

Assessing the perception of nuclear risk

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I. Introduction[1]

In an effort to reduce carbon dioxide emissions, many countries throughout the world are initiating plans to transition to more sustainable forms of energy. Nuclear energy would appear to be a powerful contender to replace fossil fuels, or at least an unavoidable option, from an energy-mix perspective. However, nuclear energy suffers often from a poor image among certain populations, who may prefer to favor the development of renewable energies. Today in France, 56 reactors are in operation, 1 under construction (EPR Flamanville), 1 to be decomissioned (Fessenheim) and the proportion of nuclear-derived electricity was 70.6% in 2019. [2] Worldwide, at the end of 2018, 450 reactors were in operation, and nuclear power accounted for about 10% of global electricity generation, while total electricity generation increased by 2.8% in 2018 from nuclear power. [3]

At the same time, the significant development of the civil nuclear industry in the Northern Hemisphere has raised new questions in terms of environmental impact, long-term management, defence and non-proliferation. Moreover, whether it is being used as a source of energy or for other applications, it is subject to controversy: Nuclear energy tends to feed phantasmagories, fears and the most diverse and varied conspiracy theories. [4] However, among the various sources of electricity production, coal remains dominant despite significant growth in natural gas production.

The Chernobyl accident in April 1986, and more recently that of Fukushima Dai-ichi in March 2011, has had a major impact in terms of energy policy in various countries, mainly Western, because of the decline of the social acceptance of civilian nuclear energy. These social concerns, the perception of the public, and industrial development thus raise fundamental scientific, technical and sociological questions.

II. Public risk perception

Perception studies have sought to «determine how the public assesses the risks in order to understand, for example, the differences observed in the positioning of the various social groups», and link «perceptions to attitudes and behaviours", and to move from «perceived reality» to an «objective reality.4 In France, the Institute for Nuclear Radioprotection and Safety (IRSN) has, since 1977, studied the perception of risks with the assistance of the Commission of the European Union. Since then, IRSN has conducted a study based on a questionnaire entitled «Barometer on the perception of risks and security» (Baromètre IRSN, 2018). [5] It is not possible to entirely recapitulate the questions asked in this barometer, since it has been published annually in this form since 1990 and it «traces the evolutions of the opinion of the French people on the social, environmental and technological risks».5

At Université Côte d'Azur (UCA) we have setup a survey, composed of multiple choice questions, supported by the Limesurvey Internet platform. This survey had the three following characteristics: it was «instantaneous», in the sense that it provided a snapshot, at a precise moment, of the perception and knowledge of nuclear energy in France; it was «atomic»,[6] because it aimed for each individual surveyed to understand how he or she received information on nuclear energy (e.g. very trustful, trustful, not very trustful, not at all trustful, etc.); it was also «contextual», since this questionnaire made it possible to observe the perception and the knowledge of the individuals according to whether they were socially and individually identified as an expert or non-expert.

Two homogeneous groups of individuals formed the population subgroups to respond to the evaluation criteria on information about nuclear energy according to their level of expertise. The first group was that of firefighters, who constituted the expert group. The second group was that of students of UCA, who constituted the non-expert group. These two groups were of relatively uniform size, with 1240 and 1075 surveyed individuals, respectively. [7] These two populations are not the most extreme in terms of profiles, indeed we could have interviewed nuclear actors and compared their opinion with those of the students, or general public. Instead, we preferred to consider the firefighters, who have some knowledge by their training but who do not depend on the nuclear industry, with those of the students. In view of the different analyses, we can say that the two populations (students, firefighters) have a rather different perception of nuclear risk, which is largely explained by the knowledge acquired by firefighters in this area through their training, and by the fact that they are mostly older than the students, they grew up with nuclear energy. In the same way, differences exist according to the field of study for the students (literary/scientific).

Perception surveys by population category shed additional light on studies conducted in the general population. They can lead to new information or even prevention messages that are targeted depending on the group. It would be particularly interesting to conduct a simultaneous comparison between different countries and populations. Of further interest is «understanding why some within the public support nuclear energy, and why others do not, [because it] is an important step toward navigating the divide between the experts and public».[8] [9] Indeed, the landscape of beliefs about local nuclear power should not be viewed in simplistic bipolar terms).

According to Stoutenborough «Risk perceptions differ from general attitudes like support or non endorsement because they require a better understanding of the issue than general attitudes». In fact, «the complexities of nuclear power suggest that attitudes cannot be easily summarised in terms of partisanship and/or political ideology». The lack of information and more accurate knowledge on nuclear energy for the population in general, and nuclear risk in particular, has an influence on individual's perceptions, while we know that improved knowledge leads overall to a better acceptance of this form of energy.
The main objective was to understand the differences of perception between the expert and non-expert population on the controversial nuclear issue, and on which aspects these differences could be the most important. But we cannot deny that the act of questioning people on the subject of nuclear power may be inherently biased due to the very nature of the subject and that fears surround it are often stigmatised.

