INL/MIS-23-73680-Revision-0

Correlation of As-read and As-run Dosimetry Data

April 2024

Stefan Elias Abbott, Brenden J Heidrich

Changing the World's Energy Future

INL is a U.S. Department of Energy National Laboratory operated by Battelle Energy Alliance, LLC

DISCLAIMER

This information was prepared as an account of work sponsored by an agency of the U.S. Government. Neither the U.S. Government nor any agency thereof, nor any of their employees, makes any warranty, expressed or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness, of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. References herein to any specific commercial product, process, or service by trade name, trade mark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the U.S. Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the U.S. Government or any agency thereof.

INL/MIS-23-73680-Revision-0

Correlation of As-read and As-run Dosimetry Data

Stefan Elias Abbott, Brenden J Heidrich

April 2024

Idaho National Laboratory
Idaho Falls, Idaho 83415

http://www.inl.gov

Prepared for the
U.S. Department of Energy
Under DOE Idaho Operations Office
Contract DE-AC07-05ID14517

Not available for content • Not available for content • Not available for content • Not available for content
Final Edge of Poster
Not available for content • Not available for content • Not available for content • Not available for content

Correlation of As-read and As-run Dosimetry Data

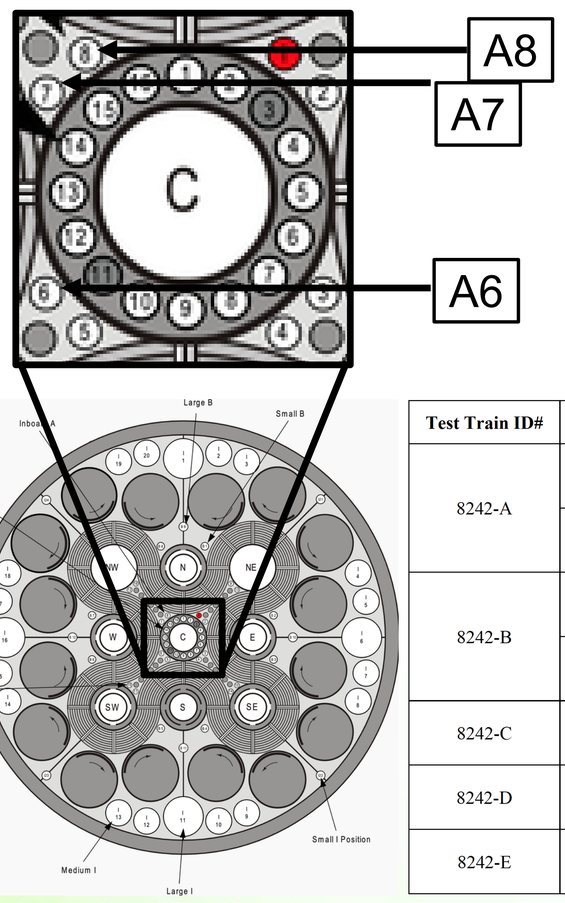
Stefan Abbott and Dr. Brenden Heidrich

Background

The Nuclear Science Users Facilities (NSUF) is responsible for the coordination of experiments conducted in Advanced Test Reactor (ATR) by Universities and other outside organizations. Completion of the experiment and data reporting process is long and expensive. As such, it is expected that targets for temperature and neutron dosage are met. Simulations of expected reactor performance under specific conditions to meet these targets are critical for this process. However, it is not often that these reports are correlated with the data produced by monitors in ATR. This project aims to correlate simulation and read data from experiments in ATR to gauge uncertainty.

BSU-8242

Many experiments have been conducted through the NSUF in the past few years with varying levels of funding and dosimetry monitoring. BSU-8242, conducted in 2018 with Boise State University, represents a project in which all dosimetry measurement techniques the NSUF currently deploys were utilized. This project can therefore be used to directly compare these techniques with expected dosimetry targets and simulation data.



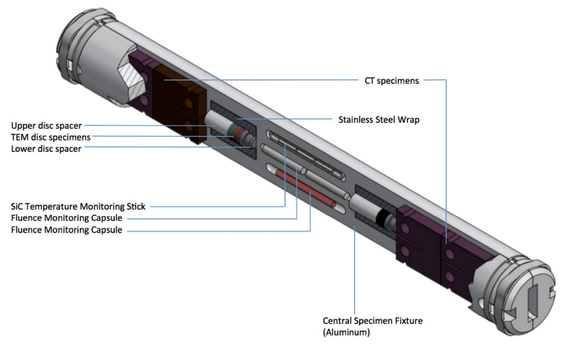


Figure 2: BSU-8242 capsule cutaway

Test Train ID#	Capsule ID	Specimen content	Irradiation Cycles	ATR position
8242-A	300C/1 DPA (X)	RT specimens: 2 CT specimens: 4 TEM specimens: 21	164A	A7
	400C/1 DPA (X)	RT specimens: 8 CT specimens: 4 TEM specimens: 48	164A	A7
8242-B	300C/1 DPA (Y)	RT specimens: 2 CT specimens: 4 TEM specimens: 0	164A	A8
	400C/1 DPA (Y)	RT specimens: 8 CT specimens: 4 TEM specimens: 9	164A	A8
8242-C	300C/3 DPA	RT specimens: 8 CT specimens: 4 TEM specimens: 33	164B, 166A, 166B	A6
8242-D	400C/3 DPA (Y)	RT specimens: 10 CT specimens: 4 TEM specimens: 60	164B, 166A, 166B	A7
8242-E	400C/3 DPA (X)	RT specimens: 10 CT specimens: 4 TEM specimens: 9	164B, 166A, 166B	A8

Figure 1: Center position of ATR and 3 experimental positions

Experiment

Seven capsules were irradiated in ATR for 1 cycle to achieve 1 DPA dosage and 3 cycles for 3 DPA, respectively. Originally, the planned positions for BSU-8242 were A4, A5, & A6. However, this was changed before testing to the positions in Figure 1, leading to as-run calculations with Monte Carlo N-Physics (MCNP) to be redone for both thermal and neutron dosage values. Additionally, it was discovered that the position of assemblies 6 & 7 had been switched during final testing cycles leading to additional recalculation. Physical data was obtained via melt wires, flux wires, and SiC wires. Analysis was performed on melt and SiC wires at HFEF while flux wire data was performed by PNNL.

