2026 International Nuclear Atlantic Conference - INAC 2026

Escola de Guerra Naval, Rio de Janeiro, RJ, August 24 - 28, 2026

ISBN: 978-65-272-2398-6

Workforce Expertise in a Program for Disposal of Disused Sealed Radioactive Sources

B. Roque[1], R. Vicente[2] , and D. A. Andrade[3],

Instituto de Pesquisas Energéticas e Nucleares, Av. Professor Lineu Prestes, 2242, São Paulo, Brazil
[1] bruna.roque@usp.br
[2] robertovicen@gmail.com
[3] delvonei@usp.br

1. Introduction

Sealed radioactive sources are used in a variety of fields due to their efficiency, but at the end of their useful life, these sources become radioactive waste called Disused Sealed Radioactive Source (DSRS), which requires rigorous management to prevent risks to human health and the environment because most of them still present a dangerous level of radioactivity. Among the proposed solutions, deep borehole disposal facilities (BDF) stand out, as they use multiple barriers to safely and permanently isolate the sources [1]. Despite some authors point out disadvantages of the concept [2], the IAEA is promoting the BDF concept for disposal of DSRS [3, 4], However, implementing this type of project is a complex undertaking, requiring highly qualified multidisciplinary teams and detailed planning to ensure safety and efficiency at every stage, from planning through to closure [5, 6].

Despite the importance of workforce management in DSRS disposal projects, there are gaps in the literature regarding the systematization of positions, competencies, and the temporal distribution of professionals' dedication to the project. This study proposes to structure the necessary workforce by identifying expertise, responsibilities, and technical and behavioral competencies, using qualitative methods, document analysis, and planning tools such as the Gantt chart. The research contributes to strategic human resources planning in nuclear projects, strengthening the safety culture and supporting processes for the recruitment, selection, and training of qualified professionals [7, 8].

2. Methodology

This study adopts a qualitative, descriptive approach based on the document analysis of 15 technical reports and publications from the International Atomic Energy Agency (IAEA). The objective is to identify the lifecycle steps and the workforce required for the planning, construction, and commissioning of deep boreholes for the disposal of disused sealed radioactive sources (DSRS). The methodology involved a systematic document review to map the phases—from site selection to decommissioning—and to detail professional responsibilities. Drawing on competency dictionaries and job description models, areas of expertise were cataloged and structured into a functional organizational chart and a Gantt chart, enabling a temporal and organizational representation of the multidisciplinary team essential for project safety and execution.

To structure the criteria for identifying and classifying these specializations and competencies, a competency-based job description and analysis methodology was employed. This approach allowed for the detailing of key activities for each professional, defining what the employee does, as well as how, where, and why

the work is performed. Subsequently, the job analysis defined assigned responsibilities and the conditions under which the work must be carried out. This process assists managers in making effective hiring decisions during recruitment and selection, as it enables the precise assessment of both the technical competencies (hard skills) and behavioral competencies (soft skills) required for each role. The distribution of professionals throughout the project highlights three aspects: multidisciplinary approach (integration of fields such as engineering and radiation protection), phase-specific specialization (managerial profiles at the start, technical staff in the middle, and specialists at the end), and technical continuity (critical cross-cutting roles to ensure safety). [8].

3. Results and Discussion

The workforce analysis for the project to dispose of DSRS, under the disposal Concept, identified 21 essential expertises, organized into three hierarchical levels: Management, Regulatory, and Technical. This structure ensures compliance with licensing and nuclear safety requirements throughout the borehole's life cycle (Figure 1). The mobilization of these professionals is presented in the Gantt chart, which follows the project schedule—from pre-mission to monitoring and control (Figure 2) [6]:

