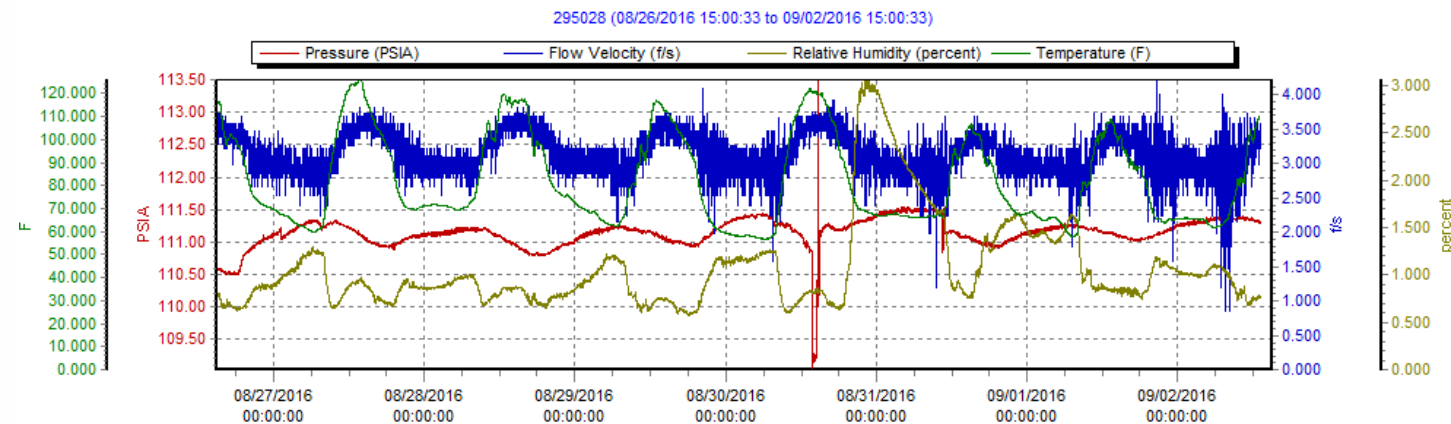
- Power requirements are independent and long-lasting.

REALTIME SENSING & INSPECTION OF DISTRIBUTION – GASCOMM™ SENSOR NETWORK

Design Concept

Data Collection

Measurements

Flow	Vibration
Pressure	Temperature
Moisture	

Data Transfer

Communication Options

Wireless Communication — Cellular Bluetooth WIFI

Ethernet

Satellite

Manage Data

Telog's Enterprise Server

Enterprise Client

SQL

Historians

Billing

Modeling

Data Sharing

Alarms

Web Viewing

SCADA/HMI

Live Data

295028 (08/26/2016 15:00:33 to 09/02/2016 15:00:33)

Pressure (PSIA)   Flow Velocity (f/s)   Relative Humidity (percent)   Temperature (F)

REALTIME SENSING & INSPECTION OF DISTRIBUTION –
GASCOMM™ SENSOR NETWORK

- Ideal Installation location of GasComm™ Sensor

  - Steel pipe, 2" to 12" in diameter

  - Location - anywhere! (direct bury, above ground, vaulted, regulator station, straight pipe length in middle of corn field!)

