2021 International Nuclear Atlantic Conference – INAC 2021
Virtual meeting, Brazil, November 29 – December 2, 2021

ISBN: 978-65-594-1256-3

Decommissioning estimation considering the facilitation by the use of remote-controlled equipment

Deiglys B. Monteiro[1], João M. L. Moreira[2], José R. Maiorino[2]

[1] *deiglysbmonteiro@gmail.com, Departamento de Exatas, Universidade Nove de Julho-UNINOVE, Av. Professor Luiz Ignácio Anhaia Mello, 1363 - Vila Prudente, São Paulo - SP, 03155-000,*
[2] *joao.moreira@ufabc.edu.br,* [2] *joserubens.maiorino@ufabc.edu.br, Programa de pós-graduação em Energia (PPGENE), Centro de Engenharia e Ciências Sociais Aplicadas (CECS), Pró-reitoria de Pesquisa (PROPES), Universidade Federal do ABC, Av. dos Estados, 5001 – Bangú – Santo André, SP, Brazil*

1. Introduction

The Nuclear Power Plants (NPPs) had been seen as one of most important ways to produce energy to attend the increase demand without produce large amounts of energy without the Green House Gases (GHGs) emissions [1, 2]. Despite of the good perception of public regarding this energy source, there is still some problems and issues to be solved. One of them is related with the end of useful life of the NPPs, when they should be decommissioned to make possible to give another new use to its site by the society [3 -7].
The decommissioning of NPPs is a long-term and costly process, requiring a very stringent planning and execution chronogram, not only to reduce the duration of process and the costs involved but also the risks offered by the process [5 - 7]. To overcome these issues, the use of automatic/autonomous and remotely controlled equipment has been done, with robots and remotely controlled arms/vehicles being employed during maintenance, for survey, before the decommissioning starts and even after accidents. In this manner, not only the risks could be reduced but also the process duration and it costs could be reduced too [7].
In the present work some of main assumptions considered to calculate the decommissioning cost for a hypothetical NPP, used as case of study, when remotely controlled equipment is employed. These assumptions would be used in future works and are detailed in section 2.

2. Methodology

To calculate the decommissioning cost, it was used the Ger-Descom tool and Av-Descom model which were proposed by [5, 7]. Besides the data such as men-hour cost and duration of each task, the model also requires the quantity of labors that would be necessary to perform a task and the difficulty factors that represents the difficulties associated to the task execution [5, 7]. For the purpose to evaluate how, in a very optimistic scenario, the cost could be reduced, it was assumed:

- All the workers were substituted by remote-controlled equipment to perform decontamination and dismantling tasks. However, since these equipment should have a human controlling it, only half of the workers are required (considering the whole process). The NPP considered is powered by a Pressurized Water Reactor (PWR) [7]. In this manner, the risks offered could be reduced for the most dangerous tasks since the equipment could perform heavy tasks and works for an extended time in such locals (if properly shielded) where the radiation fields are high, while the workers not due to the issues related to radiation dose;

- For this first approach, it was not considered that the time required to perform the tasks is reduced, despite it could occur [7];
- Since the equipment are less affected by radiation fields, if they are properly shielded, the risks offered is also reduced, reducing the tasks costs [7];
- It was assumed that the men-hour costs does not change, since the equipment with this characteristics/technology are available to be rent or acquired as need and no new developments are required [7].

Based in these assumptions, and considering the values as proposed by [5, 6, 7], the decommissioning cost was estimated by using the Av-Descom model and considering that the decommissioning strategy is the immediately dismantling and the site would be released for unrestricted use [7].

3. Results and Discussion

Considering the Av-Descom model as proposed by [5, 7], the values and other assumptions presented by these authors and the assumptions detailed in section 2, it is expected that the decommissioning cost could be significantly reduced. However, how the reference cost could be reduced in fact is highly dependent of other factors such as the availability of the technology (assumed initially as existent), the costs associated, quantity of workers required to perform the tasks together with these equipments, etc. For reference, in Figure 1 it is presented graphically the dependence of decommissioning cost regarding the variation of men-hour required to perform a task [7]. In this graphic, the author simulated an increase in the men-hour required by changing the quantity of labors required to perform a task (increase in the quantity of labors) [7]. In this manner, according to the assumptions presented in section 2, it is expected that decommissioning cost could follow this trend, being reduced as consequence of the reduction in the men-hours required. The evaluation of the extension in which this cost is reduced is subject of a future work.

