

**NYSEARCH**

# Robotics Program for the Inspection of Unpiggable Natural Gas Pipelines

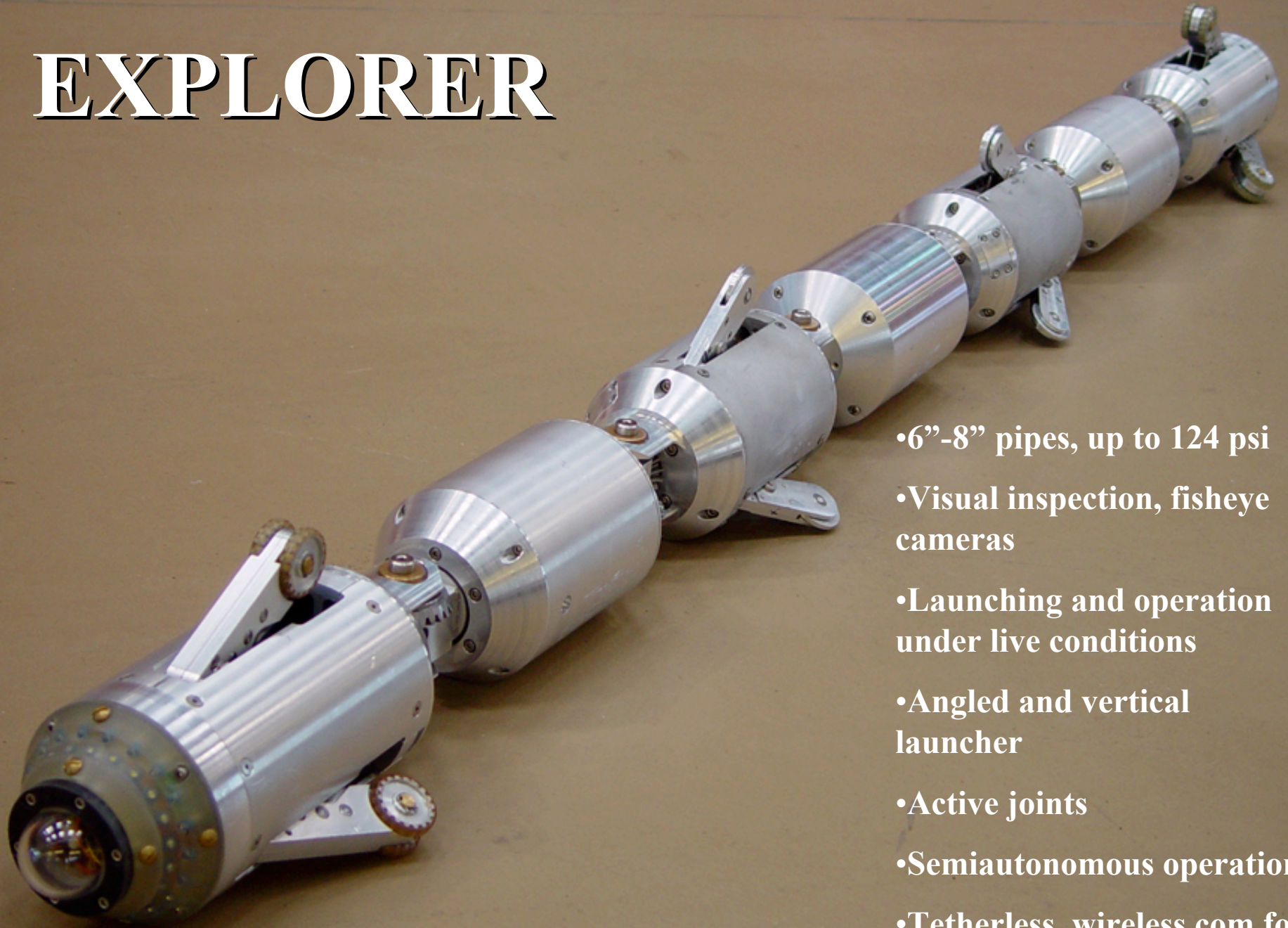
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**NYSEARCH – NGA**

*DoT Workshop*  
*June 2009*

# NYSEARCH Robotics Program Overview

- Initiated first robotics development effort in 2000 with **Explorer**
  - Visual inspection of **distribution** system
  - Modular robotic platform; tetherless
    - on-board batteries
    - two-way wireless communication for control and video feedback

# EXPLORER



- 6"-8" pipes, up to 124 psi
- Visual inspection, fisheye cameras
- Launching and operation under live conditions
- Angled and vertical launcher
- Active joints
- Semiautonomous operation
- Tetherless, wireless com for live control and video feed

