

# ***SUSTAINABILITY MANAGEMENT FOR OPERATING ORGANIZATIONS OF RESEARCH REACTORS***

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## **ABSTRACT**

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. In a country like Brazil, where nuclear activity is geared towards peaceful purposes, any operating organization of research reactor should emphasize its commitment to social, environmental, economic and institutional aspects. Social aspects include research and development, production and supply of radiopharmaceuticals, radiation safety and special training for the nuclear sector. Environmental aspects include control of the surroundings and knowledge directed towards environment preservation. Economic aspects include import substitution and diversification of production. Institutional aspects include technology, innovation and knowledge. These aspects, if considered in the management system of an operating organization of research reactor, will help with its long-term maintenance and success in an increasingly competitive market scenario. About this, we propose a sustainability management system approach for operating organizations of research reactors. A bibliographical review on the theme is made. A methodology for identifying indicators for measuring sustainability in nuclear research reactors processes is also described. Finally, we propose a methodology for sustainability perception assessment to be applied at operating organizations of research reactors.

## **1. INTRODUCTION**

Operating organizations of research reactors are using management models based on the international standards of International Organization for Standardization (ISO) and International Atomic Energy Agency (IAEA), but these models that do not include issues of sustainability in their context.

This work intends to fill a gap in academic literature on the subject, that is, integrate sustainability requirements to the strategic management of operating organizations of research reactors. According to Amano [1], Director General of the International Atomic Energy Agency (IAEA), sustainable development will be in focus at the IAEA in the coming years. Thus, the proposal of this work is in line with the IAEA policy for sustainable development.

In the context of this paper, the term “research reactor operating organization” covers the organization operating the reactor installation itself, its experimental facilities and all other facilities relevant to either the reactor or its experimental facilities located on the reactor site, including their supporting functions.

In a country like Brazil where nuclear activity is geared towards peaceful purposes, any operating organization of research reactors should emphasize its commitment to the sustainability of research reactors’ operations, considering social, environmental, economic and institutional aspects.

Social aspects include research and development, production and supply of radiopharmaceuticals, radiation safety and special training for the nuclear sector. Environmental aspects include control of the surroundings and knowledge directed towards environment preservation. Economic aspects include import substitution and diversification of production. Institutional aspects include technology, innovation and knowledge.

These aspects, if considered in the management system of an operating organization of research reactor, will help with its long-term maintenance and success in an increasingly competitive market scenario.

The results and conclusions reached with this work may serve as a reference in establishing sustainability goals for the management of Brazilian Multipurpose Reactor (RMB), currently on detailed design phase, under supervision of Brazilian Nuclear Energy Commission (CNEN).

Corporate sustainability management is a topic increasingly discussed among experts in the field of administration, however nothing was discussed to date in nuclear research. Therefore, this work begins the discussion of sustainability management in operating organizations of nuclear research reactors, and so contribute to the academic theory, not yet developed for the subject.

The purpose of this paper is to present a sustainability management system model, a methodology for establishing sustainability indicators and a methodology for assessing sustainability perception for operating organization of research reactors.

In section 2 we present a bibliographical review on sustainable development, research reactors and management systems, according FNQ, BSI and IAEA approaches. In section 3, based on bibliographical review made in Section 2, we present a sustainability management system model for operating organizations of research reactors. In section 4 we propose a methodology for identifying sustainability indicators to be used in performance assessment of an operating organization of research reactor. In section 5 we propose a methodology for assessing sustainability perception by people who work in operating organization of research reactors. In section 6, conclusions and final considerations of the study are presented. Acronyms used in the text, acknowledgements and bibliographical references are shown after conclusions.

## **2. BIBLIOGRAPHIC REVIEW**

### **2.1 Sustainable Development**

FNQ [2] describes that the term "sustainable" originates from the Latin term "sustentare" and means sustain, defend, promote, support, retain, take care. Already the concept of sustainability is related to the expression "sustainable development" and was first used in 1987 by the President of the World Commission of Environment and Development of the United Nations, Mrs. Gro Brundtland, who defined the concept as development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

The expression "sustainable development" refers to a model that seeks to reconcile economic, social, cultural and environmental. aspects of society.

Article 225 of Brazilian Federal Constitution describes sustainable development in relation to the environment: "everyone has the right to an ecologically balanced environment, which is an asset of common use and essential to a healthy quality of life, and both the Government and the community shall have the duty to defend and preserve it for present and future generations."

