MINIATURE MOTORIZED INSPECTION TOOL FOR DOE HANFORD SITE TANK BOTTOMS

Ryan Sheffield – DOE Fellow, Mentor – Dwayne E. McDaniel, Ph.D., P.E.

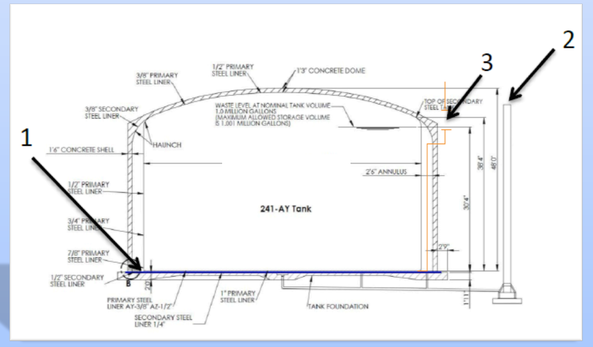
Florida International University

FIU Applied Research Center

Background

Recently, small amounts of waste have been found in the annulus of tank AY-102, prompting the need for developing inspection tools that can identify the cause and location of the leak. Three separate access paths can be used to obtain information regarding the tank bottom condition. The inspection may be conducted via:

- 1) Refractory air slots through the annulus
- 2) 4” annulus air supply pipe to central air slots
- 3) 6” leak detection pit drain from the central sump

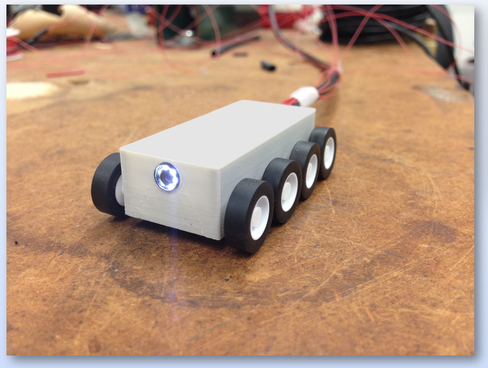


Objectives

There are various environmental and physical constraints which the tool will have to adhere to. In order for the tool to be successful, it must be capable of the following:

- Travel through small cooling channels with dimensions as small as 1.5” x 1.5”
- Provide live video feedback
- Produce enough torque to overcome the tether drag force
- Inverted travel to avoid obstacles such as tank corrosion
- Navigate up to 38 feet to the tank center, while maneuvering through four 90° turns

Prototype improvements

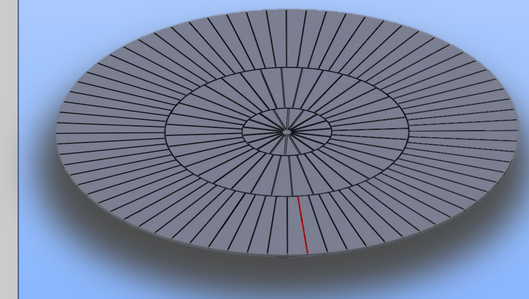


Current revision (left)
Previous revision (top)

A model of the inspection tool has been designed, assembled and reported. Areas of potential performance improvement were observed; these areas are the basis of the following design, as seen above. The changes include:

- The addition of an additional 4 wheels
- Body modification to house the camera
- A loft on the bottom from the tools edge to the magnets lowest edge
- Shaving the hubs of the current wheels
- Control method changed to a joystick

AY-102 tank info



The tank configuration through which the tool will have to maneuver are the following:

- 72 outer ring slots (1.5”x1.5”x17’)
- 36 ring slots (2”x1.5”x12 ‘)
- 18 inner slots (3”x1.5”x7’)

Tank cooling channel arrangement (above)

Actual images of cooling channels representing expected conditions (left)

Components

The components used for this design iteration are not radiation hardened nor are they designed to withstand elevated temperatures. However, this prototype has been constructed with the final goal of being radiation hardened and able to withstand elevated temperatures in mind. The components that make up this design iteration are the following:

- Arduino Uno board with ATMega328 microcontroller
- Joystick shield kit for the Arduino Uno
- Eggsnow USB Borescope Endoscope 5.5mm inspection camera
- 136:1 Sub-micro Plastic Planetary Gearmotor (4)
- 14x4.5mm wheels (8)
- 3D-printed body
- 3D-printed free rolling shafts (4)
- Neodymium magnet - 1” x 3/8” x 1/16” – 4.53 lb pull force

Looking forward

In the time to come, there are a few goals that are to be completed. The first group of tasks is associated with the testing and recording of data of the current prototype. This data will be analyzed and appropriate action will be taken based on the results of the testing. The testing will include simulating the challenges that the tool will face in the AY-102 tank. Working with the Hanford DOE site, a bag of Kaolin 2200 will be acquired to be used for the test bed to simulate tank conditions. Further modification will then be made to enable the tool to be able to maneuver through a 90° turn. Completion of this task will be a major milestone, as this tool will be readily usable in the other tanks containing HLW; as other tanks will be easier to maneuver through.

Acknowledgements

This research was supported by the U.S. Department of Energy through the DOE-FIU Science and Technology Workforce Development Program.

Special thanks to:

- Leonel Lagos, Ph.D. (FIU)

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