
# The Development of NDE Techniques for Large Cryogenic Storage Tanks

Project proposal submitted to
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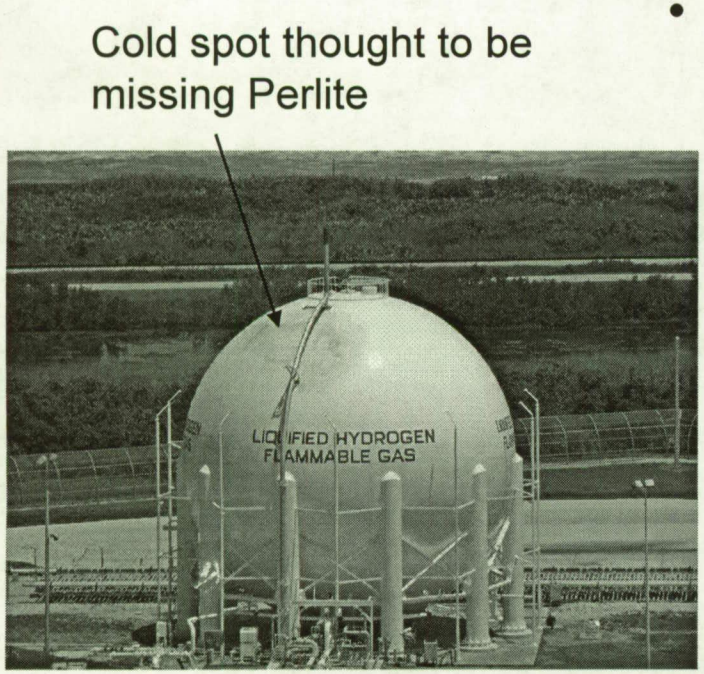
# Objectives

- Develop and demonstrate NDE techniques to evaluate the condition of large cryogenic Dewars (typically 50,000 to 900,000 gal.).
- These tanks are used across NASA for launch pads, engine test stands, cryogenic wind tunnels and other facilities: they represent a major investment.
- Issues addressed:
  - Insulation integrity of existing Dewars (powdered insulation under vacuum or sometimes ambient pressure (LO2),
  - Post fabrication insulation verification without full chill-down to avoid thermal cycling the tank (fatigue limitation of piping and compaction of Perlite).

# The Need

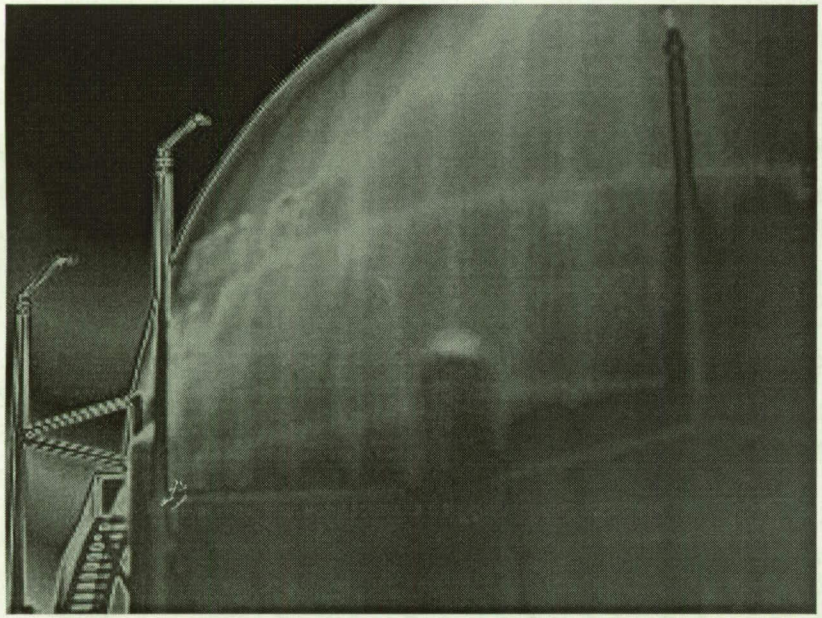
Conventional tank NDE does not address integrity of insulation system.
No methods exist to determine insulation integrity for new or old tanks.