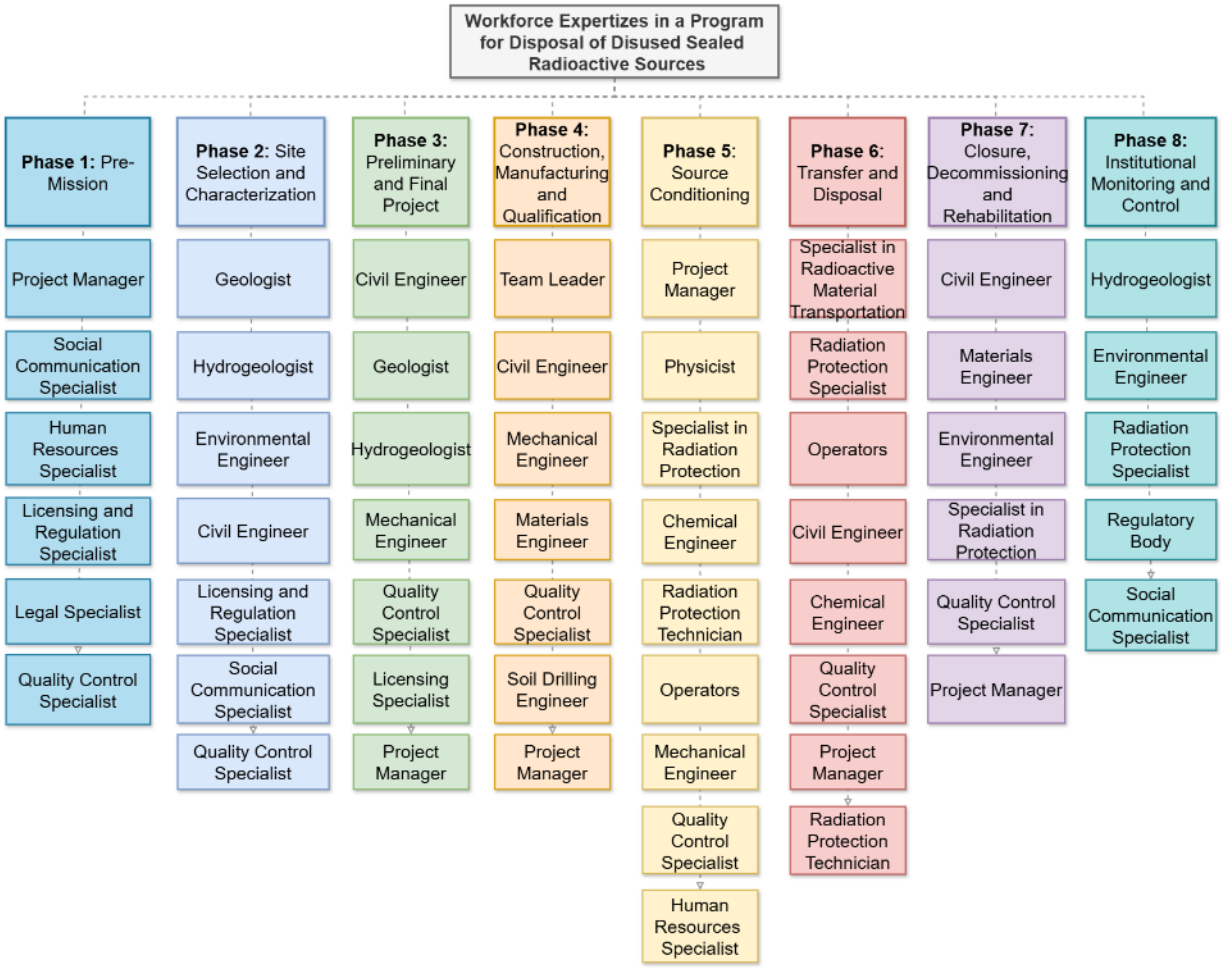


Figure 1: Organizational chart of personnel involved in the project for the disposal of DSRS.

