

Aspects of public opinion research in risk perception studies covering the nuclear field

Kátia Suemi Tanimoto, Goro Hiromoto

Instituto de Pesquisas Energéticas e Nucleares (IPEN-CNEN/SP)
Av. Lineu Prestes 2242 - Cidade Universitária - CEP: 05508-000 - São Paulo – SP, BRASIL
ktanimoto@ipen.br, hiromoto@ipen.br
<http://www.ipen.br>

Abstract. A project for site selection and construction of a national radioactive waste repository is underway at the Comissão Nacional de Energia Nuclear. Public acceptance is determinant to the deployment of an undertaking of this size. A major concern regarding the use of nuclear energy are the problems related to safe management of the radioactive waste. For effective communication between decision makers and the public, a mutual understanding of views, as well as attitudes towards risk, is needed. The use of opinions polls is necessary in order to achieve it. This work aims to point out the major aspects to be approached by an opinion poll for the study of risk perception on the candidate regions for repository construction. A risk perception research model is presented, to be applied to the case of radioactive waste disposal, along with theoretical support to the organization and implementation of its structure.

1 Introduction

The continuity of the Brazilian nuclear program is strongly associated with the definitive solution to the disposal of radioactive waste produced by the nuclear power plants operating in the country. Besides the need to comply with safety requirements of geology, hydrogeology, ecology, design and construction of the repository, public acceptance is key to implementing an undertaking of this size [1]. One of the main barriers to the nuclear energy use regards the radioactive waste disposal [2].

The Comissão Nacional de Energia Nuclear (CNEN) defines radioactive waste as “any material resulting from human activities which contains radionuclides in quantities which exceed the exemption limits, specified in the *CNEN-NE-6.02 - Licenciamento de Instalações Radiativas* act and for which reuse is inappropriate or not predicted” [3]. Although there is no universal criterion to classify radioactive waste, it is usual to group them into three categories: high level waste, intermediate level waste and low level waste [4]. High level waste (the one derived from fuel elements reprocessing, or the exhausted fuel element itself) has significant quantities of long half-life alpha emitters and high heat generation, and its definitive containment requires isolation from the biosphere for hundreds of thousands of years. In Brazil there is no national policy prescribing fuel elements reprocessing in a near future, therefore, the high level waste does not represent a problem to be

urgently solved by national authorities. Depending upon the higher or lower concentration of alpha emitters, the remaining waste is classified as medium or low level. These are characterized by low radiotoxicity and heat generation. Its definitive deposition is performed in repositories at surface level or a few tens of meters deep. Thereby, waste from Brazil is either medium or low level. Both types are being stored in the several research centers subordinated to the Comissão Nacional de Energia Nuclear and in the nuclear power plant in Angra dos Reis.

For a long time, the acceptance question by the public opinion was one of the biggest problems from the nuclear sector worldwide. A persistent association of nuclear technology with bombs, accidents and diseases created a distorted image from the nuclear sector. For decades, the nuclear sector has appeared in public debates almost always in a defensive position, merely manifesting in response to attacks by the opposers. In Brazil, a factor which contributed to the atmosphere of nuclear energy distrust was the fact that the Brazilian nuclear program was born during the military regime, a time marked by lack of dialogue with civil society. With the return of democracy, there was an opening of enterprises and entities of the sector to the civil society. It is exactly the transparency strategy adopted since then that experts point out as one of the factors which contributed to changing public perception of nuclear energy [5]. For an effective communication between politicians and decision makers and the public, it is mandatory that both parts understand each other's points of view, as well as their attitudes towards risk [6]. In order to achieve this understanding, opinion polls are used [7]. This paper aims to describe the main factors to be approached in a public opinion survey and create a questionnaire that is capable of evaluating those factors, allowing a study of risk perception regarding a radioactive waste repository.

2 Methodology

Currently, there is no defined methodology regarding how the relative importance of factors affecting risk perception and attitudes should be addressed. Several studies point to the relevance of risk perception and communication to the decision making process [8, 9, 10, 11, 12], and also indicate their role in the amplification of consequences in case of accidents [9, 13].

