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LOW AND MEDIUM LEVEL RADIOACTIVE WASTE REPOSITORY: RISK PERCEPTION

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ABSTRACT

This paper focuses on the risk perception associated to the installation of low and intermediate level radioactive waste (LLRW and ILRW) disposal facilities. The purpose is to give support for the implementation of a repository in Brazil. Public acceptance results from a long term work and trust is vital for the process as it takes long to be conquered but might be shortly lost. Therefore, it is essential to care about the way each step is conducted. The knowledge about the system and the risks, the comprehension about these risks, the commitment with safety, adequate support systems for the project (legislation, involved institutions) and the excellence as a goal to be reached are extremely important parameters. The involvement of all interested parties in the decision-making process is condition for a successful and publicly acceptable implementation of such project. The steps for public acceptance of a repository are summarized as follow: 1 – Risk perception: to verify how the local population understand and feel the installation of a repository in the region. 2 – Media observatory: to continuously follow the news reaching the region where the repository will be installed, including different media. 3 – Local population social/economical/cultural profile identification: to determine the local population social/economical/cultural profile; to conduct a survey to know their expectations, allowing the proposal of compensation and incentives to fully account for their expectations. Finally, the philosophy governing this Project is: on doubt, the public must be heard and only after this public hearing the policies concerning the project shall be formulated.

1. INTRODUCTION

Management of wastes is one of the most sensible environmental questions for all societies having production of energy by nuclear activities as well as medical, research and industrial applications of radioactive materials. This paper focuses on the risk perception associated to the siting of low and intermediate level radioactive waste (LLRW and ILRW) disposal facilities. The purpose is to give support for the implementation of a repository in Brazil. Public trust is vital for the process: it takes long to be conquered but might be shortly lost. Therefore, it is essential to care about the way each step is conducted.

There are different ways to define the location of disposal facilities. Some projects need authorization from the regulatory agencies for the technical studies from the very beginning. Others give the start applying a public survey to evaluate the local population acceptance concerning the installation of a low and intermediate level radioactive waste disposal facility. One possibility to make more participative the choice and development of the project is to have candidature from previously selected cities, according to technical evaluation. It is fundamental to keep transparency concerning the selection criteria [1]. According to a United Kingdom report about participative methods, if the interested parties can not realize how their opinions, suggestions, proposals are considered, the whole process is impaired.

Following studies about populations in risk situations, the vulnerability notion was incorporated by the scientists. Vulnerability has been proposed as the key to understanding a novel conceptualization of risk that attempts to break with the more causal, mechanistic attitudes that have characterized the relationship between human societies and their environments over past centuries and that has often been associated with western cultural norms. The concept of vulnerability expresses the multidimensionality of disasters by focusing attention on the totality of relationships in a given social situation which constitute a condition that, in combination with environmental forces, produces a disaster [2]. In the nineties, vulnerability was consolidated. Besides the environmental aspects, studies addressed also the social and technological aspects; these new approach focused social-economical processes and mainly social problems [3-4].

According to Vuorinen [5], public acceptance results from a long term work. As the public must trust the regulatory system, the responsible for this activity should be open, transparent and consider that information technically sound, clear, reliable and understandable should be available. In a partnership process the regulatory body, responsible for safety and control should provide, to the public, information about the repository and the associated logistic (transport, physical safety, among others). The involvement of all interested parties in the decision-making process is a condition for a successful and publicly acceptable implementation of such a project. Information should be available unless specifically protected by law. Every doubts and fears should be diminished or even eliminated in a fast and adequate way. Public trust is vital for the process: it takes long to be conquered but might be shortly lost. Therefore, it is essential to care about the way each step is conducted. The knowledge about the system and the risks, the comprehension about these risks, the commitment with safety, adequate support systems for the project (legislation, involved institutions) and the excellence as a goal to be reached are extremely important parameters.

Informative campaigns about the project – what it is, period of time involved – may suggest that the local community participation is important for the responsible for the implementation of the repository. The community must feel participating of the process, even to disagree from some points. If the community participation in the decisional process is not possible, the local population must be immediately informed about the chosen place, before this information be known by someone strange to the process.

The real risk from a disposal facility implementation should be explained by physical and radiological safety technical personnel. Concerning social questions, risk definition may have several dimensions, since it is based on subjective values, such as risk control, trust and equity. Thus, the risks are evaluated according to the way they are perceived by the society [6-8].