# NYSEARCH Robotics Program

## Overview (continued)

- Followed with two platforms, based on Explorer architecture, for the **ILI of unpiggable** pipelines following issuance of the 2002 OPS Ruling
  - **Explorer II**; 6" – 8", 750 psig
  - **TIGRE**; 20" – 26", 750 psig

# Robotics Program Goals

## ➤ ULTIMATE GOAL

- Develop robotic systems for the live inspection of transmission pipelines using wireless video/data communication & real-time inspection data transmission with battery-power

## ➤ CURRENT PROJECT OBJECTIVE

- Develop near-commercial prototype systems for 6"-8" and 20"-26" pipelines

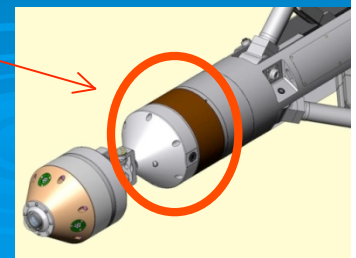
# TIGRE



- 20”-26” pipes, up to 750 psig
- Visual inspection and NDE (MFL)
- Launching and operation under live conditions
- Angled launcher
- Active joints, semiautonomous operation
- Tetherless, wireless com for live control, and data and video feed
- Able to negotiate plug valves, mitered bends, back-to-back 90s

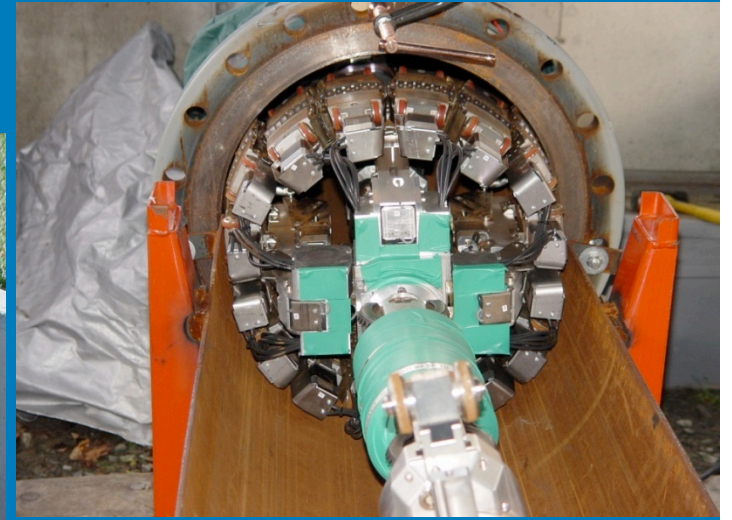
# TIGRE Specifications

- Length: ~ 34 ft.
- Weight: 1,080# (20"-22" sensor); 1,220# (24"-26" sensor)
- # Modules: 11
  - Drive (6), Battery (3), Turbine (battery) (1), Camera (2), Sensor (1)
- Power: Li-Polymer Custom packs; safety charge/discharge circuitry
- Electronics: Multi-8-bit processors with dual 32-bit embedded CPUs
- Feedback: Odometer, Angle, Inclination
- Additional position reading through **Sonde**
  - Includes emergency location under power failure



