



LB60 Workshop

Advanced Welding-Repair Technologies for Irradiated Reactor Materials

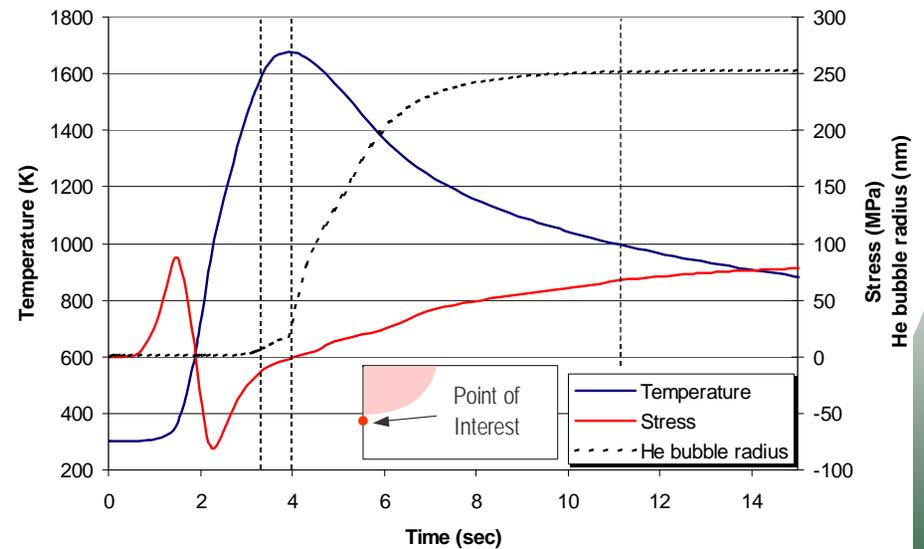
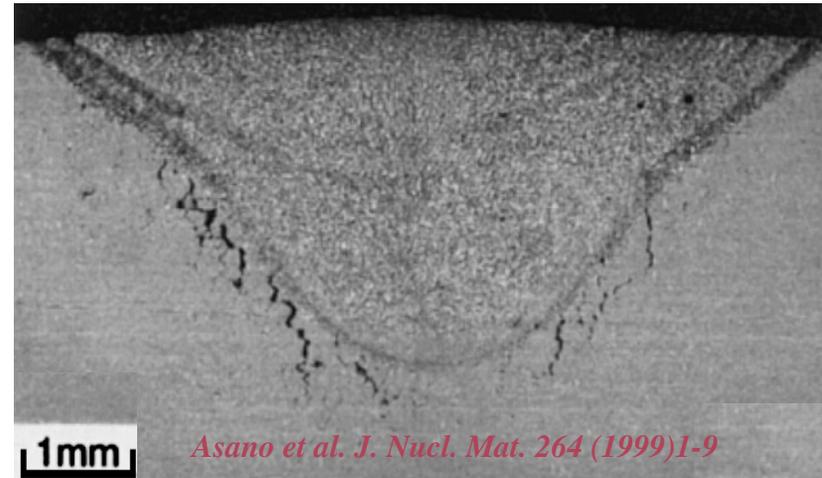
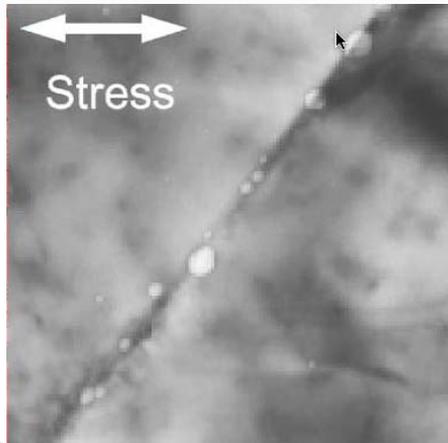
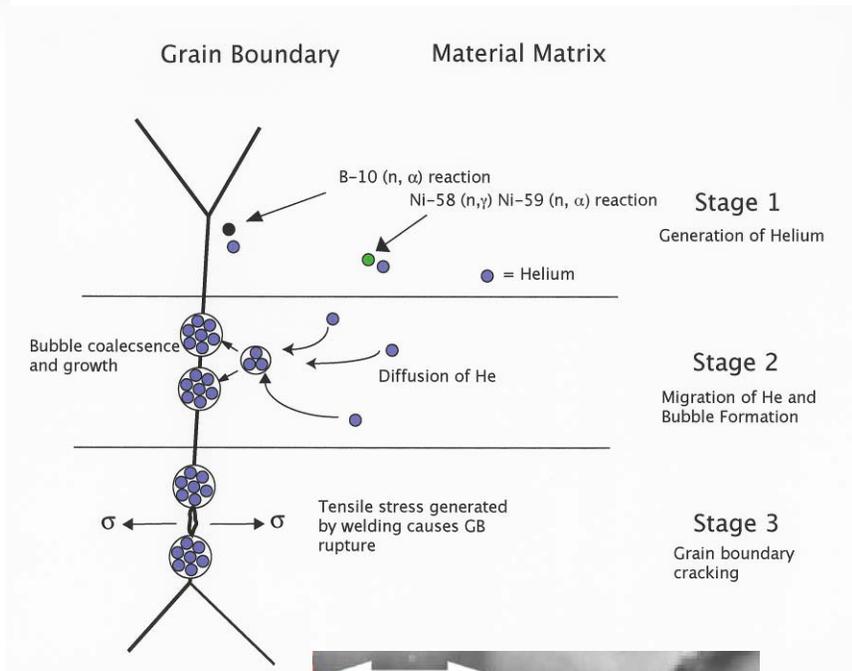
Feb 23, 2011

