

**Ministry of Education and Science of Ukraine**  
**Dnipro University of Technology**

The Department of Electric Power Engineering



**«APPROVED»**

Head of Department

Papaika Yu.A. 

« 30 » 08 2022

**WORK PROGRAM OF THE ACADEMIC DISCIPLINE**

**«Basics of electricity production, distribution and consumption»**

Field of study	14 Electrical engineering
Specialty	141 Electrical energetics, electrical engineering and electromechanics
Academic level	first (bachelor)
Academic program	«Electrical energetics, electrical engineering and electromechanics»
Specialization	-
Status	normative
Total workload	6 credits ECTS (180 hours)
Type of summative assessment	exam
Period of study	4 semester (7, 8 terms)
Language of study	English

Lecturer: Prof. Lutsenko I.M.

Prolonged: for 20\_\_/20\_\_ a.y. \_\_\_\_\_) «\_\_»\_\_ 20\_\_.

(signature, last name, first name, date)

for 20\_\_/20\_\_ a.y. \_\_\_\_\_) «\_\_»\_\_ 20\_\_.

(signature, last name, first name, date)

Dnipro  
DNIPROTECH  
2022

Work program of the academic discipline «Basics of electricity production, distribution and consumption» for bachelors of the educational and professional program «Electrical energetics, electrical engineering and electromechanics» of the specialty 141 Electrical energetics, electrical engineering and electromechanics / Dnipro University of Technology, Department of Electric Power Engineering. – D.: DNIPROTECH, 2022. – 14 p.

Authors:

– Lutsenko Ivan Mykolaiovych – Associate Professor, Candidate of Technical Sciences, Professor of the Department of Electric Power Engineering.

The work program regulates:

- the aim of the discipline;
- the disciplinary learning outcomes generated through the transformation of the intended learning outcomes of the degree program;
- basic disciplines;
- volume and distribution by forms of organization of the educational process and types of classes;
- discipline program (thematic plan by type of training);
- algorithm for assessing the level of achievement of disciplinary learning outcomes (scales, tools, procedures and assessment criteria);
- tools, equipment and software;
- recommended sources of information.

The work program is designed to implement a competency approach in planning an education process, delivery of the academic discipline, preparing students for control activities, controlling the implementation of educational activities, internal and external quality assurance in higher education, accreditation of degree programs within the specialty.

Approved by the decision of the Scientific and Methodological Commission of the specialty 141 Electrical energetics, electrical engineering and electromechanics (protocol №21/22-07 of 14.07.2022).

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## 1 AIM OF THE DISCIPLINE

In the educational and professional program «Electrical energetics, electrical engineering and electromechanics» of the specialty 141 Electrical energetics, electrical engineering and electromechanics the distribution of program learning outcomes (PLO) for the organizational forms of the educational process is done. In particular, the following learning outcomes are attributed to the discipline Φ5 «Basics of electricity production, distribution and consumption»:

PLO01	To know and understand the principles of operation of electrical systems and networks, power equipment of power plants and substations, protective earthing and lightning protection devices and be able to use them to solve practical problems in professional activities
PLO04	To know the principles of bioenergy, wind, hydro and solar power plants
PLO13	To understand the importance of traditional and renewable energy for successful economic development of the country
PLO19	To apply suitable empirical and theoretical methods to reduce electricity losses during its production, transportation, distribution and use

**The aim of the discipline** – the formation of competencies to determine the structure, analysis of modes of operation and basic technical means and solutions in the systems of production, distribution and consumption of electricity in Ukraine, promising areas of electricity industry, taking into account energy efficiency and energy saving.

The implementation of the aim requires transforming program learning outcomes into the disciplinary ones as well as an adequate selection of the contents of the discipline according to this criterion.

