STUDY OF HUMAN FACTORS AND ITS BASIC ASPECTS, FOCUSING THE OPERATORS OF IEA-R1 RESEARCH REACTOR

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RESUMO

O objetivo deste trabalho é o estudo de fatores humanos e variáveis situacionais que podem, quando alterados, vir a interferir na ação de trabalho dos operadores de instalações nucleares. Os acidentes em Centrais Nucleares demonstram que os mais graves ocorreram por falha de natureza humana. Este trabalho contribui também com o atendimento ao subitem 5.5.3 da Norma CNEN-NN-3.01 [1] - ***"Devem ser tomadas medidas para reduzir, o quanto for exeqüível, a contribuição de erros humanos que levem a acidentes ou outros eventos que possam vir a originar exposições inadvertidas ou não intencionais em qualquer indivíduo".***

Adota-se o Modelo denominado "Análise Comportamental" analisando-se os fatores e aspectos relevantes do cotidiano dos operadores do reator IEA-R1, localizado no Instituto de Pesquisas Energéticas e Nucleares – IPEN/CNEN-SP. Destaca-se que o desempenho depende de uma série de variáveis, não apenas do indivíduo, mas também situacionais, incluindo-se nestas categorias as variáveis físicas, as de trabalho, as organizacionais e as sociais. São considerados também os fatores subjetivos, tais como: atitude, habilidade, motivação etc., visando uma perspectiva global da situação, que conta com um conjunto de princípios para análise e compreensão do comportamento. Pretende-se propor mecanismos e ações corretivas para contribuir com a redução de falhas, após conhecer, detalhadamente, o cenário de aplicabilidade.

Descritores: Falhas Humanas, Fatores Humanos.

ABSTRACT

The objective of this work is the study of human factors and situational variables, which can, when modified, interfere in the actions of operators of nuclear installations. This work is focused in the operators of the IEA-R1 research reactor, which is located in the Instituto de Pesquisas Energéticas e Nucleares – IPEN – CNEN/SP. The accidents in Nuclear Plants have shown that the most serious have occurred due to human failure. This work also considers the item 5.5.3 of CNEN-NN-3.01 standard [1] - ***"Actions must be taken to reduce, as much as possible, the human failures that can lead to accidents or even other events which can originate inadvertent or unintentional expositions in any individual"***

The model named "Behavioral Analysis" is adopted. Relevant factors and aspects of the operators' routine are also considered. It is worth to remind that the performance depends on a series of variables, not only on the individual, but also situational, including in these categories; physical variables, work environment, organizational and the social ones. The subjective factors are also considered, such as: attitude, ability, motivation etc., aiming at a global perspective of the situation, which counts on a set of principles for the behavior analysis and comprehension. After defining the applicability scenario, mechanisms and corrective actions to contribute with the reduction of failures will be proposed.

Keywords: *Human Failures, Human Factors.*

INTRODUCTION

Beginning the study based on aspects of the human nature of a person engaged in a society and in a work, we realize that the man is capable to change his daily routine. The individual makes every effort so that his activity reaches the goals, benefiting not only him, but also the company he works for.

However, as this society develops, there is a bigger interest in reaching higher levels of productivity. The work organization is affected by some remarkable modifications, not always compatible with the possibilities of the man. By the way, the man was - and often still is - left in second plane, as the insertion of more and better machines are seen as what is called "total quality". Thus, the pressure for higher productivity brings problems such as of repetitivity, derived from the division of tasks; lack of pause, due to the fact the "production" cannot stop; a work often incompatible with human capacity and limitation.

In this context, it is necessary to consider that performance depends not only on the individual, but also on a series of variables, such as physical, work, organizational, and social ones, that we will call "situational variables". Such variables may cause dissatisfaction, fear, anxiety, pain, suffering and unhappiness, which may have consequences on the workers physical and mental state. Nonetheless, we cannot forget the "individual variables", because it defines how each worker will "particularly" respond to these situations.

The set of factors mentioned above may facilitate the occurrence of human failure in the work environment, what, according to CARDELLA (1999) [2], becomes one of the "strongest challenges to the human intelligence", since, apparently, there are more than enough resources to prevent the occurrence of such accidents. The evolution of technology leads to the belief that the error is under control, because all the automation is surrounded by immediate alarms, signals or immediate disconnections. It is ignored that is the man who activates the commands and interprets the data, and that the occurrences of errors are inevitable, mainly when, what it is demanded is beyond the individual limits. However, many organizations ignore or do not accept the human failure. As a matter of fact, the society as a whole condemns the failures, without critically analyzing the factors originating the process.

The occurrence of human failures, although a constant, is not seen under a very favorable point of view. In the whole world, people commit errors and cause accidents; however, when it is the human life that is at stake, situation becomes much more sensitive. According to BULHÕES (2001, p. 164) [3], the most common and convenient solution, has been making responsible all those involved, without considering the various factors that may facilitate the occurrence of these failures: "the problem rarely represents one individual failure; it is mainly the imperfection of the system".

As long as the incapacity to recognize or to accept the fact that fatigue, stress, and work situations may act on the performance remains, the error will appear, because the workers will keep ignoring the alarm signals regarding his performances and will keep on pressing the button of the human machine beyond its limits (BULHÕES, 2001. p. 257).

METHOD

The study concerning operators' human failures follows two complementary ways. Firstly, it relies on a bibliographical research to give theoretical basis to the proposed study, in which the approach is based on cognitive aspects, such as memory, attention, perception, interest and motivation, attitude, emotional state, and stress, among others.