III. The management of risks

Public risk perception about nuclear energy also depends on the capacity of operating companies to be safe and reliable. Despite considerable efforts to increase organisational reliability, the nuclear energy sector has experienced major disasters in recent years. Following the analysis of these tragic accidents, safety management increasingly integrates the notion of uncertainty and focuses on the roles played by human and organisational factors. Safety is therefore considered an emergent property of a complex system. [10] A growing number of studies at the intersection of safety and organisational fields highlights the need for dealing with both foreseen and unforeseen events. [11] Organisations perceive and respond to uncertainty by trying to diminish it (reducing freedom and standardising) or by attempting to deal with it (maximising freedom and enhancing competencies to deal with complex tasks). [12] The tension among approaches for dealing with foreseen and unforeseen events crystallises in two forms of organisational safety: regulated and managed safety. While regulated safety relies on technical and procedural barriers to cope with predictable or foreseeable events and is aimed at reducing uncertainty, managed safety aims to develop organisational capabilities to proactively deal with unpredictable events, and thus deal with uncertainty. Research on high reliability organisations and resilience shows that only a mutual reinforcement of these two forms of safety can ensure reliability and resilience. However, research also shows that the intensive development of one of these forms of safety can jeopardise the development of the other form. [13] Thus, a joint development of regulated and managed safety remains a major challenge, which has not yet been fully studied.
At Université Côte d'Azur (UCA), we have developed research to explore the process of the joint development of regulated and managed safety and its mechanisms. [14] It identifies the safety management mechanisms on which this joint development relies, that is, managerial control and coordination, mindfulness, and deliberate learning. Specifically, this research reveals possible negative effects of managerial control, suggest the presence of organisational limits and the dangers of exceeding them. This research also explores the role of leadership for safety for a joint development of regulated and managed safety. This focus on leadership for safety is in line with the preoccupations of the nuclear industry actors. Therefore, Université Côte d'Azur leads a European Leadership for Safety (ELSE) project, funded by the European Union through its Instrument for Nuclear Safety Cooperation (INSC) in cooperation with International Atomic Energy Agency (IAEA). The ELSE project's aim is to develop an innovative research-based approach

to advanced education in the domain of leadership for safety, bringing together the most up-to-date academic knowledge and professional expertise. [15]

References

1. *This paper is largely inspired from reference by Perez et al. Energy Reports 2020, 6, 2288–2298*

2. *www.edf.fr, Sept. 2022*

3. *IAEA Reference data series n°1, 2019, Vienna*
4.
5. *Brenot, J., Bonnefous, S., Hubert, Ph.,Radioprotection 1996, 31, 515–528.*
6.
7. *Baromètre IRSN, 2018. La perception des risques et de la sécurité par les Français. Les essentiels, 29p.*

8. *Boudon, R., Fillieule, R., 2018. Les méthodes en sociologie. PUF.*

9. *S. Perez, C. Den Auwer, T. Pourcher, S. Russo, C. Drouot, M. R. Beccia, G. Creff, F. Fiorelli, A. Leriche, F. Castagnola, P. Steichen, G. Carle, H. Michel, Ni. Glaichenhaus, D. Josse, N. Pottier, D. Provitolo, Energy Reports 2020, 6, 2288–2298*

10. *J. Van der Pligt, 1992. Nuclear Energy and the Public. Blackwell Publishing.*

11. *J. W. Stoutenborough, S. G. Sturgess, A. Vedlitz, 2013, Energy Policy 62, 176–184.*

12. *R. Hamer, P. Waterson, G. T. Jun, 2021, 133, 105021.*
13.
14. *G. Morel, R. Amalberti, C. Chauvin, 2008, The Journal of the Human Factors and Ergonomics Society, 50, 1–16.*
15.
16. *G. Grote, J. C. Weichbrodt, H. Günter, E. Zala-Mezö, B. Künzle, 2009, Cognition, Technology & Work, 11, 17–27.*

17. *N. Oliver, T. Calvard, K. Potocnik, 2017, Organization Science, June, orsc.2017.1138.*
18.
19. *N. Jubault Krasnopevtseva, PhD Supervisors: C. Thomas, R. Kaminska, 2022. Challenges of Developing Leadership for Safety in High-Risk Industries: An Organizational Approach. The case of the nuclear sector, Université Côte d'Azur*

20. *ELSE Project. (2021). ELSE Project presentation. https://univ-cotedazur.eu/european-leadership-for-safety-education/else-project-presentation*