

# Use of simulator training for the study of operational communication – the case of pilots of French nuclear reactors: reinforcement of reliability

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## Abstract

Studies with French nuclear reactor operating teams have shown the established use of “standard of communication” which was efficient within the team but showed drawbacks when shared outside the team. A new standard has been implemented all over the nuclear fleet. Difficulties for implementation have been identified in terms of i) changing habits inscribed in mind and body of long date, ii) requirements of a new management approach concerning the work activity. Successful results have been obtained from the safety and production standpoints.

## 1-Introduction

Industrial processes involve workers in the development of specific communication due to their specific industrial context. The materials, the process itself, the sciences to which refers the process, lead them to name and then to use specific words to indicate what they want to do, where they need to go, what they expect from each other... With time and use, the words used are reduced by removing some syllables of some specific words. This induces in dialogues a lot of implicit. Most of the time, it helps workers to be more efficient, because exchanges are done faster, mental resources are used to other cognitive tasks than making and understanding long sentences. But sometimes, it could produce some safety events that are undesirable. The aim of this paper is to present a study concerning the balance between operational communication efficiency when words are reduced, and potential safety event occurrence. It then presents the way habits can be changed on this field and the difficulties this change implies.

This illustration is accomplished on the piloting of nuclear reactors. The clinical material is acquired from simulated situations on full scale simulator of nuclear reactor, and from analyses of events of industrial

operating. By operating event, it is necessary to understand a gap between realized work and expected task. Any gap detected leads to a treatment (Fauquet, 2004, 2007, 2008a) and is assessed according to the INES scale. Quasi entirety is classified at level 0 (“no importance from the point of view of safety”).

## 2- Progressing of the "observation-analysis" period

For some reasons too long to expose in this short paper, we focused our observation efforts and analysis on the activities of the men at work in control room.

The actors have been seen in 2004 and 2005 in control room of real operating situations, and in control room of full scale simulator (Fauquet, 2009). This represents about fifty hours of observation. For this experimentation, specific scenarios were developed and being used on simulator to put the actors in potentially difficult situations of communication. The aim was to understand and to assess the robustness of the communication modalities. For not simulated situations, observations were made over the working periods of day rather than night, during periods often implicating numerous exchanges between persons (the frequency of night exchanges is much weaker).

A synthesis of observations and analysis were then presented and opened up for discussion in teams (Fauquet, 2006). These results were inserted into the study in progress at the national level of the firm to contribute to the elaboration of standards of communication. We discuss it in section "change of communication practices".

## 3-Effectiveness and limits of operational communication: observations - analysis 2004-2005

Observations show that the mode of fiabilisation of the exchange of information is function of the complicity of activity and working context. The more situation is complex, and the more the actors feel the need to explain their understanding of activity, and to question the interlocutor. This was modeled par Rasmussen et al. in 1994.

This mode of reliability, by the explicit enunciation of what is done and will be done, is particularly implemented when the actors are not much familiarized with the task to be accomplished.

In simpler contexts (that is to say for work activities known by the actors because already done several times), observations realized in 2004 and 2005 showed that

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recurrent reliability modes were in general to the number of two:

- Reliability of oral exchange by the written support: the oral message is enforced by leaning on the visual support which is the operating document, held in the hand by one of the interlocutors so that the others can support their understanding of the message by reading at the same time.
- Reliability of the oral exchange by the material support: the oral message is enforced by leaning on the visual support which is the control panels of the control room, by indicating of a gesture the control organs concerned by the message, which are affected by a tag indicating the name of equipment. However, this assumes that each of the actors understands that this concerns what about they speak.

Observations also confirmed (because known well in advance) that the mode of oral exchange used a "standard usage of communication" due to this industrial environment and founded on the typical location of equipments in the industrial places.

This is made possible due to tasks to be fulfilled and due to the location facilities of equipments in the industrial places. In effect, most of tasks concern group of given equipments identified as belonging to a «basic system" of the industrial process.

Every basic system is spotted by a number and a trigramme (example: 1RRI, 2RCV, 4SEF) where the number designs the reactor to which is devoted the basic system.

And every organ is spotted by three numbers and two letters; both letters indicate the type of organ (example: PO for pump, VA for valve) and number designs the number of the organ. So, 1RRI002VA indicates the valve number 2 of the system RRI of the reactor number 1.

This functional mark "1RRI002VA" is replaced by "2VA" [two-vee-ay] in what we named the "standard usage of communication". As we explained it, most of part the tasks concern group of given equipments identified as belonging to a "basic system".

In these conditions, the exchange between actors concerns a specific basic system and speech starts in general with the precision of the trigramme of the basic system, to evacuate it then besides of speech to make more efficient transmission and understanding of information.

In effect, the transmission of information searches systematically to minimize the number of words and the length of the signifier, what passes systematically by evacuation of number of reactor and the trigramme of the basic system.

After the first enunciation of number of reactor and the basic system, these are then put down as implicit.

Example = the pilot of reactor number 1 is meeting a problem for which he sends a field worker to control the equipment:

"Reactor 1, I have one worries on the system RIS. In the pushing back of the one-pee-ow. I would like that you go to see in place if the fifty-nine vee-pee is opened correctly."

It is necessary to understand here that the pilot asks for a control of the position opened for the valve 1RIS059VP located downstream from the pomp 1RIS001PO. Complete formulation would give:

"Reactor 1, I have one worries on the system RIS, in the pushing back of the pomp one-RIS-zero-zero-one-pee-ow. I would like that you go to see in place if the valve one-RIS-zero-fifty-nine-vee-pee is opened correctly."

