

IMPLEMENTATION OF THE ENVIRONMENTAL MANAGEMENT SYSTEM IN NUCLEAR FUEL CYCLE. A CASE STUDY OF THE USEXA – CTMSP.

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ABSTRACT

CTMSP is the institution where the Brazilian Nuclear Navy Program is developed. The objective of this program is to dominate the technology, industrial and operational processes in nuclear facilities, applied to navy propulsion. In the nuclear fuel cycle, the most complex technological stage is the Uranium Enrichment, that is, a higher concentration of Uranium isotope 235, allowing its utilization as a fuel element of the nuclear reactor. The USEXA - Unit of Production of Uranium Hexafluoride will develop the following stages of the project cycle: material reception and storage, washing drum, production of uranyl nitrate, production of uranium trioxide, production of uranium tetrafluoride; production of fluorine; production of uranium hexafluoride; recoveries of uranium; effluent and waste treatment; and storage of chemical products. This paper presents the advantages and the importance of the Environmental Management System – EMS application, in accordance with ISO 14001: 2004 standard, in Nuclear Public Units, in implementation stages. The incentives are sent to the responsible sectors with questions on the environment, to be answered by the workers affected. An EMS brings any company (public or private) benefits resulting from its implementation, decreasing expenses, enhancing the environment and expanding human resources capability. The paper also shows a new approach of the Environmental Management Implementation: an outside and inside view, with personal motivation as the main tool in human resources.

1. INTRODUCTION

1.1 The Environment

Issues related to the environment left the fashion category to become a really serious theme, acquiring the status of necessity. This change in relation to environmental questions occurred, mainly, as a result of the climatic changes in recent years. The global heating and the perceivable climatic changes in the world have become a major environmental concern.

The existing reasons for the environmental design of products and the improvement of internal processes of production brings the company the following advantages: greater satisfaction from the customers, public image improvement, conquer of new markets, costs reduction, better performance, risks reduction, more efficient administration, longer market-life for its products, easier financing conditions, more facilities to obtain an environmental

certification, besides the positive exposition to customers, neighbors, shareholders, and others.[1]. Thus, it is perceivable that the preservation of the environment by itself is not a motivation for the companies to invest in the Environmental Management System or more efficient technologies of monitoring and environmental depollution. The environment is an additional factor of competitiveness in the consumption market. MOURA approaches the necessity of implantation of a EMS with the following affirmation: “The decision on the necessity or not of an environmental management system implantation has to be made analyzing whether this will meet a customers needs or if this system will collaborate, significantly, for the fulfillment of the legislation” [1].

The environmental question involves an economic vision. Traditional economists, with some exceptions, always theorize on the economic systems without considering the natural environment as materials and energy supplier for human beings and a receptor of the resultant residues and wasted energy from anthropogenic activities [2].

In the ecological vision, the economy attacks the environment. In the economic vision, the ecology is making the development difficult. Both visions, judging they are correct in their rights. However, both questions - economic and ecological - have their importance based on the meaning that is given by the etymologic root of these two vocabulary prefixes. *Eco* means *oikos* that stands for house in Greek. Therefore, there is the common concern to protect this *house*, the planet Earth [2].

1.2 Environmental Management System – EMS

The Environmental Management can be considered as an administrative or operational set of guidelines for direction and activities, for example: planning, direction, control and allocation of resources to obtain a positive effect on the environment, with the reduction or elimination of the problems caused by the human being action [3].

The standard ISO 14001 is a tool created to assist the organizations in the implantation, development and/or improvement of an Environmental Management System (EMS). The norm is based on the methodology known as PDCA - Plan-Do-Check-Act [4].

The models of environmental management can be used by any organization, and, alike to quality systems approach, it guarantees that the success in this area is becoming an important consideration in many organizations development plans, supporting the progress toward the goal of a sustainable development.

Environmental management programs establish the activities to be developed, the sequence between them, as well as, the agents responsible for their execution. These programs should enclose the most important environmental aspects and to pursue a continuous improvement, extending their scope of work in the course of time. They should, also, possess enough dynamism and flexibility to adapt to changes that may occur in their both immediate and future environments [5].

The implementation and operation of an Environmental Management System is, in fact, the application of concepts and techniques of administration, directed to environmental issues [1].

One of the most important tools and that can summarize the implantation of the EMS process is the PDCA cycle, also known as Deming cycle, composed by four major steps : Plan (To plan); Do (To carry through); Check (To verify); and Act (To act to correct) and, then, re-starting a new cycle. This cycle must be preceded by an activity of “Establishment of the Environmental Policies” of the company [6].

