

# A Sensor for Measuring Pressure in a Sealed Container

Dennis G. Douglas, Vista Engineering Technologies, LLC

Phillip C. Ohl, Vista Engineering Technologies, LLC

Donald E. Ball, Vista Engineering Technologies, LLC

3000 George Washington Way

Richland, WA 99352

ddouglas@vistaengr.com, (509) 375-3374

Darrel R. Duncan, Fluor Hanford, Inc.

Richard A. Sexton, Fluor Hanford, Inc.

PO Box 268

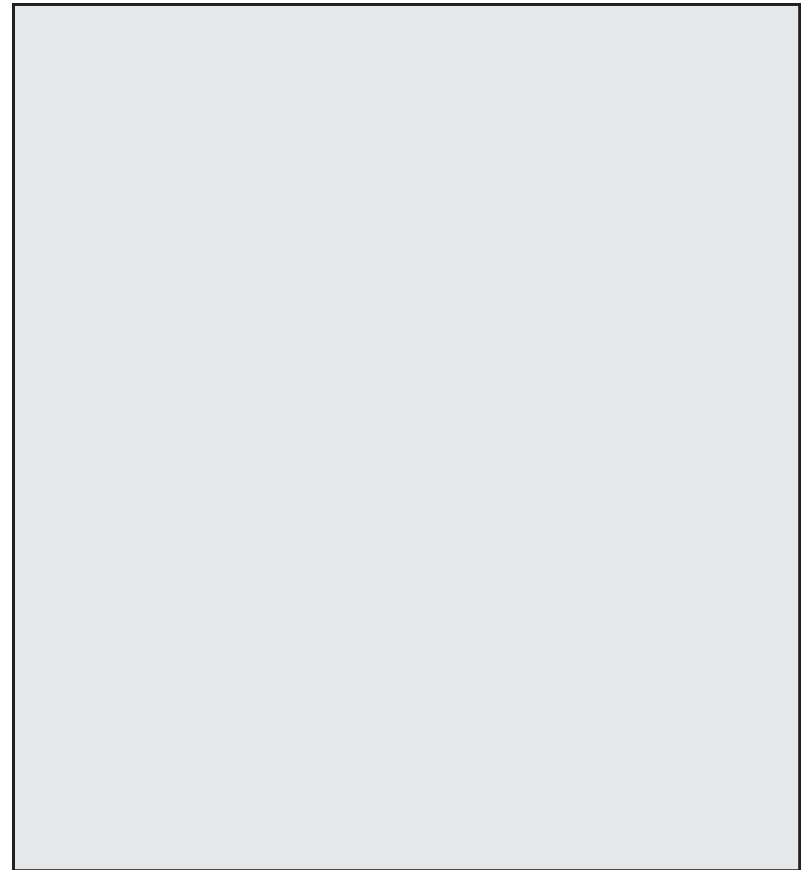
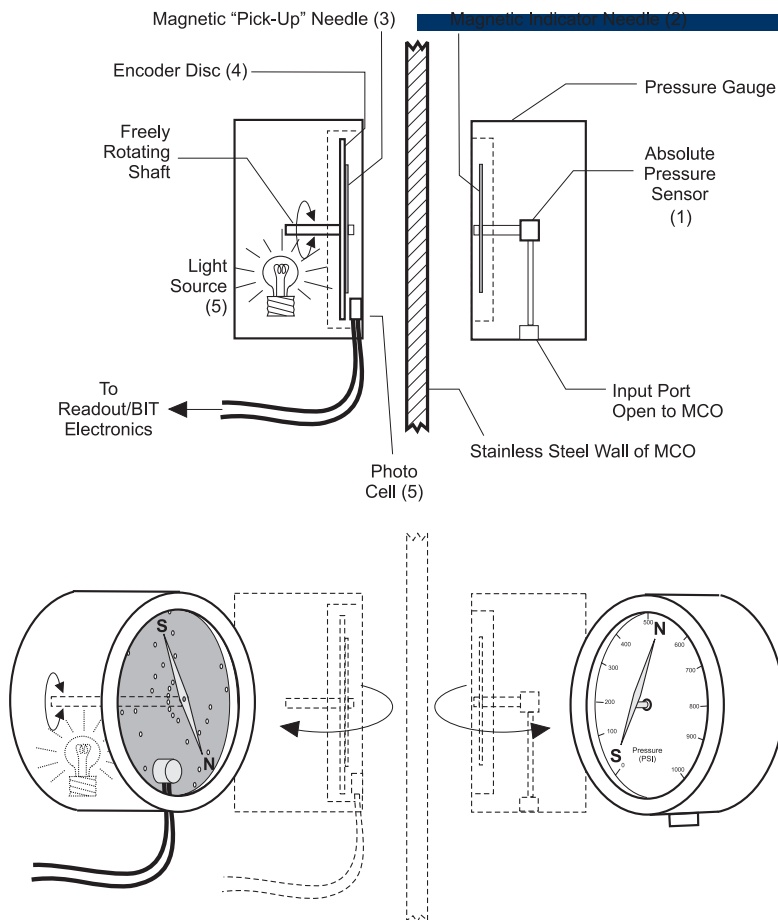
Richland, WA 99352