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Fundamental Issue Effecting the Weldability of Irradiated Materials (The Problem)

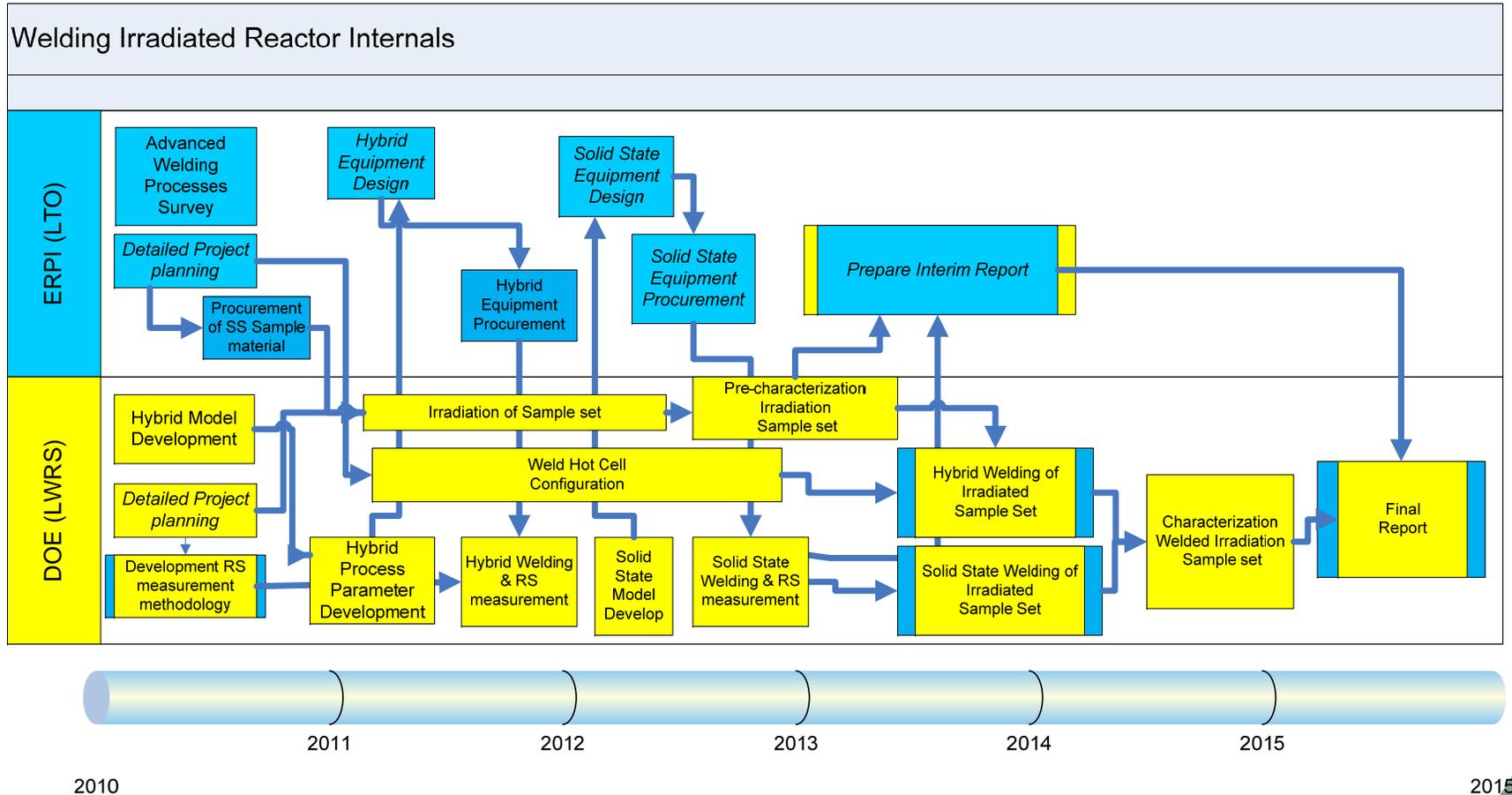


Source: Z. Feng

Project Objectives and Scope

- Develop advanced welding technology required for reactor repair and upgrade to support reactor life extension beyond 60 years with an integrated approach between Industry EPRI/LTO and the DOE/LWRS -ORNL
 - Development of Advanced Welding Technologies to Weld Highly Irradiated Material