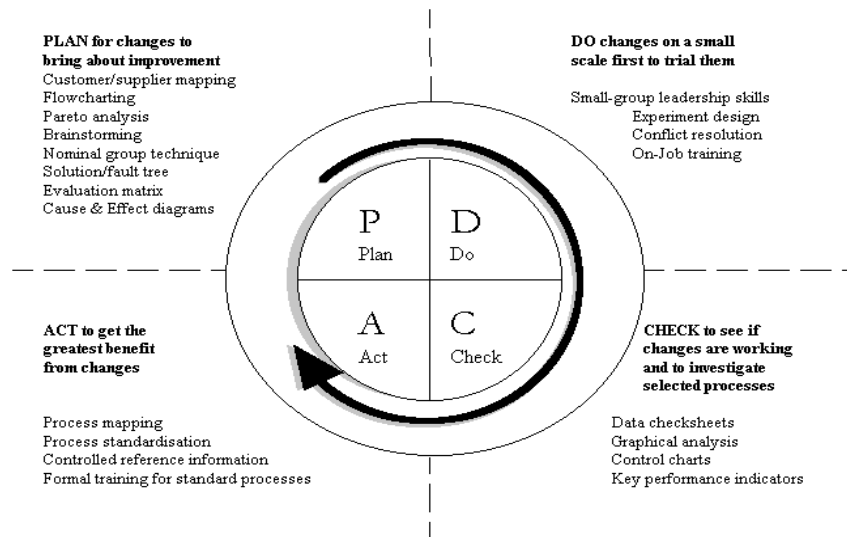


Figure 1 – Cycle PDCA [7]

The public sector, for working, most times, without competition, compared with the private segment, do not possess stimulations for the implantation of an EMS in its units. Besides, it has to be considered the difficulties represented by the implantation cost and, later, by the cost of the certification and its maintenance.

The stimulations are propagated from responsible sectors through environmental questions to the employees, who can be touched by these actions. However, the benefits that an EMS brings to the companies, public or private, are perceived with the own implantation dynamics, bringing costs reduction, great environmental benefits and qualification of the company human resources.

The implementation and the success of an EMS, as well as the environment preservation, depend on human beings awareness and their role in the environment, as part of it. The behavior of a person should be the same inside the company, the community or in his/her house.

1.3 Awareness and Training

The performance of an organization is strongly associated with the quality of its human resources. If a company intends to implant the environmental management in its organizational structure, it should have in mind that its employees can become a threat or the greatest potential element for the expected results to be reached [5].

A basic aspect of the human resources area concerns the training for the environmental management, developing abilities to deal with this question. Therefore, besides the necessity

to provide specific information for the environmental area knowledge the actions to take and their consequences in the preservation of the environment, the emphasis in the training should focus the possibility of changing the attitudes, on the part of the managers and their staff, so that they can, consequently, develop adequate environmental behavior in their daily activities.

Social systems are formed by people and their necessities, feelings and attitudes, as well as their behavior, while group integrants. The social system has as much, or more, influence on the performance of the organization than its technical system, formed by machines, working methods, technology, organizational structure, norms and procedures. Human beings, not technical systems, are in the center of the administrative procedures and, when a behavioral vision is applied: “the human being is the measure of everything” [8].

The modern behavioral approach has two basic subjects of study: the characteristics that differentiate people one from the other; and the collective behavior of the people, while members of groups, organizations and the society [8].

Another point of influence in the behavior is the organizational culture related to a system of values, which are shared by the members of an organization and that differ from one organization to another one [9]. That system is, eventually, a set of key-characteristic, worthy for the organization.

1.4 São Paulo Navy Technological Center

On October 17, 1986, the Special Projects Coordination (COPESP) was created, through nr. 93.439 Decree. A fast development of this institution work occurred, culminating with the inauguration of the Experimental Center Aramar (CEA), in 1988, in order to make possible the construction of a small power Nuclear Reactor and to dominate all the stages of the fuel cycle. On September 11, 1995, the denomination was modified to São Paulo Navy Technological Center (CTMSP) [10]. CTMSP is one of the Brazilian institutions comprised by the Brazilian Nuclear Program for development of nuclear technology [11].

The CTMSP is an organization that works with nuclear and energy systems research and development, to be applied in the propulsion of ships, aiming to preserve the maritime interests of Brazil.

