Integration of computerized operation support system on a nuclear power plant environment

G. D. G., Jaime[1], J. C. S., Almeida[1], M. V., Oliveira[1]
e-mails: gdjaime@ien.gov.br , jcsa@ien.gov.br, mauro.vitor.360@gmail.com

[1] *SEESC, IEN*

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This work presents the development, implementation and integration of selected components to achieve a higher level of computerized/automated operation on a specific target system, with the goal of achieving workload reduction to the operators of the LABIHS compact NPP simulator, as illustrated on Figure 1. Specifically, we discuss three components: (i) Automatic Plant Mode Detection, (ii) Automatic Alarm Filtering, and (iii) Computerized Procedures [1].

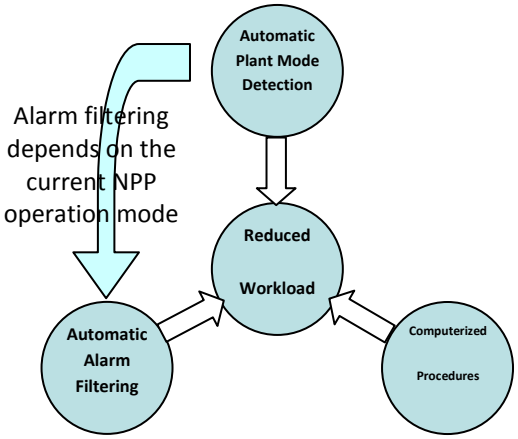

Figure 1. How the three integrated modules contribute to workload reduction

The purpose of the Automatic Plant Mode Detection module is to monitor a set of variables neutronic/thermodynamic variables and, based on its values, decide in which one of six possible operation mode the plant is currently on: refueling, cold shutdown, hot shutdown, stand by, startup and power.
Currently under implementation, the Automatic Alarm Filtering module main purpose is to suppress an unnecessary alarm base 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 are enabled, but a subset of the alarms refers to consequences to a root cause. When this is the case, then all consequences of a given cause may be suppressed, as working around the cause will inherently fix its consequences.
For example, suppose that the Intermediate range high flux rod stop alarm on is currently on (enabled). The cause-consequence column indicates that alarm ID 34 is a root cause. Then, if alarm RCO trip intermediate range hi flux, is also enable, then Intermediate range high flux rod stop should be suppressed.
Plant operation procedures are used to guide operators in coping with normal, abnormal or emergency situations in a process control system. Historically, the plant procedures have been paper-based (PBP), with the digitalization trend in these complex systems computer-based procedures (CBPs) are being developed to support procedure use.
The development and evaluation of computerized operation procedures for advanced control rooms is one of research areas of the Human-System Interface Laboratory (LABIHS) [2,3]. In [2] and [3], we developed a CBPs system in the LABIHS simulator. The ImPRO CBP [3] tool was chosen for our implementation because it is available for download in the Internet.
A procedure in ImPRO is decomposed into steps, and a step is decomposed into both actions and check. Both elements are connected in the flowchart. After either action or check is performed, the next action or check is ready to perform. Action has single input arrow and single output arrow, whereas check has single input arrow and double output arrows according to its evaluation. Figure 6 shows the snapshot of ImPRO.

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