

DISCUSSION

*E. Landerman*¹—Although the A533B with 0.03 percent Cu shows decreased radiation embrittlement, materials of this copper level are not available to the nuclear industry. Copper levels for currently used heats (using selected scrap) have been lowered in recent years to ~ 0.10 to 0.15 percent. Special scrap would be required for 0.03 percent Cu heats and are not available for materials required for current reactor vessels within any reasonable schedule and for needed construction planning.

J. R. Hawthorne (author's closure)—Formal disclosure of the research findings of Potapovs and Hawthorne which first provided positive identification and experimental verification of the detrimental effect of copper and phosphorus on radiation embrittlement resistance dates back only to June 1968 (see Ref 3). Understandably, some time would elapse before the industry (reactor vendors and vessel fabricators) would come to realize and seek the marked benefits of reduced copper and phosphorus impurities in reactor vessel steels. Only of late have steel producers had sufficient inquiries for such steel to prompt a reexamination of their technology and capabilities for providing low-copper and -phosphorus melts. Thus, it is fully understandable that steel vendors have not yet established those limits for copper content which can be supplied on a standard or a premium cost basis or which can be supplied on a small or large tonnage basis. In effect, the full circle of indoctrination from laboratory to general practice has not been completed, but, hopefully, the results for the demonstration melt will accelerate the process.

I recognize the current difficulties in obtaining low-copper content melts. It is encouraging that Lukens Steel Co., the prime supplier of thick plate for reactor vessels, is exploring the problems attending routine production of such melts. One major problem presented to a cold metal shop such as Lukens is the quality and availability of low-copper content scrap. Conceivably, this problem can be eased somewhat by the use of a hot metal charge (or alternately, ingot iron) either alone or in conjunction with selected scrap to boost volume and to lower copper contents as well. It is pointed out that a 0.06 percent copper content (maximum) was the research target for the current study and may well be sufficiently low for steel optimization.

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