Other specific case: observation and event analysis put in an obvious place one generality. Some workers weaken the quality of exchanges because their activities allow them only exchanges by telephone, and the actors have then tendency to implement an implicit communication by habit (Fauquet-Alekhine, 2009; Fauquet-Alekhine & Pehuet, 2011) and to neglect the reformulation of request while it takes all its importance in such context.

Cases of partial reformulation of exchanges of messages were noticed during this specific context ; in these cases, the actors choose the key elements in the message in order to make more reliable according to themselves the understanding of asked action, such as a part of functional marks, of number of place, of number of task form. It is still a product of the standard usage of communication displayed above.

#### 4-Safety event analysis

We explained how the actors implemented a "standard usage of communication" founded on the functional location of equipments and on a specific protocol of exchange inserting implicit information, notably by the reduction of the signifiers. At first glance, the implicit in teams appears as a strength as much as it helps to have more efficient collaboration, notably via the exchange of information, by allowing a quicker understanding of information.

But this implicit functioning is specific to a given group by using a code which is its own one; if the constitution of the group changes, it is necessary to make hypothesis that the implicit will not work anymore so efficiently, since one or several persons of the exogroupe have no full knowledge of the group code.

The event analysis has shown which can be consequences.

If the "standard usage of communication" can lead to critical situations, then it is clear that it is necessary to replace it with another standard without losing its efficient side or losing few.

#### 5-Changes of communication practices

Studies led on the nuclear plant of Chinon were compared with other studies led on other nuclear sites in France. Results introduced above were confirmed by the analysis of observations accomplished as well as by the event analysis (Fauquet, 2006; Fauquet-Alekhine, 2009). In 2006, the head quarter of the company decided to hire a Human Performance Programme on all the 19 nuclear sites of France. This program comes from studies made in numerous industries, in France and abroad, and has been fostered by studies such as that introduced here, and others (Colas, 2001; Rousseau, 2008).

The Human Performance Programme urges the actors of the nuclear plants to make more reliable their interventions by using 6 reliability practices. We shall be focused on one of the practices of expected reliability concerning exchange between actors during their working activity. It is named "reassured communication". The prescribed usage of communication has vocation to take the place notably of the "standard usage of communication" presented above, and to hire those who do not use standard of communication to apply it.

It is expected for interventions on equipments of the nuclear installation, particularly during routine activities. It is said "3 ways": interlocutor INT1 enunciates a request, interlocutor INT2 repeats request, and interlocutor INT1 confirms or rectifies.

### 6-Changes of communication practices

Going to this mode of "reassured communication" cannot be immediate, all the less that the modalities of communication in work, such as the "standard usage of communication" exposed above, are inscribed in mind and in body of long date (see for example Fauquet, 2008b ou Dejours et al.,1994). We explained that the way the actors communicated between them has a sense which we tried to understand. Thus, any request of application of another protocol of communication is going to be confronted with established practices. In effect, this habitus is historically and socially constructed according to rigid norms. Changing these attitudes is all the less easy as the sense of behaviors is still not aware for the actors. This is valid for reassured communication, but also for other reliability practices inscribed in the Human Performance Program.

To lead the actors to implement and to insert into their professional practices this modality of reliability, several stages were worked out since 2007.

These steps are carried out by management at all hierarchic levels, helped by human factor consultants or by specialized training people. We shall not develop the detail of these steps because it is not the main object of this publication.

The first step was a pedagogic training of preliminary.

The second step was principally a step of analysis.

The third step is a stage of permanent deployment.

This third step also leans on the full scale simulators, maintenance simulator or piloting simulator. They are used to teach the workers and the managers the technical gestures of reliability practices, and to help them to incorporate these practices, that is to say to live them with the body in working situation. Simulated situations also make demonstration of the effectiveness of reliability practices at work (see Klein et al., 2005; Fauquet, 2008c; Fauquet-Alekhine, 2009).

In parallel to these centered training situations on simulator, the managers offer punctually in the teams pedagogical animations, the objective of which is to support in the mind of the workers the practices gain. Management create this type of debate regularly in teams.

For it, management is also subjected to a specific training. A computer tool to draw identification and the

treatment of these difficulties has been developed. To make more dynamic deployment beyond the action of management, role models workers are identified and trained specifically. They are persons acknowledged technically by the colleagues, who were spotted to have very quickly accepted reliability practices. These role models are able of helping or recommending their colleagues on the subject. The role models are enlivened in local network, what allows them to share their experience and knowledge, difficulties and solutions.

### 7-Conclusion

The French nuclear production division of EDF has decided to involve every worker in a large reliability activity plan, the Human Performance Programme, in which reliability of operational communication is concerned.

We shall take two examples to objectify results acquired at national level:

- The number of reactor automatic scrams of diminished by a factor close to 2 between 2007 and 2008, and the decrease is going on in 2009.
- The number of events which would be owed to non-application or ineffectual application of reliability practices diminished by a third.

These results are particularly satisfactory as for the effectiveness of progress. Yet, it also objectifies the remaining margin of progress.

However, changing from a mode of "standard usage of communication", inscribed in mind and in longstanding body, to a mode of "reassured communication" prescribed, cannot be immediate and will never be absolute.

Two questions at least now can be put in study with a view to following ongoing progress:

- Since the mode of communication between workers is led to change, evaluating from a tradition to a prescription, how this mode of "reassured communication" prescribed can generate "misappropriations" of application? In effect, numerous studies, among which notably those of Clot (1995, 1999, 2000, 2002, 2003, 2004), put in an obvious place the involvements of prescription on working activity and what can implement the actors to answer it in a deviated way or not.
- How the future generations of workers will put in their professional practices this mode of "reassured communication" prescribed?

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