The risk evaluation has been treated as an exclusive scientific area, that is, by quantitative and objective evaluation. Nowadays, the public reaction to risks is considered for public policies adoption and when establishing organizational strategies [9-10]. There is a difference in the way each social group understand risk, causing great difficulty in the communication between specialists in safety and the general public.

Risk perception notion for the general public is influenced by some aspects and characteristics of the risk itself. This has been identified in risk perception and

communication [9, 11]. Opinion surveys might be useful as tendency indicative of the population expectation. The applied methodology is adapted to the regional reality.

To improve the population knowledge about real risks it is needed to have informative material, specially produced for the project (videos, folders, articles in mass media), besides providing proper information about the project implementation.

Discrepant opinions have been treated by the industries and governors as a public evaluation mistake, which has to be educated to understand the project. It is a unidirectional view that has been refuted [12-14].

Risk communication involves not only information about risk; it comprehends perception, opinion and preference exchange among stakeholders. Risk perception is as important as the real risk and its acceptance depends more on the trust on an efficient management than in quantitative estimates.

Some available tools are monitoring of local media, giving interviews and talks to schools, local organized associations and environmental organizations. The local community participation in the facility construction originates income to the population, allowing also access to information that is disseminated. A fundamental principle is not to leave any legitimate request without answer. Even if the answer is: "we do not have this information at the moment, but as soon as we have it will be available". It is recommended that written documentation is used instead of oral communication.

Acceptation is affected by risk and damage distribution: those living nearby some plant that they believe may present risk, may minimize them if the proposed benefits are high enough. Depending on the local conditions, the population expectation may be identified. Access to the benefits may improve the local population acceptance. But these must be very well planed to avoid the impression of "bribery" or a hidden intention of changing attention. It should be explained in which measure the interested parties' wishes had impacted the decisions.

Studies done in other countries, like USA, show that job and income, originated from the plant installation, allow better quality of life. The main beneficiaries are the local residents. Money from tributes allows improvements in school and public services offered. Besides, there is an expansion in the local real state market. The survey conducted at several locations in USA was published by Bezdek and Wendling [15]. In Brazil, it is important the legislation improvement, to allow that the chosen location may receive, as improvements, part of the tributes paid by the repository. It would be interesting to have a local committee to define the priorities for the financial resources application.

Benefits for the residents of the siting location play also the role to prove that the plant may be an economical development agent. However, the access to information and other aspects, like the regulatory agency strengthening, the actuation of a disposal management research and development committee, including national and international programs on radioactive waste disposal facilities and the reliability concerning the materials inventory – they have to be stored safely in an ideal place – are fundamental parameters to set bounds for the project.

According to the literature, some answers obtained in a survey conducted at Hungary done with the resident population close to the nuclear radioactive waste disposal, concerning “compensation”, should be appointed to warn about some possible drawbacks.

> "Life may not be compensated"; "Local residents should not accept compensation because the risks will affect future generations”; "Compensation is bribery” and “We may not be bought[1]”.

To verify the local demands it is important to have a close contact with the local community, besides opinion surveys. Workshops, public meetings and public consulting are equally needed. Strategy for population engagement must be improved since the very beginning of discussions about the siting local selection.

Political questions or involvement should be avoided since the beginning. Technical criteria should guide the whole project development. Besides, if the proposals are based on public consulting, it is easier to contemplate the local population desires. Increasing the public awareness relative to the risks inherent to modern society, associated to the comprehension that specialists evaluation are limited by the lack of reliable data about certain risk agents action, has directed the decisional process to the society benefits [11, 16].

Risk management consider human health, environment and economy impact evaluation, besides risk acceptability, that depends on risk perception and attitude by the public, on the economical and political interests and on development and quality of life concepts. The relevance each one of these aspects will have on the final decision depends on the kind of facility and on the individuals or social groups involved in the decision. The relative importance of these aspects may not be defined. Some studies point for risk perception and communication as the main ones [9, 11-14, 17], indicating their role in amplifying the consequences in accidents situations [11, 18].

It is important to have a commitment with the next generations by creating strong and permanent interaction systems. The program should be a learning opportunity for all the parties involved – entrepreneur, regulatory agents and the public. The program efficiency is also associated to the representativeness it may obtain with the ones involved in the construction. Another essential point is the interactivity possibility allowing continuous rearrangement and improvement of the project, taking in consideration all contributions received [19].

