

## ASSESSMENT OF REDUCTION IN PERCEPTION OF NUCLEAR RISK RELATED TO PERCEPTION OF ENVIRONMENTAL RISK

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### ABSTRACT

This work presents a bibliographic research accomplished to evaluate the matter of reduction in risk perception, on people in general, that nuclear energy can show, for generation of electric power, face to perception of risk associated to environmental questions, as the global warming, from greenhouse effect, addressing the matter to the relevance of public acceptance for the development of new technologies.

### 1 INTRODUCTION

As consequence of population growing the demand toward energy and technology rises too and fortunately, along these requirements, the environmental concernment starts to appear in various sectors of society, especially in industries. Besides that, global population lives in continuous crises, it is normal the press inform the alimentary crisis, the oil crisis, the power crisis, among others, which leads to the reflection about how much this has been influencing life quality of human beings, and especially, which was the individual contribution to get at that situation and towards the same direction, what can be done to soften such “crises”.

The perception of risk associated to environmental degradation is experimented in a single way for each society member. Considering that, constantly, the human being is involved in risk situation, the population has its perception face to it influenced by different historical moments, affecting postures due to given threats [1].

A long ago the environmental matter is being discussed, but, from 1992, the discussion intensified in function of The Second Worldwide Conference for the Environment, called Eco-92, carried out in Rio de Janeiro. Eco-92 gave continuity to 1972 Stockholm Conference and in this conference it was questioned about Earth future, and which posture the man should assume, a series of relevant documents were formulated, in spite of a lot of them have been failed to be put in practice up to now, at least they induced new discussions and reflections about responsible subjects by environmental concerns.

*“ONU Conference favored discussion and mobilization of international community around the requirement of an urgent change in behavior aiming to life preservation in Earth” [2] ( p. 17)*

A great repercussion from this meeting in communication ways favored to the population, in general, to get acquaintance about worldwide environmental conditions, aiming to laic environment information about the problem.

At that moment, the power problem was a theme very discussed, especially due to aggravation of climatic questions, resulting from a raise in accumulation of gases responsible by greenhouse effect in land atmosphere. Studios depicted the nuclear technology as an answer to the production of clean energy being considered by some people as more correct way for the generation of electric power, what the population has being charged so intensely, lately. [3].

Today, after elapsed more than fifteen years from this meeting, the environmental discussion goes on up to date, at the press, in the academic environment and in the population day by day. Due to this, the continuity of studies and the development of nuclear energy seems relevant, not only as a State politician, but as a society trend in participating of planet preservation, in accordance with *Constituição da República Federativa do Brasil, 1988*<sup>1</sup>, in its article 225[4].

*“Everybody has its right to an environment ecologically balanced, asset of people common use and essential to a healthy life quality, imposing to the Public Power and to the society the duty of defending and preserving it to present and future generations”*

Nuclear energy in Brazil starts to take new courses, due to, principally, to growing expectations for the area and factors, as the approval of *Plano Nacional de Energia 2030* [5], elaborated by *Empresa de Pesquisas Energéticas (EPE)*, subsidized by *Ministério de Minas e Energia*, which by means of studies and analyses among past, present and future outlined a long-term planning for the power sector in the country. In this Plan, predictions are accomplished about the area, as the construction of six new nuclear plants. This way, the area earns a plus in its incentive, besides the approval of construction for Angra 3 nuclear plant and the announcement of investment in resources for the Brazilian Navy nuclear program, that should, at long-term, contribute significantly to the environmental matter.

This way, the country, after extensive exhaustion, again drives attention to nuclear sector, but the recovering of *Programa Nuclear Brasileiro*, can only be accomplished under public opinion consent that perceived the necessity of avoiding an environmental collapse. In this case, the assistance by communication ways was fundamental, so the environmental discussion, daily scheduled in the press, pointed out principally man responsibility on the serious attained situation and how much this can mean if providence failed to be taken. It should be taken into account that there are difficulties which subsist to its operation that can be analyzed toward easing its negative posture face to the question.

Nuclear energy history is full up of confrontations among the own scientists from that time, referring to peaceful use of nuclear technology, whereas some of them tried to contain technology replication, other ones defended the feasibility of atomic bomb, a lot of them participated of projects by simple obligation and with plenty of discomfort [6].

Since the discovery of destructive potential inherent to nuclear energy the polemic is around its development. In the past, a lot of discussion in scientific environment divided opinions.