## 2. EXPECTED DISCIPLINARY LEARNING OUTCOMES

Code of PLO	Disciplinary learning outcomes (DLO)	
	Code of DLO	content
PLO01	PLO01-Φ5	Know and understand the main purpose, principles of operation, structure of electrical systems and networks, modes of operation of the neutral of electrical installations of different voltage classes and be able to use them to solve practical problems in professional activities, taking into account trends in the innovative development of relevant systems
PLO04	PLO04-Φ5	Know the principles of bioenergy, wind, hydro and solar power plants
PLO13	PLO13-Φ5	Understand the main indicators of the current state of conventional and renewable energy in Ukraine and the world and the necessary measures for the rational development of relevant systems, taking into account the problems of interaction of relevant energy sources
PLO19	PLO19-Φ5	Apply relevant methods for calculating electrical loads of consumers, analyze actual electricity consumption schedules with the development of effective solutions to reduce electricity losses during its production, transportation, distribution and use, while implementing rational solutions for the selection of nominal parameters of electrical equipment

### 3. BASIC DISCIPLINES

Discipline Name	Achieved learning outcomes
Б1 «Higher Mathematics»	PLO07 To carry out the analysis of processes in the electric power, electrotechnical and electromechanical equipment, the corresponding complexes and systems.
Б2 «General physics»	PLO08 To select and apply suitable methods for analysis and synthesis of electromechanical and electrical systems with specified parameters.
Б6 «Electrical materials»	PLO07 To carry out the analysis of processes in the electric power, electrotechnical and electromechanical equipment, the corresponding complexes and systems.
Ф3 «Fundamentals of metrology and electrical measurements »	PLO02 To know and understand the theoretical foundations of metrology and electrical measurements, the principles of automatic control devices, relay protection and automation, have the skills to perform appropriate measurements and use these devices to solve professional problems. PLO18 To be able to learn independently, acquire new knowledge and improve skills in working with modern equipment, measuring equipment and application software.

### 4. WORKLOAD DISTRIBUTION BY THE FORM OF EDUCATIONAL PROCESS ORGANIZATION AND TYPES OF CLASSES

Type of classes	Workload, hours	Distribution by forms of education, hours						
		Full-time		Part-time		Workload, hours	Extramural	
		Classes (C)	Individual work (IW)	Classes (C)	Individual work (IW)		Classes (C)	Individual work (IW)
lecture	80	43	37	-	-	138	10	128
practical	50	8	42	-	-	66	6	60
laboratory	50	17	33	-	-	66	6	60
seminars	-	-	-	-	-		-	-
TOTAL	180	68	112	-	-	270*	22	248

\*- the difference in the number of hours between full-time and extramural forms of study is due to the redistribution of credits (hours) allocated for the study of the discipline "Physical Culture and Sports" within the curriculum for extramural study.

### 5 DISCIPLINE PROGRAM BY TYPES OF CLASSES

Code of DLO	Types and topics of classes	Volume of components, hours
	<b>Lectures</b>	<b>80</b>
PLO13-Ф5	1 The current state of the electricity industry of Ukraine and the world	8
PLO04-Ф5, PLO13-Ф5	2 Characteristics of the main systems of electricity production and consumption	8
PLO01-Ф5	3 Features of the power system of Ukraine	8
PLO01-Ф5	4 Characteristics of electricity consumers and their operation modes	
PLO01-Ф5, PLO19-Ф5	5 Methods of calculating electrical loads of consumers	8
PLO01-Ф5, PLO19-Ф5	6 Characteristics of electrical network substations and their basic equipment	8