Currently the analysts claim that nuclear energy acceptance is higher than in the years immediately following the Chernobyl disaster. Recent years without any accidents have been fundamental. Also, the fear of climate changes has contributed for lower rejection to nuclear technology. Studies done in England and published in 2006 demonstrated that climate changes interfered in the view people has about the nuclear energy share to the energetic matrix: there is a tendency for increased acceptance. Other studies indicated that the negative image association to nuclear energy is somehow put aside, but any accident or incident may revival all the fears [20].

[1] http://www.piercelaw.edu/risk/vol7/spring/vari.htm

2. BRAZILIAN CASE

It is important to note that in Brazil the renewable energy presence in the energetic matrix is proportionally higher than in the world as a whole. Also ethanol and the biofuel have been disclosed as competitive advantage, besides hydro electrical, aeolian and solar potential. Special surveys should be made around the country to define specific aspects. Since there are no previous studies it would not be possible to verify any evolution or change in the population notion about nuclear energy.

The strategy to be adopted by the country should be to organize and qualitative and quantitative analyze the available data, trying to compare with results obtained from studies in other countries [21-22]. Afterwards the risk indicators considering public perception to several agents should be identified, together with the environmental, geological and economical indicators, for the decisional process taking into account the chosen place for the repository installation.

Two questions are predominant concerning risk perception: technical and psychological aspects; neither one might be considered alone. Technical aspects are marked by scientific criteria. Experience from countries having started the construction process shows that public participation is fundamental as their perception should be taken into account when choosing the siting location. The communication process should be comprehensive and kept updated. It is important to establish criteria to measure the satisfaction at each step and to determine the best way to reach the proposed objectives.

Communication is always an essential tool and emotions may not be disregarded by the application of informative techniques. Accidents must be avoided and the nuclear area has this commitment, employing modern and reliable resources. Disclosure of safety questions may bring two feelings: trust or even higher fears. The credibility conquer is a fundamental point for all the involved ones, facility manager and regulatory agencies.

Countries with high income, schooling grade, HDI – human development index – among other factors, are the ones considered the best examples, with well succeeded projects. However, they have conditions distinct from Brazil. Formation differences among the populations must be considered. As an example, the French revolution in education was done during the Napoleonic period, while in Brazil it is still going on. So, great care must be taken with stranger models replication.

Examples from unsuccessful projects were based mainly on technical information and had postponed the population participation. Transparency, access to information and discussion channels facilitates the project acceptance (Sweden, Finland and Hungary). Examples from ongoing projects in several countries may strengthen the trust from the population in the quality of the work and on the seriousness of the agencies involved. The idea of having independence and opening to external technical evaluation increased the credibility.

The main question in Brazil is to have nuclear energy acceptance for electric energy generation in a country with so many other possibilities of renewable energy sources. In countries having no other options for energy generation these arguments are not employed.

The longevity of the plant, which should last for five centuries, is the same time as the discovery of the country by the Portuguese.

3. CONCLUSIONS

The need for a disposal facility and its management should be explained in a favorable way to show that the activities involving nuclear material in other areas are responsible for quality of life improvement, as well as the nucleoelectric generation. The nuclear area must pass through a kind of revolution to become able to talk to interlocutors out of the specialists group. To overcome this frontier is the first step to start a participative process, more democratic and that may allow the nuclear industry to occupy the due place in view of the modern world challenges.

The definition of steps in the Communication and Interaction with the Society Program implementation is a very sensible parameter, and the proposal of this is summarized in Table 1.

Table 1. Public acceptance program for low and intermediate level radioactive waste disposal facilities

ACTIVITY	DESCRIPTION	REASON
RISK PERCEPTION	To verify how the local population understand and feel the installation of a repository in the region.	Acceptance is affected by risks and harm distribution; however it is needed to know how population understands the disposal facility installation where they live.
MEDIA OBSERVATORIUM	To continuously follow the news reaching the region where the repository will be installed, including different media.	During the Project implantation great agility is needed to neutralize possible calumnious or alarmist campaigns. In these cases, an immediate answer is essential to mitigate the effects of deleterious actions.
LOCAL POPULATION SOCIAL/ECONOMICAL/CULTURAL PROFILE IDENTIFICATION	To identify the local population social/economical/cultural profile. To conduct a survey to know their expectations, allowing the proposal of compensation and incentives to fully account for their hopes. It is possible to substitute the word **compensation** by **incentives**.	One of the main difficulties in establishing compensations is to create a direct communication channel with the population and to avoid having obligations concerning personal interests from the local authorities. Knowing the population expectations enable to make more attractive proposals, not necessarily more costly. The proposals should be presented at the public meetings, increasing the possibility of success. However, to obtain this competitive advantage it is need a good knowledge of the local population.