After radiologic accidents in Goiania and Chernobyl such discussions took possession of environment laic, crucial too for the heating of discussion were the attacks with atomic bombs on Hiroshima and Nagasaki cities in 1945, that silenced the world and forced the population, in a general way, to think about the destructive power of such technology and how much it would mean face to wars and conflicts among nations, since it could be fatal in wrong hands.

At that time, nuclear energy found more enemies which fought for its end, since the fear of nuclear holocaust seized the social imaginary, principally close affected areas, either of bombs attacks, or bombs attacks, as in case of accidents in plants.

## 2 LITERATURE REVIEW

### 2.1 A Little of History

In 1973, at the first oil crisis, from the own creation of *Organização dos Países Exportadores de Petróleo (OPEP)*, countries searched for alternatives for electric power generation in thermoelectric plants operated under fossil combustible. This attitude caused a raise of nuclear installations that, concomitantly with Cold War, raised the fear of a nuclear holocaust, according to destructive power accumulated by occidental and European East countries. After Berlim Wall fall and the splitting of *União das Repúblicas Socialistas Soviéticas – URSS*, 1989, was a reduction of concernment due to a great war.

From these facts, mankind in its overall starts to get conscious of planet fragility in environmental terms. Reports, before restrict to politic and scientific extent, appeared in first pages of newspapers and magazines worldwide, denouncing the precariousness of environmental conditions in the major part of countries called developed.

Due to occurrence of 1972 report rescue from *Clube de Roma*, entitled “Os limites do crescimento”, that pointed out crucial problems for the Planet in development [7]. Other relevant publication was Brundtland Report, on “*Nosso futuro comum*”, published in 1987, emphasizing the necessity of sustainable development. Both reports culminate with greenhouse effect and consequent aggravation of climate questions.

Besides reports, great environmental accidents readdress to environmental discussion, as occurred with Exxon Valdez tanker oil, in Alaska, March, 1989, causing a big oil spilling in the sea and victimizing millions of animals.

Nuclear activities contributed for the raise of concernment to environmental questions, especially with the accident in Chernobyl nuclear plant, April 1986. The explosion of Reactor four generated a radioactive cloud that contaminated a part of Europe. In Brazil, radiologic accident in Goiania, September 1987, put the population aware of the question and in this case, the theft of a radiotherapy apparatus, in an abandoned hospital, occasioned the contamination of hundred of people with Cesium-137.

These accidents, especially Chernobyl one, considered the worst in worldwide nuclear history paralyzed a lot of projects which were in progress and cancelled other ones. But, from these events, a great number of researches were accomplished on risks associated to nuclear energy and such publications affected directly the public perception, in many countries were

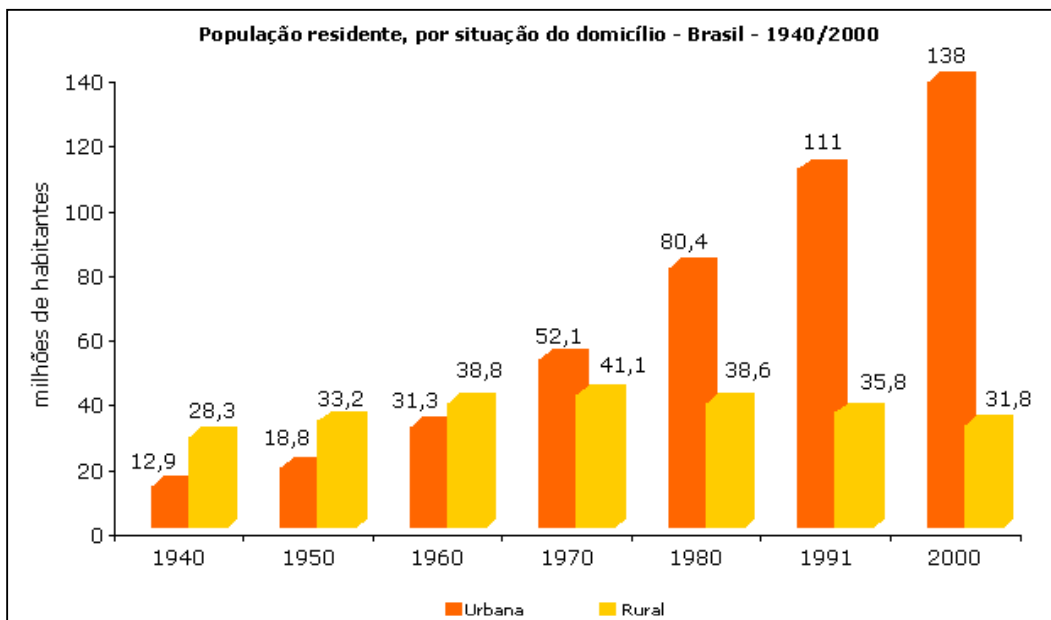
accomplished public manifestations against sector development and the use of atomic energy, for any purpose.