Results

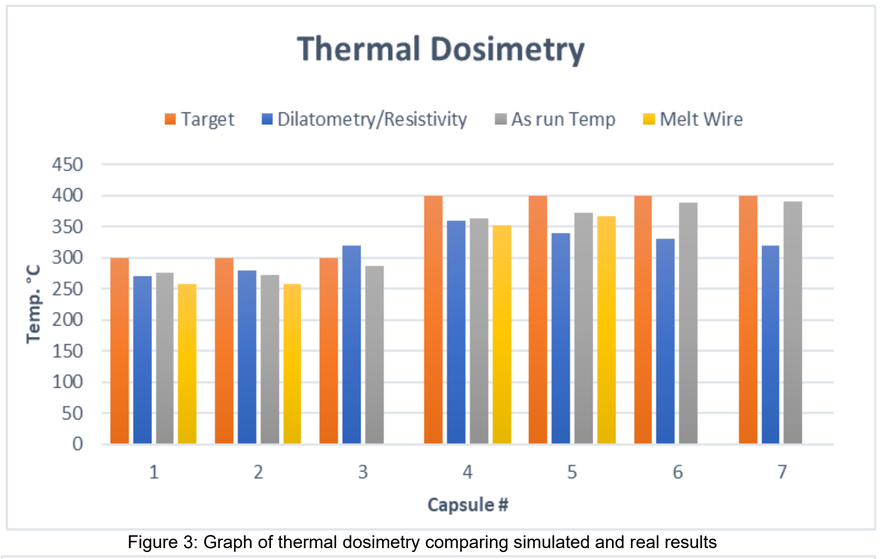


Figure 3: Graph of thermal dosimetry comparing simulated and real results

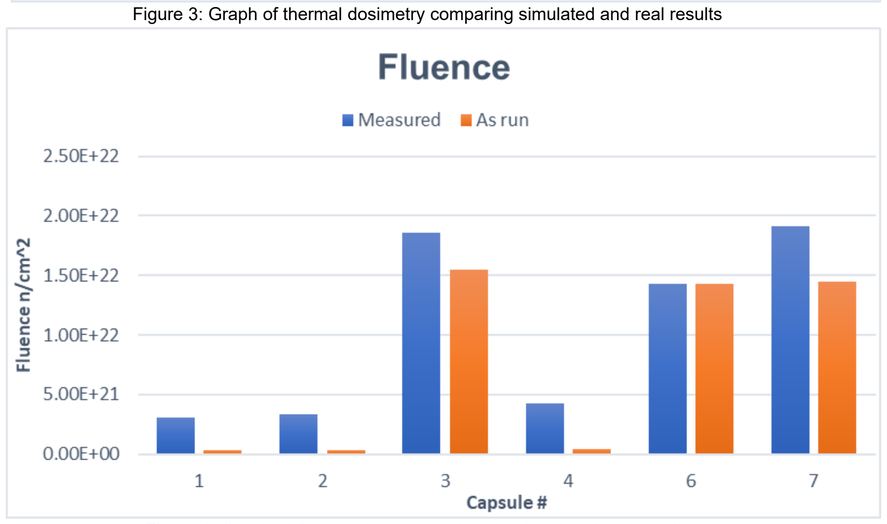


Figure 4: Graph of fluence data comparing simulated and real results

Discussion

A comparison of as-run simulated data and real readings is shown in Figures 3 & 4. While the simulated and real results are not in major disagreement, there is a tendency to undershoot thermal targets. This trend has appeared across datasets beyond BSU-8242. It may also be apparent that the melt wire data for 3 dpa samples is absent, which are still in process. The melt wire data which is present shows ideal behavior, matching well with the Dilatometry data from the SiC wire. Generally, this is not the case and melt wires vary greatly in accuracy across datasets. Figure 4 displays great variation in fluence data, in both the 1 & 3 DPA capsules. The variation from measured fluence in the 1 DPA as-run data has not yet been accounted for but appears to be a clerical error in the reports. Manual calculation based off the MCNP flux output suggests similar fluence to measured data. Lastly, there is a discrepancy between the as-run and read data in the 3 DPA capsules. The as-run data predicts a lower overall fluence while the measured data is high at capsules 3 and 7.

Conclusions & Future Work

A correlation study was conducted on the BSU-8242 reports. Thermal data was found to be relatively consistent with simulations while fluence data was not. Therefore, future work will consist of investigating other datasets to discover root causes of incongruities between data types. Additionally, there is special interest in quantifying the uncertainty in measurement with SiC and melt wires. Thus far only the error in MCNP calculations and flux wire measurements has been determined.

www.inl.gov

This work was supported by the U.S. Department of Energy, Office of Nuclear Energy under DOE Idaho Operations Office Contract DE-AC07- 05ID14517 as part of the Nuclear Science User Facilities

Battelle Energy Alliance manages INL for the U.S. Department of Energy's Office of Nuclear Energy

INL Idaho National Laboratory

Final Edge of Poster
Not available for content • Not available for content • Not available for content • Not available for content
Not available for content • Not available for content • Not available for content • Not available for content