Sustainable development goals (SDGs) are international guidelines proposed by the United Nations (UN), for mitigating and eliminating the negative impacts of human interference in the environment and in the communities. The 17 objectives that comprise the SDGs are:

1. End poverty in all its forms everywhere;
2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture;
3. Ensure healthy lives and promote well-being for all at all ages;
4. Ensure inclusive and quality education for all and promote lifelong learning;
5. Achieve gender equality and empower all women and girls;
6. Ensure access to water and sanitation for all;
7. Ensure access to affordable, reliable, sustainable and modern energy for all;
8. Promote inclusive and sustainable economic growth, employment and decent work for all;
9. Build resilient infrastructure, promote sustainable industrialization and foster innovation;
10. Reduce inequality within and among countries;
11. Make cities inclusive, safe, resilient and sustainable;
12. Ensure sustainable consumption and production patterns;
13. Take urgent action to combat climate change and its impacts;
14. Conserve and sustainably use the oceans, seas and marine resources;
15. Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss;
16. Promote just, peaceful and inclusive societies;
17. Revitalize the global partnership for sustainable development.

Achieving the 17 SDGs is not a simple task. The current view of organizations in relation to sustainable development is still incipient. Often, they do not understand their own social and environmental impact, their context of sustainability and the risks involved.

## **2.2 Research Reactors**

Nuclear research reactors are reactors used for research, development, education and training. Their main function is to produce neutrons for use in industry, medicine, agriculture and forensic science.

A nuclear research reactor is a large enterprise which demands a lot of attention to nuclear safety, physical security, international safeguards and the control of nuclear materials.

A well-structured strategic planning, a consistent management and an adequate funding are essential to ensure the safe and efficient operation of research reactors.

IAEA [3] provides a database of nuclear research reactors. According to this database, there are currently in the world 218 research reactors in operation, 9 in construction, 10 planned, 22 with temporary shutdown, 8 with extended shutdown, 124 with permanent shutdown, 20 decommissioning and 361 decommissioned.

In Brazil, there are currently four research reactors in operation: the IEA-R1, a 5 MW pool type; the IPR-R1, a 100 kW TRIGA Mark I type; the ARGONAUTA, a 500 W Argonaut type and IPEN/MB-01, a 100W nationally developed critical facility. These reactors are mainly used for training, teaching, nuclear research and for the development and qualification of reactor physics.

The fifth Brazilian research reactor will be Brazilian Multipurpose Reactor (RMB), currently in detailed design phase. The main applications of this reactor will be the production of radioisotopes for use in nuclear medicine, production of radioactive sources to the sectors of health, industry, agriculture and the environment, performing irradiation tests in nuclear fuel and materials and realization of scientific and technological research with neutron beams.

The lifespan of a research reactor is estimated to be 40 to 60 years, but there is a possibility to extend this lifespan by modernization of these reactors. Increasing research reactor lifespan by modernization characterizes an increase in its operation sustainability.

