Proceedings of the 33rd European Safety and Reliability Conference (ESREL 2023)
Edited by Mário P. Brito, Terje Aven, Piero Baraldi, Marko Čepin and Enrico Zio
 Published by Research Publishing, Singapore.

Enhanced Bayesian Network for Reliability Assessment: Application to Salt Domes as Disposal Sites for Radioactive Waste Problem

Andrea Perin[1], Jonas Suilmann[2], Thomas Graf[2], Matteo Broggi[1]

[1]Institute for Risk and Reliability, Leibniz University Hannover, Hannover, Germany. E-mail: {andrea.perin, broggi}@irz.uni-hannover.de
[2]Institute of Fluid Mechanics and Environmental Physics in Civil Engineering, Leibniz University Hannover, Hannover, Germany.
E-mail: {suilmann, graf}@hydromech.uni-hannover.de

Risk assessment of radioactive waste disposal requires a comprehensive evaluation of the potential hazards and uncertainties associated with the disposal, e.g. hydro-geological conditions, over a time span of thousands of years. Among the tools available to assess risk in engineering application, Enhanced Bayesian Networks (EBNs) [1] are capable to provide a deep understanding of multidisciplinary models affected by uncertainties. Contrary to traditional BN, EBNs can be exploited for addressing the long-term safety analysis of radioactive waste disposal [2], allowing the additional incorporation of information with a non-discrete nature. The usage of EBNs can improve the accuracy of the risk measurements, maintaining the traditional BNs advantages such as compact-representation, human-readability, scalability and multidisciplinary-usability, in various applications

In this work, the safety of salt domes [3] as deep geological radioactive waste disposal over long terms is analyzed. The main idea is to use EBN as a probabilistic framework for evaluating the possible contamination of the biosphere in different scenarios.
Literature, reports and expert knowledge will be used to determine the EBN's nodes [4].
Nodes combinations produce the set of inputs and uncertainties for a finite element (FE) model able to deal with density-driven (thermohaline) flow, heat transport, transport of dissolved salt and a radionuclide in discretely-fractured porous media.

Keywords: Enhanced bayesian network, Scenario, Risk analysis, Radioactive waste disposal, Density-driven flow.

References

1. D. Straub and A. Der Kiureghian, "Bayesian Network Enhanced with Structural Reliability Methods: Application," *Journal of Engineering Mechanics*, vol. 136, pp. 1259–1270, Oct. 2010.
2. S. Tolo, E. Patelli, and M. Beer, "Risk Assessment of Spent Nuclear Fuel Facilities Considering Climate Change," *ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems, Part A: Civil Engineering*, vol. 3, p. G4016003, June 2017.
3. M. B. Refifa, L. Guellouz, E. Canot, E. Laabidi, and R. Bouhlila, "Revisiting the salt dome problem: New insights with the salt dissolution and pollutant release–induced processes," *Arabian Journal of Geosciences*, vol. 12, p. 294, May 2019.
4. J. T. Birkholzer, C.-F. Tsang, A. E. Bond, J. A. Hudson, L. Jing, and O. Stephansson, "25 years of DECOVALEX - Scientific advances and lessons learned from an international research collaboration in coupled subsurface processes," *International Journal of Rock Mechanics and Mining Sciences*, vol. 122, p. 103995, Oct. 2019.