Appendix 12d

REPORT

to occupy the academic position:

"Professor"	
"Associate Professor"	X
	one of the academic positions indicated shall be marked with the sign "X"

Candidates to occupy the position:

1	Senior Assistant Professor	Ph. D	Vasil	Ivanov	Karastoyanov	UCTM
№	academic position	scientific degree	name	middle name	last name	workplace

Scientific area:

4.	Natural sciences, mathematics and informatics
code	name

Professional area:

4.2	Chemical Sciences
code	name

Scientific specialty:

Physical Chemistry

The competition has been announced:

23	19.03.2023	Department of Physical Chemistry	Faculty of Chemical Technology
in SG issue	date	for the needs of the Department	Faculty

The report was written by:

Assoc. Professor	Ph. D	Greta	Veselinova	Radeva	UCTM
academic position	scientific degree	name	middle name	last name	workplace

1. Report for the candidate:

Senior Assist. Prof.	Ph. D.	Vasil	Ivanov	Karastoyanov
academic position	scientific degree	name	middle name	last name

1.1. Meeting the minimum requirements under the Regulations:

A) The candidate meets the minimum requirements	20 points	X
B) The candidate doesn’t meet the minimum requirements	0 points	
		one of the answers given is marked with the sign "X"

It must be filled in if answer B is marked. The publication activity of the candidate is analyzed. The response of the results achieved (quoted) is analyzed.
The candidate presents a scientific asset of 16 publications in international journals (Scopus, Web of Science). He is the author of a university textbook - "Workshop on fuel cell technology", Sofia, 2024, ISBN 978-954-465-166-4. 3 publications for the acquisition of the educational and scientific degree "doctor" are presented separately. 158 citations were noticed on the publications presented in the competition for "docent". According to the competition Senior Assistant Professor Ph. D. Engineer Vasil Karastoyanov presents participation in 5 scientific research contracts.

1.2. Relevance of scientific and / or applied research:

A) The research is relevant. Part of the research is pioneering (no results are known on the topic by other authors)	8 points	
B) Research is relevant. Results from other authors are known for each of the topics and / or applications studied.	6 points	X
C) Most of the research is relevant, but also some results are presented that have no scientific and / or applied value	4 points	
D) The smaller part of the research is relevant	2 points	
E) Research is not relevant	0 points	
		one of the answers given is marked with the sign "X"

The evaluation of the relevance of the research must be substantiated.

The relevance of scientific research is indisputable. The main object of research are objects interesting from a theoretical and applied point of view, such as: modelling the growth and restructuring of oxide films on structural materials, the influence of the water-chemical regime on the corrosion of fuel jackets in nuclear reactors, the mechanism of corrosion erosion and sludge formation in the second loop of nuclear reactors.

1.3. Objectives of the research:

A) Realistic and of scientific and / or applied interest	8 points	X
B) Realistic, but not of scientific and / or applied interest	4 points	
C) Unattainable (unrealistic)	0 points	
		one of the answers given is marked with the sign "X"

Objectives must be specified. The type of the set objectives must be justified
The goals set by Senior Assistant Professor V. Karastoyanov in developing the various studies are correctly and realistically placed and represent scientific and applied interest. In general, they can be systematized in three main directions. 1. Modelling the growth and restructuring of oxide films on structural materials of the first circuit of nuclear power plants. 2. Investigation of the influence of the water-chemical regime on the corrosion of the fuel claddings in nuclear reactors with pressurized water. 3. Determination of the mechanism of corrosion erosion and sludge formation in the second circuit of nuclear power plants. In addition to the main goals, tasks have also been set for: 4. Modelling of the formation processes of barrier oxide films on niobium and tungsten 5. Modelling of the formation processes of anodic oxide films on titanium and titanium alloys 6. Synthesis and modification of steel and titanium oxides as photocatalysts for water decomposition. 7. Online NobleChem simulation in nuclear fluidized bed reactors The goals are of a scientific-applied nature and this is confirmed by the results obtained.

1.4. Candidate research contributions:

A) With lasting scientific and / or applied response, they form the basis for new research and applications	20 points	
B) They are of significant scientific and / or applied interest, complete and / or summarize previous research	16 points	X
C) They are of scientific and / or applied interest	12 points	
D) Lack of significant contributions	8 points	
E) Lack of contributions	0 points	

		one of the answers given is marked with the sign "X"

