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Review Report on PhD Thesis

Title: **Application of the European Basic Safety Standards Directive in Underground Mines: A Comprehensive Radioecology Study in a Hungarian Manganese Mine**

Written by: **Amin Shahrokhi**

Supervisor: **Dr. Tibor Kovács, PhD**

Reviewer: **Dr. Begy Róbert Csaba, PhD**

This report presented here is in accordance with the invitation letter from the Doctoral School of University from Pannonia based on the PhD Thesis of Mr. Amin Shahrokhi.

The thesis consists of three main chapters (Introduction, Materials and Methods, and Results and Discussion), in addition to the other separate sections (Abstracts, Summary, Bibliography, Thesis). The thesis has 140 pages, all in English that is not the native language of the candidate.

The thesis discusses how to fulfil the recently established regulation's requirements (European Basic Safety Standard) in an underground mine (case study: Úrkút manganese mine) and finding the effects of the difference between the actual and recommended parameters (equilibrium factor and dose conversion factor) on dose estimation. Additionally an interesting experiment has been done on the reuse of manganese mining residue.

The scientific discussion begins with the abstracts (in English, Hungarian and Russian) and an introduction to the subject, which covers all the aspects of the thesis topic and directly leads to a list of several main goals of the thesis. In the Materials and Methods chapter, the candidate clearly described the applied experimental methods using very attractive illustrations. The results are presented and discussed in three ways: text, diagrams and tables in chapter 3, making it easy for the reader to understand. The summary section is particularly noteworthy in which the author was able to comprehensively express all the thesis, including the purpose of the thesis, methods and results, in just three pages. The literature of the thesis is carefully referenced (~115 references) and all references listed in the bibliography section are cited in the text; however the reviewer has criticisms in the citation style which is used in the bibliography section. The main finding of the study are listed at the end of the dissertation in English and Hungarian languages.

Overall the thesis is prepared in a good structure standard. The topic of thesis is current and relevant in the context of the up-to-date research. The results are new and supporting the topic of the thesis. All the figures are carefully prepared and clearly presented. The language is comprehensive and coherent while errors and inaccuracies are not numerous. There are some mistakes in the thesis, but they do not have any influence on the results and the quality of the thesis.

The thesis by the candidate Amin Shahrokhi is perfectly adequate for gaining the Ph.D. degree.

1. The thesis's actuality and suitability for scientific interest.

The risk of radon in the underground workplaces is well-known and poses an additional risk factor for the miners. The thesis deals with an important topic how to fulfil the recently established regulation's requirements (European Basic Safety Standard) in an underground workplace. The thesis describes a comprehensive radiological survey and characterization of the radiological parameters of the rock samples by different nuclear measurement techniques in the Úrkút underground manganese mine in Hungary. The candidate attempted to identify the radon potential sources in the mine and based on that developed a mitigation system to reduce the radon risk of the workers focusing on the new legislation. Long-term personal radon dosimetry measurements on the miners were carried out to determine the effective dose from the radon and its progeny to gain more precise information about the radiation risk of the workers by comparing the estimated dose based on the candidate measurement parameters and the recommended parameters given by ICRP and EPA , in addition to find out if the radon reduction could address the concerns from dosimetry point of view. Lastly an experiment relatively relevant to the topic of the thesis on the reuse of mining residue based on European Basic Safety Standard was carried out, however the results of this experiment can help to identify the possibility potential of another radon source in the mine.

2. Thesis work structure, ratio, construction, logical construction.

The structure of the dissertation conforms to the principles and requests to the structure of a scientific thesis. The literature outline reflects the applicant's professional and scientific preparedness. The construction of the whole work is logical and systematic, each practical part (measurements' results) is immediately followed by its assessment. The thesis well represents that the author has appropriately acquired the language of publishing in English. It seems that there is a balance between the cited references in terms of time, so that in addition to the use of new references, the old sources with high scientific value were used as well; about 56% of the all cited references belong to last decade, around 17% are published between 2000 and 2008, and the rest (27%) belongs to before 2000.

3. Standard, modernity of the examination methods.

The thesis is inspired from both of the theoretical and methodological point of view. Aims and methods are clearly described, author represents the ideas and knowledge with sufficient theoretical background. The aims were fulfilled, methods of research work are appropriate to the aims and the thesis points of the dissertation. The materials and methods section uses the currently accepted modern techniques and methods available for the PhD student.