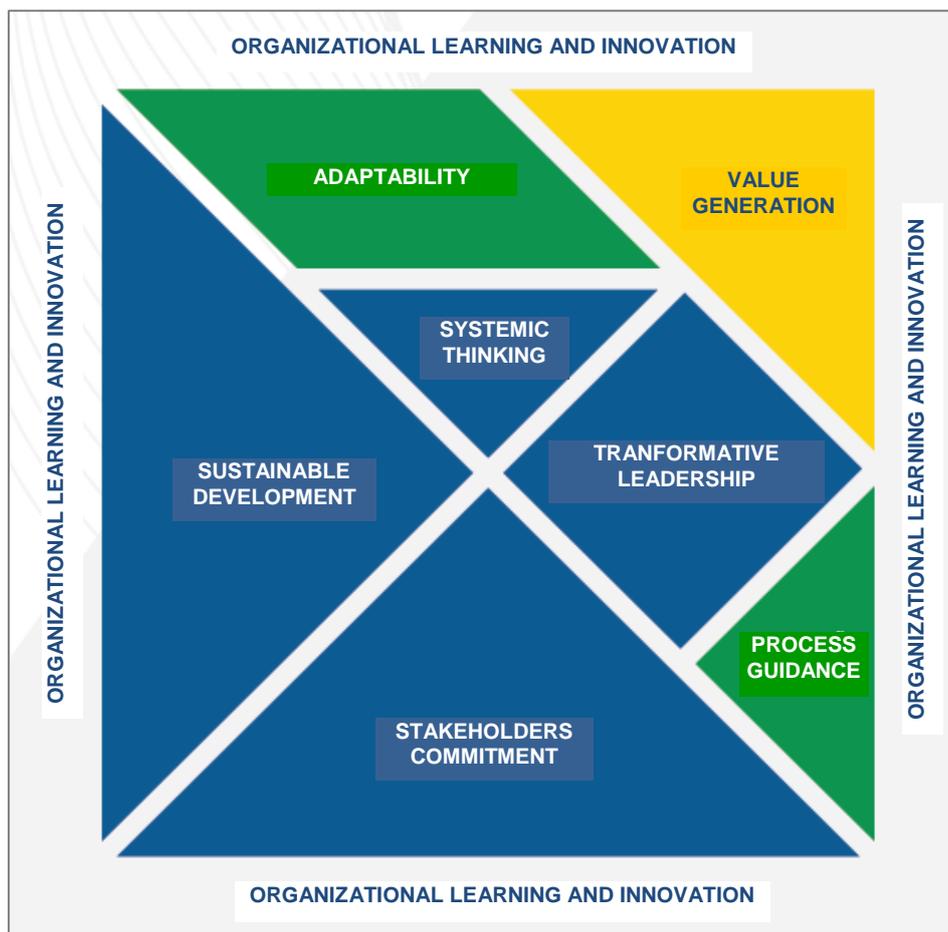
## 2.3 Management Systems

FNQ [4] defines Management System as a set of standardized practices, logically interrelated with the purpose of managing an organization and produce results. The Management System covers all its management subsystems, such as ISO 9001, ISO 14001, OHSAS 18001, etc.

The objective of the management system is to provide organizations with elements and an effective model that can be integrated with other management requirements. This factor of integration is the key point in the management of the organization.

### 2.3.1 Management Excellence Model (MEM) [5]

FNQ [5] introduced a new diagram for Management Excellence Model (MEM), based on Tangram (Chinese puzzle of seven pieces), inspired by the colors of Brazilian flag and in the PDCL cycle (Plan-Do-Check-Learn). Figure 1 shows this diagram.



**Figure 1 – Diagram for Management Excellence Model (MEM) based on Tangram [5].**

When using MEM as a reference, the organization must adapt it (remount it) on the best way to set its management model. MEM diagram symbolizes a model of relationship between the organization, considered as an adaptive system, which generates products and information,

and its organizational and technological environment, beyond their own external environment.

Considering Sustainable Development and Stakeholders Commitment, the Transformative Leadership, starting from Systems Thinking, defines how the strategies and plans must be implemented and materialized through Process Guidance and Adaptability, resulting in Value Generation for the own organization and stakeholders. After this, the organization seeks to evolve through Organizational Learning and Innovation, which permeate the system promoting excellence.

An organization is excellent when it meets in a balanced manner all the fundamentals, which denotes a high degree of maturity in its management system.

MEM consists of eight management excellence fundamentals, which are subdivided in themes:

1. Systemic Thinking: Alignment, Decision Making;
2. Stakeholders Commitment: Stakeholder Requirements, Customer, Stakeholder Relations, Supplier, Workforce;
3. Organizational Learning and Innovation: Improvement, Knowledge, Key Competences, Innovation;
4. Adaptability: Ability to Change, Flexibility;
5. Transformative Leadership: Organizational Values and Principles, Governance, Organizational Culture, Looking to the Future, Succession;
6. Sustainable Development: Financial-Economic, Environmental and Social;
7. Process Guidance: Organizational Information, Process Management, Product;
8. Value Generation: Sustainable Results.

According to FNQ [6], the SDGs address four main dimensions, social, environmental, institutional and economic, and they are in line with MEM's proposal. In Table 1 FNQ [6] shows a correlation between SDGs and MEM's fundamentals.

**Table 1 - Correlation between SDGs and MEM's fundamentals [6].**

<b>SDGs</b>	<b>MEM's fundamentals</b>
1. No Poverty 2. Zero Hunger 3. Good Health and Well-being	Stakeholders Commitment
4. Quality Education	Organizational Learning and Innovation
5. Gender Equality	Adaptability Transformative Leadership
6. Clean Water and Sanitation 7. Affordable and Clean Energy	Sustainable Development
8. Decent Work and Economic Growth	Value Generation
9. Industry, Innovation and Infrastructure	Organizational Learning and Innovation
10. Reduced Inequalities	Adaptability
11. Sustainable Cities and Communities	Stakeholders Commitment
12. Responsible Consumption and Production 13. Climate Action	Systemic Thinking
14. Life Below Water 15. Life on Land	Sustainable Development
16. Peace, Justice and Strong Institutions	Process Guidance Transformative Leadership
17. Partnerships for the Goals	Transformative Leadership

FNQ [6] describes MEM's fundamental "sustainable development" depicts the organization's commitment to respond for the impacts of its decisions and activities on society and the environment, and to contribute to the improvement of the living conditions of both current and future generations, through ethical and transparent behavior. The themes of this fundamental, namely, Financial-Economic, Environmental and Social, once granted, bring to organization excellence in terms of sustainability and the adoption of MEM represents a viable way to achieve a sustainable paradigm for organizations of any kind.