Contributions must be specified. The type of results achieved must be justified.
The scientific contributions are significant and have a scientific-applied nature. They can be summarized as follows: 1. Modelling the growth and restructuring of oxide films on structural materials of the first circuit of nuclear power plants. Quantitatively described the corrosion processes occurring on the surfaces of the primary circuit of nuclear reactors. Through a combination of in-situ impedance spectroscopy and ex-situ, the thickness and chemical composition of the oxide layers were characterized by XPS. The dependences of the corresponding atomic fractions on the distance to the alloy/inner layer boundary are presented. The profiles of the metal component were calculated using a system of equations of non-stationary diffusion. The rate constants and diffusion coefficients of the individual oxide components obtained by this method are calibrated based on nonlinear regression of impedance spectra to the transfer function of the mixed conductivity model. Based on the proposed model, software was developed for predicting the accumulation of radioactivity in the primary loop of nuclear power plants, implemented in Kozloduy NPP in 2010. The kinetic model was extended to quantitatively evaluate the effect of the water chemistry regime under simulated hot-running conditions on the electrical and electrochemical properties of the passive film on alloy 690. Increasing the LiOH concentration in the simulated hot-running conditions was found to result in higher rates of dissolution, metal oxidation, and transport in the oxide. Additions of H3BO3 have a beneficial effect that counteracts the accelerating influence of Li. An optimal hot run-in water chemistry regime with low to medium Li content and B addition is proposed, which leads to the growth of layers with better electrochemical stability and corrosion resistance. 2. Investigation of the influence of the water-chemical regime on the corrosion of the fuel claddings in nuclear reactors with pressurized water. A quantitative model of the corrosion of zirconium alloys as nuclear fuel claddings has been developed, quantitatively describing both the processes during the stable growth of the protective oxide layer and the transitions between two periods. In-situ electrochemical measurements during the growth of oxide layers in simulated hydrochemical regimes of the first circuit of pressurized water plants were carried out and a database was created. A laboratory re-circulation loop was designed, built and put into operation for conducting electrochemical measurements at temperatures up to 350 °C and pressure 15 MPa. Based on a developed kinetic model, equations were derived for the growth of the oxide thickness and the amount of introduced hydrogen depending on time, temperature and the water chemical regime. The influence of irradiation on the alloy was simulated by preliminary in-situ and ex-situ electrochemical implantation of protons in it under cathodic polarization. The model has been validated and software has been developed for its implementation, which was implemented at the Kozloduy NPP in 2021.

3. Determination of the mechanism of corrosion erosion and sludge formation in the second loop of nuclear power plants The corrosion erosion of carbon steel in the heat carrier of the second circuit of nuclear power plants with pressurized water was investigated by impedance spectroscopy in the temperature range 100-240 °C at a pressure of 9 MPa and an inlet flow rate of the heat carrier 4-10 dm3 h-1. The influence of the flow rate on the corrosion potential, on the change of the corrosion product with increasing temperature and on the impedance, spectra was investigated. The results are interpreted with a quantitative kinetic model involving two parallel processes - growth and dissolution of oxide with the final product colloidal magnetite and dissolution of Fe through the protective film, with product soluble iron ions (probably FeOH+). The model is calibrated with the thickness of the oxide at the end of the oxidation and is parameterized by complex nonlinear regression of the experimental impedance spectra to the corresponding transmission function depending on the temperature (100-240 °C). Equations are derived for the rate of oxide growth and release of soluble corrosion products. The temperature dependence of the rate of corrosion erosion was determined. Based on a preliminary assessment of the electrical properties of the magnetite particles in the coolant, a quantitative model of sludge formation and consolidation was developed depending on the hydrochemical regime in a second circuit. Software was developed for the application of the model, which was implemented in Kozloduy NPP in 2021. Undoubtedly, the candidate has made a significant personal contribution to the scientific developments presented. The presented materials show systematic, precise and in-depth studies of problems that are important from a scientific point of view, but also have real practical significance.

1.5. Participation of the candidate in the achievement of the presented results:

A) The candidate has at least an equal participation in the submitted papers	8 points	
B) The candidate has at least an equal participation in most of the submitted papers	7 points	X
C) The candidate has a secondary participation in most of the submitted papers	4 points	
D) The candidate participation is unnoticeable	0 points	
		one of the answers given is marked with the sign "X"

Critical notes must be provided if one of the items C or D is marked.

1.6 Pedagogical activity:

A) The candidate has effective and sufficient pedagogical activity at the university. The textbooks issued are modern and useful (they meet the requirements of the Regulations). The work with undergraduate and doctoral students is at a high professional level.	8 points	X
B) The candidate has sufficient pedagogical activity at the university. The textbooks issued satisfy the requirements of the Regulations.	6 points	
C) The pedagogical activity and / or textbooks issued are insufficient (do not meet the requirements of the Regulations)	0 points	
		one of the answers given is marked with the sign "X"

Critical notes must be provided if one of the items B or C is marked.

1.7. Critical notes:

A) Lack of critical notes	8 points	X
B) Critical notes of a technical nature	7 points	
C) Critical notes that would partially improve the results achieved in a small part of the research	5 points	
D) Critical notes that would partially improve the results achieved in most of the research	3 points	
E) Significant critical notes	0 points	
		one of the answers given is marked with the sign "X"

Critical notes must be provided if one of the answers C, D or E is marked.

1.8. Conclusion

A) The evaluation of the candidate’s activity is **POSITIVE**	This evaluation is assigned to a total number of at least 50 points	X (73 p.)
B) The evaluation of the candidate’s activity is **NEGATIVE**	This evaluation is assigned to a total number below 50 points	
		one of the answers given is marked with the sign "X"

To be filled in if requested by the member of the scientific jury
The materials submitted in the competition allow me with conviction to give a positive evaluation of the research and pedagogical activities of the candidate because they correspond to and for some indicators exceed the minimum requirements determined in the Law for the Development of the Academic Staff in the Republic of Bulgaria (LDASRB) and the Regulations for the application of LDASRB at the UCTM. Based on the stated above and due to my positive personal impressions of the candidate, I would recommend Senior Assistant Professor Ph.D. Vasil Karastoyanov to be appointed at the academic position “Associate Professor” in the professional area 4. Natural sciences, mathematics and informatics; 4.2. Chemical Sciences (Physical Chemistry).

24.06.2024	The report was written by:	
date		signature