To approach the goals of this study, we chose a flexible research model of risk perception, applied to the case of radioactive waste destination.

This work relied mainly on studies carried out by Sjöberg [6], focusing on identifying factors which explain the perception and attitudes towards nuclear energy and, more particularly, radioactive waste, and in the credibility assessment of institutions and sectors related to nuclear energy.

The questionnaire comprises eight blocks of questions. Each block aims to evaluate an explanatory variable. The first block intended for the study of attitudes toward radioactive waste and nuclear power, is composed of ten questions with closed answer alternatives. The second block, which examines trust, defined as one's expectation to rely on competent and predictable behavior of individuals and institutions [14], has six questions with closed alternatives, including the possibility of answering 'I don't know'. On the third block there are two questions relating to benefits of nuclear energy, in an attempt to identify whether the public appears to be

more concerned with activities whose benefits are unclear. The fourth block applies the psychometric approach or expressed preferences approach, through five questions concerning the assessment of certain technologies and activities for each of the characteristics or dimensions in particular. On questions within this block, risk sensitivity is used to measure differences in the tendency to assess all risks as large or small. The fifth section targets real risk, as it is a useful concept to explain the perceived risk [15]. The sixth block seeks to understand the role of emotional reactions. The seventh block examines the precautionary principle and the last block is designed to clarify the respondent's profile.

3 Results and Discussion

The eight questions blocks developed are presented below. All answers are presented as a 7-point linear scale, with or without the additional 'I don't know' option. On the following description, we list only the extremes of the scales, omitting the 5 other possible intermediate answers.

3.1 First block

The first two questions aim to understand attitudes, essential for the risk communication proposal suggested in this study. On the first question, the respondent must indicate '1' if he/she feels extremely negative concerning a radioactive waste repository in his/her municipality, and '7', if extremely positive. On the second question, the respondent is asked whether he/she is committed to the repository issue and must indicate '1' for 'no, absolutely not' and '7' for 'yes, definitely so'.

- (1) How do you feel about a radioactive waste repository being located in your municipality?
 - (2) Do you feel involved in the issue of a repository situated in your municipality?
- Questions 3, 4, 5 and 6 explore the risk denial, i.e., the fact that people usually claim to be less subject to risks than the others [16]. The risk denial level is related to attitudes [15]. In each of these questions, the respondent should denote '1' in case of 'no, absolutely not' and '7' in case 'yes, definitely so'.
- (3) Do you think a radioactive waste repository would carry risks to the municipality where it is located?
 - (4) Do you think a radioactive waste repository would carry risks to you personally?
 - (5) Do you believe you would be able to protect yourself against a possible accident in the repository?
 - (6) Do you believe residents of your municipality would be able to protect themselves against a possible accident in the repository?

Questions 7, 8 and 9 aim to assess beliefs regarding a radioactive waste repository being located in the municipality, which reflect positions against or in favor of it. As attitude is determined by the set of beliefs held by a person, an attitude is only useful to predispose the person to get involved in a set of behavior that, if as a group, is consistent with the said attitude [17]. On questions 7 and 9, the respondent is asked to point out '1' for 'no, absolutely not' and '7' for 'yes, definitely so', while on question 8, '1' for 'yes, definitely so' and '7' for 'no, absolutely not'.

- (7) Considering a repository acceptance in your municipality, judge the following statements.

The repository would bring economic benefits to the municipality.

The country would be benefitted from the repository construction in your municipality.

A repository would bring a sense of optimism to the municipality.

Companies from others sectors could settle in your municipality.

A repository would bring a sense of proud to the municipality.

- (8) Considering opposition to a repository being located in your municipality, judge the following statements.

A repository would imply risks to human health.

The municipality would get a bad reputation.

Many people would move to other locations.

Many companies would leave the municipality.

- (9) Do you think a radioactive waste repository can cause adverse effects to local residents' health?