### **2.3.2 Managing Sustainable Development of Organizations [7]**

BSI [7] provides guidance on managing sustainable development and a framework that assists organizations to enhance performance and effectiveness. It provides a coherent approach to the management of social, economic and environmental aspects of the activities of an organization

BSI [7] establishes four fundamental principles for the sustainable development of an organization:

- a) Inclusivity: a clearly expressed intention or policy of including key stakeholders in the development of organizational strategy, corporate planning and direction;
- b) Integrity: adherence to a set of commonly held ethical norms and law-abiding behavior;
- c) Stewardship: position of accountability for managing all activities of an organization throughout all the stages of its life span;
- d) Transparency: openness about decisions and activities that affect society, the economy and the environment, and a willingness to communicate these in a clear, accurate, timely, honest and complete manner.

Application of the four fundamental principles increases levels of stakeholder's confidence and helps to improve credibility and transparency of an organization's performance.

BSI [7] proposes an approach to the management of sustainable development that includes assessing risks and opportunities, identifying key performance indicators and evaluation of effective performance goals and indicators chosen.

BSI [7] recommends the use of a matrix to assess the maturity of sustainable development over time. When an organization is developing its matrix, it is useful to involve many stakeholders with differing roles and responsibilities, seeking consensus on the most appropriate and meaningful practices and stages. A periodic review should be conducted of the organization's position along its sustainable development path and of the continued relevance of the stages in the matrix. Adjustments to the matrix might be required to reflect changing circumstances, stakeholder priorities, regulations, etc.

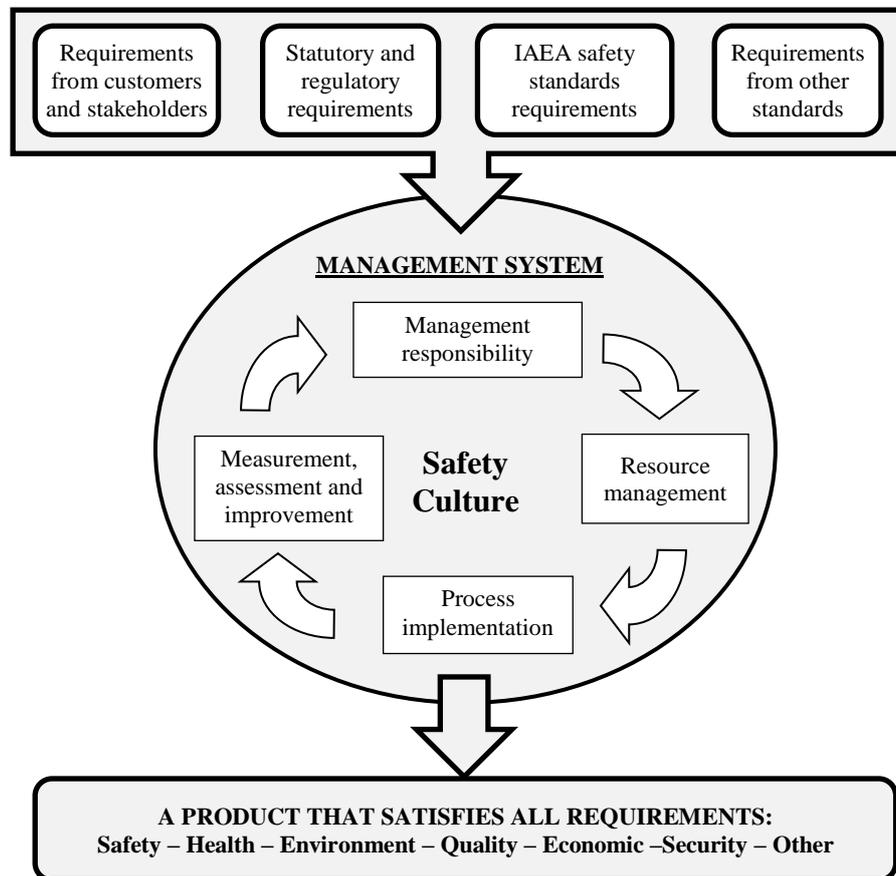
### **2.3.3 Management System for Research Reactors [8, 9]**

IAEA [8] describes that an operating organization of research reactor must establish, implement, evaluate and continuously improve an integrated management system. This organization shall ensure, by means of an integrated management system, the research reactor has defined location and is designed, constructed, commissioned, operated, used and decommissioned safely.

An integrated management system is a coherent management system in which all components of an organization are integrated to allow the objectives of the organization are achieved. Such elements include the organizational structure, resources, and organizational processes. Regulatory requirements should be included in the management system. Figure 2 shows a typical IAEA management system model.

