

# COMPUTERIZED PROCEDURE SYSTEMS: PROCEDURE EDITION AND MAINTENANCE CHALLENGES

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## ABSTRACT

Very few nuclear power plants are using computerized procedures to guide the control room operation. A CPS implementation consists of two processes: digitalization and computerization. The former deals with the transformation of paper-based procedure into a digital data; the latter is referred to as the addition to that data of extra information that is meaningful for decision-making. This information may include real-time data (plant parameter values and binary process values to indicate equipment states), provide access to trends and historical data, etc. In order to be efficient and to optimize the digitalization and computerization processes, these set of aids should be implemented at the same time as operating procedures are digitalized

There are references of plants having successfully implemented Computerized Procedures Systems (CPS) for emergency procedures, but when questioned about normal or abnormal operating procedures, operators and plant management seem reluctant to take that step. Given that a CPS is meant, by design concept, to increase operation crew efficiency by facilitating the procedures execution and reducing human error, why are we reluctant to enjoy CPS benefits in the most common plant status (i.e. normal operation)?

Although there are many answers to this question, one is shared by most of the users: CPSs are not designed for editing and maintaining procedures easily and reliably. Normal operating procedures, in opposition to the emergency procedures, are often reviewed. Nowadays, these edition activities are performed easily with a word processor software and using paper, but what is required when dealing with a CPS?

*Key Words:* Computerized Procedure System (CPS), Configuration Management System, Procedures Edition, Procedures Maintenance

## 1 INTRODUCTION

This paper tries to provide an answer to these questions, outlining requirements to be imposed to a CPS editing tool and describing the process that allows to define them. Requirements range from simple, obvious facts like the need of keeping the CPS operable while doing an update to one or multiple procedures, to a configuration management features to procedures collection structure. The key point to define such requirements is to use a user-centered design approach that applies an unusual point of view: the focus is placed on the maintenance of procedures and all related administrative tasks, instead of the conventional approach that directs its attention to procedure execution.

## 2 PROCEDURES EDITION AND MAINTENANCE

Normal operating procedures, in opposition to the emergency procedures, are often reviewed due to the following factors (these among others):

- Operation sequences are modified looking for optimized strategies
- Set points and equipment are modified as plant ages or due to simple loops tuning
- Redlines correcting errors or adding details and notes are scribed online in the control room and
- Human performance tools are included based on training, corrective actions programs and operating experience

Due to these facts, when a CPS is used, an edition tool seems essential to enable the maintainability of the operating procedures. Nowadays, these editing activities are performed easily with a word processor and using paper, but these tools lack of an easy integration with CPSs. Could it be possible to design a specific editing tool that embraces both easy integration with CPSs and specific features for reviewing and maintaining operating procedures? Which specific requirements will be necessary to enable procedures edition and maintenance with this editing tool?

## 2.1 Edition and Revision of procedures: Challenges

Traditionally, operating procedures have been created, edited and reviewed using word processors.

The main advantage of this process is that there are many well-known office automation programs that can be used for the purpose. However, this way of managing the edition of procedures happens to be inefficient and may lead to human errors. A good example that shows this lack of efficiency is when there is a change of a variable setpoint: a previous research should be done in order to identify which procedures will be affected by that variable change and subsequently this variable change will be implemented manually, procedure by procedure.

In the best of the cases, there is a database in which the procedure variables locations are registered so that the previous research can be optimized; although this is not usually the norm. On the other hand, for the variables changing process itself, there is a great scope for improvements in order to make the revision process more efficient and also to reduce human errors.

Moreover, the most important challenge for current traditional editors is that they are not designed in order to integrate those procedures (already in a digital format) in the CPS execution tool. To this day, no procedure editor on the market is able to allow both, operating procedures editing and revision process as well as the direct integration of those procedures (already digitalized) into the CPS execution tool.