In Brazil, after accident in Goiânia with Césio-137, it can be observed manifestations from Brazilian population, as rejection, denouncement, prevention, inspecting, discrimination reactions and, at last solidarity [8].

Period within 1986 and 1989, with nuclear and environmental accidents in social imaginary, was a key factor for the gradual fear transference by the nuclear holocaust to the fear for environmental collapse.

From 2006, collective conscious starts to change, with divulgation and the great efforts of science, the population starts to get acquainted of environmental problems, charging postures of changes from State and enterprises, influencing directly the market.

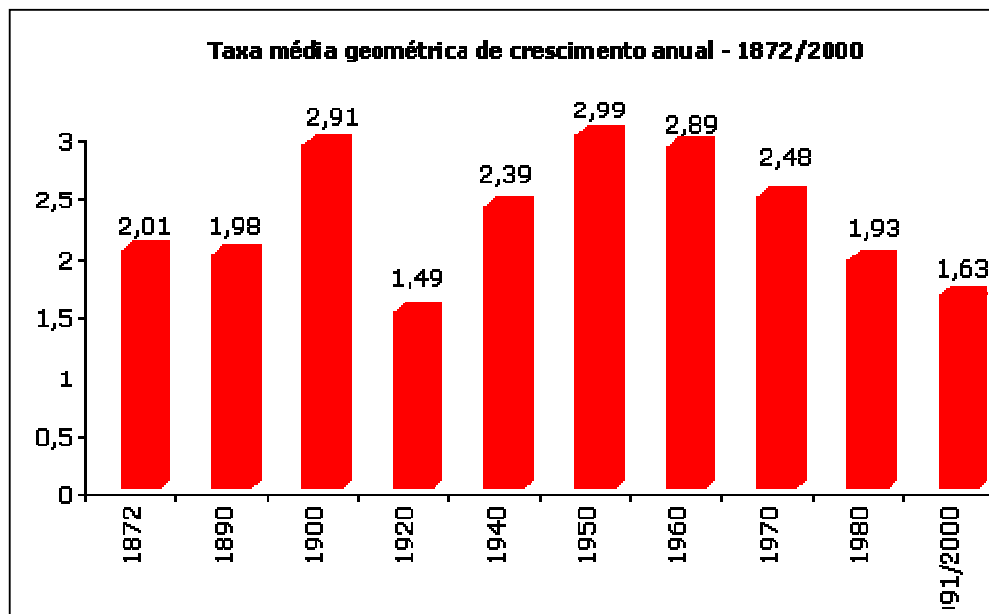
Specific energetic requirements were caused too by a change in worldwide population distribution, Brazil, in particular, data from Census accomplished by IBGE [9], each ten years, as presented in graph 1, show that Brazilian population has been migrated from rural areas to urban ones, since 1970 decade.



(Source: IBGE 2001, *Tendências demográficas*, 2000, apud IBGE)

**Graph 1.** Concentration of Brazilian population.

So, we verified the occurrence of some problems, as the appearing of an alimentary crisis, aggravated by the rural exodus, for just part of migrants had subsistence agriculture and these ones, after departure to urban centers, transferred their condition from micro-producer to consumer.



(Source: IBGE 2001, *Tendências demográficas*, 2000, apud IBGE)  
**Graph 2.** Brazilian population growth.

As shown in graph 2, population growth has been reducing since 1960 decade, but people are concentrated in urban areas, especially in search of work and development opportunities, thus increasing the requirement and consumption of energy, causing upset in such localities.

## 2.2 Environmental crisis

Current planet ecological unbalancing points the human being as the major responsible, in spite of some society members still keep a kind of environmental apathy face to environmental matters. Due to this, it is relevant to emphasize that the solution is in human hands. Although there are positive signals with solutions creation for given situations, it is still necessary to put into practice public actions and politics, besides reinforcing for the population the importance of individual actions for task success as a whole thing.

Current focus of environmental crisis can be represented by global warming phenomenon, which became too the great challenge of the century, either for the science or for the State. The theme has been causing a lot of discussion and concernment of actions to be taken, towards reducing CO<sub>2</sub> emission, especially originated by burning fossil fuel for production of electric power.