Question 10 examines the notion that a radioactive waste repository would cause stigma. That is a strong opinion and can't be measured but the usual attitudes questions. Nine statements about a radioactive waste repository are formulated in an objective manner, to clarify the respondent's concerns over implications of a radioactive waste repository. The respondent is asked to judge the statements concerning a waste repository and point out '1' to 'absolutely agree' and '7' to 'absolutely disagree'.

- (10) Judge the statements below, concerning a radioactive waste repository being located in your municipality.

- A radioactive waste repository in my municipality...

Would be totally unacceptable.

Would be shameful.

Would bring a very bad reputation to the municipality.

Would make companies move out.

Would make people move out.

Would lead to serious conflicts between people.

Would be strongly worrisome to local residents.

Would make me move out if I had the opportunity.

Would make me vote in a party against this decision.

3.2 Second block

Trust in people and institutions is important as it promotes belief in the message content [18]. Question 11 and 12 assess trust in organizations and authorities linked to radioactive waste management. In question 11, it should be pointed '1' for 'very little', '7' for 'very great' or 'I don't know', while in question 12 and 13, '1' for 'no, absolutely not', '7' for 'yes, definitely so' or 'I don't know'.

- (11) Rate your trust in the following organizations/institutions when addressing any issue linked to nuclear energy.

Comissão Nacional de Energia Nuclear (CNEN)

Instituto de Pesquisas Energéticas e Nucleares (IPEN)

Universities

Government authorities

Church

Media

Politicians

Local leaderships

(12) Do you think government authorities omit information about the potential risks of radioactive waste?

(13) Do you think that CNEN omit information about the potential risks of radioactive waste?

Question 14 evaluates antagonism, found to be an important factor in trust [19]. It should be pointed out '1', if the matter is 'totally against my interests', and '7', if it is 'totally compatible with my interests', or 'I don't know'.

(14) To what extent are the following authorities and organizations contrary to my interests?

Comissão Nacional de Energia Nuclear (CNEN)

Instituto de Pesquisas Energéticas e Nucleares (IPEN)

Universities

Government authorities

Church

Media

Politicians

Local leaderships

Questions 15 and 16 evaluate epistemic trust, i.e., confidence in the science underlying a technical solution to radioactive waste management and storage. In those questions, mark '1' to 'no, absolutely not' and '7' to 'Yes, absolutely yes' or 'I don't know'.

(15) Current scientific knowledge is sufficiently reliable to allow building a radioactive waste repository in a safe way.

(16) Scientific and technical issues related to radioactive waste disposal are being adequately taken care of.

3.3 Third block

Risks perception cannot be analyzed separately from the benefits perception. The acceptance of a given risk is closely linked to the expected benefits from the activity which presents the risk, either consciously or unconsciously. The public acceptance concept is strongly tied to the benefit concept, not to the risk concept. Risks are not accepted in an absolute condition, they are instead related to perceived benefits, including context and, above all, confidence in the agent responsible for the practice [20]. Questions 17 and 18 examine the perceived benefit issue. In question 17, the respondent is prompted to choose '1' for 'no, absolutely not' and '7' for 'yes, definitely so' and in question 18, '1' for 'yes, definitely so' and '7' for 'no, absolutely not'.

(17) Do you believe nuclear energy benefits the society?

(18) Judge the following statements about a repository.

- Among potential benefits of a waste repository in your municipality are:

New jobs for municipality residents

Positive reputation to the municipality

Growth in optimism and trust on the municipality
Companies from others sectors would seek the municipality
More jobs related to tourism and others touristic undertakings
Be recognized in a positive way
Possibility of positive consequences not yet identified

3.4 Fourth block

Questions from this block assess (a) people willingness to face risks, (b) knowledge about the risk, (c) to what extent risks are known by science, (d) risk controllability and (e) severity of consequences. So, in question 19, 1 = involuntary, 7 = voluntary; in question 20, 1 = totally unknown risk level, 7 = totally known risk level; in question 21, 1 = totally unknown, 7 = totally known; in question 22, 1 = totally impossible to control, 7 = totally controllable; in question 23, 1 = surely will not be deadly, 7 = surely will be deadly.