In a second moment, the study converges to a quantitative and qualitative research, in which questionnaires to the operators are applied, in order to know their degree of enrollment with their tasks, and also to make a little more particular analysis of human potentialities as these are remarkable in a decision taking. The analysis of all data and information collected from the application of these methods comes later and considers measures that guarantee the minimization of failures.

RESULTS

Discussing Human Failure without firstly realizing what it is meant and understood as safety, inside the installation that is under analy-

sis, is absolutely impracticable. Thus, a preliminary research was elaborated, by means of a questionnaire based on variables involving the performance concerned to which is described in the safety norms. This research was carried out with the purpose of evaluating the degree of enrollment of this nuclear installation to the attributes of safety focused on the perceptions and reactions of the employees, considering that one of the concerns of the "International Atomic Energy Agency" - IAEA, is the improvement of the safety in nuclear installations.

This questionnaire presents the methodology of HAYES (1997) [4], which allowed us to evaluate the reliability by the Alpha estimate of Cronbach (correlations between items) (Hayes 1997). Although we have a reliable questionnaire, the purpose of validity is to give us condition, if we so wish, of arguing what was really observed and if its strategy is related to the content, to the criterion, and to the structure (Hayes 1997).

The form used was of the Likert type (Hayes, 1997). It allowed the employee to indicate his perceptions to the safety attributes in a scale of four points. These extremes were 1 and 4. The selection of the questionnaire items adopted the attributes of safety described by IAEA, in chapter 2 of the "Safety Standards Series in the GS-R-3" [5], and was defined in groups: (i) valuation of the safety, (ii) hierarchy and leadership, (iii) responsibility, (iv) people integration and organization, (v) learning and attitude of questioning.

This Questionnaire was applied to 24 employees of the installation, including supervisors and operators, who received previous orientation for filling it out. These people are distributed among different levels of academic education: medium, superior and postgraduate.

The results presented until this moment show a satisfactory degree of correlation for all the items analyzed, except for responsibility and integration, whose correlations of three items were below 0.50. The probable causes of these occurrences may be related to the Responsibility - lack of clarity of the employees about the attributions of responsibility with respect to safety; and - oriented towards the existence of appropriation of relationship with the regulating agency that assures the licensing of the organization under the responsibility aspect. With respect to the dimension integration, it is questioned if the factors affecting the motivation and the satisfaction with the work are considered.

In the calculation of the alpha of Cronbach with respect to all the dimensions, the smaller value was of 0.84. Thus, it is possible to observe that the relations were direct and significant between the dimensions, and correlational weights were above 0.80, which gives confidence in its measurement.

These results, as it was our initial intention, indicate the necessity of a further research, questionnaire, containing other factors. This will have a deeper strategy of analysis, considering that some factors may cause a more negative effect than others, mainly if we consider that the results call more our attention in this first research, "responsibility in relation to the safety" – external factor to the individual, and "integration" oriented to the motivation and satisfaction – internal factors, considered more conflicting.

If we consider that, as an analysis result, motivation is the internal factor that more influentiates the attention – we pay much more attention to everything that either motivates or gives us pleasure, than to things that do neither interest nor stimulate us -, this is our first analogy, among many others that will appear in the course of a bigger work, entitled "Study of Human factors, and observation of its basic aspects, focused on operators of the research reactor IEA-R1, aiming at the prevention of accidents caused by human failures", that is in development by these same authors, in which this article is based.

DEFINITIONS

It is important to define the meaning of human failure used in the development of this work. According to FIALHO and SANTOS (1995) [6], "human failure may be seen under two approaches, depending on the intentionality of whom commits it". The aim of this work is oriented to the non-intentional human failures, also known as human errors, not disregarding the importance of the intentional failures (violations, breakings). Therefore, whenever the term Human Failure is used, it will mean Human Error.

COMMENTS AND CONCLUSIONS

The study of human failures may be used in every place where it may occur, but its amplitude will obey the time of the research, however that it serves as a signal, as a human alarm, to prevent the process that leads to failure, and, mainly, if it occurs, be considered in a form that involves these factors, after all this is the way for its minimization.

Believing in the potential and in the importance of this study, mainly as a parameter to demystify the human error, in its individual and situational aspect, we present some, that when modified, may be used to detect possible non-intentional human failures. Nonetheless, we should emphasize that there are many alternative methods and techniques that may be used for this purpose, which means that choices are necessary, and should be based, mainly, on the best contribution to the specific goals of the proposed analysis, however respecting the tools which are not mentioned nor used in this research.

REFERENCES

[1] COMISSÃO NACIONAL DE ENERGIA NUCLEAR – Diretrizes Básicas de Proteção Radiológica – CNEN-NN-3.01 – janeiro de 2005.

[2] CARDELLA, BENEDITO, Segurança no trabalho e prevenção de acidentes: uma abordagem holística, São Paulo: Atlas, 1999.

[3] BULHÕES, IVONE., Riscos do trabalho de enfermagem. 2. ed. Rio de Janeiro: o autor, 1998.

[4] HAYES, BOB E., Medindo a satisfação do cliente / Bob E. Hayes; tradução Luiz Liske - Rio de Janeiro: Qualitymark Ed., 1995, 228p.

[5] INTERNATIONAL ATOMIC ENERGY AGENCY. Application of Management Systems for Facilities and Activities Guide. - Safety Standard Series GS-G-3.1 - Vienna: IAEA, 31/Aug/2006.

[6] FIALHO, FRANCISCO; SANTOS, NÉRI DOS., Manual de análise ergonômica no trabalho. Curitiba: Gênesis, 1995.