Greenhouse effect is resultant from the accumulation of some gases, such as carbon gas, methane, various CEC's, among others, which allow that sunlight cross atmosphere layer and impede that the heat escape to the space, so greenhouse name, and, the higher gases concentration, the higher the warming.

**Table1.** Major gases responsible for greenhouse effect

<i>Gases</i>	<i>Quantity</i>
Carbon dioxide – CO <sub>2</sub>	60%
Methane – CH <sub>4</sub>	20%
Nitrous oxide – N <sub>2</sub> O	6%
Halogenated – HFC, PFC e SF <sub>6</sub>	14%

Among major sources that contribute for greenhouse effect, energy and heat generator plants correspond to 33% of CO<sub>2</sub> emissions, i.e., energetic sector has a great part in actual state of worldwide climate, especially due to the use of fossil fuels [3].

The best solution, besides the polemic, pointed out for some and criticized for other ones, is the utilization of nuclear energy for the production of electric energy in a great amount. It is relevant to emphasize that other clean sources can be used, but, is of public knowledge that hydroelectric and wind Brazilian potentials, although large, are limited and their existences and capacities production are regionalized and seasonal. Brazilian uranium reserves allow the maintenance of a vast energy generation program for centuries.

### **2.3 Nuclear energy**

The discovery of using atom capacity for energy generation, culminated with the knowledge of its power of massive destruction, affecting significantly scientific community at that time and interested governments, principally in belligerent power that could be acquired with technology dominium in producing energy generation and nuclear bombs.

A race involving scientists capable to develop such act has started quickly, transforming the types of wars which were in course, at that time.

Accidents happened along the years from nuclear plants made processes more cautious and the creation of rules for construction and maintenance of reactors and their equipments, as well of their operators.

Nuclear attacks, principally those ones occurred in Hiroshima and Nagasaki, were punctual as for the power of atomic weapons and in new postures of authorities face to the subject, that caused too a certain reaction on attention from worldwide population.

Today midia goes on informing actions involving nuclear energy and the control exerted by International Atomic Energy Agency – IAEA – as for nuclear weapons. More recent news on nuclear energy refers to its use for energy production, with the purpose of softening the prejudices of traditional production, as a way of controlling global warming and minimization of consequences due to man actions on the environment.

Nuclear energy is seen by some people as a solution for energy production and consequent reduction of global warming, due to be considered one of the cleanest sources. In spite of a lot of people insist on contrary idea that nuclear energy should not be used.

This study has not as objective to identify which is the most utile or just way to be used, but the posture of population face to this possible solution, i.e., how much people are ready and

prepared to accept the production of nuclear energy and how much they are able to collaborate for this decision.

## **2.4 Risk perception**

Various risk definitions are found and, in summary, all of them give the idea of a predictable possibility of danger, with threat to some person or to something. So, as a risk perception, it is possible to understand as the act of realizing that a threat can be harmful.

Risks perception is compounded by values and Standards existing in individual cognitive structure, based fundamentally in the social vision, as for globalization questions and so it has direct influence on the culture, and consequently the acceptance or not of risks has a strong influence of cultural and social factors [10].

The development of new technologies is associated to accidents and failures, as the own history tell us, a lot of researchers, engineers, workers, suffered serious accidents when working and for this it is necessary to take into account that such happenings addressed to an improvement and to a progress in safety, in various knowledge sectors. But nuclear energy involves enormous risks, and impossible to use trial and error method [11].

Last years, sources considered risky, were changed, especially due to science progress, that reduced or eliminated a series of risks. As answer to that, such progress brought too new risks, present in daily life of mankind. It is relevant to emphasize that the risk can be characterized from different viewpoints, i.e., subjective questions are involved in risk perception [1].

Risk perception associated to nuclear technology and to environmental degradation is part of modern world, but various factors influence the social posture face to such questions, as well its acceptance has been caused changes in population actions and attitudes, in science, stimulating new discoveries and research areas.

A characteristics around risk perception is the fear, since these danger sources generate fears to the person and consequently various reactions, different for each one, as the ignorance can cause too fear and discomfort, among manners of reacting, are the mechanisms of *psique* defense, as escape, negation, projection, isolation, rationalization, among others. In the most part they are inefficient, and, consequently, risk communication is a relevant fact for the minimization of such public reactions.

So, this study will have as focus the assessment of risk face to laic population, trying to know how perception of nuclear and environmental risk interferes in its posture face to such questions. Knowing that risk conception, along the years was incorporated by various sciences, among them social ones, studies point that risks analysis can not be restrict only to a quantitative evaluation, since cultural factors and values are mixed in public perception [12].