  - Tap either Mueller "No-Blo" or TDWilliams fittings

  - Flow sensor location optimization

    - Upstream - Straight pipe of 6 pipe diameters

    - Downstream - Straight pipe of 6 pipe diameters

  - Requires Maintenance and Construction crew for installation

    - Involves excavation, welding, tapping and sensor installation

  - Keyhole installation

GENERAL INSPECTION & LEAK DETECTION –
sUAS REGULATORY & TECHNOLOGY ASSESSMENT

- Confirm FAA regulatory compliance of sUAS applications

- Evaluate the capabilities and benefits of an sUAS (Small Unmanned Aerial Systems) in performing routine and emergency gas pipeline inspections and surveys
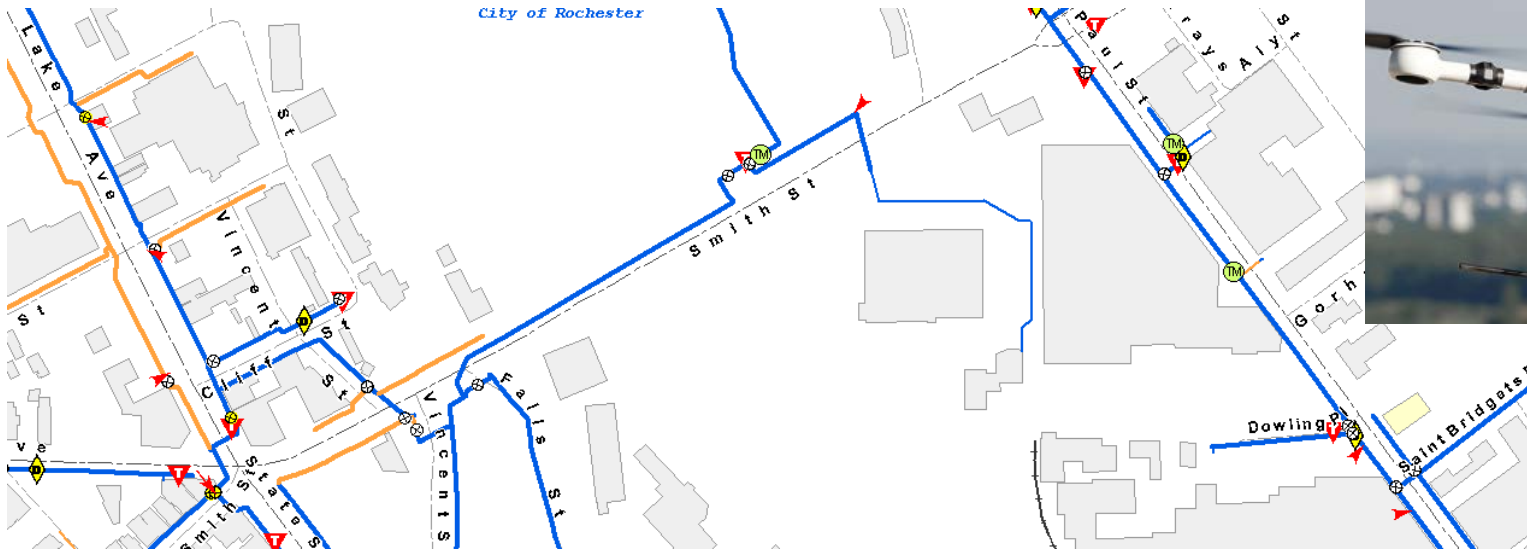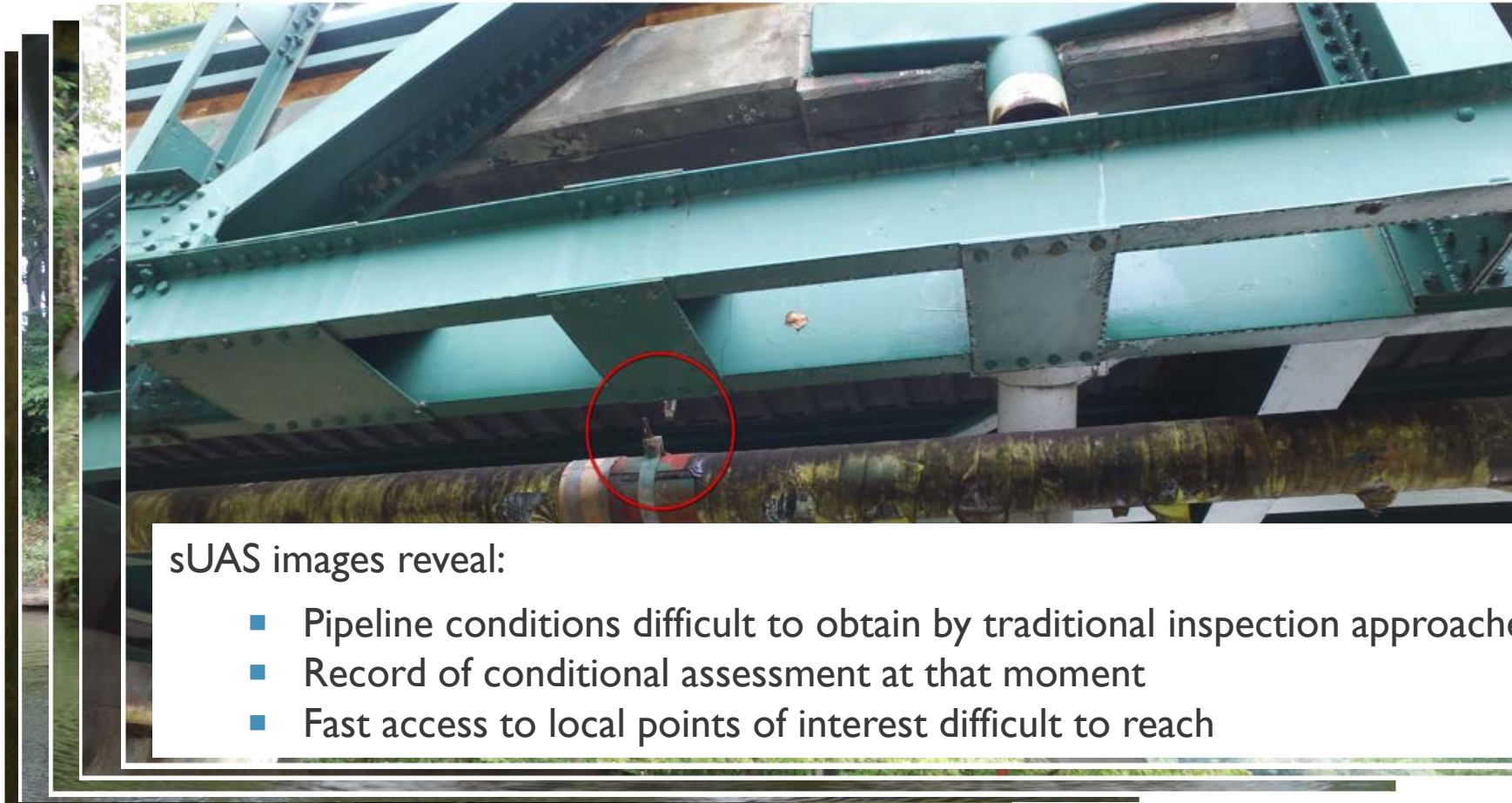
GENERAL INSPECTION & LEAK DETECTION – sUAS REGULATORY & TECHNOLOGY ASSESSMENT