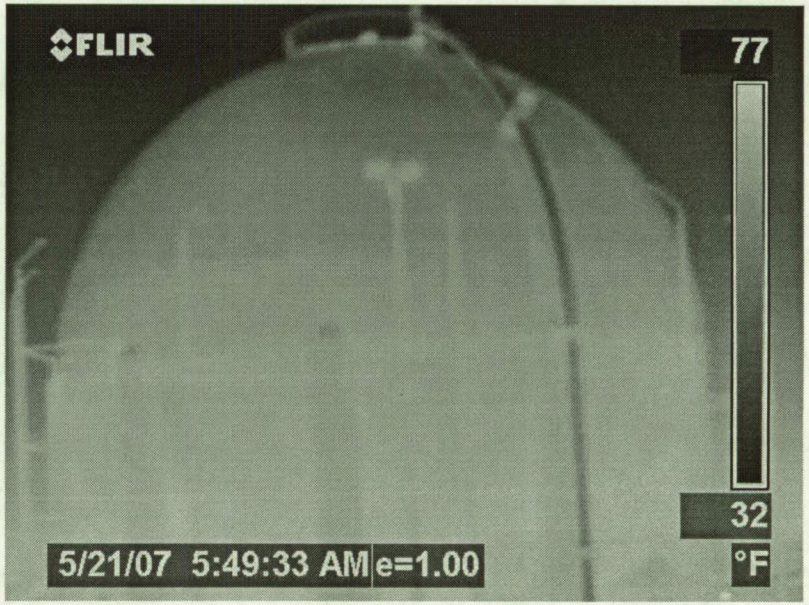



Pad B LH2 Dewar

- The LC-39 Pad B 900,000 gal. LH2 Dewar exhibits a boil-off loss rate over twice that of an identical Dewar on Pad A. This has been know since the tank was built (1964) and has resulted in millions of dollars of loses.
  - It is now being evaluated for upgrade or replacement and accepted tests do not exist for quantifying the insulation integrity: repairs would require thermal cycle of the tank including piping and Perlite insulation.
  - If repairs are made, the tank insulation can only be tested by chilling down the sphere and determining boil-off rate.
- Aries V (Pad A) will require the construction of (possibly) 4 each 1MGal Dewars.

# Proposed Approach Year 1






Past IR images (above) show some interior bracing (left). Image on right shows reflections and shadows of exterior objects.

Use time lapse Thermography coupled with measurements and modeling to provide interior structural details and insulation value. Metal structure under paint is highly reflective so environmental IR and solar effects must be subtracted.

# Proposed Approach Year 2


- Develop IR images to verify insulation integrity of newly fabricated Dewars along with a method of partial chill-down of interior tank.
- Method will use the sun as “thermal wave” heat source.
- Tank interior will be reduced using refrigerated air system so that thermal effects on structural and piping elements is minimized.


- Metrics:
  - Demonstration of insulation health using long term thermal monitoring on a cold tank. The determination of the ability to spot insulation issues against a variety of environmental background interferences.
  - Demonstration of an insulation health measurement technique that can be performed on a large cryogenic tank before chill-down, i.e. while still warm.
- Products:
  - An NDE method for monitoring insulation health using long term thermal modeling on a cold tank.
  - An NDE technique for acceptance testing a large cryogenic tank while warm, before chilldown.


**Schedules/Milestones:**

- Demonstration of thermal monitoring as a health indicator for large powder insulated cryogenic tanks 9/30/09

- Demonstration of an NDE technique for acceptance testing a large cryogenic tank while warm 9/30/10

# Resources

| | FY09 | FY10 | FY11 | FY12 | FY13 |
|---|---|---|---|---|---|
| **Requested Budget** | $80k | $90k | | | |
| Civil Servant Salaries | | | | | |
| Civil Servant Travel | | | | | |
| Procurement | $80k | $90k | | | |
| **TOTAL Budget Requested** | $80k | $90k | | | |
| Workforce-summer students | | | | | |
| Direct Civil Service (FTEs) | | | | | |
| On-Site Direct Contractor Work Year Effort (WYE) | .3 | .3 | | | |
| **Total Requested Workforce** | .3 | .3 | | | |

| | FY09 | FY10 | FY11 | FY12 | FY13 |
|---|---|---|---|---|---|
| **Additional Funds Provided By Customer(s)** | | | | | |
| Civil Servant Salaries- Shuttle program/Constellation** | .4 | .4 | | | |
| Civil Servant Travel | | | | | |
| Procurement | | | | | |
| **TOTAL Additional Funds *** | | | | | |
| Workforce-summer student program | .2 | .2 | | | |
| Direct Civil Service (FTEs) | .4 | .4 | | | |
| On-Site Direct Contractor Work Year Effort (WYE) | | | | | |
| **Total Additional Workforce** | .6 | .6 | | | |

**Additional funds must be 15% or greater of total proposal*

# Contacts

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