The Experimental Center Aramar (CEA) is an integrant part of the CTMSP and it is located in Iperó town, São Paulo state, in an area belonging to the Ipanema Forest National - FLONA Ipanema, which is a remainder of the Atlantic forest. Besides the environmental importance of the FLONA, the area also has a great historical and cultural importance, because it shelters the first steps of the Europeans in the Brazilian countryside.

The CEA comprises two well defined areas of work: the nuclear fuel cycle and the nuclear propulsion.

The conception activities are performed in the CTMSP and the experimental phase is developed in the CEA, with specialized workshops, laboratories, tests work-stations and, pilot units for industrial demonstration of the nuclear fuel cycle and infrastructure for the installations support [11].

The Unit of Production of Uranium Hexafluoride - USEXA is located in the CEA, focus of this paper, with the purpose of producing uranium hexafluoride (UF₆) with nuclear degree, from the Uranium concentrate (yellow cake).

In the nuclear fuel cycle, the cost of the uranium hexafluoride production stage represents 8%, approximately. The highest cost is the enrichment stage, by means of ultracentrifugation technology. The domain of this technology is strategic due to the fact that nuclear plants type PWR (Pressurized Water Reactor) need enriched uranium (²³⁵U) to operate and the process of ultracentrifugation requires uranium under the gaseous form. The UF₆ is the only uranium product that remains stable under gaseous form, in reasonable conditions of temperature and pressure UF₆ [11].

The USEXA is one of the several facilities in the CEA, aiming the nuclear fuel cycle conversion stage. The complete installation of the USEXA is composed of many units of process, utilities and support, each directed to a specific stage of the process.

2. OBJECTIVE

The objective of this paper is to suggest guidelines that will support the implantation of the EMS for the USEXA, from its planning to its implementation, improving the EMS elements comprehension, concerning human resources.

3. METHODOLOGY

The implantation of the EMS in the USEXA, will be based on ISO 14.001 standard series and the cycle PDCA. The processes units of USEXA that will be enclosed in this work are:

- Raw material stocking;
- Purifying of nitrate of uranyl (NTU);
- Production of Uranium trioxide (UO₃);
- Production of tetrafluoride (UF₄);
- Production of hexafluoride uranium (UF₆);
- Distillation of hexafluoride uranium (UF₆);
- Uranium Recovery of and Treatment of Effluents and Wastes;
- Production of Fluorine (F₂);
- Storage of chemical products;
- Storage of acid fluoride; and
- Administrative building and warehouse

Table 1 shows the Implantation Plan, detailing the main stages of EMS and its respective activities.

Table 1 – Implantation Plan of the EMS

IMPLANTATION PLAN	
Stages	Activities
1. Environmental diagnosis	Survey of information
2. Commitment of the high direction	To define representatives of the administration To define work group
3. Environmental aspects	Mapping of the processes/activities/products Identification of the aspects and impacts
4. Legal requirements	Survey of the legal requirements Verification of conformity
5. Significant Environmental aspects	Definition of significance criterion Evaluation of significance To carry through applicable environmental adequacies
6. Environmental policies	Definition of the Environmental Policies
7. Objectives & Goals/PGA	Environmental definition of objectives and goals Definition of the Environmental Management Program
8. Procedures	General procedures of the EMS Aspect/Impact Legal requirements Operational control Monitoring, measurement and registers Identification of the Environmental Risks Emergency Assistance Training and Awareness Internal and External communication Critical Equipment maintenance Treatment of nonconformities Internal audits
9. Training and Awareness	Training for employees/third
10. Internal auditorship	Formation of Internal Auditors/Act of contract Accomplishment of Internal Auditorship
11. Critical analysis	Periodic Critical analysis by the Top Management
12. Certification	Act of contract of the Certifier Agency External audit of Certification

The Environmental Management Program – EMP will gather together the information listed in Table 1 and each one of the stages will be a chapter of the EMP.

The PDCA cycle will be the tool used to control and to obtain efficient and trustworthy results from all the activities, allowing the process to be improved.

When overlapping the PDCA cycle with the implementation Plan of the EMS, it is possible to conciliate the 4 phases of this cycle with the described stages in Table 1.

In the PLAN phase, the objectives, goals and the actions programme will be established. This phase can be correlated with the environmental diagnosis of the USEXA, for establishment of “where we are” and of “where we want to arrive”.

In the phase DO or Make, the people will be organized, trained and the actions will be implemented.