<b>Code of DLO</b>	<b>Types and topics of classes</b>	<b>Volume of components, hours</b>
PLO01-Φ5, PLO19-Φ5	7 Choice of power transformers and units for reactive power compensation	8
PLO01-Φ5, PLO19-Φ5	8 Power lines and features of their design and selection	8
PLO19-Φ5	9 Energy saving in industry and the municipal sector	6
PLO13-Φ5	10 Energy Strategy of Ukraine until 2035	6
PLO13-Φ5	11 Scenarios for the development of electricity generation systems in the IPS of Ukraine	6
	<b>PRACTICAL CLASSES</b>	<b>50</b>
PLO01-Φ5, PLO19-Φ5	1 Calculation of electrical loads	20
PLO01-Φ5	2. Calculation and selection of power transformers, power lines	20
PLO19-Φ5	3. Analysis of the peculiarities of the operation modes of the main electrical equipment of substations and networks from the standpoint of energy- and resource-saving	10
	<b>LABORATORY CLASSES</b>	<b>50</b>
PLO19-Φ5, PLO13-Φ5, PLO04-Φ5	1. Determining the indicators of electrical load schedules of generation and consumption systems	10
PLO19-Φ5, PLO13-Φ5, PLO04-Φ5	2. Determining the impact of non-uniformity of the schedule of electrical loads on the efficiency of electricity production	10
PLO01-Φ5, PLO19-Φ5	3. Calculation of the consumers' electrical loads	15
PLO01-Φ5, PLO19-Φ5	4. Reactive power compensation in electrical networks	15
<b>TOTAL</b>		<b>180</b>

For the implementation of the mixed form of education of students, the electronic resources of the e-learning platform in the discipline are used: <https://do.nmu.org.ua/course/view.php?id=2363>

## **6. EVALUATION OF LEARNING OUTCOMES**

Certification of student achievement is accomplished through transparent procedures based on objective criteria in accordance with the University Regulations “On Evaluation of Higher Education Applicants' Learning Outcomes”.

The level of competencies achieved in relation to the expectations, identified during the control activities, reflects the real result of the student's study of the discipline.

### **6.1 Grading scales**

Assessment of academic achievement of students of the Dnipro University of Technology is carried out based on a rating (100-point) and institutional grading scales. The latter is necessary (in the official absence of a national scale) to convert (transfer) grades for mobile students.

*The scales of assessment of learning outcomes of the DNIPROTECH students*

<b>Rating</b>	<b>Institutional</b>
90 ... 100	відмінно / Excellent
74 ... 89	добре / Good
60 ... 73	задовільно / Satisfactory
0 ... 59	незадовільно / Fail

Discipline credits are scored if the student has a final grade of at least 60 points. A lower grade is considered to be an academic debt that is subject to liquidation in accordance with the Regulations on the Organization of the Educational Process of DNIPROTECH.

## 6.2 Tools and procedures

The content of diagnostic tools is aimed at controlling the level of knowledge, proficiency/skills, communication, autonomy, and responsibility of the student according to the requirements of the National Qualifications Framework (NQF) up to the 6<sup>th</sup> qualification level during the demonstration of the learning outcomes regulated by the work program.

During the control activities, the student should perform tasks focused solely on the demonstration of disciplinary learning outcomes (Section 2).

Diagnostic tools provided to students at the control activities in the form of tasks for the formative and summative knowledge progress testing are formed by specifying the initial data and a way of demonstrating disciplinary learning outcomes.

Diagnostic tools (control tasks) for the formative and summative knowledge progress testing are approved by the department.

Types of diagnostic tools and procedures for evaluating the formative and summative knowledge progress testing are given below.

### *Diagnostic and assessment procedures*

<b>FORMATIVE ASSESSMENT</b>			<b>SUMMATIVE ASSESSMENT</b>	
<b>training sessions</b>	<b>diagnostic tools</b>	<b>procedures</b>	<b>diagnostic tools</b>	<b>procedures</b>
lectures	control tasks for each topic	performing the task during lectures	complex control work (CCW)	determination of the average result of formative assessments;
laboratory work	control tasks for each topic	performing the task during individual work		performing of CCW during the exam at the request of the student
practical	control tasks for each topic	performing the task during individual work		

During the current control, lectures are evaluated by determining the quality of specific control tasks. Laboratory classes are evaluated by the quality of the assigned task according to the report. Practical classes are assessed by the quality of the control task.

If the content of a certain type of classes is subordinated to several components of the description of the qualification level according to the NQF, the integral value

of the grade can be determined taking into account the weighting coefficients set by the lecturer.

Provided that the level of results of the formative assessments of all types of training at least 60 points, the summative assessment can be carried out without the student's immediate participation by determining the weighted average value of the obtained grades.

