2013 International Nuclear Atlantic Conference - INAC 2013
Recife, PE, Brazil, November 24-29, 2013
ASSOCIAÇÃO BRASILEIRA DE ENERGIA NUCLEAR - ABEN
ISBN: **978-85-99141-05-2**

ENVIRONMENTAL INDICATORS FOR THE NUCLEAR AREA

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ABSTRACT

Environmental indicators are tools utilized for measuring the industrial environmental performance and are globally used to provide the company and other stakeholders with information concerning its effectiveness and sustainability. Furthermore, the environmental indicators are an important methodological tool used for monitoring the effectiveness of Environmental Management System goals, as well as its compliance with the established environmental policies. Currently, major companies have reported their environmental indicators based on specialized guides, such as the CDP (Carbon Disclosure Project) and the GRI (Global Reporting Initiative), enumerating the most important indicators for the company activities. However, the GRI as other bibliographies of this subject does not include specific indicators for the nuclear area, leaving a significant gap to be considered for the measurement of environmental performance of this industry. Therefore, it becomes relevant to raise the following questions. May the nuclear sector use the same indicators of the non-nuclear industry? Are these indicators effective in demonstrating environmental commitment? In this work, a discussion of the indicators for the nuclear area and the CTMSP will take place.

1. INTRODUCTION

Indicators are important tools used for monitoring and evaluating different sectors of productivity. They have been used from the assessment of personal expenses to the investment decision of a company.

The word indicator comes from the Latin word "*indicare"* and it means "highlight, advertise, report, estimate". Therefore, indicators should transmit information in order to clarify a fact that is not readily observable. Indicators have their perception as quantitative or qualitative expressions to provide information on specific variables and their interrelationships, i.e., essential information to the continuous improvement of processes within companies [1].

The concept of sustainable development, which has quickly become one important subject in all segments of society, caused further discussion about its real theoretical and practical significance. The main question established from this approach is: how may sustainable development be defined and operationalized to be used as a tool, in order to adjust the direction that the society is taking concerning its interaction with the natural environment? The main response to such issue has been the development of indicators systems and assessment tools that try to measure sustainability actions [2].

The importance of environmental indicators has been emphasized by Deming, one of the masters of quality, who said that "what can not be measured can not be managed" [3].

Performance indicators are the most important criteria on the evaluation stage in the Environmental Management System - EMS, allowing the corporations to measure the results achieved, the level of EMS implementation and actions effectiveness, together with technical and management areas [4]. ISO 14001, Item 4.5 (Environmental Management System) says: "The organization shall establish, implement and maintain a procedure (s) to monitor and regularly measure the key characteristics of its operations that can have a significant environmental impact. The procedure(s) must include documentation to provide track performance information, relevant operational controls and conformance with the organization's goals and targets "[5].

Monitoring and evaluating the environmental performance allows the organization to assess whether or not it is reaching the goals set previously. ISO 14031 provides a process for monitoring environmental performance, where the tool Environmental Performance Evaluation (ADA) was developed to provide the information management through continuous, reliable and verifiable actions. This tool has been used by organizations of all types, sizes, locations and ranges of complexity, benefiting both organizations with environmental management systems already deployed, as well as those in which this system is still in the implementation phase [6].

Stages of an environmental performance assessment are based on the PDCA (Plan, Do, Check, Act) evaluation process, with the objective: plan and select indicators; collect, analyze, communicate and report data; review and improve the organization environmental performance.

The choice of performance indicators to be adopted by an organization should be based on aspects such as:

- Objectives of the evaluation;
- Scope of its activities, products and services;
- Local and regional environmental conditions;
- Significant environmental aspects;
- Legal requirements and other demands of stakeholders;
- Ability of financial, material and human resources for the development of measurements.

This work aims to promote an initial discussion on the environmental indicators used in nuclear institutions.

2. METHODOLOGY

The methodology consists of environmental indicators assessment, which is often used in organizations that report their indicators and, from those data, to start their materiality study in nuclear institutions: herein, more specifically in the CTMSP (Navy Technological Center in São Paulo).

The CTMSP is responsible for developing the Navy Nuclear Program in Brazil, developing knowledge in the field of nuclear technology for naval propulsion. Due to this large field of research, the CTMSP is divided into two sites, CTMSP-SEDE and Centro Experimental de Aramar (CEA). The CTMSP-SEDE is located in the city of São Paulo, within the University of São Paulo (USP), where military and civilian workers perform technical activities related

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to engineering, research and development, besides the project of management activities. The CEA is another facility located in Iperó - SP, about 120 km far from São Paulo state capital: there, the implementation of major workshops, factories, laboratories and prototypes developed by the CTMSP are located. Among these facilities, under implementation, there are the Laboratório Radioecológico (LARE), responsible for the control of effluents released to the outside of the CEA and the monitoring of environmental samples in the nearby area, and the Laboratorio de Geração de Energia Nuclear (LABGENE), which will be an experimental facility, in land, for the nuclear propulsion plant [7]. Since 2002 CTMSP has begun the implementation of an Environmental Management System in both locations, SEDE and CEA.

