

Humans Factors in French Nuclear Industry

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Abstract

The Human Factor Policy for French nuclear reactor fleet is presented. The key job of Human Factor Consultant (HFC) is described from its genesis in the company to its today re-questioning. The different skills domains of the HFC are commented.

1. Introduction

Electricité de France Nuclear power plants are submitted to strict formal rules. Respect of these rules, and especially functional parameters or materials configurations, allows to guarantee in case of technical problem, that the process and organization will manage to control the situation and the installations. The aim is to protect Human and his environment from radioactive contamination by the containment of nuclear coil and derivative products.

A deviation with regards of referential (a valve in a state not in accordance with requirements for example) can be treated as a significant safety event. Such a deviation must then be analyzed and explained to Nuclear Safety Authority (the national regulator). It is clear that for EDF industrial company, such deviations are not acceptable as they involve and discredit dispositions adopted to guarantee nuclear safety on power plants.

Consequently, all means are implemented to avoid occurrence of exploitation events concerning nuclear safety (see Fauquet 2002, 2003, 2004). By exploitation event, it is necessary to understand a gap between realized work and expected task. Any gap detected leads to a treatment (Fauquet, 2007, 2008) and is assessed according to the INES scale. Quasi entirety is classified at level 0 ("no importance from the point of view of safety").

The contribution of the Human Factors Consultant (HFC) and the policy of Human Factors in the company, help to avoid occurrence of exploitation events.

This paper will give a short description of the HF policy and will explain what has been identified as a key

competence which is the one of Human Factors Consultant, and why.

Then it will expose briefly the four domains concerning the missions of a HFC on a nuclear plant organization.

2. Human Factors policy and Human Factors Consultant

Let us first suggest a definition for "Human Factors" in industries.

The Human Factors (HF) are the factors which contribute to the occurrence of a situation by the action or the decision of Human, individually or collectively: behavior, attitudes, organizations, decisions, and all their interactions.

Thus, it is fundamental to notice that HF are centered on the work activity. For industries such nuclear exploitation, one of the important implication parameters is the formal prescription (Fauquet et al., 2002). Other high risk industries or companies are concerned at the same level; chemical industries, refineries, aircraft and navy companies (Amalberti, 1996 et 2001; Clostermann, 2010), for example. Process is so complex, and stakes are so important, that companies and industrial firms are involved in heavy training programs with the use of expensive full scope simulators (Fauquet-Alekhine, 2009). And since 2006, EDF is involved in a specific Human Performance Program which one the Human Factors experts must sustain (Fauquet-Alekhine, 2010; Colas, 2001; Rousseau, 2008).

Taking into account the HF aspects is thus quite important. This has been notably pointed out after the nuclear Tchernobyl accident (Ukraine) during which the Human contribution to the accident occurrence has been significant. It gave rise to the realization that the process safety could not be only or at least mainly based on technical automatic controls. The place of Human inside the process had to be reconsidered.

For the French nuclear industry EDF, one of the main points has been to development a HF policy, with the creation of the job on each nuclear power plant: Human Factors Consultant. The HFC must help to take into account the HF dimension at work. According to my colleague of Air France, Jean-Philippe Barat, "taking into account the Human Factors dimension at work is to make visible what is invisible".

Personally, the definition can be: Human Factors are factors which contribute to the case of a situation due to action or to decision of Human, individually or collectively: behaviors, attitudes, organizations, decisions, as well as all interactions between them.

The HFC is involved in 4 domains:

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- Contribution to feedback event and work activities analysis: analysis of the organization (remedial, or proactive such as socio-organizational and human impact analysis), event analysis.
- Support and advice to departments or teams: projects of teams, analysis of particular situations such as controversial, re-organization, ...
- Support and advice to the unit head management.
- Development of HF knowledge: lectures and demonstrations in departments or teams, in trade academies, in classroom training sessions and training on simulators, in the deployment of the Human Performance Program with notably Manager in the field and Reliability Practices (Human Performance tools).

