Instrumentation and Control in Experimental Support Facilities for Generation IV Lead-Cooled Fast Reactors: A Review of Architectures and Functional Requirements

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ABSTRACT

Experimental facilities supporting lead-cooled fast reactor development require instrumentation and control systems adapted to different phenomena and experimental timescales. This narrative review examines architectures and functional requirements across six ALFRED support infrastructures, using NOGATILL, developed within ANSELMUS, as an application example. Published studies and selected I&C and SCADA research are analysed through measurement representativeness, timing consistency, functional responsibility and data traceability. Control allocation is distinguished from the integration of slow and fast acquisition, while standardized information services are distinguished from application-defined messages. A traceability matrix links documented functions to proposed requirements and verification evidence. These requirements concern channel identification and validity, timestamp preservation and data-gap identification, execution and recording of defined control states, and retention of configuration context. NOGATILL illustrates heater supervision, alternative temperature feedback and dissolved-oxygen monitoring. Timing, accuracy and availability constraints must be established for each experiment. The contribution is an applied synthesis for specification and verification; the proposed checks are not presented as completed performance-validation tests.

Keywords: instrumentation and control; lead-cooled fast reactors; experimental facilities; distributed SCADA; oxygen control and data logging.