- Federal Aviation Administration (FAA)

  - Regulation Released August 2016

    - 49 FR Code Part 107 (testing and certification)

  - sUAS Restrictions are enforced per Part 107

    - 36 Specific Operating Limitations, for example:

      - Unmanned aircraft must weigh less than 55 lbs

      - Visual line-of-sight (VLOS) only

      - Daylight-only operations

      - Minimum weather visibility of 3 miles

      - Operations in Class B, C, D and E airspace with permission

sUAS REGULATORY & TECHNOLOGY ASSESSMENT

- An Example flight at a pipe bridge crossing for Inspection of Conditional Assessment
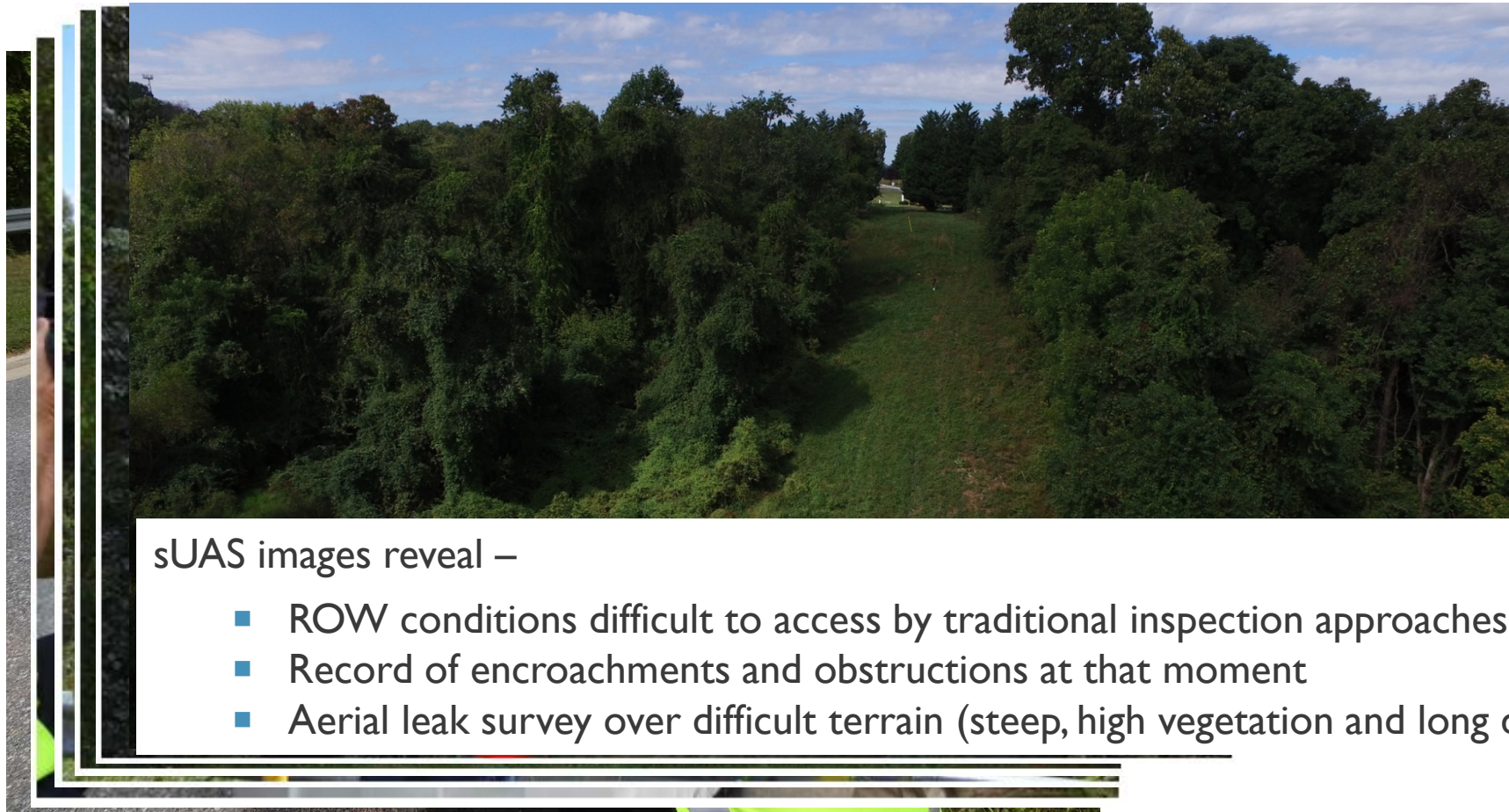