Regardless of the results of the formative assessments, every student during the exam has the right to perform the CCW, which contains tasks covering key disciplinary learning outcomes.

The number of specific tasks of the CCW should be consistent with the allotted time for completion. The number of CCW options should ensure that the task is individualized.

The value of the mark for the implementation of the CCW is determined by the average evaluation of the components (specific tasks) and is final.

The integral value of the assessment of the implementation of the CCW can be determined taking into account the weighting coefficients established by the department for each component of the description of the qualification level of the NQF.

### 6.3 Criteria

Actual student learning outcomes are identified and measured relative to what is expected during the control activities using criteria that describe the student's actions to demonstrate the achievement of learning outcomes.

To assess the performance of control tasks during the formative assessment on lectures, laboratory and practical classes the coefficient of mastery is used as a criterion, which automatically adapts the assessment indicator to the rating scale:

$$O_i = 100 a/m,$$

where  $a$  is a number of correct answers or significant operations performed in accordance with the solution standard;  $m$  is the total number of questions or significant operations of the standard.

Individual tasks and complex control works are assessed expertly using criteria that characterize the ratio of requirements to the level of competencies and indicators of assessment on a rating scale.

The content of the criteria is based on the competency characteristics defined by the NQF for the bachelor's level of higher education (given below).

***General criteria for achieving learning outcomes  
for the 6<sup>th</sup> qualification level of NQF (bachelor)***

<b>Description of qualification level</b>	<b>Requirements for knowledge, proficiency/skills, communication, autonomy and responsibility</b>	<b>Indicator evaluation</b>
<b><i>Knowleges</i></b>		
Conceptual scientific and practical	The answer is excellent - correct, reasonable, meaningful. Characterizes the presence of:	95-100

<b>Description of qualification level</b>	<b>Requirements for knowledge, proficiency/skills, communication, autonomy and responsibility</b>	<b>Indicator evaluation</b>
knowledge, critical understanding of theories, principles, methods and concepts in the field of professional activity and / or training	- conceptual knowledge; - high degree of knowledge of the state of the art; - critical understanding of the basic theories, principles, methods and concepts in education and professional activity	
	The answer contains minor errors or omissions	90-94
	The answer is correct, but has some inaccuracies	85-89
	The answer is correct, but has some inaccuracies and is insufficiently substantiated	80-84
	The answer is correct, but has some inaccuracies, insufficiently substantiated and meaningful	74-79
	The answer is fragmentary	70-73
	The answer shows the student's vague ideas about the object of study	65-69
	The level of knowledge is minimally satisfactory	60-64
	The level of knowledge is unsatisfactory	<60
<b><i>Proficiency/Skills</i></b>		
In-depth cognitive and practical skills, mastery and innovation at the level required to solve complex specialized tasks and practical problems in the field of professional activity or training	The answer characterizes the ability to: - identify problems; - formulate hypotheses; - solve problems; - choose appropriate methods and tools; - collect and interpret information logically and clearly; - use innovative approaches to solving problems	95-100
	The answer characterizes the ability to apply knowledge in practice with minor errors	90-94
	The answer characterizes the ability to apply knowledge in practice, but has some inaccuracies in the implementation of one requirement	85-89
	The answer characterizes the ability to apply knowledge in practice, but has some inaccuracies in the implementation of the two requirements	80-84
	The answer characterizes the ability to apply knowledge in practice, but has some inaccuracies in the implementation of the three requirements	74-79
	The answer characterizes the ability to apply knowledge in practice, but has some inaccuracies in the implementation of the four requirements	70-73
	The answer characterizes the ability to apply knowledge in practice when performing tasks on the model	65-69
	The answer characterizes the ability to apply knowledge in performing tasks on the model, but with inaccuracies	60-64
	The level of skills is unsatisfactory	<60
<b><i>Communication</i></b>		
♦ reporting to specialists and non-specialists information, ideas,	Fluency in industry issues. Clarity of the answer (report). Language: - correct; - clean;	95-100