darrel\_r\_duncan@rl.gov, (509) 372-1013

# MCO: Interim Storage Cask

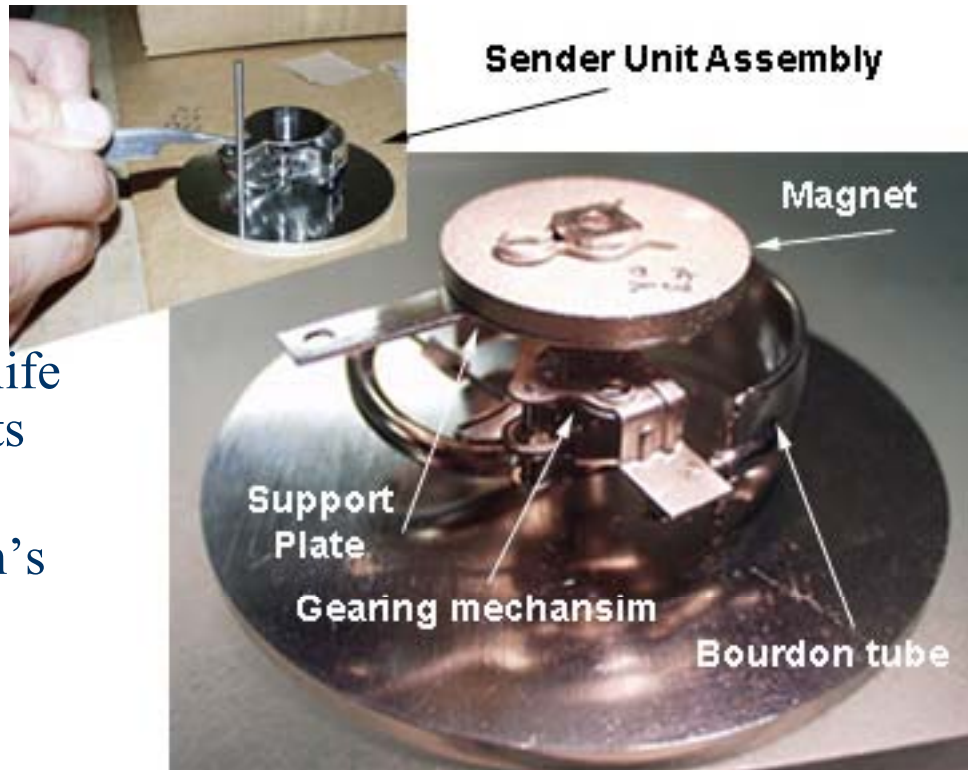
- ◆ 400 “Multi-Canister Overpack” (MCO) casks will contain 2,300 metric tons of decaying fuel
  - Stainless steel 14’ long x 24” dia, with ½” walls
  - Sensor desired to monitor internal pressure
    - No penetrations of Pressure Boundary allowed...
    - No internal power...
    - No organics
    - High radiation, high temperature environment
    - 40-year operating life

# Magnetic Coupling Provides Solution



# MCPG Designed for Application

- ◆ 100psi & 600 psi pressure ranges
  - 2" to 8" "reach" => powerful magnets
  - SmCo matches rad, life & temp environments
  - magnets chosen to compensate for earth's magnetic field



