Los Alamos
NATIONAL LABORATORY

memorandum

DX-Division
DX-5, Experiment and Diagnostic Design, MS D411

To/MS: **JAY BOETTNER, DX-DO, MS P915**
Thru: **VAL HART, DX-5, MS P942** VH
From/MS: **NEILS R. BORCH, DX-4, MS C925** N.R.B.
Phone/FAX: 7-4624/FAX 5-5422
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SUBJECT: HISTORY OF SELECTION OF HSLA-100 FOR CONFINEMENT VESSELS

The recommendation for the use of HSLA-100 for future confinement vessel procurements was made in memorandum J-6-90-132, dated May 7, 1990, from the author to Cary Skidmore, M-4. At that time, the author was being utilized as a consultant to M-4. See attached memo.

The recommendation was based on the need to procure confinement vessels that could be utilized at ambient temperatures down to zero degrees Fahrenheit (0 F). The last confinement vessels that had been procured were fabricated from ASTM A-537, Class 2, and subsequent testing revealed that they all required significantly higher operating temperatures, typically 90 degrees F or higher, to satisfy the design requirement of assured crack arrest to preclude the possibility of catastrophic failure of the vessels. HSLA-100 was under development and early testing indicated that it would easily meet our low temperature fracture toughness requirements. The higher yield strength of this new material, 100 ksi vs. 60 ksi for the ASTM A537, was deemed to be a benefit which might permit larger HE charges to be used should the experimental need arise.

J-6 was at this time instituting a fracture safe design philosophy and had started replacing ASTM A-517Q with HSLA-100 for certain emplacement hardware which had to have assured fracture arrest capabilities at 0 F. This new material was found to be more readily welded in fabrication than the material it replaced and it easily met the performance requirements, particularly in that the welding heat-affected zone (HAZ) no longer was the limiting factor for fracture control.

HSLA-100 steel was developed as a replacement for HY100 in naval ship construction. The reason for the development was to significantly reduce the cost of ship fabrication by removal of the requirement for weld pre-heating and post-heating. The reason is that HSLA-100 is a very low carbon steel and the normally brittle constituent that formed in the heat affected zone (HAZ) adjacent to the weldment , called martensite, is not brittle at low carbon content. Martensite is a transformation product that occurs on rapid cooling from high temperatures, such as exist at material adjacent to the molten weldment, and pre- and post-weld heating is usually required in the case of high strength steels to preclude rapid cooling. HSLA-100 is currently utilized as structural armor on surface combatant ships and for non-pressure hull application on submersibles. It is intended to be used for pressure hulls for future submersibles.

Based on the above recommendation M-4 proceeded to procure, on a developmental basis, HSLA-100 hemishells and nozzle forgings for evaluation and possible future fabrication into test vessels. A contract for the vessel fabrication was let in 1994 and two vessels were delivered in 1995. A very thorough quality assurance program was implemented for this fabrication. These vessels are intended to be utilized in the Appaloosa program.

Attachment: Memo: J-6-90-132

cy: DX-5/R183 File
DX-5/216 File