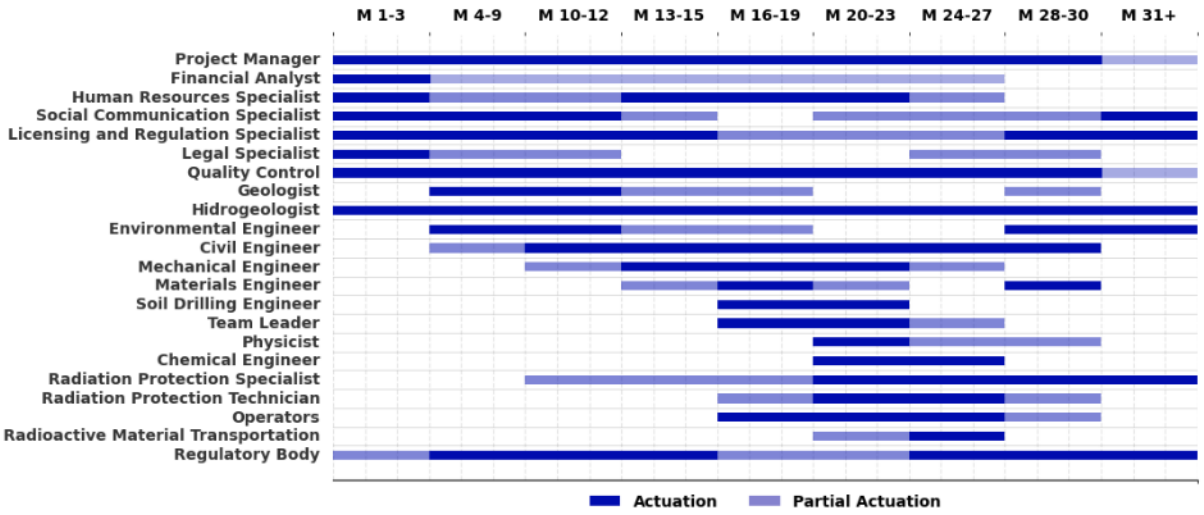


Figure 2: Distribution of Expertises Throughout the Project – Gantt Chart.

4. Conclusions

The complexity of a project to dispose of DSRS requires strategic human resources planning. Furthermore, the integration of job analysis with the identification of necessary competencies highlighted the importance of competency-based management as a strategic tool for nuclear projects. It was found that different phases of the project require specific sets of knowledge, skills, and attitudes, reinforcing the need for structured recruitment, selection, and training processes. As a contribution, this study provided a structured framework for defining the workforce in projects for the disposal of FRSD, which can be used as a basis for organizational planning, the development of human resources policies, and to support decision-making in similar contexts.

Acknowledgments

The authors acknowledge the support of Fundação para o Desenvolvimento Tecnológico da Engenharia (FDTE) and Instituto de Pesquisas Energéticas e Nucleares (IPEN).

References

[1] VAN BLERK, J. J. et al. The borehole disposal concept for spent sources: volume I: development and evaluation of the concept GEA-1353 (NWS-RPT-0013). Pretoria: South African Nuclear Energy Corporation (NECSA), 2000.

[2] B. KOCHKIN, V. MALKOVSKY, S. YUDINTSEV, V. PETROV, M. OJOVAN. Problems and perspectives of borehole disposal of radioactive waste. Progress in Nuclear Energy. Vol. 139, Sept. 2021, https://doi.org/10.1016/j.pnucene.2021.103867.

[3] MATA, Elissandra da. GPC Course: Learn How to Implement All HR Subsystems Based on the Competency-Based People Management Model. Goiânia: Instituto RH na Prática, 2023. Available at: https://institutorhnapratica.com.br/curso-gpc/. Accessed on: Apr. 29, 2026.

[4] INTERNATIONAL ATOMIC ENERGY AGENCY. Borehole Disposal Facilities for Disused Sealed Radioactive Sources. IAEA, Vienna, 2024. (Safety Standards Series No. SSG-1 Rev. 1). DOI10.61092/iaea.hhr9-xnr3

[5] CHIAVENATO, Idalberto. People Management: The New Role of Human Resources in Organizations. 5th ed. Rio de Janeiro: Atlas, 2020

[6] MATA, Elissandra da. GPC Course: Learn How to Implement All HR Subsystems Based on the Competency-Based People Management Model. Goiânia: Instituto RH na Prática, 2023. Available at: https://institutorhnapratica.com.br/curso-gpc/. Accessed on: Apr. 29, 2026.

[7] NEL, B. vd L. (comp.). Road map and Procedures to Implement the Borehole Disposal Concept: GEA- 1626. Pretoria: Nuclear Energy Corporation of South Africa (NECSA), 2004.

[8] REIS, A. et al. A mixed-methods study on soft and hard skills: the perspectives of students and hiring companies. Portugal: University of Aveiro, 2022. Available at: https://proa.ua.pt/index.php/iciemc/article/view/29770/20740. Accessed: Apr. 20, 2026.