sUAS images reveal:

- Pipeline conditions difficult to obtain by traditional inspection approaches
- Record of conditional assessment at that moment
- Fast access to local points of interest difficult to reach

GENERAL INSPECTION & LEAK DETECTION –
sUAS REGULATORY & TECHNOLOGY ASSESSMENT

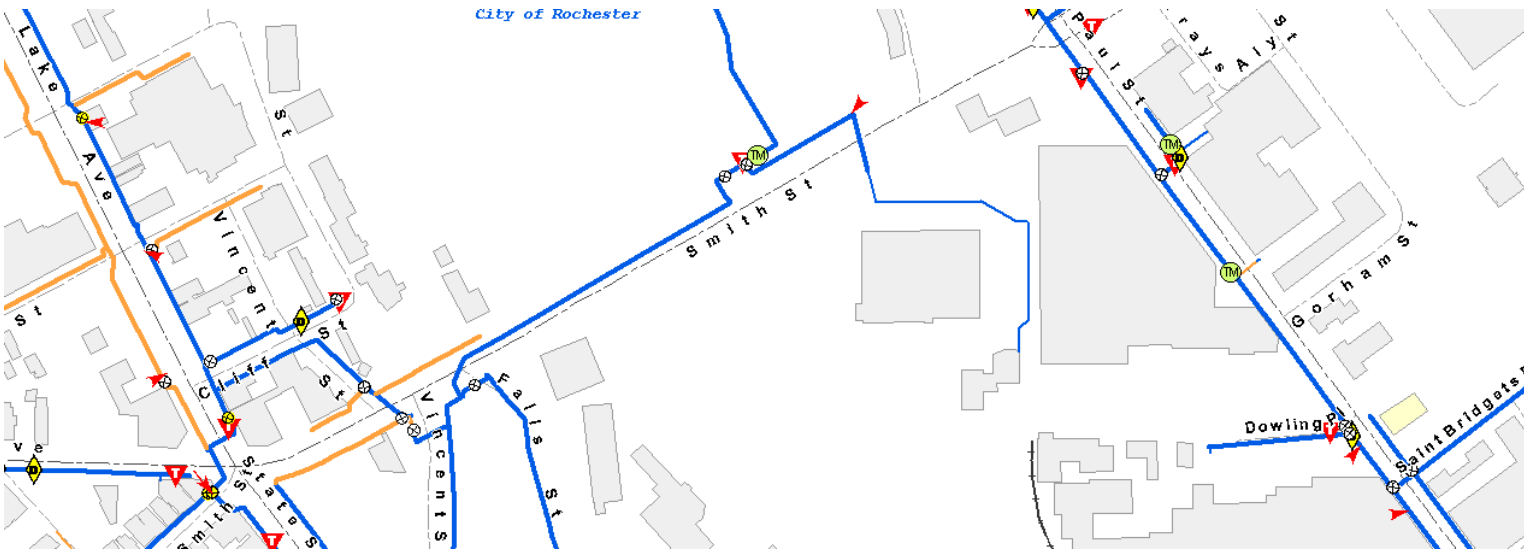- An Example flight for Right-Of-Way Inspection and Leak Survey

sUAS images reveal –

- ROW conditions difficult to access by traditional inspection approaches
- Record of encroachments and obstructions at that moment
- Aerial leak survey over difficult terrain (steep, high vegetation and long distance)

GENERAL INSPECTION & LEAK DETECTION –
JPL / NASA METHANE DETECTOR

- Integrate a commercially available methane detector onto a sUAS and develop a software control system to allow for detection and location of methane emissions.