4. The thesis work's scientific value, description of the scientific novelties.

The results and discussion part has the adequate number of results, and their evaluation seems to be done properly as well. Beside the radon measurements which seems to be similar to the previous findings, the author have found the potential source of radon in the mine which can be counted as the first thesis point. Following the first achievement, the application of the new developed mitigation and reporting of its success would be another novelty. The other very interesting finding of this study is the problem of using generalised parameters in dose assessment relies on the effect of the actual environmental conditions on the dose assessment and considering if exposure to radon concentration below the reference level can guarantee the dose being below the recommendation value. Finally, a novelty finding about the reuse of mangenues mining residue in the building industries.

5. Information available in the thesis work and on the separates

In general, the presented results are new and seem to be reliable. Data in the thesis work are given according to the publications. The list of the full publications of the candidate was not attached to the dissertation. But in connection with the thesis topic, I found (using websites which provide access to a database of scientific research and the candidate self-citation in the dissertation's text) two articles directly related to the dissertation's results and an article in support of one of the thesis method and measurement written by the author and published in the impact factor journals. I could see the candidate published several articles (not relative to this thesis, but in connection of his study) all in impact factor journals.

In my opinion and based on the findings of the thesis, another two additional articles can be extracted for publication and increase the total of extracted articles to 5 published paper which are more than enough to underline the thesis.

6. Notes, comments, questions on the thesis work

Overall, there are a little number of mistakes and errors in the dissertation, e.g. typographical errors, wrong initial in some cited references, etc., but these mistakes do not influence the results and findings of this work and not deteriorate the quality as well. Some of the remarks and the questions to the candidate are included at the end of this report.

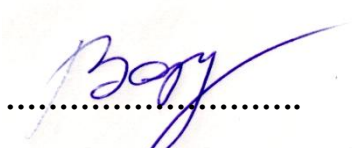
With this work the candidate provided evidence for her suitability for individual research work, and professional understanding. I support her doctoral degree, and congratulations for her valuable work.

7. Evaluation statement

From what was said above, it is clear that the candidate is able to organize and realize the significant research work and in my opinion, the reviewed thesis fulfils all requirements aimed for obtaining PhD degree. This thesis is ready to be defended orally, in front of respective committee.

I, the reviewer of the thesis entitled as “Application of the European Basic Safety Standards Directive in Underground Mines: A Comprehensive Radioecology Study in a Hungarian Manganese Mine” belongs to Mr. Amin Shahrokhi, am pleased to recommend the reviewed thesis for acceptance into the Doctoral public defending at the University of Pannonia.

Cluj-Napoca, 2018. November. 30



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List of notes and comments

1. Page 17, Line 1: "As it shows in Table 5. (EPA, 2016)…..", I cannot find the proper table associated with this resource; however, the cited reference some hoe could solve this problem.
2. There are some small grammatical errors, e.g. Page 17, Line 4: "Tables 3." it is just one table then "s" is unnecessary.
3. In the Table 8. the unite of the elements changed from the original reference to the SI units what was good idea, but I think in case of converting U unit from ppm, the unit was used in the reference, to the Bq/kg, the candidate had mistaken in conversion process. This results showing wrong values at Table 17. As well. (It is my opinion)
4. In Table 16. the font of head raw could reduce, then the abbreviation for elements would be displayed correctly.
5. The quality of the figures used in the Section 3.4. "Manganese Ore Mining Residue" is not is not appropriate when enlarged.
6. In the bibliography section, there are some cited references with wrong initial, i.e. in some places the First name written in full and family name initialled; these can reflected in the thesis text where citation used. However this error could not have any influence on finding the cited references on the internet and they can be easily found in the current state.
    - Mansy, A. is Mansy, M.A.
    - Masahiro, H. is Hosoda, M.
    - Nobuyuki , H. & Yuki, F. are Hamada, N. & Fujimichi, Y.
    - Yonggang, H., Peng, X., Chunlin, Z. & Feng, Y. are Huo, Y., Xu, P., Zhou, C. & Yang, F.
    - Lecomte, J.-F. is Lecomte, J-F.

Questions to the candidate

1. Why candidate didn't stablish a deep mathematical modelling simulation in case of contribution of the exhalated radon from water to the mine air?