## 2.2 New Edition Tool

Bearing in mind the current challenges that traditional procedure editors are facing, the *New Editing Tool* should be able, not only to optimize the procedure edition and revision process, but also to enhance the integration of those procedures in the CPS execution tool.

At this point, the question is whether to use an commercial editor (already available on the market) and integrate it with the CPS execution tool or to develop an ad-hoc designed editor to meet specific needs derived from the CPS execution tool.

### 2.2.1 Internal editor vs External editor

There are both, advantages and disadvantages regarding the two options raised (ad-hoc and commercial editor). The most important ones are explained below:

**Table I. Ad-hoc Editor vs Commercial Editor**

Key Features	Editor	
	Ad-hoc	Commercial
Learning curve (knowledge and familiarity with the editing tool)	long	non existent
Integration capability with execution tools	very high	very low
Text edition functionality	medium	high
Control of changes and versions	very high	medium

To make an assessment of which of the two options is the most appropriate to implement, there are also other *variables* to take into account such as:

1. whether the CPS execution tool will also be implemented or not;
2. if operating procedures are already written and maintained using a commercial editor;
3. whether that word editor is meeting the expectations of usability; etc.

### 2.2.2 Possible Scenarios

In order to clarify, considering the *variables* mentioned above, some scenarios are presented below, specifying the boundary conditions and possible solutions using both, an ad-hoc and a commercial editor (if applicable).

Three scenarios are presented:

- **Scenario 1:** Current operating procedures that will be executed with the CPS Execution Tool
- **Scenario 2:** Current operating procedures that will not be executed with the CPS Execution Tool
- **Scenario 3:** New operating procedures that will be executed with the CPS Execution Tool

**Table II. Scenarios**

N° of Scenarios	Scenario variables	
	Operating procedures	CPS Execution Tool
Scenario 1	Current	Yes
Scenario 2	Current	No
Scenario 3	New	Yes

#### 2.2.2.1 Scenario 1: current operating procedures to be executed with the CPS Execution Tool

In this case, operating procedures already exist and were developed and are maintained by a commercial word editor. There are two possibilities:

To continue with the conventional commercial editor and to develop a ‘program translator’ in order to manipulate the data the editor outputs and transform it as expected by the CPS execution tool. The principal disadvantage of this option is that creating a translator is not a straight forward task. This translator has to be extensively tested in order to be able to guarantee its reliability. Moreover, this translator has to be updated according to the commercial editor versions.

To design and develop a specific a custom-made editor (ad-hoc editor) that enhances the computerization process of operating procedures, and allows a straightforward integration of these procedures into the CPS execution and the maintenance tools. This is the case of *Edipro*. Tecnatom has developed an internal editor in order to enhance procedures maintenance as well as procedures execution through the Tecnatom CPS execution tool (*EASE-t-pro*).

#### **2.2.2.2 Scenario 2: current operating procedures not to be executed with the CPS Execution Tool**

In this situation, important inefficiencies should take place in the procedure maintenance process to justify the economic investment required to migrate the current operating procedures to the new tool (for example, *Edipro*). These inefficiencies are mainly related to the modifications in procedures due to changes in variables such as setpoints, alarm descriptions, equipment tags, etc.

If ad-hoc editor is selected, the implementation will take place without the execution module as this set of requirements will not be necessary in this case.

Another commercial editor could be used to substitute the current one. In this case, an important economic investment will also be necessary in order to pay for the license to use it, to train plant personnel in this new edition environment and to finally, migrate all operating procedures to this commercial editor.

#### **2.2.2.3 Scenario 3: new operating procedures to be executed with the CPS Execution Tool**

In this case, there are two main options. The first one is to use the ad-hoc editor attached to CPS execution tool. This editor will be used to develop operating procedures from scratch as well as to maintain procedures and create new procedure revisions. In addition, plant personnel in charge of operating procedures will be able to create CPS aids (to be used during the CPS procedures execution) at the same time that they develop operating procedures. Due to this synergy, both, the procedure development process and the CPS aids creation process, are optimized and human errors are reduced.