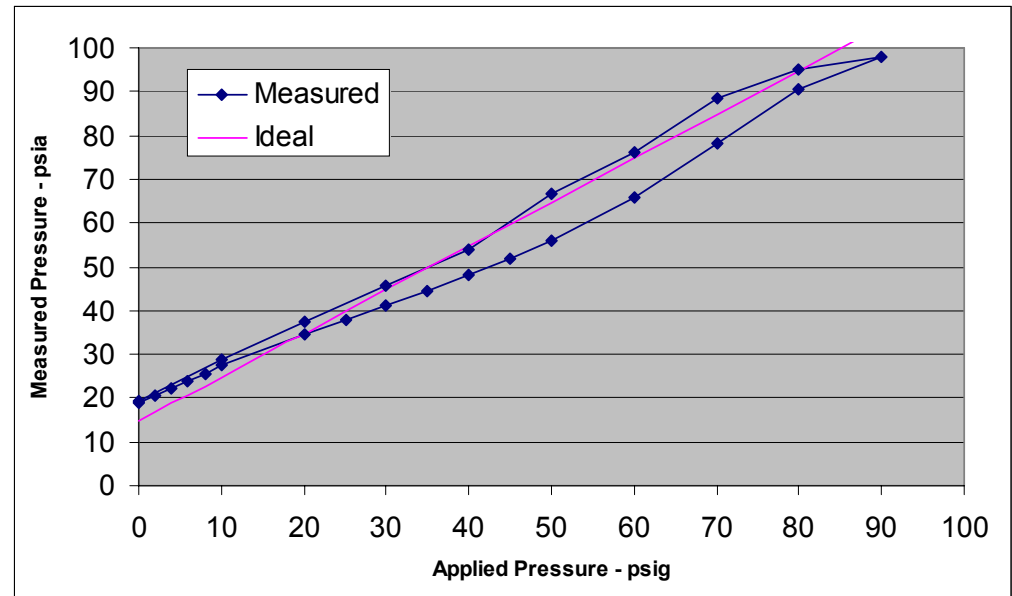
# System Meets Mechanical & Environmental Requirements



- ◆ 3” diameter sender
- ◆ Sender height varies
  - 2.75” for 600psi
  - 1.25” for 100psi
- ◆ All stainless steel, except for ceramic thrust bearings and magnet

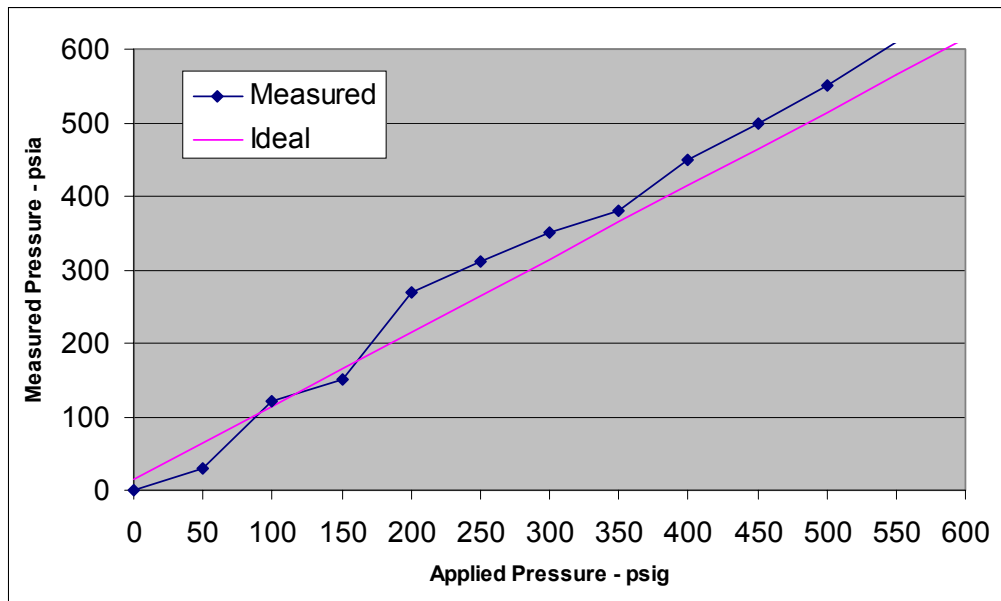
# Performance Measured In Terms of Accuracy

