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Tanks Focus Area

Topographical Mapping System for Hazardous and Radiological Environments

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1. INTRODUCTION

This report focuses on the results of the acceptance test of the Topographical Mapping System (TMS) delivered to the Hanford site. The TMS was tested for accuracy over the specified range of 45 feet. The TMS was also tested to ensure that the unit could be deployed through multiple risers and maintain accuracy and registration of the surface mapping data. In addition, the TMS was disassembled and reassembled and redeployed to test field replacement of modules that make up the sensor head that is deployed in the vapor space of Underground Storage Tanks such as those located at the Hanford site in southeastern Washington State. The results from these tests along with temperature testing on the complete system and radiation testing of selected susceptable components are covered in this report.

2. DESCRIPTION OF THE ACTUAL WORK

The primary purpose of the TMS is to generate reliable and accurate three-

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dimensional maps of the internal surfaces of a storage tank.[1] In addition to the walls, dome, and waste, these tanks also contain vertical elements such as air circulator risers and thermocouple trees and objects that have fallen or been placed in the tank. One use for these mapping systems is in creating and maintaining a current map of the tank interior as input to a robotic "world model" that is used to test remediation strategies or plan robot trajectories. Another use is tracking the movement of the waste surface as it responds to expanding bubbles of trapped gas. A third use of the TMS is to perform a volumetric analysis of the amount of waste removed from the tanks during remediation.

Performance requirements are based on the "Functions and Requirements for the Light-Duty Utility Arm Integrated System" document from Westinghouse Hanford Company and Pacific Northwest Laboratories along with insights and lessons learned at Oak Ridge National Laboratory through surface mapping projects.[2,3,4,5,6] The requirements are as follows:

- Accuracy requirements may vary considerably. For example, to track the movement of the waste surface, it may be necessary to measure changes as small as 2.5 mm (0.1 inch). For collision avoidance, measurement errors of 100 mm (4 inch) may be acceptable. The TMS has been specified to provide an accuracy of +/- 0.25 inches over a range of up to 45 feet.

- Mapping data densities should be at least one point per 150 mm by 150 mm (6 inch by 6 inch) region. The time required for mapping cannot exceed 2 hours at this data density, although more time would be allowed for mapping at higher densities. The highest density that the TMS is required to provide is one point in every 1 square inch of surface. Coverage of 95% of the surfaces may be needed.
- The TMS has been specified to operate in a continuous flux of 500 Rads/hr and an intermittent peak flux of 1000 Rads/hr up to a total absorbed dose of 10E6 rads without failure due to radiation.
- The TMS has been specified to be deployed through a 3.5 inch clear aperture to allow deployment through the 4 inch risers at the Hanford site.
- The TMS has been specified to be Class 1 Division 1 Group B Hazardous environment to permit the use of the TMS in tanks that contain flammable gases.
- A temperature range of 50° - 122° Fahrenheit with noncondensing relative humidity of 95% has been specified to allow the TMS to operate in the varying environments that may be found in the tanks at the Hanford site.

A sensor head contains the laser, cameras, and their positioning systems and constitutes the in-tank hardware. The tank interface equipment consists of

the mechanical support for the sensor station, the tank sealing means, and the environmental enclosure box for all the electronics that must be near the sensor station. The Human Machine Interface is a remote UNIX-based scientific and engineering workstation that provides the graphical operator interface and supports the various command, control, and communication functions required for proper system function.

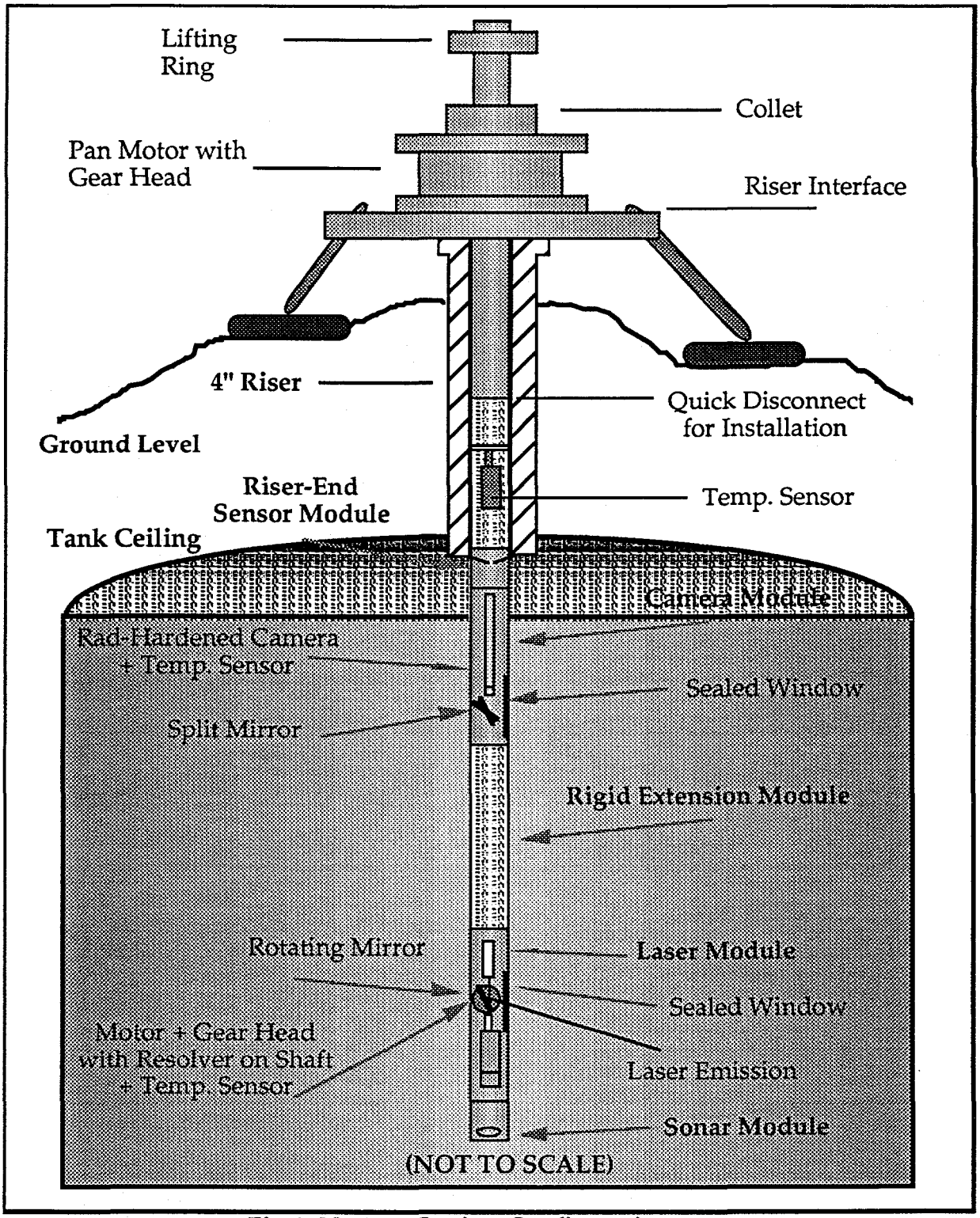

Fig.1 Narrow Station Configuration

3. RESULTS

The results will be gathered during acceptance testing of the TMS at the Hanford site during August 1995.

4 REFERENCES

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