At the beginning of the 90's, when the HFC job has been created, it was rigged by technicians, people from the industrial process trades. Soon it has been pointed out the need of Human Sciences academic knowledge for such a job, and around 2000, people from Human Sciences universities have been employed for the job. It appeared to be a good choice from the analysis standpoint, but nevertheless, it was difficult for a lot of those persons to be effectively efficient concerning the understanding of the industrial process. It has been then written, in 2002, a frame of reference for the job, after a national study of one year, in which have been recorded all the competences required and all the topics on which the HFC could work. The following years, some few people with both the technical and Human Sciences competences were chosen for the job, and in parallel, the national division, with the support of the Research and Development division, have created a specific Human Sciences Master for the technicians craving for the HFC job. In 2008, the first "students" attended the Master session.

Today, the national division is thinking about the needs for the following years. With the strains of the economic market, with the new projects in which the HFC have been involved like the Human Performance Program, the job has changed, and expectations have to be reconsidered. Again, the national division is leading an analysis, the results of which are expected before 2012.

Nowadays, the typical organization on a nuclear power plant, for the HF management is as follows.

The HFC is usually attached to the vice-director Safety-Quality, who is attached to the head director of the nuclear power plant. This close relationship to the head management of the plant has shown a lot of advantages for the HF dimension to be sustained by the whole management.

The operational departments of the plant have designed one HF correspondent. The aim is to create a short link between the department and the HFC, in order to make the people of the trade feel more easy to speak of HF questions. Those correspondents meet four times a year to share about problems, solutions, or knowledge.

The HFC also works with the social partners, which are the social worker, the work medicine, the union trades, and of course, the management and the teams.

We shall describe here after briefly every domain in which the HFC is involved. The readers will note that the HFC is definitely oriented in a safety management way.

3. Feedback event and work activities analysis

One of the main contributions of the HFC for this domain is the safety event analysis.

Safety event analysis is curative (comes after safety events). It is an important part of the HFC's activity for at least two reasons:

his competence is needed to help to find the deep causes of the event,

by doing this kind of analysis, the HFC reaches some information that helps him to have a better comprehension of what is going right or wrong on the plant, and this information can help him for other analysis.

The treatment of the safety events falls under logic of a framework which is declined, in the ideal, in several phases:

a-the collection of the facts near the actors by the writer of the final report, in order to trace the chronology of the event as soon as possible, and to work out a first analysis,

b-the meeting of the actors of the event in collective discussion with the HFC, to work out the tree of the causes, to identify the failing states and inappropriate actions, and to put under discussion the elements of comprehension,

c-the outline, at the time of this meeting, of the corrective actions,

d-the drafting of the report and its validation by the actors,

e-the validation of the report by a collective authority specific to the trade (see its functional description and analysis in Fauquet, 2004),

f-the validation of the report by Management of the power plant,

g-the diffusion of the teaching of the analysis report in the teams.

Items b and c are fundamental because they contribute to put under discussion, within the group of workers, the practices of work which possibly led to the event. This setting under discussion, which is articulated in particular around the elements of comprehension of inappropriate actions, makes it possible the group of workers to make evolve its individual and collective practices, to decide together this evolution, in order to apprehend a similar situation in a different way, and to reduce the probability of renewal of the event. Thus, the context of the event is thought and discussed as if it were necessary to replay it differently in order to apprehend next similar situation differently.

In the same way, items e and g make it possible to share on these changes of practices with the peers, and other actors potentially concerned with these changes.

The fundamental difference between, on the one hand items b and c, and, on the other hand, items e and g, lays in the objective of transformation and sharing between workers associated with these transformations.

Details are fully developed in Fauquet (2005), and the individual or collective analysis presented are based on the works of Clot (1999) and Clot et al. (2002), Vygostki (1930) and Scheller (2001).

The results and conclusions of such analysis are then used to adapted organizations, at the nuclear power plant level, but also at the national level.