- ◆ Requirement:
  - 600 psi “monitor”
    - 10% f.s. accuracy
  - 100 psi “gauge”
    - 4% f.s. accuracy
- ◆ Response shows influence from earth’s field and frictional forces
- ◆ Perfect response:
  - $P_m = P_a + 14.7$



- “Typical” 100 psi response shown
  - 1% accuracy
  - 5% precision ( $\sigma$ )

# Magnet Mass Affects Performance

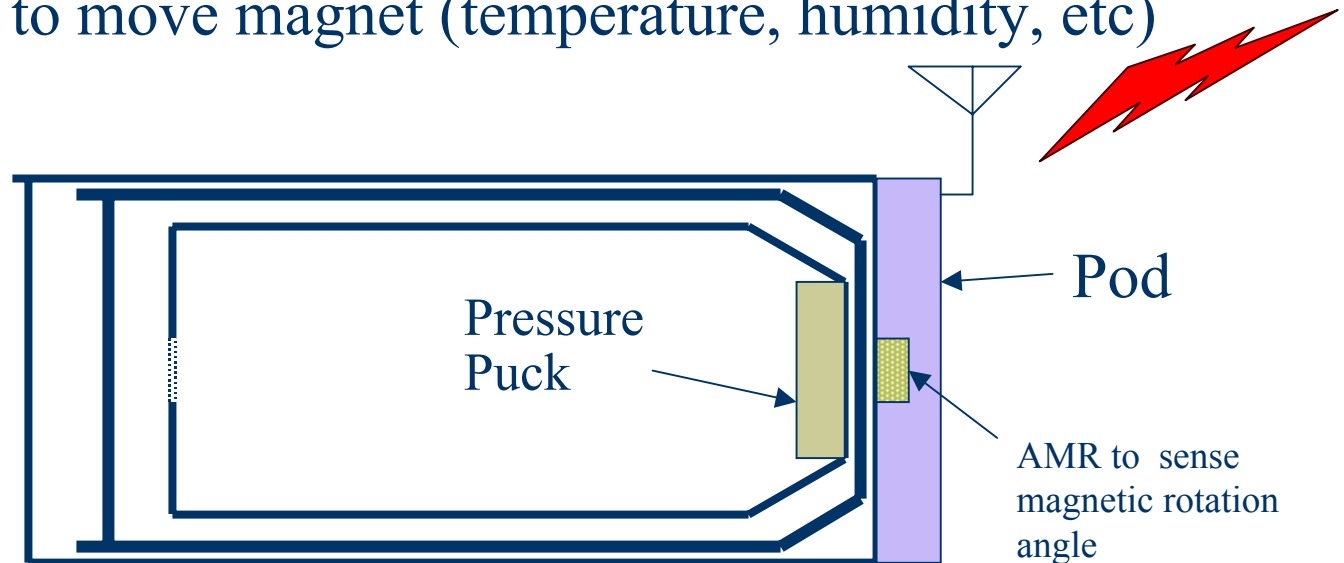


- ◆ “Typical” 600 psi up-pressure response shown
  - 3% f.s. accuracy (8% if down-pressure considered)
  - 5% f.s. precision (7% if down-pressure considered)

- ◆ Longer “reach” means more magnet mass
- ◆ More mass means more friction on bearing surfaces
- ◆ Longer-reach system used for qualitative indication of pressure

# Magnetically Coupled Gauge Has Many Applications

- ◆ Inside-outside through low-permeability materials
- ◆ Measure any quantities whose sensor has sufficient force to move magnet (temperature, humidity, etc)



•One example is MCPG in 3013 canister, coupled to “tag”

# Conclusions

- ◆ A new and significant method has been developed to support Spent Nuclear Fuel program
  - MCPG assures knowledge about MCO pressure environment
  - Uses no electrical power or external support or maintenance
  - Working life measured in decades
  - Uses mechanical or electrical means to read internal sensor value
  - Pressure data is instantaneous, can be read directly or remotely
- ◆ Method has many other potential applications