For evaluation of the Environmental Management System adopted in the Navy Technological Center in São Paulo - CTMSP, the following environmental indicators were proposed: water consumption, regular waste not recycled, recyclable waste, laboratory waste stored, energy, emissions of greenhouse gases (GHG), replanting, investments in environmental improvements, action plan achievements and number of environmental non-compliances.
The environmental indicators of the CTMSP were selected from the objectives listed in the SGA, guided by standard practices in the disclosure of environmental indicators, which are based on the CDP (Carbon Disclosure Project) and the GRI (Global Reporting Initiative): both will be further explored in items 2.1 and 2.2.

The significance of these practices may be evidenced by their representative use worldwide. Approximately 3000 organizations, in 60 countries, measure and relate their emissions of greenhouse gases and their strategies for climate change through the CDP. Moreover, nearly 1900 organizations published a report based on the GRI, in 2010 [8], placing these methodologies among the most used in the world to report on indicators as to environmental aspects and impacts from corporative activities: for this reason, these strategies will be used as a parameter to analyze the materiality of environmental indicators practiced in the nuclear activity.

2.1. Carbon Disclosure Project (CDP)

The Carbon Disclosure Project - CDP is an independent nonprofit organization that holds the largest database of corporate climate change impact in the world and it is the responsible for managing one of the most applied methodologies for climate indicators [9]. Despite the fact that the initial intention of the CDP was to provide information on emissions of greenhouse gases, now its indicators cover other topics tied to corporate sustainability. The methodology proposed by the CDP has its indicators stated in the form of a questionnaire, conducting the clarification of the indicator report. In general, the indicators proposed in the CDP address the following themes: climate change [10], water [11], supply chain [12] and forests [13]. Table 1 presents the indicators separated per theme.

Table 1: CDP´s indicators addressed by themes

Climate change	Water	Supply Chain	Forests
Governance	Water management and governance	Governance	Deforestation risk assessment
Strategy	Risk indicators	Strategy	Traceability and Supplier Engagement
Targets & Initiatives	Risk assessment	Targets and Initiatives Targets	Public commitments on Forsts and Climate Change
Communications	Impacts to business	Emissions Reduction Initiatives	Targetong & Performance Improvement
Climate Change Risks	Opportunities	Communications	Supply chain capacity building and suport
Climate Change Opportunities	Managing trade-offs between water and carbon emissions	Climate Change Risk	Structure and Governance Process
Scope 1 Emissions	Withdrawals and recycling	Climate Change Opportunities and emissions	Risk and Opportunities
Scope 2 Emissions	Discharges	Energy	
Energy	Water intensity		
Emissions Performance and trading			
Scope 3 Emissions			

2.1. Global Report Initiative – GRI

The Global Report Initiative - GRI was established in Boston, the United States, in 1997 by CERES - Coalition for Environmentally Responsible – together with Tellus Institute, both nongovernmental and nonprofit institutions [14], with the objective of improving quality, accuracy, and pertinence of sustainability patterns, besides standardizing sustainability reports. In 2002, the GRI was invited to be a cooperating organization of UNEP - United Nation's Environment Program, where it has remained until these days.

In order to emphasize such commitment, in 2000, GRI launched the first version of the Global Reporting Initiative - Guidelines, which went through successive improvements to its latest version, released in 2013 and titled G4-Sustentability Reports Guidelines [15].

The purpose of this document is to provide a standard to disclosure sustainability reports from different types of organizations, regardless their size, sector or location. This document also provides an international reference for all those interested in promoting their management practices concerning environmental, social and economic actions to the society, governmental institutions or other stakeholders.

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Therefore, the G4 - Sustainability Reports Guidelines [16] suggest a total of 92 specific indicators, divided into different categories. The first category refers to the management approach, with one indicator; the second category is economic, counting 9 indicators, followed by 34 environmental indicators and 48 social indicators. All indicators should be reported qualitative and quantitatively, presenting, whenever is possible, the history of each indicator during the company's activities. The indicators to be used for the targeted parameter are selected by the organization, always taking into account the indicator representation, as to the organization activities, besides the maturity and reliability of the reported data.

The 34 environmental indicators, which are part of this work object of interest, are shown in Table 2, covering 11 aspects.

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Table 2: Summary of environmental indicators divided by the GRI G4 aspects analyzed