IAEA [9] emphasizes that the processes and activities of an operating organization of research reactor must be developed and managed effectively to achieve the objectives of the organization, without compromising safety.

IAEA [9] stresses the importance of promoting a strong safety culture in the operating organization of research reactor. All practical efforts should be made to prevent and mitigate nuclear accidents or radiation.



**Figure 2 – IAEA typical management system model.**

The development and implementation of a management system must ensure:

- Research reactors safety for all activities during all stages of the project, in order to protect the public, workers and the environment from the risks of undue radiation;
- Compliance with regulatory requirements;
- Proper and safe modification, renovation and modernization;
- Safe and effective use of research reactor facilities, including quality control of products and services delivered; and
- Better operating performances of research reactors, as well as programs and maintenance procedures

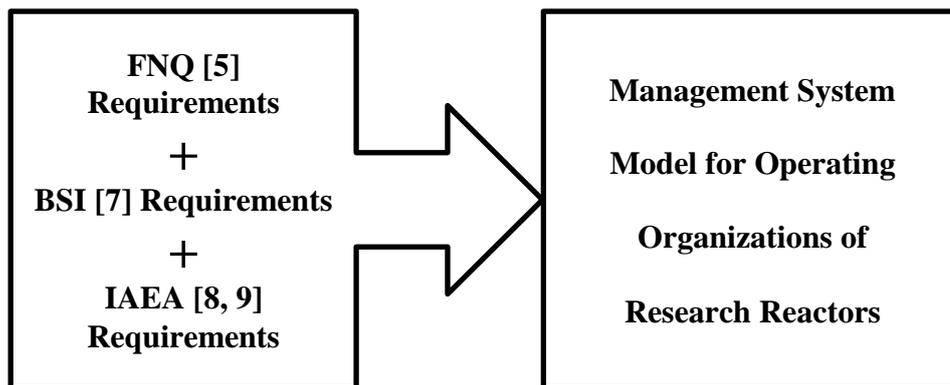
The management system should be developed and implemented using a graded approach, considering:

- The importance and complexity of the organization's safety and security, installation operation or activity performance;
- The dangers and the magnitude of the potential impacts (risks) associated with the elements of the safety, health, environment, physical protection, quality and cost of each facility or activity;

- The possible consequences for safety in case of a failure or unforeseen event happens, or if an activity is planned or carried out inappropriately.
- The management system effectiveness must be measured, evaluated and improved to increase safety performance.

### 3. SUSTAINABILITY MANAGEMENT SYSTEM MODEL FOR OPERATING ORGANIZATIONS OF RESEARCH REACTORS

To construct the management system model for operating organizations of research reactors, we will use as reference the requirements established by FNQ [5], BSI [7] and IAEA [8, 9]. Figure 3 presents a simplified schematic of this proposal.



**Figure 3 – Simplified schematic for the construction of a management system model for operating organizations of research reactors.**

The management system shall include the requirements of FNQ [5], BSI [7] and IAEA [8, 9] as described below:

- FNQ [5] requirements: eight fundamentals, including respective themes:
  1. Systemic Thinking: Alignment, Decision Making;
  2. Stakeholders Commitment: Stakeholder Requirements, Customer, Stakeholder Relations, Supplier, Workforce;
  3. Organizational Learning and Innovation: Improvement, Knowledge, Key Competences, Innovation;
  4. Adaptability: Ability to Change, Flexibility;
  5. Transformative Leadership: Organizational Values and Principles, Governance, Organizational Culture, Looking to the Future, Succession;
  6. Sustainable Development: Financial-Economic, Environmental and Social;
  7. Process Guidance: Organizational Information, Process Management, Product;
  8. Value Generation: Sustainable Results.
- BSI [7] requirements:
  - Four fundamental principles for the sustainable development: inclusivity, integrity, stewardship, transparency; and
  - A matrix to assess the maturity of sustainable development.
- IAEA [8, 9] requirements:
  - Safety is paramount goal of the management system;
  - Management system shall be integrated, including safety, health, environment, quality, economic, security and other elements;
  - A strong safety culture shall be promoted;

- Requirements from customers and stakeholders;
- Statutory and regulatory requirements;
- IAEA safety standards requirements;
- Requirements from other standards (ISO 9001, ISO 14001, OHSAS 18001 etc.).

The integration of BSI [7] and IAEA [8, 9] requirements to FNQ Management Excellence Model [5] can be seen in Figure 4, suggesting an approach for a sustainability management system model for operating organizations of research reactors.