Annual safety analysis gathers those information for each plant, and global analysis is done for the whole division. Among the tools used, the data base called L@cid gives accurate details of each event which allow fine categorizations of the events and statistical approach of the data. HFC are involved in entering data and analyzing them.

4.Support and advice to departments or teams

This kind of support can be involved by national organization or by local requests.

One example of national implication is the SOH impact analysis.

SOH impact analysis is at first proactive (the analysis comes systematically before the action), and must integrate event and work feedbacks and thus, can also carry on a curative aspect of work analysis.

SOH impact analysis is connected to a national modification of the materials. This modification is first studied from the technical standpoint, and then a large analysis is done, led by the national departments with the help of a few power plants called "head of series". This analysis needs usually several months, and is enriched by the feedback given by the "head of series" plants. It concerns impacts on the equipment, the organization, the resource, the training needs.

Conclusions are then gathered and send to other plants with the modification documents in order to be taken into account. Sometimes, the plant management decides to engage a new SOH analysis to be sure that the analysis will take into account all the specificities of the plant (technical and organizational). This local analysis is led by an engineer TLI (Local Technical Integrator), supported by the HFC if needed.

Support and advice to departments or teams also concern local requests as actions concerning the management of people and of work activities. It can be changes of organization, of process, for example, but it can be resolution of controversial situations or conflicts inside or between the teams, or between management and teams.

Some specific meetings help the HFC to give advice to the departments: every month or every two months (depending on the department organization), a work safety group (description and analysis in Fauquet, 2004) takes place to discuss all safety points of interest.

5.Support and advice to the unit head management

The HFC is expected to give support and advice to the unit head management at least in two ways: on request and according to his own analysis.

On request, the unit head management asks the HFC specific analysis concerning organization changes, management decisions, both before or after their application. It can be formal (with a study or analysis report delivered by the HFC to the management) or informal (a discussion in the director's office).

According to his analysis, the HFC can ask the management to pay specific attention to the consequences of a decision of a new organization. To be able to do it, the HFC must make permanent macro analysis of the plant works, by gathering all the knowledge he has concerning every thing on the plant. To be efficient on this kind of job, it is important for the HFC to be involved in a lot and diverse analysis on the plant, and to be in touch with most of the operational departments.

Some specific meetings help the HFC to give advice to the management staff of the plant: every month, a safety technical group takes place to discuss all safety points of interest.

6.Development of HF knowledge

During the past years in most of the cases concerning this domain of his work, the HFC was involved in some lectures and demonstrations in departments or teams. On request of the teams, or to improve some work practices (Fauquet-Alekhine, 2009, 2010), the HFC could work with the pilots on full scope simulator during training sessions.

Since 2007, with the Human Performance Program, the HFC is much more involved in the training sessions, both on maintenance and piloting full scope simulators, and both in conception and teaching of the training programs. HFC also helps for the management to enforce their action in the field, according to the needs of the teams.

Besides, trade academies have been created for people recently employed in the company. In this frame, the HFC is asked to provide specific lectures concerning HF policy on the plant, and concerning the reliability of work.

And for managers who are concerned by operational work, the HFC is asked to make lectures concerning the event analysis methods.

7.Concluding remarks

History of the French industrial process at EDF have shown how much important is to take into account the Human's place in the process, whatever is the industry (see for example Colas, 2001; Clostermann, 2010). The EDF company has built since several years a Human Factors policy which must answer these kinds of needs.

To help the success of such a policy, an expert is involved in the safety management: the Human Factors Consultant. On every nuclear power plant, one to three persons are employed for such a job.

Organizational feedback and studies have pointed out that, for such a job, both technical and Human Sciences knowledge and competence were required. In this aim, the company, with the help of other big industries and universities, has created a specific Master.

In parallel, the company has understood that the Human Factors policy had to be adapted periodically. This has been done at the beginning, in the 90's, done again in the 2002's, and again it is in progress now with expected results before 2012.

As we can see, Human Factors policy needs specifics means and organization, and constant adaptation to be efficient.

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