This phase concepts will be approached in more details, since it is where the PDCA cycle presents one of the most important stages for the success of the EMS implantation. In this phase, advanced concepts in environmental education will be applied, in accordance with PEDRINI, 2007 [12].

These concepts on environmental education, according to same author, derive from the Treat on Environmental Education for Sustainable Societies and Global Responsibility that, together with the pedagogical foundations of the International Conference Declaration, in Tbilisi, 1977, form a conceptual route of the environmental education targeted in the planet.

The use of these concepts in the Brazilian environmental education contexts (formal, communitarian, in enterprises) has had an increasing demand and has been adopted, integrally, by the National Program of Environmental Education [13] that operates the National Policies of Environmental Education.

The next phase is CHECK that monitors and measures the achieved results and audits the processes.

Finally, the phase ACT is that where the actions based on the results, presented in the step *Check*, are executed to promote continuous improvement.

4. FINAL CONSIDERATIONS

The EMS is an important tool, because it allows magnifying the interfaces of the USEXA with the environment. The nuclear facilities and the environmental issue are, most times, approached only under the view of radioactive and chemical substances, frequently conducted, exclusively, by Programs of Environmental Monitoring. The implantation of the EMS in the USEXA will approach, for example, programs of optimization for non-renewable resources (water and energy) and management programs for common solid residues from the facility.

This study intends to bring a contribution to the Brazilian Nuclear Program, regarding the role played by the São Paulo Navy Technological Center, in the development of genuinely national technology, not only for the submarine project but, also, for nuclear plants technology development (electricity generation) and to add advanced management tools to the CTMSP permanent concern with the environment.

The implantation of the EMS also will, also, take into consideration the Decree Nr 1809 of 1980, which institutes the System of Protection to Brazilian Nuclear Program - SIPRON, in its Article 1st “... *the continued execution of steps that aim at to take care of to the necessities of safety of the Brazilian Nuclear Program and of its staff, as well as of the population and of **environment** with it related*” [14] and also the Law Nr 9605 of February 12, 1998 “It makes use on the penalties and administrative derived from behaviors and harmful activities to the environment, and of the other steps”; in its Section IV (From the Crimes against the Urban Order and the Cultural Patrimony), in its Article 62 that says that “*To destroy, to make unusable or to spoil: I - well especially protected by law, administrative act or sentence; e II - archive, register, museum, library, art gallery, **scientific or similar installation protected by law, administrative act or sentence***” [15].

CONAMA Resolution - National Council of the Environment Nr 237, of December, 19, 1997 considers, amongst others, the necessity to incorporate into the system of environmental licensing the instruments of environmental management, aiming at the sustainable development and the continuous improvement. In its article 4th - it competes to the Brazilian Institute of Environment and Renewable Natural Resources - IBAMA, the environmental licensing of enterprises and activities with significant nationwide or regional environmental impact, and in item IV of this article includes, amongst the activities “*destined to search, to cultivate, to produce, to benefit, to carry, to store and to make use radioactive material, in any period, or that they use nuclear energy in any of its forms and applications, by means of seeming of the National Commission of Nuclear Energy - CNEN*”. This places in evidence, under the environmental point of view, any institution that participates in the Brazilian Nuclear Program [16]. Consonant CONAMA Resolution Nr 01, which establishes in its Article 3rd that: *It will depend on the elaboration of study of environmental impact and respective Environmental Impact Assessment and Environmental Impact Report, to be submitted to the approval of the IBAMA, the licensing of activities that, by law, are of federal competency* [17].

Besides complying with the Nuclear and Environmental Legislation in all its extent, the EMS will search to line up the CTMSP with the correlated social-environmental interests of international agreements in which Brazil is signatory, as the TEASS and the Objectives of the Millennium.

The modern Environmental Management will be lined up to the 8 Objectives of the Millennium of the United Nations Organization - the UNO, which the CTMSP can be adjusted with, at least, four of these Objectives: “2nd - basic Education of quality for all”, “3th - Equality between sexes and valuation of the woman”, “7th - Quality of life and respect for the environment” and “8th - Everybody working for the development” [18].

The implantation of the EMS on the USEXA will be the link of a modern management preventing errors/imperfections in the implantation of the EMS, since the CTMSP will expand this process beyond its borders. It will be given relevance in the identification of environmental aspects, elaboration of environmental programs and treatment of effluent liquids from the processes located in the CEA: the CEA is part of the Ipanema National Forest, which has environmental, historical and cultural importance, besides being next to the Ipanema River.

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