**Figure 4 – Sustainability management system model for operating organizations of research reactors based on FNQ Management Excellence Model [5].**

In this approach, we expect to obtain as value generation, the compliance with stakeholders’ needs and expectations, the achievement of Sustainable Development Goals (SDGs) and the compliance with IAEA safety requirements, including the promotion of a strong safety culture within the organization. Value generation can be demonstrated in terms of social, economic, environment and institutional indicators.

#### 4. SUSTAINABILITY INDICATORS

The environmental and human issues are often treated superficially, for they cannot be measured and so not be included in a report.

For companies and organizations of all sizes be aligned with the SDGs, it is necessary that they adopt a methodology which allows them to measure variables, empower leaders to take

key decisions, encourage employees to engage in the search for better processes and, finally, demonstrate not only the viability of these processes, but guide the organization to follow them fully and rationally.

Alves [10] realized that Sustainable Development Indicators (SDI), suitable for nuclear research institutes in Brazil, could not be found in academic literature.

She proposes a methodology for the construction of sustainability indicators for nuclear research institutes (Figure 5). Based on this methodology, we can perform the construction of sustainability indicators for research reactors operators.

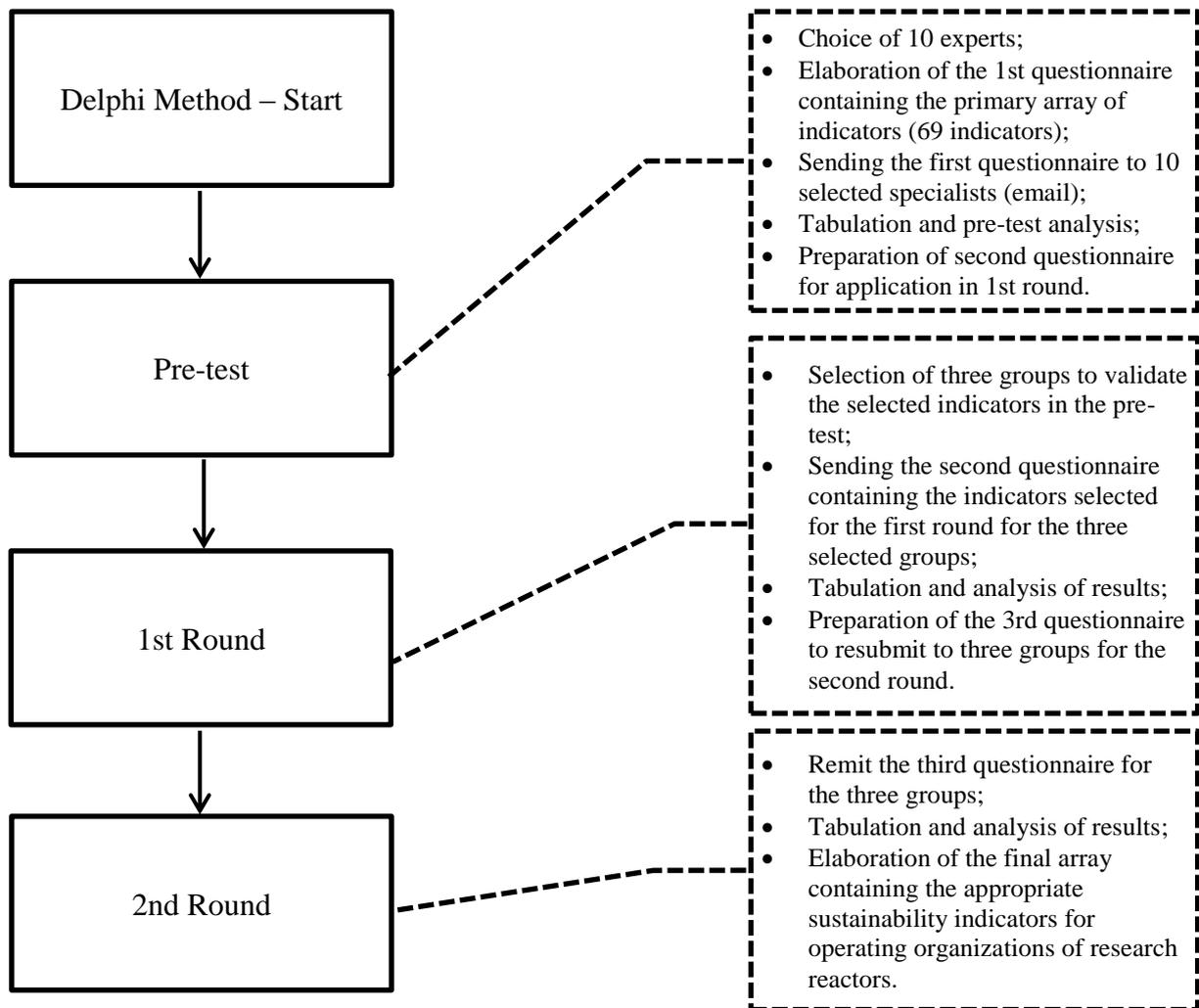


Figure 5 – Delphi Method Flowchart Delphi, adapted from Alves [10].