In the second option a commercial editor is used. However, a specific translator to enable the procedure computerization (needed to execute operating procedures in the CPS execution tool) has to be designed and developed.

#### **2.2.2.4 Scenario conclusions**

After the analysis of these scenarios, it seems clear that if an CPS will be used to execute operating procedures, the internal editor is the best option as it will be specifically designed to enable operating procedures maintainability and computerization to enhance their integration with the CPS execution tool.

Due to this fact, requirements to be imposed to a CPS editing tool are outlined in this paper. Requirements range from simple, obvious facts like the need of having CPS operable while doing an update to one or multiple procedures, to savings expected by applying a configuration management concept to procedures collection structure.

### **2.2.3 Key features of New Editing Tool**

This *New Editing Tool* should be designed taking into account the following requirements. This editor should provide, similar conventional edition capabilities that a common office software has and also special features explained along this paper. Moreover, the method to define those requirements was a user-centered design approach applying a different point of view than usual: procedure maintenance and all related administrative tasks; contrary to the conventional approach of designing these systems with the focus only on procedure execution. This *New Editing Tool* should provide:

- *Same edition features as common office software editors*: in order to provide the same edition functionality to users.

- *User-friendly tool*: as this tool is not a commercial editor already available in the market, the editor interface should be similar to current commercial editors in order to cut out the learning curve.
- *New edition features regarding the execution tool requirements*: as mentioned, some special features regarding the operating procedures computerization and CPS aids addition process should be included in this new editor. The aim of this requirement is to find synergies between the digitalization (transcription to the new editor) and the computerization process (addition of CPS aids to be used during the procedure execution), optimizing both processes.
- *Direct communication with the CPS execution tool*: both editor output and CPS input shall fit together to streamline the process of editing procedures and putting them ‘into operation; reducing this step in the computerization process, making it more efficient and human error safe.
- *Changes traceability*: this feature is essential in order to trace changes among procedure revisions. This new edition tool has to enable the establishment of a new procedures modification process and has to be very flexible as this process is directly related to each plant administrative tasks.
- *Ensure that the latest procedure version is the one that is unequivocally available for the execution tool*: this tool has to guarantee that the latest approved version of each procedure is available to be executed by the CPS execution tool. In addition, CPS execution tool has to be operable while updating one or multiple procedures.
- *Paper procedures backup*: the editor should provide a paper-procedure output in order to enable the execution of procedures in case of CPS execution tool failure.
- *Modifications of procedure variables*: a procedure variable database is required as well as mechanisms to enable the variable link to procedures in a direct, equivoque and traceable manner. If this requirement is implemented in this new editing tool, time-consuming activities such is the research of which procedures will be affected by that variable change as well as the implementation itself of these changes, could be optimized.
- *Different user profiles and interaction between them*: a proper management of variables database content shall require the existence of different user profiles. Only a few of these profiles should have access to perform data base changes.

### 3 CONCLUSIONS

Finally, the following conclusions are drawn from this paper:

1. It is essential to know both, the process in which procedures are developed and maintained and the CPS execution tool in which operating procedures will be executed, in order to design an ad-hoc editor that meet these requirements with the aim of optimizing the edition, revision, digitalization and computerization processes and reducing human errors along them.
2. Apart from the procedures edition and maintenance and the integration with the CPS execution tool, the ad-hoc editor has to count on a friendly word editor-looking interface. Moreover, this editor should provide flexible means to stablish workflows and to assist in the planning of procedure revisions; activities typically linked with the administrative tasks of plants.

3. The editor has to comply with cyber-security criteria in order not to compromise either this tool or the CPS execution tool. Although the editor will not be implemented in the main control room, the editors output is the CPS execution tool input, which, in this case, will be integrated in the main control room.

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