- A successful outcome for this project would result in a new technology that would allow the gas industry to effectively detect and localize pipeline emissions from a sUAS mounted methane detector

JPL / NASA METHANE DETECTOR

- Completed Testing – Calgary – July 3-5, 2018

  - Tested two instruments to determine the optimum survey instrumentation:

    - Pergam DIAL sensor for general methane detection.

    - JPL OPLS sensor for specific ground localization of methane emission.

  - Data compiled from the JPL OPLS sensor identifies methane and ethane emissions with sensitivity of ppb (billion).

  - Additional tests incorporating both sensors, are upcoming in October.
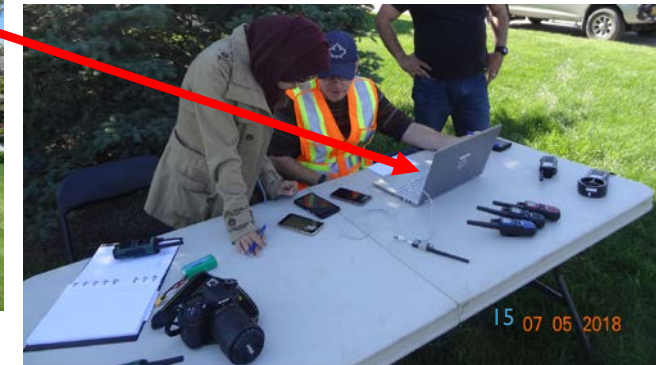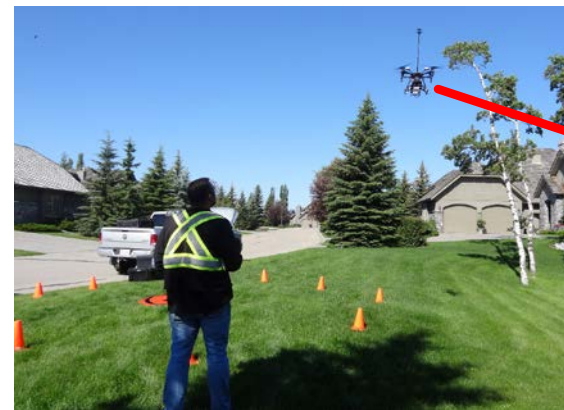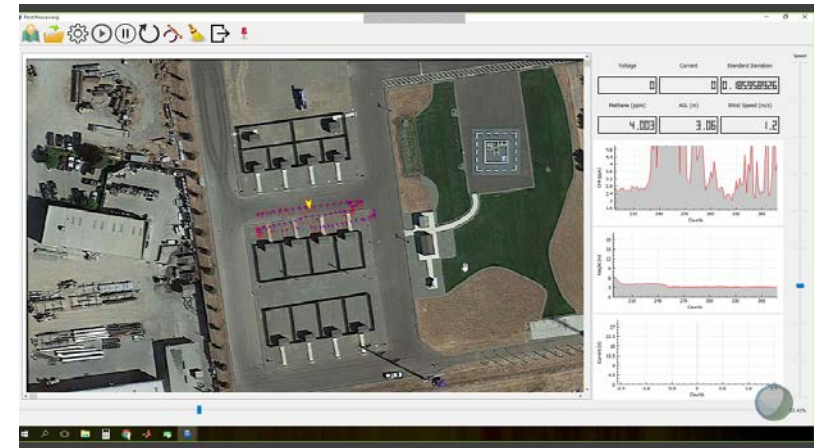
PIPE LOCATION AND DAMAGE PREVENTION –
DEVELOPMENT AND TESTING OF RFID TAG FOR COILED PE PIPE

- Develop and test a tag and reader system using RFID technology embedded in coiled PE pipes to locate pipe installed via trenchless applications
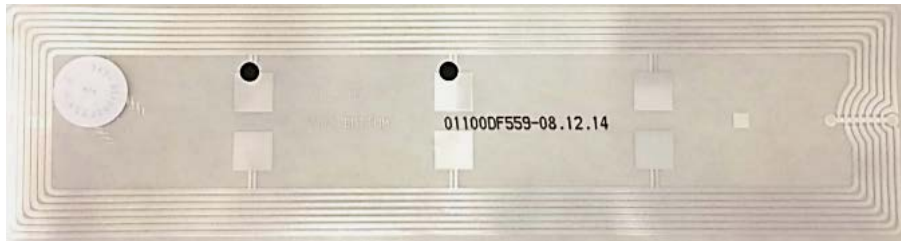

