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Long-term Institutional stability for radioactive waste governance

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1. Introduction

The isolation of radioactive waste requires long-term storage before disposal and depends on the institutions in charge of maintaining security and safety, which must endure for the required time to perform their duties. However, past experiences indicate that are multiple causes of loss of long term institutional control. It is arduous for institutions to remain stable for several centuries, possibly affecting the correct radioactive waste management.

In Brazil, this is the case in the storage of spent fuel from research reactors and disused sealed radioactive sources, for which the disposal facilities are expected to be operational some decades in the future. Past examples of accidents caused by the loss of institutional control may raise the question that the loss of institutional stability should be incorporated in the scenarios on safety analysis of waste management projects.

The most significant example is the radiological accident in Goiânia, Brazil, in 1987. Even with some divergence regarding the responsibility for the accident, institutional fragility led to a failure in the oversight and management of the radioactive source that caused the accident. In the worst non-nuclear accident in history, at least 249 people were contaminated, and 4 died within 15 days [1].

There are also examples of loss institutional control in radiological safety. The three examples below are the cases of the former republics of the Union of Soviet Socialist Republics (USSR), where sources of category one or two of the D system established by the International Atomic Energy Agency (IAEA), were left unattended and caused accidents with fatal or seriously injured victims as a result of exposure to the radiation.

In 1994, a serious radiological accident in Estonia caused the death of one person and injury to many others. The origin of the accident happened when three brothers entered the radioactive waste storage facility at Tammiku, without any authorization, and stole a 137Cs radioactive source, a shiny metal cylinder without any warning sign of danger, to sell as metal scrap.

In 1997, radioactive cesium sources that are believed belonged to a specialized army troop of the former USSR were found in a training camp in the Republic of Georgia, after having caused severe burns in eleven Georgian soldiers who were unaware of their existence. It seems reasonable to presume that the demise of the former government staff and of the chain of command left the sources orphaned.

In 2001, two 90Sr sources with an activity of 1295 TBq were found in a forest by three individuals who were collecting firewood. These unknown objects were used by the three men as heaters in the cold night they spent in the woods. Those radioactive sources were former heat sources of radioisotope thermoelectric generators in a radio relay system of hydroelectric power projects that was discontinued because of the collapse of the USSR. Because of the high activity, the sources caused serious skin injuries in two of them. The Georgian authorities could not determine the circumstances under which the sources became orphaned.

It is fair to assume that all these three accidents have the same main reason: loss of institutional stability. Because of the dissolution of the USSR, their regulatory system for radiation protection and waste management needed to be adapted to the new States and as long as this process was not completed, many accidents have occurred since then.

The main purpose of this paper is to present the status of the research that aims to understand the relationship between institutional stability and radiological safety of radioactive waste in the long term. The motivation for this paper is to better understand the behavior of institutions in the long term and what can be done today so that the safety of radioactive waste is reasonably assured in the future. For these reasons, the present research is in development and does not present preliminary results.

2. Methodology

The proposed research methodology will primarily consist of literature analysis and the implementation of strategic planning concepts and tools in proposing strategies for the entities involved in radioactive waste management and regulatory oversight of corresponding processes [2].

The literature on the subject is scarce, specifically for radioactive waste management. In addition, documents outlining the creation, responsibilities, and mission of European, North American, and other regional organizations will be examined, along with any publications from these organizations referencing long-term waste control. These documents will be analyzed to identify recommendations for constructing a long-term strategy to ensure radioactive waste management when it relies on active safety. Passive safety, based on natural and artificial barriers installed now to operate in the remote future, theoretically do not require institutional stability to function. For active safety, the organization needs to be fully operational [3].

Extensive literature exists on models for the strategic management process of private and public organizations, as well as long-term strategies [4]. This literature have been critically analyzed to select, among the dozens of models available, the one or ones that best apply to the issue analyzed in this work.

It is noted that the term “long-term” in that literature refers to a much shorter period than the one being dealt with in radioactive waste management. Two decades, under typical circumstances, represent a significant period of time. However, in the context of radioactive waste, this same period of two decades may not be meaningful. When addressing the long term in the field of radioactive waste, it refers to centuries, and even decades of centuries. Whether it will be possible to adapt this is still an open question, and perhaps it will be necessary to create a new model, considering the factor of long-term institutional stability in the analysis method.

This multifaceted approach aims to enrich the understanding of institutional dynamics, particularly within the context of human behavior. Due to the above reasons, the present research will adopt a dual

methodological approach, combining the hypothetical-deductive method with elements of exploratory-descriptive methodology [5].

3. Results and Discussion

Institutions, just like other living organisms, are born, develop, age, and can die [6]. The duration of institutions, however, is an interesting question. Considering the natural temporality of institutions, it is important to emphasize the significance of the following matter: there is currently no assurance of public safety from accidental exposure to radioactivity from sources stored in sites reliant on long-term institutional stability, because there is no guarantee regarding the stability of these institutions.

At IPEN, disused sealed radioactive sources (DSRS) have been kept safely in interim storage, many of them for more than forty years, with no indication of how much longer they will remain in this situation, since there is no policy that defines their final destination. It is not because the sources have been safe for forty years that it can be assumed that they will remain that way for another forty years. Nonetheless, belief in the future should not be used as an argument for taking safety for granted.

Economic recessions or global pandemics are some examples of reasons for institutional failure, such as, other reasons can be evaluated to gather data on potential institutional failure or, at least, the loss of some of its functions. It is also important to note that institutional stability is directly associated with political stability of the state. For political scientists, the wave of consecutive presidential impeachments in Latin America since its democratic transition brings a sense of uncertainty and political and institutional fragility [7]. Since institutional instability is associated with political instability due to its institutional actors and the role played by these organizations within society, it is possible to affirm that institutional instability is also associated with uncertainty regarding the institutions' management capacity.

Considering the above points, the present study will employ the hypothetical-deductive methodology to analyze the current long-term radioactive waste security policies of Europe and the United States, and, based on these data, to conduct a prospective analysis of potential shortcomings of these policies, in accordance with current literature, pinpointing potential causes of institutional stability loss.

After this analysis, the paper will also analyze alternatives that can be used in case the institution responsible for the security of the radioactive waste loses its management capacity. It is important to have, in addition to an alternative plan, the effective creation of a method capable of signalizing the prediction of an unusual event that could destabilize or cause irreversible damage to the responsible institution.

4. Conclusions

Analyzing the institutional behavior, it is reasonable to assume that the human management of sites where radioactive waste will be stored for hundreds of years in the future is an insurmountable challenge. According to these observations about the temporality of institutions, the following question arises: It is also necessary to get to the cause of what can lead to institutional failure? Is it possible for this to occur in the future? Finally, the present paper intends to analyze the institutions and the difficulties in maintaining them stable for several centuries that radioactive waste requires. Furthermore, it is necessary to strategize what can be done to prevent it from occur, or at least mitigate the worst scenarios.

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