Alves [10] methodology consists of:

- Bibliographic survey: literature review, critical analysis of literature, conceptualization about sustainability and sustainability indicators, nuclear technology indicators and nuclear technology sustainability indicators.
- Proposition of sustainability indicators: construction of an array of sustainability indicators for operating organizations of research reactors;
- Validation of the sustainability indicators: validating the proposed sustainability indicators through the Delphi method (Figure 5).

## 5. SUSTAINABILITY PERCEPTION ASSESSMENT

A field research will be held with the staff of CNEN institutes that operate nuclear research reactors, namely, IPEN, CDTN and IEN, with the purpose of analyzing their perceptions about what their organizations have made regarding the sustainability management.

The choice of this population of respondents aims to portray the current knowledge of people involved in processes related to nuclear research reactors, with respect to sustainability. We also intend with this field research, stimulate the concept of sustainability strategic management with those who will be the future managers of these organizations.

The instrument to be used in field research will be a questionnaire drawn up with SurveyMonkey<sup>1</sup>, composed of 45 questions using the Likert scale with five values, namely (1) I strongly disagree, (2) I disagree in part, (3) I have no opinion about it, (4) I partially agree and (5) I totally agree. The extreme value (1) identifies the perceptions of respondents that sustainability is not implemented within organizational strategy, since the opposite value (5) identifies the perceptions of respondents that sustainability is implemented within organizational strategy. The intermediate values identify the intermediate perception of respondents for that matter. Beyond the values of one to five established as the Likert scale, the respondent can express ignorance on the subject and he will have the opportunity to make additional comments, supplementing information or justifying the values assigned to each question.

FNQ [2] describes that companies can be classified in five stages of maturity in relation to sustainable development: elementary, engaged, innovative, integrated and transformer.

According to the responses given to each question, we will be able to have an idea of how the organizations surveyed servers know and perceive the presence of sustainability in the strategic management of their organizations. Also, based on the replies received, we can classify the organizations researched about their maturity in relation to sustainable development, as proposed by FNQ [2].

The result of this field research will allow us identify gaps and opportunities for improvement in sustainability strategic management in these organizations, as well as serve as an aid for sustainability strategic management planning of Brazilian Multipurpose Reactor (BMR), throughout its operation.

For preparing the questionnaire for the evaluation of the perception of sustainability within the strategic management of operating organizations of research nuclear reactors, we use as reference the values of sustainable management suggested by FNQ [2] and Teles et al. [11]. A possible questionnaire to be used is described below.

### Questionnaire

1. Has the organization a code of ethics/conduct, or equivalent document, which expresses its values and principles?
2. Is the code of ethics widely disseminated in all hierarchical levels?
3. Do the code of ethics or statement of principles expressly forbid illegal practices (such as unfair competition, piracy, bribery and "two box") to obtain advantages in business?
4. Has the organization councils, committees or groups responsible for the ethical issues?
5. Are the principles of sustainable development, including social and environmental aspects incorporated into the strategic planning?

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<sup>1</sup> *SurveyMonkey* is an online survey development cloud-based software as a service company, that can be accessed at site <http://www.surveymonkey.com/>.

