

5.10 TASK 10

Damage Detection and Degradation Tracking in High Strength Steel Canisters

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Task 10 Technical Requirements

The use of tritium in experimental work and established weapons systems is of importance throughout the weapons complex. The storage of tritium however poses safety and reliability issues due to hydrogen/helium embrittlement and the increased potential for cracking and brittle failure in high strength steels. The degradation of material properties and crack formation from tritium decay in high strength steels used throughout the weapons complex is well documented.

Currently there are evaluation methods such as ultrasonic testing and various forms of microscopy used to determine the degree of embrittlement and health status of embrittled metals. These methods require periodic examination or destruction of the system with costly evaluation.

It is desirable to have an evaluation method that continuously monitors the health status of a system, is nondestructive and cost effective. To this end, it is proposed to carry out experimental research to determine the feasibility for developing a Structural Health Monitoring (SHM) detection method that will continuously and autonomously monitor the formation of hydrogen/helium embrittlement induced cracks. SHM refers to the discipline of damage detection as applied within the areas of aerospace, civil, and mechanical engineering. The process of SHM involves the use of an array of sensors distributed over a structure to make observations of the system's dynamic response. The sensors' responses are measured and then evaluated using statistical analysis to determine if damage is present and thus ascertain the current health status of the system. The proposed SHM research will focus on detecting cracks with inexpensive piezoelectric macro-fiber composite (MFC) patches. The MFC patches will be used to implement two damage detection techniques: 1) Guided wave and 2) Impedance methods. Guided wave techniques detect damage in a system through the propagation of waves in the system. Impedance methods detect damage in a system by measuring changes in the systems mechanical impedance.

Task 10 Deliverables

	Task 10 - Deliverables	Due Date (days after contract award)
10.1	Submit copy of proposed experimental design/plan for testing to LANL	30
10.2	Update Presentation to LANL's GTS Group and submit copy to LANL	180
10.3	Submit copy of Conference paper/journal article to LANL	360
10.4	Submit copy of MS Thesis to LANL	360