 - Development Modeling simulation to guide processes development and predictive application on irradiated materials
- Development of welding hot cell to deploy advance welding and coating processes
- Material degradation assessment development
 - Advanced weld simulation tool for lifetime prediction and weld performance assessment (Future years)

Overall EPRI/DOE Project Flow Chart



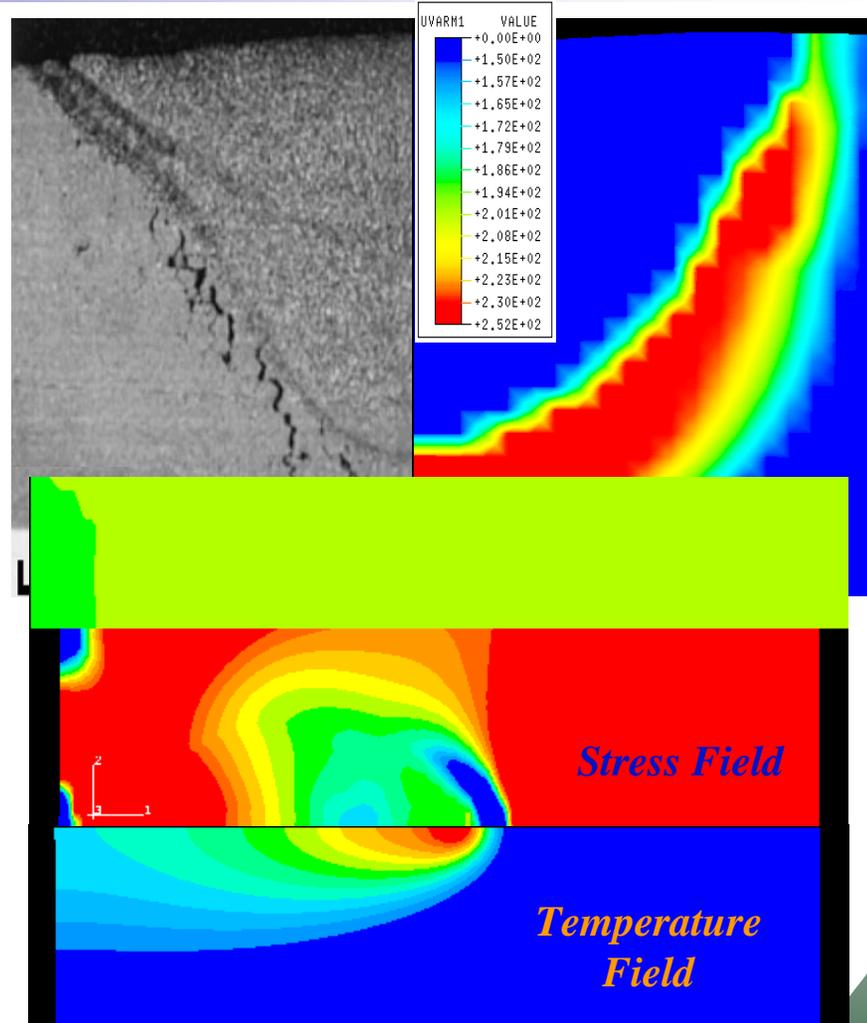
Welding process development based on fundamentals of welding science