Description of qualification level	Requirements for knowledge, proficiency/skills, communication, autonomy and responsibility	Indicator evaluation
problems, solutions, own experience and argumentation ♦ data collection, interpretation and application ♦ communication on professional issues, including in a foreign language, orally and in writing	<ul style="list-style-type: none"> <li>- clear;</li> <li>- accurate;</li> <li>- logical;</li> <li>- expressive;</li> <li>- concise.</li> </ul> Communication strategy: <ul style="list-style-type: none"> <li>- consistent and consistent development of thought;</li> <li>- the presence of logical own judgments;</li> <li>- appropriate reasoning and its compliance with the defended provisions;</li> <li>- correct structure of the answer (report);</li> <li>- correct answers to questions;</li> <li>- appropriate technique for answering questions;</li> <li>- ability to draw conclusions and formulate proposals;</li> </ul>	
	Sufficient knowledge of industry issues with minor flaws. Sufficient clarity of the answer (report) with minor flaws. Relevant communication strategy with minor flaws.	90-94
	Good knowledge of industry issues. Good clarity of the answer (report) and appropriate communication strategy (three requirements in total are not realized)	85-89
	Good knowledge of industry issues. Good clarity of the answer (report) and appropriate communication strategy (four requirements not implemented in total)	80-84
	Good knowledge of industry issues. Good clarity of the answer (report) and appropriate communication strategy (five requirements not implemented in total)	74-79
	Satisfactory knowledge of industry issues. Satisfactory clarity of the answer (report) and appropriate communication strategy (a total of seven requirements have not been implemented)	70-73
	Partial knowledge of industry issues. Satisfactory clarity of the answer (report) and communication strategy with errors (a total of nine requirements are not implemented)	65-69
	Partial knowledge of industry issues. Satisfactory clarity of the answer (report) and communication strategy with errors (a total of 10 requirements are not implemented)	60-64
	The level of communication is unsatisfactory	<60
<b>Autonomy and responsibility</b>		
♦ managing complex technical or professional activities or projects ♦ ability to take responsibility for making and making	Excellent command of personal management competencies focused on: 1) management of complex projects, which involves: <ul style="list-style-type: none"> <li>- research nature of educational activities, marked by the ability to independently assess various life situations, phenomena, facts, identify and defend a personal position;</li> <li>- ability to work in a team;</li> </ul>	95-100

<b>Description of qualification level</b>	<b>Requirements for knowledge, proficiency/skills, communication, autonomy and responsibility</b>	<b>Indicator evaluation</b>
decisions in unpredictable work and / or learning contexts ♦ formation of judgments that take into account social, scientific and ethical aspects ♦ organization and management of professional development of individuals and groups ♦ ability to continue studies with a significant degree of autonomy	<ul style="list-style-type: none"> <li>- control of own actions;</li> <li>2) responsibility for decision-making in unpredictable conditions, including: <ul style="list-style-type: none"> <li>- justification of own decisions by the provisions of the regulatory framework of the industry and state levels;</li> <li>- independence in the performance of tasks;</li> <li>- initiative in discussing problems;</li> <li>- responsibility for relationships;</li> </ul> </li> <li>3) responsibility for the professional development of individuals and/or groups of individuals, which involves <ul style="list-style-type: none"> <li>- use of professionally oriented skills;</li> <li>- use of evidence with independent and correct argumentation;</li> <li>- mastery of all types of learning activities;</li> </ul> </li> <li>4) the ability to continue learning with a high level of autonomy, which includes <ul style="list-style-type: none"> <li>- the degree of mastery of fundamental knowledge;</li> <li>- independence of evaluative judgments;</li> <li>- a high level of general learning skills;</li> <li>- independent search and analysis of information sources</li> </ul> </li> </ul>	
	Good mastery of personality management competencies (two requirements not met)	90-94
	Good mastery of personality management competencies (three requirements not met)	85-89
	Good mastery of personality management competencies (four requirements not met)	80-84
	Good mastery of personality management competencies (six requirements not met)	74-79
	Satisfactory mastery of personality management competencies (seven requirements not met)	70-73
	Satisfactory mastery of personality management competencies (eight requirements not met)	65-69
	The level of responsibility and autonomy is fragmentary	60-64
	The level of autonomy and responsibility is unsatisfactory	<60

## **7 TOOLS, EQUIPMENT AND SOFTWARE**

Technical training tools. Moodle remote platform, MS Teams.