6. Publishes information about its social management? Where? (E.g. Annual Report, GRI, IAN (annual information), IBASE, Social and Environmental Balance, Ethos, company web site, Social balance), Another. Which?
7. Publishes information about its environmental management? Where? (E.g. Annual Report, GRI, IAN (annual information), IBASE, Social and Environmental Balance, Ethos, company web site, Social balance), Another. Which?
8. Are social actions communicated? For who? (Ex. School, general public, Neighborhood, NGOs, authorities, Other. Which?)
9. Does the organization have ISO 9001 or equivalent standard? How long?
10. Does the organization have ISO 14001 or equivalent standard? How long?
11. Does the organization have OHSAS 18001 or equivalent standard? How long?
12. Does the organization have environmental policy?
13. Is responsibility for environmental management set?
14. Does the organization have social responsibility policy?
15. Is responsibility for social responsibility management set?
16. Does the organization comply strictly with legal parameters, related to environmental management?
17. Does the organization develop actions to prevent environmental impacts caused by its processes and products or services? (Such environmental impacts refer to productive processes, administrative, and third-party vendors.)
18. Does the organization regularly conduct improvement programs and control and monitoring activities?
19. Does the organization produce impact assessments throughout the production chain?
20. Does the organization develop partnerships with suppliers to improve their processes and minimize the impacts?
21. Does the organization develop partnerships with other institutions to improve their processes and minimize the impacts?
22. Does the organization have known standards of selection and evaluation of suppliers covering requirements and criteria for compliance with labor, social security, environmental and tax legislation?
23. Does the organization provide customers and consumers detailed information about environmental damage resulting from the use and disposal of their products?
25. Does the organization know the origin of the inputs, raw materials and products used in its operations, and guarantees that, in these sources, human rights and the environment are respected?
26. Does the organization have purchasing policy that prioritizes those vendors that have environmental certifications (such as ISO 14000, SA8000, FSC, FLO etc)?
27. Does the organization have formal procedures for receiving, recording and responding to stakeholders' demands?
28. Does the organization monitor waste with indicators (solid, effluent, air emission, noise and vibration)?
29. Does the organization have goals of reduction, reuse and recycling of waste?
30. Does the organization invest in technology to reduce waste generation?
31. Does the organization make selective collection of garbage?
32. Does the organization monitor natural resources with indicators (water, electricity, fuel, firewood and charcoal, and mineral resources)?
33. Does the organization have goals for reducing use of natural resources?
34. Does the organization have a management and collection system for toxic materials or potentially harmful to the environment and to health?

35. Does the organization have projects that contribute to the development of children of employees?
36. Does the organization support projects focused on children and adolescents of the community?
37. Does the organization comply strictly with the legal obligations and have goals to achieve standards of excellence in health, safety and working conditions (including indicators to monitor the achievement of those goals)?
38. Does the organization have development and training policies, aiming at the continuous improvement of its entire staff?
39. In addition to promoting training, does the organization offer scholarships or similar, in order to improve the employability of employees?
40. Does the organization maintain an illiteracy eradication program (absolute and/or functional), a supplementary education program or a completion of basic education program for its employees, with goals and resources defined?
41. In relation to diversity, are there explicit policies of non-discrimination (race, gender, age, religion and sexual orientation) on wage policy, on admission, promotion, training and dismissal of employees?
42. Does the organization comply with the legislation on the employment of people with disabilities and maintains programs for the insertion of these people in the company?
43. Does the organization have profit sharing plan for employees?
44. Does the organization have formal policies in order to contribute to the Elimination of child labor and forced labor, discussing the issue with suppliers and encouraging them to abide by the law?
45. Does the organization support, technically or financially, public policies and actions (governmental or third sector entities) focused on improving public health and education, the eradication of child labor and other actions of strengthening of citizenship?

## **6. CONCLUSIONS AND FINAL CONSIDERATIONS**

Sustainable development will be in focus at the IAEA in the coming years. To comply with Sustainable Development Goals (SDGs) established by United Nations, in this paper we try to understand how sustainability requirements can be integrated to management systems of operating organizations of research reactors.

Based on a bibliographical review on sustainable development we proposed a sustainability management system model, a methodology for establishing sustainability indicators and a methodology for assessing sustainability perception for operating organization of research reactors.

For the management system model, we proposed an integration of sustainable development requirements and nuclear safety requirements to FNQ Management Excellence Model (MEM). MEM is a world class business management system disseminated in Brazil by FNQ. Aligned with the main recognized international systems, the MEG model is a result of the experience, knowledge and research of several national and international organizations and experts. MEM's fundamental "sustainable development" depicts the organization's commitment to respond for the impacts of its decisions and activities on society and the environment, and to contribute to the improvement of the living conditions of both current and future generations, through ethical and transparent behavior.

For identifying sustainability indicators, we proposed a methodology based on Delphi Method and already applied to nuclear research institutes. After the identification of these indicators it will be possible to assess the performance of operating organizations of research reactors, regarding its sustainable development.

For assessing sustainability perception by people who work in operating organizations of research reactors we proposed a methodology found in literature based on a field research, using SurveyMonkey tool.

This paper aims to contribute to the theory of management systems for operating organizations of research reactors, including aspects of sustainable development, not yet included in nuclear management systems.

## ACRONYMS USED IN THIS PAPER

BSI – British Standards Institution;  
CDTN – Nuclear Technology Development Center  
CNEN – Brazilian Nuclear Energy Commission;  
FNQ – National Quality Foundation;  
IAEA – International Atomic Energy Agency;  
IEN – Nuclear Engineering Institute  
INAC – International Nuclear Atlantic Conference;  
IPEN – Institute of Energy and Nuclear Research;  
ISO – International Organization for Standardization;  
MEM – Management Excellence Model;  
RMB – Brazilian Multipurpose Reactor;  
SDGs – Sustainable Development Goals;  
UN – United Nations.

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