Aspect	Indicator						
Materials	Materials used by weight or volume	Percentage of materials used that are recycled input materials					
Energy	Energy consumption within the organization	Energy consumption outside of the organization	Energy intensity	Reduction of energy consumption	Reductions in energy requirements of products and services		
Water	Total water withdrawal by source	Water sources significantly affected by withdrawal of water	Percentage and total volume of water recycled and reused				
Biodiversity	Operational sites owned, leased, managed in, or adjacent to, protected areas and areas of high biodiversity value outside protected areas	Description of significant impacts of activities, products, and services on biodiversity in protected areas and areas of high biodiversity value outside protected areas	Habitats protected or restored	Total number of iucn red list species and national conservation list species with habitats in areas affected by operations, by level of extinction risk			
Emissions	Direct greenhouse gas (ghg) emissions (scope 1)	Energy indirect greenhouse gas (ghg) emissions (scope 2)	Other indirect greenhouse gas (ghg) emissions (scope 3)	Greenhouse gas (ghg) emissions intensity	Reduction of greenhouse gas (ghg) emissions	Emissions of ozone-depleting substances (ods)	No_x, so_x, and other significant air emissions
Effluents and waste	Total water discharge by quality and destination	Total weight of waste by type and disposal method	Total number and volume of significant spills	Weight of transported, imported, exported, or treated waste deemed hazardous under the terms of the basel convention annex i, ii, iii, and viii, and percentage of transported waste shipped internationally	Identity, size, protected status, and biodiversity value of water bodies and related habitats significantly affected by the organization's discharges of water and runoff		
Products and services	Extent of impact mitigation of environmental impacts of products and services	Percentage of products sold and their packaging materials that are reclaimed by category					
Compliance	Monetary value of significant fines and total number of non-monetary sanctions for non-compliance with environmental laws and regulations						
Transport	Significant environmental impacts of transporting products and other goods and materials for the organization's operations, and transporting members of the workforce						
Overall	Total environmental protection expenditures and investments by type						
Supplier environmental assessment	Percentage of new suppliers that were screened using environmental criteria	Significant actual and potential negative environmental impacts in the supply chain and actions taken					
Environmental grievance mechanisms	Number of grievances about environmental impacts filed, addressed, and resolved through formal grievance mechanisms						

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3. CONCLUSION

The use of indicators to assess the environmental performance of a company is very important. BOOG, 2003 [17] highlights the significance of using indicators as management tools to give clear and indisputable operational and environmental conditions, directing corporate efforts towards preventive and/or corrective environmentally friendly actions.

After analyzing the indicators proposed by the CDP and the GRI, used as reference herein, it is possible to observe a great materiality of these indicators for actions developed by industrial and other corporative activities, presenting, also, a great significance in order to provide an overview of the main related environmental issues. Therefore, the extensive use of these methodologies, in diverse nationalities, is confirmed by the Global Reporting Initiative publication [8].

The CDP, as it was initially created to cover only aspects related to climate change, even with the rise of new themes, does not cover many topics nor does it present quantitative characteristics, as demonstrated by the GRI. This index has, already, a number of indicators with greater adherence to different types of activities. The production efficiency in function of the proposed environmental aspects is the key factor for most indicators performance improvement.

BOOG, 2003 [17] also concludes that the environmental performance indicators show their effectiveness, obtained as a function of, for example, production - in case emissions do not decrease due to reduced production, but as a result of the investments applied.

However, although quite inclusive, while applying the CDP and / or the GRI indicators on nuclear facilities, such as the CTMSP and the nuclear industry, it is observed that the materiality of the indicators is questionable, considering the different interests of the stakeholders in this activity. For example, indicators could be established to give information regarding the amount of training provided to the problem awareness together with methods to reduce the generation of radioactive waste. Besides, indicators that showed the number of accidents occurring during storage of this waste would be useful information for stakeholders. The amount of accumulated waste would serve as another important material indicator for the nuclear area: not only the waste generation, as mentioned in the methodologies studied.

BOOG, 2003[17], also concludes that the environmental performance indicators show their efficiency when obtained in function, for instance, of the production: releases diminish not due to the production reduction, but as a result of the investments effectively carried out.

Another issue that deserves attention in the use of the indicators proposed by the CDP and GRI is their materiality when applied in research institutions. The indicators that provide information about products manufactured by the company should, somehow, be adapted to the performance of the institution in function of the amount of knowledge generated.

Regarding the management of activities that influence the climate change, due to their emissions of greenhouse gases, the indicators studied showed significant materiality and detailing: the methodology used during the GEE inventory is crucial for this indicator. However, the nuclear activity, as power generator, provides a free source of GHG emissions, what results in lower emissions for this activity, which has a common practice of greenhouse

gases generation. Nuclear companies, like Eletronuclear, generate electricity and present indicators of the amount of energy produced; yet, they do not relate this production and the benefits to the global climate, what would be a potential indicator. WALTER 2009 [18] emphasizes that nuclear energy is an alternative energy generation considered "clean" in view of climate change. Therefore, indicators that point this benefit, by generating free GHG energy from this sector, provide relevant information to stakeholders, stressing that this issue is currently one of the most discussed in terms of sustainability.

Nevertheless, the implementation of an EMS is important to provide accurate and systematized information to the indicators defined by the organization, including those of the nuclear and / or research area, and should be treated as a priority in this field. Additionally, the indicators should be treated as parameters of the organization to monitor the effectiveness of their environmental management.

Finally, it is suggested the feasibility of using indicators for the nuclear area that (a) list the benefits to the reduction of greenhouse gases; (b) identify the amount of waste stored during its useful life, according to its activity (low, medium and high) and physical state (liquid and solid); and (c) show the efficiency in procedures and quantitify the training adopted to reduce this type of waste: issues that are not addressed by the market practices.

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