REFERENCES

1. Identification of Information Needed to Decide with Confidence on the Long Term Management of Options for Long Lived Radioactive Waste, Londres, out 2002.
2. Bankoff, G. "Vulnerability as a measure of change society". *International Journal of Mass Emergencies and Disasters,* 21, p 5-30, 2003. *apud* Pfister, C. and Brázdil, R. "Social vulnerability to climate in the "Little Ice Age": an example from Central Europe in the early 1770s" *Climate of the Past Discussions*, 2, S79–S87, 2006. in: www.climate-of-the-past.net/cpd/2/S79/ European Geosciences Union
3. Mendonça, F. "Riscos, vulnerabilidade e abordagem socioambiental urbana: Uma reflexão a partir da RMC e de Curitiba". *Revista Desenvolvimento e Meio Ambiente. UFPR*, **10**, pp.139-148, jul./dez., 2004.
4. Marandola Jr., E. and Hogan, D. Vulnerabilidades e risco: entre geografia e demografia. Revista Brasileira de Estudos de População. ABEP, vol. 22, n. 1, pp.29-53, jan./jun., 2005.
5. Vuorinen, A., *Regulators' role in development of Finnish nuclear waste disposal program*, Progress in Nuclear Energy **50**, pp.674-679 (2008).
6. Hansson, S. O. "Dimension of risk". *Risk Analysis*, **9**(1), (1989).
7. Lindell, B. "The risk philosophy of radiation protection". In: Norwegian Radiation Protection Authority. Radiation risk, risk perception and social constructions: proceedings of workshop on… Oslo, Norway, 19-20 out, 1995. Brussels, pp.157-164 (1996).
8. Nielsen, T. H. "Risks in technology, society and the mind". *Radiation Protection Dosimetry* **68**(03), pp. 181-4 (1996).
9. Slovic, P. "Perception of risk from radiation". In: Norwegian Radiation Protection Authority. Radiation risk, risk perception and social constructions: proceedings of workshop on… Oslo, Norway, 19-20 out, 1995. Brussels, pp.165-180 (1996).
10. INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA). *Radiation and society: comprehending radiation risk: proceedings of an International Conference*, Paris, v.l, pp. 24-28 Viena. (1994).
11. Drottz-Sjöberg, B. and Sjöberg, L. "Risk perception and worries after the Chernobyl accident", *Journal of Environmental Psychology* **10**, pp. 135-149 (1990).
12. NATIONAL SAFETY COUNCIL (NSC), *Regulating risk: the science and politics of risk*, Washington,D.C., International Life Science Institute (1993).
13. Garrick, B. J. *The analysis, communication and perception of risk*, New York (1991).
14. Covello, V.T. (ed). *Environmental impact assessment, technology assessment and risk analysis: contributions from the psychological and decision sciences,* New York (1985).
15. Bezdek, R.H and Wendling, R. M., "The impacts of nuclear facilities on property values and other factors in the surrounding communities", *Int. J. Nuclear Governance, Economy and Ecology*, **1** (1), pp. 122-144 (2006).
16. Kolluru, R.; Bartell, S.; Pitblado, R.; Stricoff, S. *Risk assessment and management handbook*. New York, McGraw-Hill (1996).
17. Nyland, L. G. "Risk perception in Brazil and Sweden." *Risk Research Reports*, Report 15. Center for Risk Research, Stockholm. Nov (1993).
18. Petterson, J. "Perception vs. reality of radiological impact: the Goiania model." *Nuclear News*, nov 1988.
19. "Managing Radioactive Waste Safely/ Participatory Methods" - Workshop Report, Vol.1: Final Report, London, jul. 2003

20. Pidgeon, N. F, Lorenzoni, I, Poortinga, W. "Climate change or nuclear power—No thanks! A quantitative study of public perceptions and risk framing in Britain", *Global Environmental Change*, **18**, pp. 69–85, UK (2008).
21. Slovic, P. "Facts and fears: understanding perceived risk" In: *The perception of risk*, pp 137-153. Earthscan, London (2000).
22. Sjöberg, L., "The perceived risk of terrorism," *Risk Management: An International Journal*, pp.43-61, (2005).