- The contractor, Engie, is co-funding the project and is working in partnership with Eliot and RYB, a major plastic pipe manufacturer in France, who is prepared to license this technology to US pipe manufacturers

  - Ongoing NYSEARCH development & planned field tests to ensure fit-for-purpose and visibility to N. American industry


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PIPE LOCATION AND DAMAGE PREVENTION –
DEVELOPMENT AND TESTING OF RFID TAG FOR COILED PE PIPE

- Lab tests completed with different types of pipe, diameters, materials at different depths and in various types of soil

- The preliminary results of the prototype are positive

- NYSEARCH currently evaluating an advanced prototyping and field testing phase
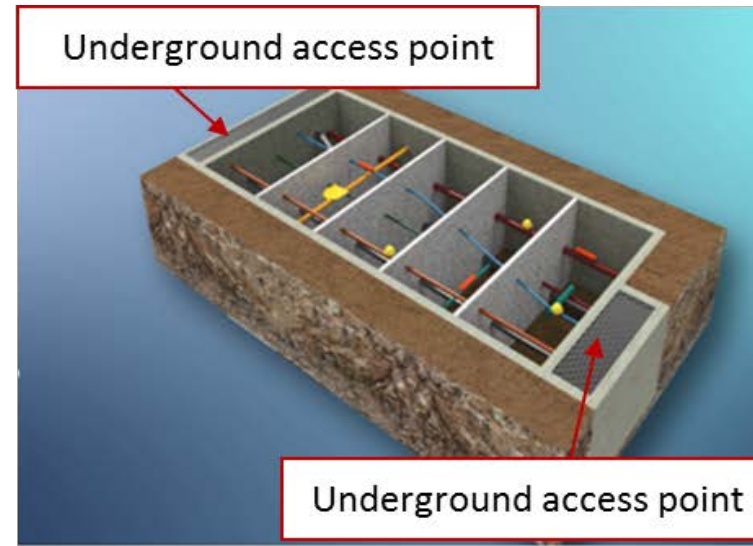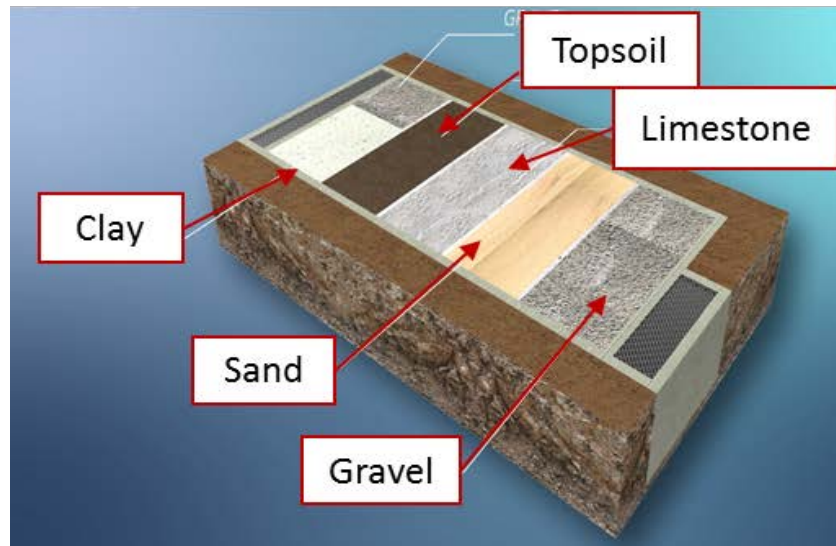
PIPE LOCATION AND DAMAGE PREVENTION –
METGLAS DETECTABLE TAPE FOR PLASTIC PIPE LOCATION

- A project to develop the potential of Iron-Based Detectable Tape for plastic pipe location

- Amorphous Iron-based Tape is a paper thin ribbon that has high magnetic permeability and high tensile strength and is cost effective.

- Because of its high magnetic permeability, it can be located with commercially available magnetic gradiometers.

- Tapes are laminated to prevent rust/corrosion.

- Tape remains functional and locatable even in the event of discontinuities due to damage to the tape.

