

Nuclear site selection using fuzzy logic: a risk assessment contribution

V. A., Rodrigues¹, C. F., Barros², L. C., Nacif Junior¹, C. H. S., Grecco³, C.A. N., Cosenza¹

E-mail: grecco@ien.gov.br

¹ COPPE/UFRJ

² ICT/UFF

³ Division of Nuclear Engineering – IEN

Keywords: nuclear site, location process, fuzzy logic, risk assessment.

This report presents a fuzzy logic application on the nuclear site selection process supporting established by Electric Power Research Institute - EPRI Siting Guide, concepts, and criteria. The guide model advocates a decision tree use on four major phases. A process involving the sequential application of exclusion, avoidance, and adequacy criteria, including weight factors development on adequacy criteria application. Phases 1 and 2 generate candidate areas and potential sites from a region of interest and phases 3 and 4 determines the excellent site for a nuclear power plant venture on suitability, weighting, and utilitarian functions criteria. The Fuzzy Logic provides a powerful tool to work on complex issues, wide application variety in this type of decision [1]. The materials and methods provide a systemic approach, using fuzzy logic to integrate the various dimensions of intervention, describing the concepts of an integrated assessment system, represented by fuzzy maps, seeking to maximize the results to stakeholders and minimize adverse impacts to the host community and the society. The nuclear site location procedure foremost must determine a philosophical direction and provide reasonable impartial results for a neutral observer as stated by the concepts [2].

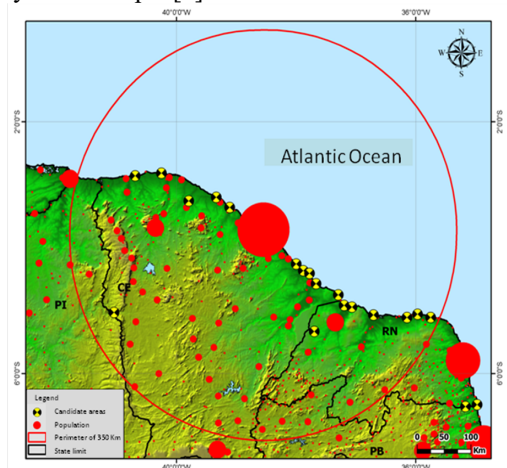


Figure 1. Nuclear site selection process.

In the Figure 1 is showed the fuzzy results of the selection process.

The integrated assessment system challenge for nuclear sites location according to the result analysis must achieve [2]:

- simple concepts;
- transparent relational inferences, understandable to all involved;
- inclusion capacity, absorption on various political, social, environmental, economic, technological and cultural aspects;
- systemic correlation on all significant entities of the reality to be represented in the model and their mutual interference levels;
- progressive absorption of new information over time in a continuous incremental mode as the accumulated experience provides; and
- consistency, all involved must not seek external decision orientation to the evaluation system.

The fuzzy logic application facilitates a systemic context approach, dynamic and flexible requirements demand, and a support tool confirmation to uncertainty and mutability conditions, on a high reciprocal interference ambient.

The nuclear power decision process development includes site and technology selection, economic structure, project finance, construction, and operation. Therefore, an accurate and appropriate technology selection process using fuzzy logic equally presents as a risk mitigation contribution opportunity.

The proposal in its entirety demonstrates the importance of risk analysis as an integral part of the project, from the initial design and not isolated in the operational phase.

Concepts based on the 40 Brazilian nuclear power plants potential sites project developed by COPPE-UFRJ Federal University of Rio de Janeiro for a national nuclear power company.

References

- [1] BARROS, C. F. O.; COSENZA, C. A. N.; RODRIGUES, V. A.; PEREIRA, R. Um Sistema de Seleção de Sítios Nucleares baseado no Modelo EPRI Siting Guide usando Lógica Fuzzy: Um Exercício Exploratório. In: 1º EINEPRO 2015, RJ.
- [2] BARROS, C. F. O.; COSENZA, C. A. N.; RODRIGUES, V. A.; ATALA, D. L. A Selection System of Brazilian Nuclear Sites based on EPRI Siting Guide Model using Fuzzy Logic: An Exploratory Exercise in Reliability Engineering. In: 38º ENEGEP, 2018, AL.