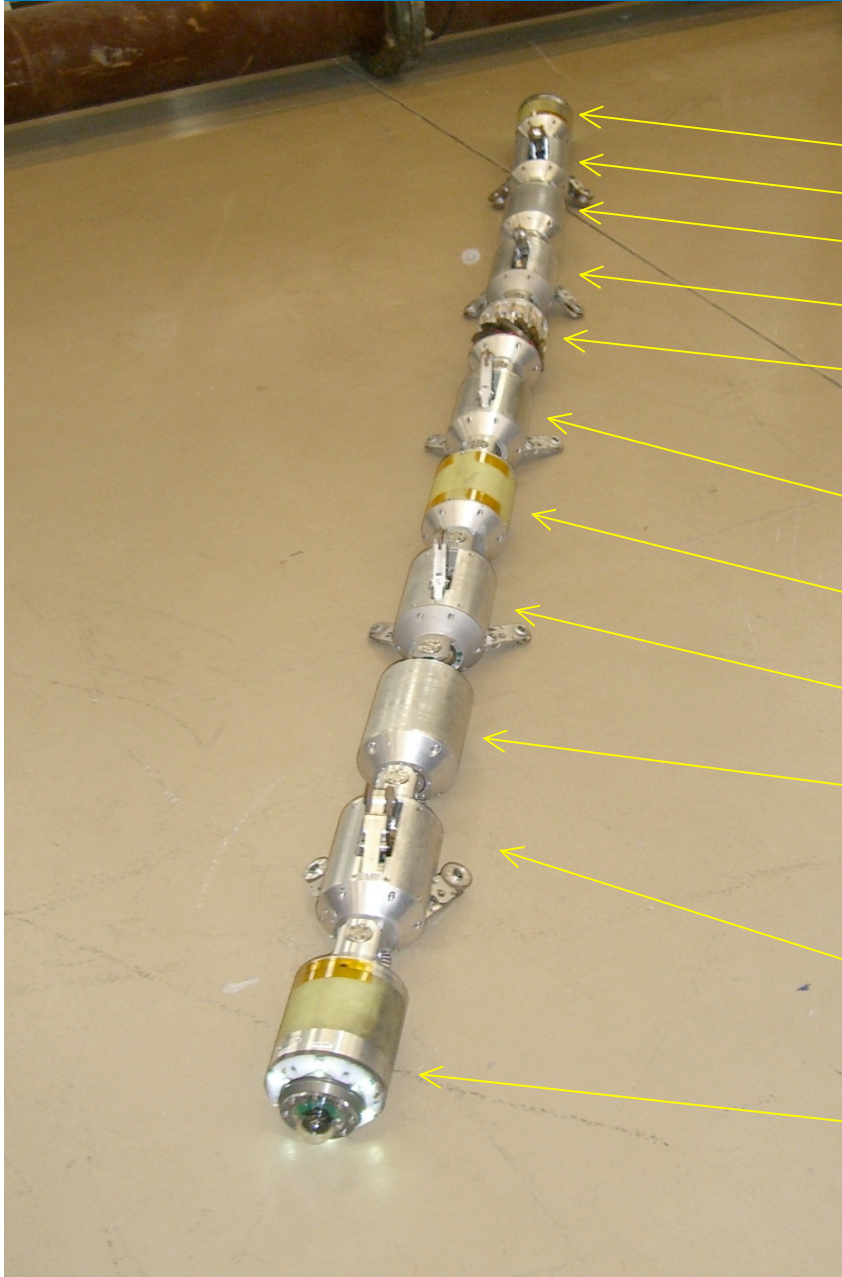
# TIGRE Demonstration

(at NYSEARCH Test Bed)





# EXPLORER II



Camera module

Drive module

Battery Module

Support module

RFEC sensor module

Support module

RFEC exciter coil

Support module

Battery

Drive module

Camera module

- 6"-8" pipes, up to 750 psi

- 10 ft long; ~40 lb

- Visual inspection, fisheye cameras

- RFEC NDE capabilities

- Angled launching

- Operation under live conditions

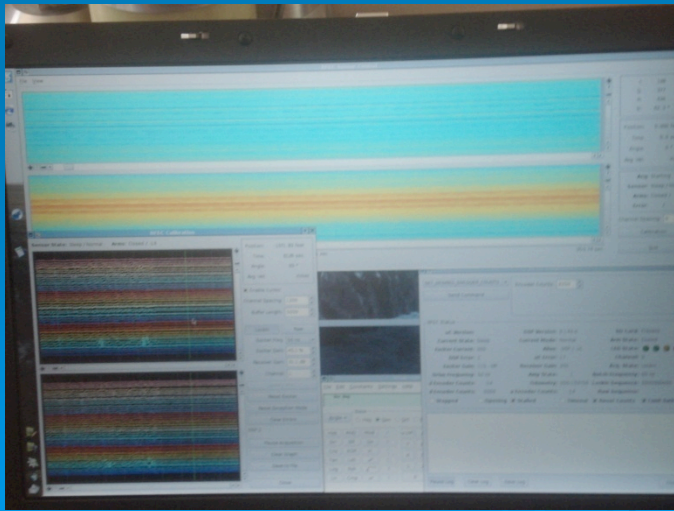
- Active joints

- Semiautonomous operation with sonde for emergency location

- Tetherless, wireless com for live control, and video and data feed

- Able to negotiate mitered bends but not plug valves

# Explorer-II Demonstration



# Program Status and Future

- Explorer II in pre-commercialization field demonstrations in live pipelines
- TIGRE expected to be ready for demonstration in live pipelines in early 2010
- New robotics technologies promise to revolutionize our abilities to inspect unpiggable pipelines
- Major technology advances in sensing, electronics and battery technologies as well as in computer science will continue enhancing our capabilities in this area