For technologies or activities listed below:

- Genetically modified food
- Nuclear energy
- Pesticides
- Internet
- Wind energy
- Radiography
- Food additives
- Firearms
- Home appliances
- Antibiotics
- Alcoholic drinks
- Hydroelectric energy
- Cigarettes
- Solar energy

The respondent is requested to answer, to each,

(19) How willingly do you compromise yourself with the technologies and activities listed below?

(20) How much is the risk known by people exposed to it?

(21) To what extent are the risks known by science?

(22) If you are exposed to the risks of the activities or technologies listed, to what extent can you avoid death after getting involved with them?

(23) If some accident involving the activities or technologies listed happens, how likely will the consequences be deadly?

3.5 Fifth block

Questions 24 and 25 analyze perception of risks with which people have some experience, either directly or indirectly, involving daily life aspects, as a realistic perception of those risks is expected [15]. In both questions, for each item must be marked '1' for 'very little', '7' for 'very great', or the 'I don't know' option in case it is not possible to answer'.

(24) Among the cited items, assess the risk to YOU personally.

- Smoking
- Drugs
- Alcoholism
- Ground contamination
- Chemical waste
- Obesity in youth
- Radioactive waste
- Air pollution
- Traffic accidents
- Climate change
- Inappropriate diet
- Chemical industry
- Nuclear power plants
- Terrorism
- Floods
- Radioactive waste repository
- Forest fire
- Home accidents
- Genetically modified food
- Medical radiography
- Noise

(25) Among the cited items, assess the risk to people in general.
(Same as 24)

3.6 Sixth block

Sjöberg (2007) have found that emotions play an important role in risk perception and attitudes related [21]. People react emotionally to threats, sometimes out of proportion with the real threat, as in the case of a repository, revealing “instinctive reactions” and shaping hard attitudes, difficult to change by information means. It is understood that processes in which there is public participation can ease the opposite reactions [16].

Better information about the emotional reactions can be obtained when the respondent is asked to answer exactly at the moment the question is being read. In questions 26 to 30, ‘1’ should be pointed out for ‘very low degree’ and ‘7’ for ‘very high degree’.

(26) Judge, fast and spontaneously, the feelings toward genetically modified food according to what you feel.

Anger
Scorn
Fear
Satisfaction
Guilt
Shame
Concern
Pessimism
Optimism

- (27) Judge, fast and spontaneously, the feelings toward terrorism according to what you feel.
- (28) Judge, fast and spontaneously, the feelings toward a radioactive waste repository according to what you feel.
- (29) Judge, fast and spontaneously, the feelings toward nuclear energy according to what you feel.
- (30) Judge, fast and spontaneously, the feelings toward solar energy according to what you feel.

3.7 Seventh block

According to Sjöberg (2009), the precaution principle affects risk perception and attitudes concerning radioactive waste. It has been found people tend to exhibit a concordance high level to items prescribing precaution and deny items that favor risks [22]. In question 31, the respondent is required to answer '1' if she/he 'absolutely agrees' and '7' if she/he 'absolutely disagrees' to each statement.

(31) The deployment of a radioactive waste repository facility may present risks, so it should...

- Be avoided, unless proven not to bring risks
- Be accepted, since it offers some benefits
- Be accepted, if there is no evidence of danger
- Be accepted, even if it brings unknown risks, however minimum
- Be absolutely avoided, regardless of how safe information about risks is
- Be accepted, if more benefits than risks can be proven
- Be avoided, if it can be replaced by another technology or an alternative activity, at reasonable costs
- Be avoided, until more is known about the risks
- Be avoided, unless risks are willingly assumed by the exposed individuals
- Be avoided, since not even science will achieve absolute knowledge about future associated risks
- Be avoided, if people worry about risks, even though it is not proven
- Be avoided, unless strong scientific arguments that risk is minimum be provided

3.8 Eighth block

Designed for characterize the socioeconomic and cultural profile of the respondent.

