Computerized Operation Support Systems of LABIHS Simulator

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Introduction

Automation of certain tasks in a Nuclear Power Plant control room is expected to result in reduction of operators' mental workload, which may result in other benefits such as enhanced situation awareness and improved system performance. The final goal should be a higher level of operational safety. The Human-System Interface Laboratory (LABIHS) compact NPP simulator incorporates several advancements in the design of computerized operation support systems (COSSs). Each one of these COSS has to be carefully designed/integrated to avoid undesired effects such as, the reduction in the operator's system awareness, an increase in monitoring workload activity, and a degradation in manual skills, which could lead to plant operation failures.

Computerized Based Procedures (CBPs)

The development and evaluation of CBPs for advanced control rooms is one of the research areas of the LABIHS. Initially, before developing a toolbox, we evaluate the ImPRO CBP construction tool [1], which is free and available for download on the Internet. Fig. 1 illustrates a scenario in which the simulator is under a transient event and the operator uses a CBP to identify the transient Anticipated Transients Without Scram (ATWS).

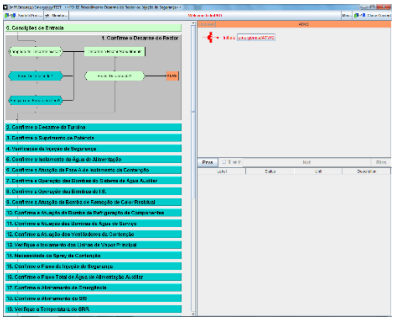

Fig. 1 - CBP in the LABIHS simulator.

Automatic Plant Mode Detection (PMD)

The purpose of the automatic PMD module is to monitor a set of neutronic/thermodynamic variables and, based on their values, decide in which operation mode the plant is currently on. The plant operation modes are Refueling (RFL), Cold Shutdown (CSD), Hot Shutdown (HSD), Standby (HSB), Startup (STP), and Power (PWR). The PMD is present on all GUI screens of the simulator (see example on Fig. 2). This way, the operator is always aware of the current operation mode of the plant.

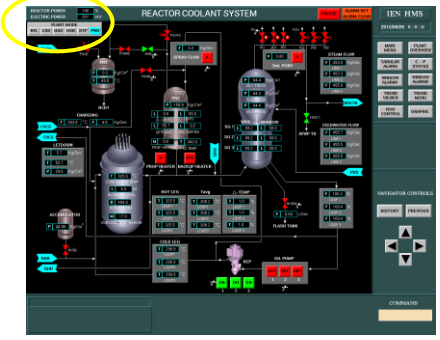

Fig. 2 - Plant mode detection.

Automatic Alarm Filtering (AF)

The main purpose of the automatic AF module is to suppress unnecessary alarms based on four sources of information: Cause-Consequence, Operational Mode, Redundancy and Initializer Event. The Cause-Consequence alarm suppression is performed when a set of alarms is enabled, but a subset of the alarms refers to consequences and not to a root cause. In this case, all consequence alarms of a given cause are suppressed. The basic idea of the Operational Mode alarm filtering is to suppress all non-indispensable alarms due to a given plant mode operation. The Redundancy alarm is the third source of alarm filtering and its idea is simple. If, for example, the alarm *pressurizer water level hi* is actuated, and after that the *pressurizer water level hi-hi* is actuated, then the first one is suppressed. Finally, the purpose of the Initializer Event alarm is to detect which one of several events was the first one in time to be triggered. This allows for the suppressing of all the other events to be initialized after the first one.

References

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