Control System Migration for the Fuel Handling Machine Heads Testing Rig to Current Standards: Framework and Technological Challenges

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ABSTRACT

This paper presents the conceptual architecture and technical basis for transitioning the Fuel Handling (F/H) Machine Head Test Rig Control System at Technologies for Nuclear Energy State Owned Company (RATEN) Institute for Nuclear Research (ICN) Pitești to modern standards. The Testing Rig represents a critical infrastructure capable of carrying out to the pre-acceptance and acceptance tests of F/H Machine Head for Units 3 and 4 of the Cernavodă Nuclear Power Plant (NPP). Due to the natural wear and aging of the legacy hardware platform (PEP OS9 / VME42) and process interfaces, which have reached maturity and are being phased out by manufacturers without ongoing technical support, a hardware migration is required to align with modern industrial technology. transition, built on the fundamental requirement to maintain the initial configuration of the Control System logical control driver, developed in the IsaGRAF environment.

To achieve this objective, preserving the legacy software, a comprehensive comparative study of modern industrial automation hardware architectures was performed. Through this evaluation, key technical challenges were identified to ensure alignment with current standards, meeting the required real-time performance, sampling rates, and software portability constraints. Furthermore, an Operator Decision Support Expert System (SE-ADO) based on web technologies was integrated into the architecture.

The proposed solution integrates robust programmable automation controllers, advanced data acquisition modules, with local web infrastructure, establishing interactive Human Machine Interface (HMI) to assist operators and ensure safe, procedural testing workflows.