Ribbon

Pipeline

Plow Install
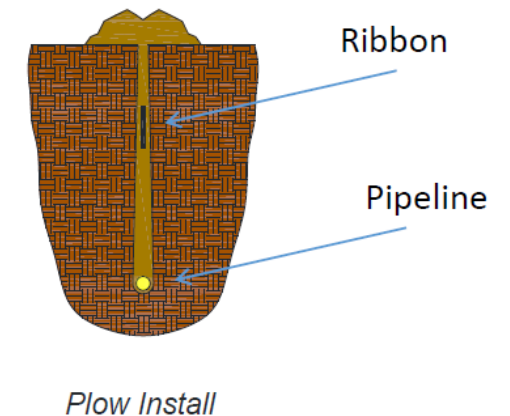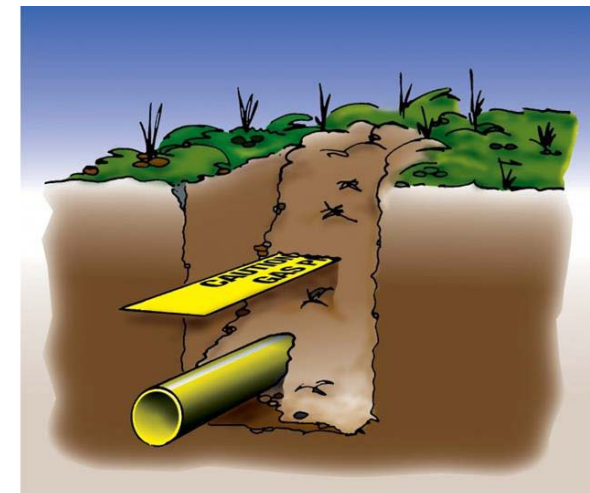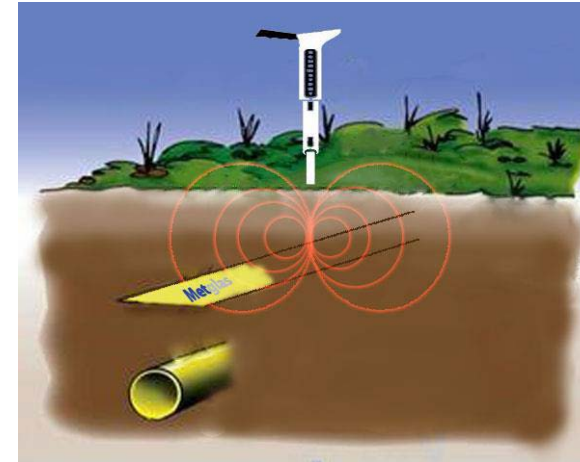
EXPLORER ROBOT INSPECTION PLATFORM

- A robotic system that can be used for inspection of LDC owned unpiggable transmission pipes.

- Launched and retrieved under live conditions via off-the-shelf fittings.

- Bi-directional.

- Able to negotiate most pipeline features; short-radius bends, mitered bends, vertical segments, back-to-back bends, plug valves (>20" pipelines)

- Provides Visual, Magnetic Flux Leakage (MFL), Laser Deformation Sensor(LDS) data for pipe integrity, metal loss, and mechanical damage/ovality.

- Battery-powered

- Tether less (wireless communication)

- Range currently limited by batteries and wireless
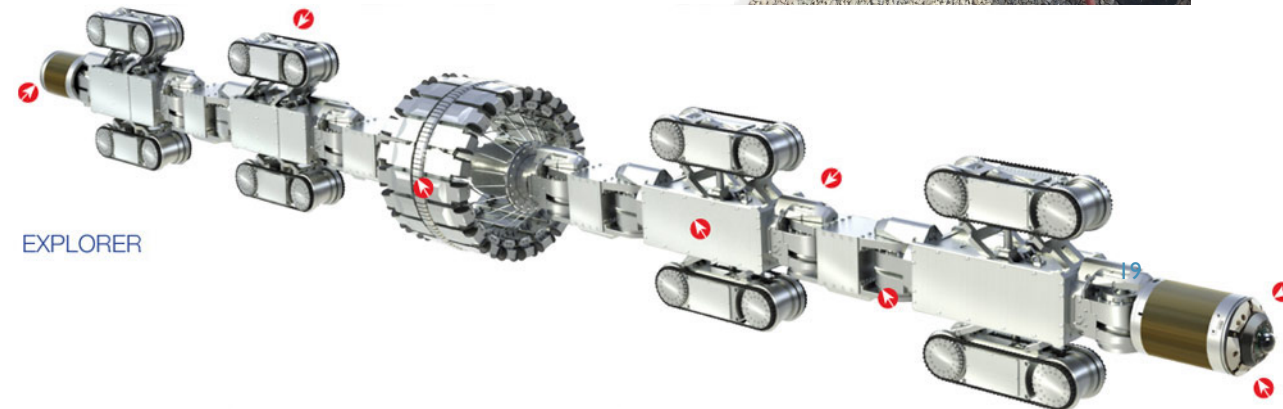
EXPLORER

