

# REPAIR and Remedy

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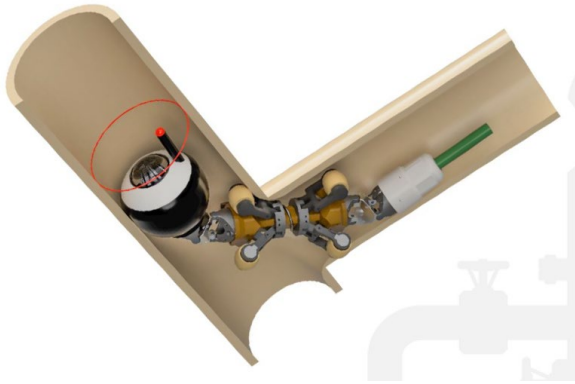
## ▶ Repair

- Fix pipes from inside, avoid excavation
- 3 yr, \$38 MM program funding 10 teams

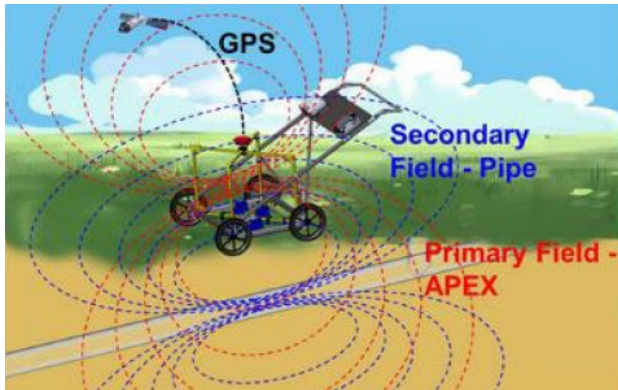
## ▶ Remedy

- 3 yr \$42MM program
- Reduce methane emissions from
  - Coal mine ventilation (3 teams)
  - Engine slip
  - Flares

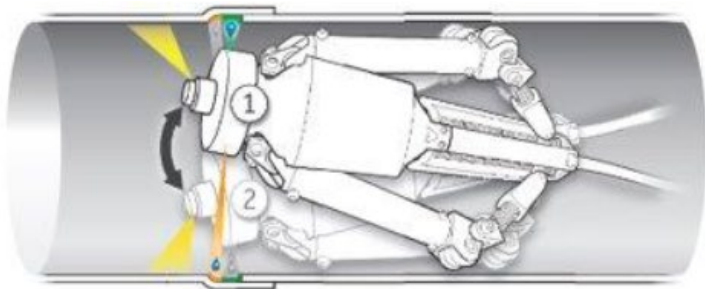
# REPAIR



JP Robotics (Carnegie Mellon) – 3D internal pipe images, 500 micron resolution, locating within +/- 2% X and Y; 10% Z direction

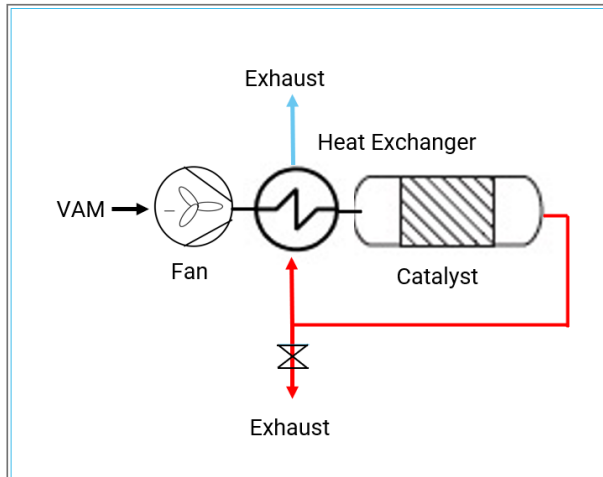


White River – 3D maps for metal pipes from surface or internal pipe, locating ~2 inches X and Y, ~5 inches Z direction. Can identify pipe material and diameter

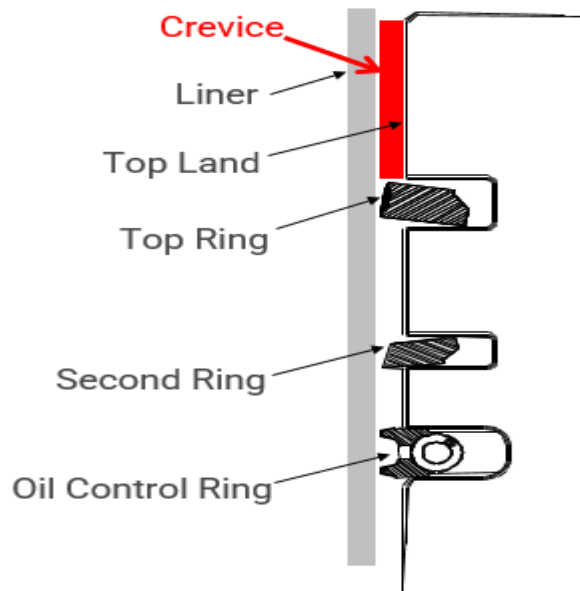


General Electric (Pluto spin-out) – Inspection tool, epoxy coating, deposition robot.

# REMEDY VAM and Engine Slip

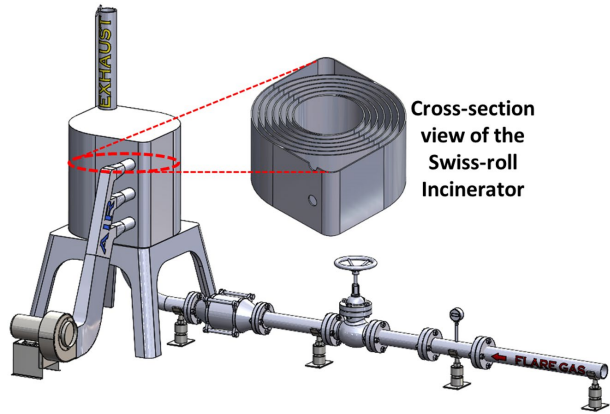


- ▶ Coal mine ventilation air (VAM)
  - Catalytic combustor for <math><1\%</math> methane concentration
  - Potentially useful for dilute streams >0.2% methane concentration
  - Johnson Matthey
  - MIT (Moxair start-up)
  - Precision Combustion, Inc.



- ▶ Methane slip natural gas-fired lean burn engines
  - 2-5% of fuel exhausted without getting burned
  - Crevices and crankcase vents
  - CSU/Caterpillar
  - Mahle/SUNY Buffalo, Oak Ridge, Johnson Matthey
  - Innio Waukesha
  - Texas A&M/Cooper
  - Marquette/Cooper

# REMEDY Flare



Advanced Combustion Technology – “Swiss Roll” silicon carbide “enclosed combustor”. Operates over wide range of fuels, air/fuel ratio. Tank vents, small flares, pipe/compressor blowdowns



U Michigan/Steffes – Retrofit flare tip with intense mixing. Small-medium flow flares



Cimarron – “Dream Duo” retrofit assist air control/incipient smoking control and “Hybrid flare” Advanced Combustion Technology – “Swiss Roll” new flare for medium-high flow flares