Evaluation_Proposal__dubois

Evaluation of RANCOR

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RANCOR is a nuclear power plant control room simulator for engineers and human factors designers to test system controls and incidence response procedures for operators. The software is developed on the Windows .NET framework. The source code hosted on GitHub provides researchers access to make revisions to test different control layouts and scenarios, and to collect data during session interaction with participants.

The software is under development by Drs Thomas Ulrich and Roger Lew under the support of Idaho National Laboratory. The software is a *Microworld* simulator; a simplified simulation environment, "designed to reproduce important characteristics of real situations while leaving open the possibility of manipulation and experimental control" (Funke, 1993). Rancor offers a limited model for real-world control rooms, focusing on major elements of vital control sub-systems, divided between the *Primary, Secondary* and the *Turbine* subsections.

Access to the source code repository can be granted by the authors, and documentation can be found at this URL https://rotorox.github.io/rancor-doc/Getting-Started

Experimental Value

Rancor is currently configured to support investigation of attention and situation awareness in nuclear process control. Scenarios are designed to present participants either routine procedures, or rare failure conditions requiring alert and timely response. Trials using the software can capture response time and user error, to guide the development of both procedure and control interface.

Captured data reveal actions of participant controllers with respect to game time and game events. The simulator also tracks electrical output to the grid, dollar denominated, as an performance metric. (Reminder, customer electrical power is the product of nuclear power plants)

#audience

The presentation of the control software is meant to be accessible to naïve users with

minimal training, while retaining immediate familiarity to experienced operators for high transferability.

Review Scope

Rancor's most relevant design standard is provided by the NUREG-0700. The document is over 500 pages in length, broadly covering human-system interface (HSI) elemental design guidelines, to workplace design, control room configurations, upgrades, maintenance, and process degradation or failure.

#goal

The evaluation will provide a scoring of the software features versus guidelines provided by available standard. **The evaluation will focus on features of the HSI representable by software control simulation, only**.

Concerns of workplace environment, maintenance, and upgrade are beyond scope.

NUREG-0700

#standard

The U.S. Nuclear Regulatory Commission (NRC) staff reviews the human factors engineering (HFE) aspects of nuclear power plants in accordance with the Standard Review Plan (NUREG-0800, Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition).

NUREG-0700 is a guide published by the US Nuclear Regulatory Commission (NRC) that provides information and guidance on designing safety systems for nuclear power plants. The document provides guidance on the design of safety systems, including the selection of system components and the development of control system logic. The purpose of NUREG-0700 is to ensure that safety systems in nuclear power plants are designed to provide adequate protection against accidents and to ensure the safety of the public and the environment. NUREG-0700 provides criteria for evaluating the reliability, maintainability, and availability of the system design, to ensuring that they meet the NRC's requirements for accident prevention and mitigation.

The guidelines are organized into four parts

1. HSI element basics
    1. Information Displays

2. User Interface interaction and management

3. analog displays and controls

2. HSI reviews

1. alarm system

2. safety parameter display system

3. group view display system

4. soft control system

5. computer based procedure system

6. automation system

7. communication system

3. Review of workstations and workplaces

4. Review of HSI support

As defined by **scope**, this review will utilize guidance furnished in Parts 1 and 2.

User GUI

The RANCOR simulator software runs effectively in a minimal windows environment. Although the deployment of the simulator is flexible and can scale across multiple screens of any size, it is designed to meet a minimum use case, such as provided by a standard laptop on a single screen. The screen capture in figure 1 is from a single HD monitor on a Windows workstation.

The three relevant participant UI sections are the PID View, the Overview panel, and the Control panel. Each section is windowed and scales maintaining layout positions and proportion independently.
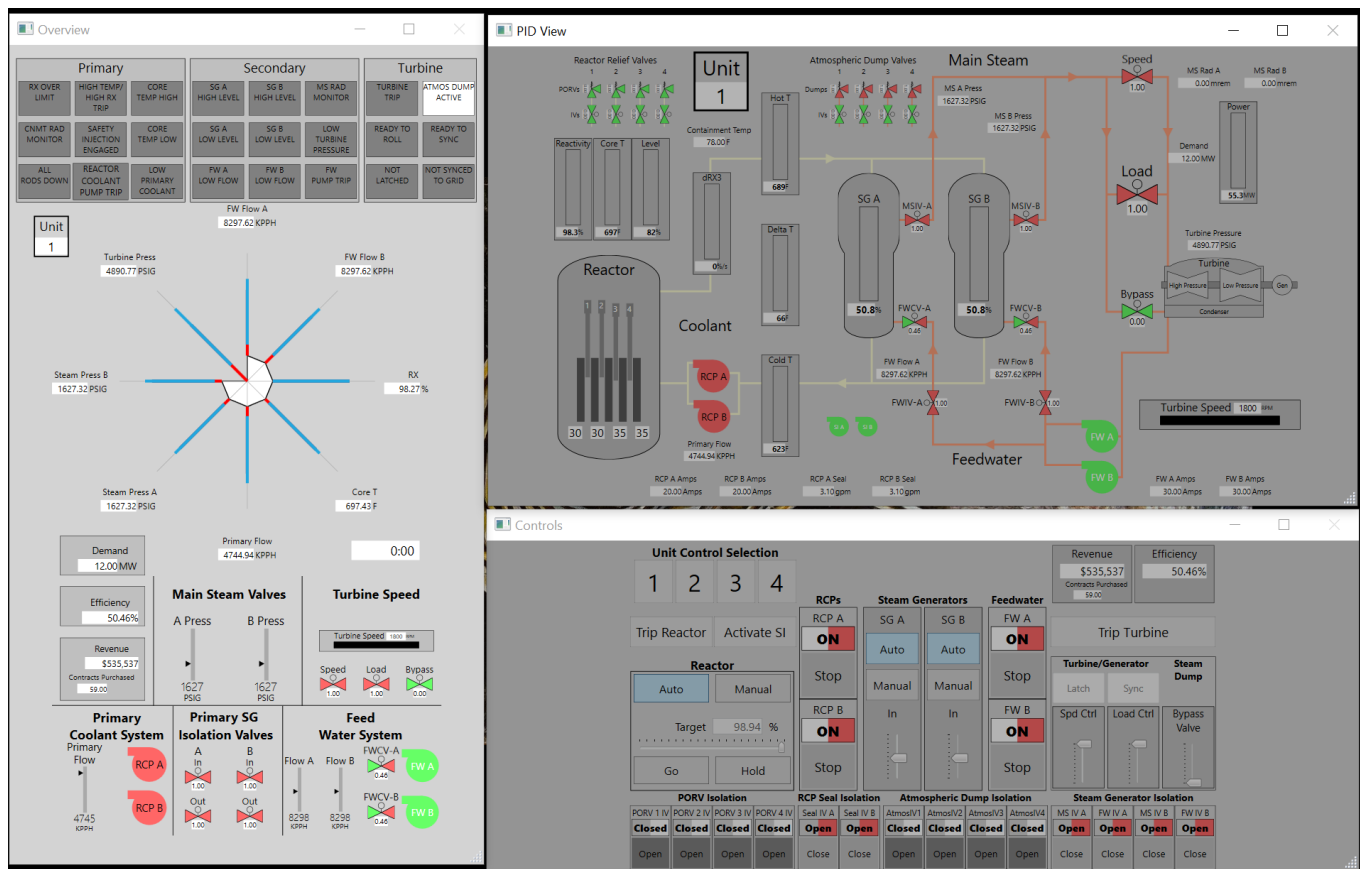
Figure 1, Rancor UI view