## **2.5 The social imaginary**

The social imaginary is a social product, since it is created by a set of relations that compose the memory of groups in their social habitat and consequently is transmitted from generation to generation, being influenced by society situation at that specific historical moment. That is, it is created a world of own meanings from that society, that in an unconscious manner is

followed by all their members, occurring actions without questioning, up to a degradation point where it is the planet, in this moment some members start to rationalize and are succeeded in evaluating the situation, reinforcing such questions in other people, capable to attain collective dilemma, that involve a great number of people in search of a solution for a common problem, transforming, this way, individual distress in collective dilemma.

It is relevant to emphasize that part of *constructos* which compose social imaginary, has its origin in religious, politic and cultural questions, capable to be reinforced by influences of groups interested in leading the public to a common thought.

The psychology has as study object the behavior and human experience, based in their mental aspects and their relation with physical and social environment, which are full of meanings, with them, people live in constant interaction, so, they are considered social *constructos*, i.e., are meanings, values, constructed via interaction of various members in a social group, from which they belong too, the conscience, environmental culture, predominant at that society.

The search for a dreamed sustainable development should start from a social action, it is not enough a single person to take part in this action, it requires support and assistance from the society as a whole, so, one of the ways to get at this point is reinforcing in social imaginary the relevance that each person has a pro-environmental behavior, i.e., an action behavior previous analyzed from viewpoint of environmental preservation.

This way, social imaginary is based on these questions that take part of life in the society, nuclear question is one of them, its destructive power discovered after bombing in Hiroshima and Nagasaki, besides accidents in nuclear plants, it was determinant for reinforcing the idea of invisible contamination risk, generating a possible nuclear technology fear [8].

Public opinion transformed along the years for playing the role of technology and modernity and risks that it could bring to environment, and due to that, discussion about problems brought by development start to be placed on agenda [1].

*“Actually, it is observed a dubious posture of the public in relation to scientific knowledge: science and technology are considered the cause and the solution of modernity risks.” [1] (p. 19)*

With this, we verified that concernments about risk from the development of sciences and technology are perceived by the public as a whole, that induces to believe that such feelings are settled in population social imaginary.

### 3 METHODOLOGY

Research work had as focus in a bibliographic research, referring to historical evolution of environmental concernments, either by nuclear extent or by environmental extent, discovering as the social imaginary influenced on the posture of population face to the development of this technology, in respect to acceptance and understanding of such use of nuclear energy, as well the perception of associated risk. Having as basis study themes in environmental psychology and social imaginary, as per a comparative analysis of material studied, aiming to s critical analysis.



This way, it was accomplished an explanatory research, with the purpose of presenting a general view on the theme in question, for inciting further studies about social influence in decision making on nuclear topic [13].

By using hypothetical-deductive method, it was verified the relation of perception of environmental and nuclear risks. Investigating how this is related to the social imaginary, in associating the risk with a possibility of environmental aggression.

With this we intend to check what it is required to do and what it can be done for a total acceptance in using nuclear technology for a peaceful purpose of energy production and tentative of reduction in emission of gases from greenhouse effect.

#### **4 RESULTS DISCUSSION**

The history shows that for a long time public perception on nuclear energy was a matter of difficult acceptance, since its history was associated to bombs, accidents and diseases. Today this changed too much, principally with a raise in concernment with environmental questions, as greenhouse effect, global warming.

A research from Ibope, accomplished in 2001, Rio de Janeiro, showed that 46% of interviewed were for the use of nuclear sources for electric energy; 34% were against and 21% did not have a settled opinion. This research was ordered by Associação Brasileira de Energia Nuclear (ABEN) [14].

In worldwide scenery, a research accomplished in 2005, by IAEA in 18 countries, pointed out that 62% of interviewed are in favor the use of nuclear technology for generation of electric energy [14].

#### **5 CONCLUSION**

Exploratory research showed that concernment with environmental questions have been raised in last years, having as major cause the global warming, in consequence of greenhouse effect.

Due to it, alternate ways for generating energy were thought, in order to minimize such effects, an alternate suggested by specialists was the use if nuclear energy.

From then the question about the use of nuclear energy was put in agenda for discussion in various sceneries and by the public, in general. Researches accomplished by various sources point that a great part of population is for the use of nuclear energy for the purpose of generation of electric energy.

With this, we perceived that there was a raise of environmental preoccupations by the public, in general, and consequently a reduction of concernments by the peaceful use of nuclear energy, principally for generation of electric energy, aiming to a lower emission of gases from greenhouse effect and a control of climate changes.

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