EXPLORER ROBOT INSPECTION PLATFORM

- Since 2011, NYSEARCH[1]/Invodane and Pipetel have commercialized:

  - Six Inspection platforms (X8, X10/14, X6/8, X16/18, X20/26, X30/36)

  - Six MFL sensors (X8, X16/18, X20/26, X30/36, X20/22-plug-valve, X24/26-plug-valve)

  - 4 LDS for mechanical damage/ovality (X8, X16/18, X20/26, X30/36)

  - In-line recharge system

Over 40 gas companies in N. America have used these tools

[1]NGA/NYSEARCH licensed Intellectual Property to Invodane for exclusive commercial sale of Inspection Services. Pipetel is a spin-off service company of Invodane.

EXPLORER ROBOT SUPPORTING TECHNOLOGIES

- The Explorer Robot platform is modular and new supporting technologies for additional capabilities are being developed.

- Products in commercialization or pre-commercialization phases include:

  - Bend sensor

  - Hardness tester

 - Crack sensor

  - Cleaning tool with flow

TECHNOLOGY TO ENHANCE INSTALLATION, TRAINING & REPAIR
HOLOLENS AS APPLIED TO GAS OPERATIONS / TRAINING

- Augmented Reality (AR) is a revolutionary technology that superimposes a computer-generated image on a user's view of the real world.

- AR tools such as the Microsoft HoloLens have become available that harness this technology and are viewed as a revolutionary method of enhancing communications.

- Some gas utilities are keen to implement AR – key is to understand applications / benefits / challenges of AR and identify highest impact opportunity

HOLOLENS TEST PROGRAM – TRADITIONAL PROGRAM
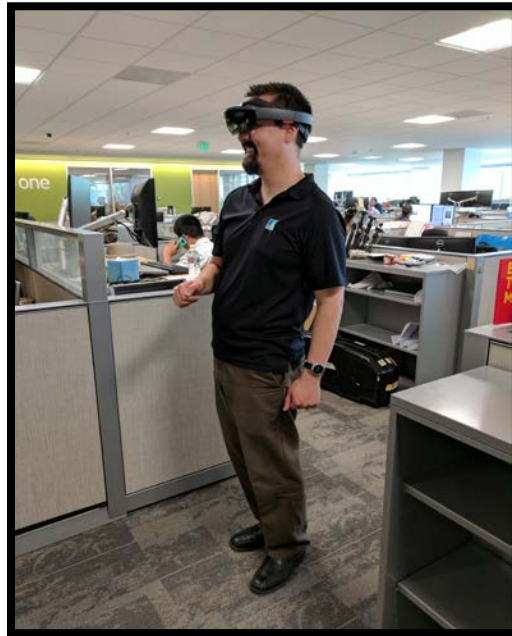
- NYSEARCH has distributed and piloted the Microsoft HoloLens at multiple funding utilities to explore AR, provide feedback, and identify specific operator training tasks where AR could provide the most benefit

  - Identified two vendors with strong command of developing AR applications

  - Developing the next phase in the program to build and test specific gas training task applications

NYSEARCH NOW WORKING ON APPLICATION DEVELOPMENT

- Three operational tasks identified from survey

  - *Pilot Lighting*

  - *Gas Leak Survey, Investigation, and Response*

  - *Meter Set Assembly Installation, Change, Inspection*

- Each of these training tasks demonstrates the capabilities of AR through the use of Microsoft HoloLens

  - A heads-up hands-free training tool which projects visual information and instructions in the frame of view of the user.

  - AR can be used to simulate real-world scenarios in a safe, controlled environment

RECENTLY APPROVED PROJECTS JUST GETTING STARTED

- Plastic Pipe Inspection using Terahertz Technology

- Methane Dispersion Study

- Siloxanes Study for RNG

- Living Lab Project with National Grid's Newtown Creek Wastewater Treatment Facility (re-start)

- State-of-the-Art Risk Assessment of Renewable Natural Gas (RNG) Technologies

DISCUSSION SUMMARY

- NYSEARCH R&D programs have resulted in several products in commercial use.

- Important areas of R & D continue to be leak detection, damage prevention, pipe location, and innovations to improve safety.

- Focus increasing for last several years on reducing gas emissions and technologies to aid de-carbonization.

- Continuing to focus on innovations to efficiently collect more detailed data in real time.

- Starting to take advantage of information technology to help provide options for future operations training

QUESTIONS

Questions?