4 Conclusion

A questionnaire was created, in which question blocks evaluate the following items: attitudes toward radioactive waste and nuclear energy, risk denial, beliefs, stigmata, social and epistemic trust, antagonism, expressed preferences, specific risk, emotional reactions and the precautionary principle. It should be emphasized that the questionnaire is flexible within each block, allowing the introducing of other explanatory variables easily, according to the polling agent's interest.

References

1. COMISSÃO NACIONAL DE ENERGIA NUCLEAR. Seleção e Escolhas de Locais para Depósitos de Rejeitos. Rio de Janeiro: CNEN-NE-6.06, CNEN, 1989.
2. ELETRONUCLEAR. Panorama da Energia Nuclear no Mundo. Rio de Janeiro, 2009.
3. COMISSÃO NACIONAL DE ENERGIA NUCLEAR. Gerência de Rejeitos Radioativos em Instalações Radiativas. Rio de Janeiro: CNEN-NE-6.05, CNEN, 1985.
4. INTERNATIONAL ATOMIC ENERGY AGENCY. Classification of Radioactive waste. Vienna, Nov. (2009) (GSG-1).
5. AGUIAR, P. Por uma imagem real da energia nuclear. Rev. Brasil Nuclear (2009) ano 14, n. 34.
6. SVENSK KÄRNBRÄNSLEHANTERING AB – SKB Rapport R-06-97: Opinion och attityder till förvaring av använt kärnbränsle, SKB Rapport R-06-97. Stockholm, Sweden: 2006.
7. SJÖBERG, L. Asking questions about risk and worry: dilemmas of the pollsters. Journal of Risk Research (2004) v. 7, n. 7, p. 671-674.
8. SLOVIC, P. Perception of risk from radiation. Radiation Protection Dosimetry (1996) v. 68, n. 3/4, p. 165-180.
9. DROTTZ-SJÖBERG, B.; SJÖBERG, L. Risk perception and worries after the Chernobyl accident, Journal of Environmental Psychology (1990) v. 10, pp. 135-149.
10. GARRICK, B.J.; GEKLER, W.C. The analysis, communication and perception of risk, New York: Springer (1991).
11. ROHRMANN, B. Risk perception, risk attitude, risk communication, risk management: a conceptual appraisal (Keynote). In: 15th THE INTERNATIONAL EMERGENCY MANAGEMENT SOCIETY, June 17-19 (2008) Prague.
12. INSTITUT DE RADIOPROTECTION ET DE SÛRETÉ NUCLÉAIRE – Baromètre IRSN: La perception des risques et de la sécurité par les Français, Rapport IRSN-DSDRE n° 16. France: 2009.
13. PETERSON, J.S. Perception vs. reality of radiological impact: the Goiania model. Nuclear News (1988) v. 31, p. 84-90.
14. BOTTERILL, L.; MAZUR, N. Risk & risk perception
15. SJÖBERG, L. Factors in Risk Perception. Risk Analysis (2000) v. 20, n. 1, p 1-11.
16. SJÖBERG, L. Risk Perception, Emotion, and Policy: The Case of Nuclear Technology. European Review (2003) v. 11, n. 1, p. 109-128.
17. INTERNATIONAL ATOMIC ENERGY AGENCY. Public Attitudes toward Nuclear Power. IAEA BULLETIN (1976) v.18, n. 5/6, p. 53-59.
18. SJÖBERG, L. Dynamics of risk perception (Seminar). In: Seminário Internacional: Risco, Saúde e Meio Ambiente, September 21-22 (2009) São Paulo.
19. SJÖBERG, L. Antagonism, trust and perceived risk. Risk Management (2008) v.10, p. 32-55.
20. TOUZET, R.E.; BARÓN, J.H.; CASPANI, C.; REMEDI, J.O. Risk Perception and Benefits Perception (Survey Results and discussion). In: 10th International Congress of the International Radiation Protection Association, Mayo 14-19 (2000) Hiroshima.
21. SJÖBERG, L. Emotions and risk perception. Risk Management (2007) v.9, p. 223-237.
22. SJÖBERG, L. Precautionary attitudes and the acceptance of a local nuclear waste repository. Safety Science (2009) v. 47, p. 542-546.