LTO/LWRS Project Task 1 (2010/11)

- Fabrication of Sample Set for Irradiated Welding Experiments
 - Three material to be fabricated
 - Type 304 SS
 - Type 316 SS
 - Ni-alloy 182 (wrought)
 - Determination of initial Boron concentration to achieve desired helium level using HYFER irradiation details
 - Flux, energy spectrum, etc.....
 - Target level levels for 50, 60 and 70 years of operation for reactor internals
 - Determine the steel making practice to use for sample fabrication
 - Powdered metallurgy
 - Conventional steel making practice (VIM)
 - Hot working
 - Detail calculations for HFIR exposure and sample holder design and fabrication

LTO/LWRS Project Task 2 (2010/11)

- Survey of present art of hybrid welding processes
- Development of advanced computational model for hybrid welding processes
- Develop hybrid laser weld process model to optimize the weldability of irradiated material
 - Science/modeling based welding process development
- Develop experiment methodology for direct measurement of transient high-temperature temperature and stress history during welding



LTO/LWRS Project Task 3 (2010/11)



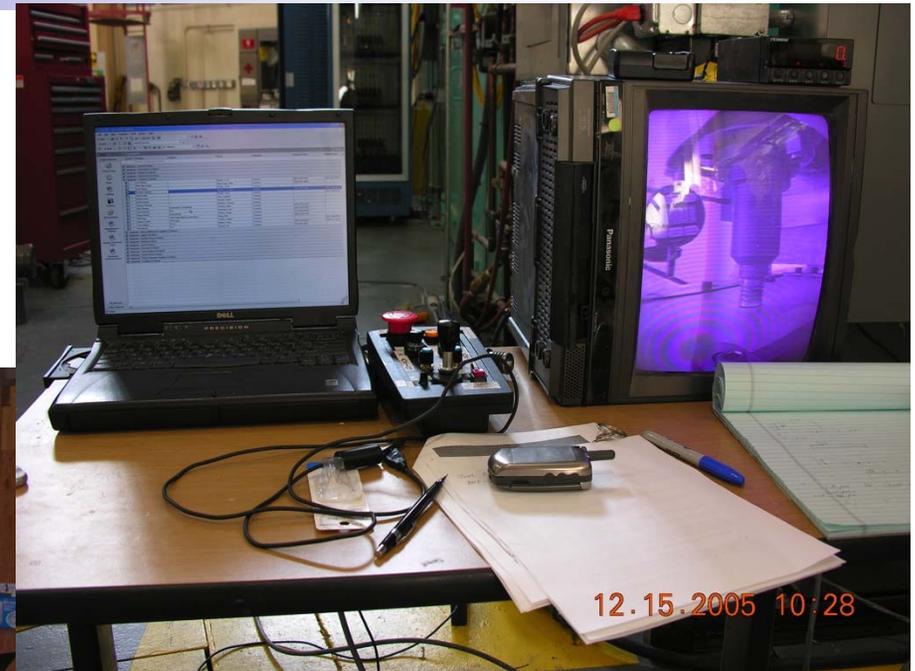
EPRI is participating in the design and development of a New Welding Hot Cell (ORNL)

Welding Capabilities:

- Laser conventional and hybrid
- Friction stir
- Ultrasonic
- Powder coating
- Cold spray

LTO/LWRS Project Task 3 (2010/11) Cont.

Motion control platform centered
around FSW system



LTO/LWRS Project Task 4 (2010/11)

- Advance modeling of hybrid welding process and optimization of stress state for welding irradiated materials
- Installation of laser welding cell at EPRI Charlotte facility
 - New fiber laser welding (2kW) system
 - Procurement of secondary heat sources
 - Procurement and installation of manipulator
- Welding experiments with real time stress measurement
 - Provide feedback for calibration of hybrid welding model

EPRI Roadmap for Welding Irradiated Material in the LWRs