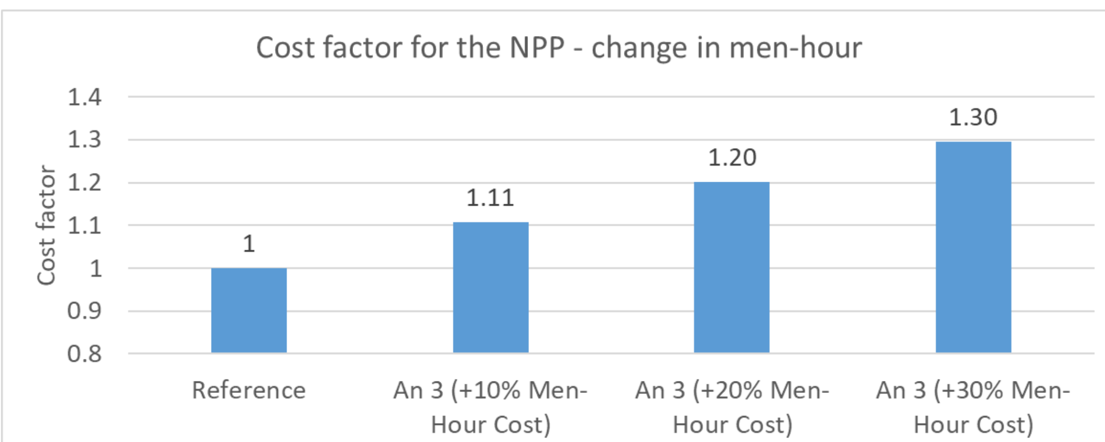

Figure 1: Decommissioning Cost trend after change the men-hour required to perform the decommissioning.

4. Conclusions

The use of new technologies to decommissioning a NPP is an important way in which the process could be realized in an optimized way and offering lower risks. Based on some assumptions, it is possible to conclude that, by reducing the men-hours required to perform some key tasks of decontamination and dismantling it is expected that the process cost could be reduced too in the same extent in which the rection in men-hours is considered. Despite of this simple relation, in future works it would be evaluated the real reduction in cost that could be obtained since the difficulty factors could affect this trend once at least one worker per equipment would be still required to operate it, even remotely.

Acknowledgements

The authors are thankful to UFABC for the opportunity to conduct this research.

References

[1] "Carbon Dioxide Emissions from Electricity". World Nuclear Association. https://www.world-nuclear.org/information-library/energy-and-the-environment/carbon-dioxide-emissions-from-electricity.aspx. (2021).

[2] OECD-NEA. "The Role of Nuclear Energy in a Low-Carbon Energy Future" (2012).

[3] "Decommissioning Nuclear Facilities". World Nuclear Association. https://world-nuclear.org/information-library/nuclear-fuel-cycle/nuclear-wastes/decommissioning-nuclear-facilities.aspx. (2021).

[4] "Decommissioning nuclear reactors is a long-term and costly process". EIA. https://www.eia.gov/todayinenergy/detail.php?id=33792. (2021)

[5] Monteiro, D.B.; Moreira, J.M.L.; Maiorino, J.R., "A new management tool and mathematical model for decommissioning cost estimation of multiple reactors site". *Progress in Nuclear Energy*, vol. 114, pp. 61-83 (2019).

[6] Monteiro, D.B.; Moreira, J.M.L.; Maiorino, J.R., "A method for decommissioning strategy proposal and a cost estimation considering a multiple reactor site with interdependent plants". *Progress in Nuclear Energy*, vol. 127, 103440 (2020).

[7] Monteiro, D.B., "Decommissioning of the Nuclear Power Plants in Brazil: Proposal of a management tool for the decommissioning cost estimation". PhD Thesis. UFABC (2017).