## **8. RECOMMENDED SOURCES OF INFORMATION**

1. Тулуб С.Б., Разумний Ю.Т., Рухлов А.В. Проблеми сучасної енергетики. Навч. посібник в 2 ч. – Д.: Національний гірничий університет, 2007. Ч. 1. – 192 с. / 1. Tulub SB, Razumny UT, Rukhlov AV Problems of modern energy. Teaching. manual in 2 hours - D .: National Mining University, 2007. Part 1. - 192 p.
2. Маліновський А.А., Хохулін Б.К. Основи електроенергетики та електропостачання: Підручник. – Львів: Видавництво Національного університету “Львівська політехніка”, 2007.– 380 с. / Malinovsky AA, Khokhulin BK Fundamentals of power engineering and power supply:

- Textbook. - Lviv: Lviv Polytechnic National University Publishing House, 2007.– 380 p.
3. Проектування електрообладнання об'єктів цивільного призначення. ДБН В. 2.5-23-2010. – К.: Держ. ком. України з буд-ва. та архіт., 2004. – 129 с. / Design of electrical equipment for civil purposes. DBN V. 2.5-23-2010. - K. : Держ. com. Of Ukraine from the building. and Architect., 2004. - 129 p.
  4. Бондарчук А.С. Внутрішньоквартальне електропостачання. Курсове проектування. Навчальний посібник / А.С. Бондарчук, В.Г. Рудницький. – Суми: Університетська книга, 2012. – 371 с. / Bondarchuk AS Intra-quarter power supply. Course design. Textbook / A.S. Bondarchuk, VG Rudnytsky. - Sumy: University Book, 2012. - 371 p.
  5. Ціни та тарифи [Електронний ресурс] [www.nerc.gov.ua/](http://www.nerc.gov.ua/) / Prices and tariffs [Electronic resource] [www.nerc.gov.ua/](http://www.nerc.gov.ua/)
  6. Разумний, Ю.Т. Енергозбереження: навч. посіб. / Ю.Т. Разумний, В.Т. Заїка, Ю.В. Степаненко. – Дніпропетровськ: НГУ, 2005. – 166 с. / Reasonable, Yu.T. Energy saving: textbook. way. / Ю.Т. Razumny, VT Zaika, Yu.V. Stepanenko. - Dnepropetrovsk: NMU, 2005. - 166 p.
  7. Вирівнювання графіка електричного навантаження енергосистеми. Режим доступу: [http://www.energetika.by/arch/~page\\_m21=10~news\\_m21=169](http://www.energetika.by/arch/~page_m21=10~news_m21=169). / Alignment of the schedule of electric load of the power system. Access mode: [http://www.energetika.by/arch/~page\\_m21=10~news\\_m21=169](http://www.energetika.by/arch/~page_m21=10~news_m21=169).
  8. Енергетика України 2018. Інфографічний довідник. Видання 2-ге. – 2018. – 44 с. Режим доступу: <https://businessviews.com.ua/ru/the-infographics-report-energy-of-ukraine-2018/> / Energy of Ukraine 2018. Infographic guide. 2nd edition. - 2018. - 44 p. Access mode: <https://businessviews.com.ua/ru/the-infographics-report-energy-of-ukraine-2018/>
  9. Стан і перспективи розвитку технологій «інтелектуальних» електромереж, управління попитом та систем режимного управління в умовах розвитку поновлюваних джерел енергії у зарубіжній енергетичній сфері. Київ – 03/2018. Режим доступу: <https://ua.energy/wp-content/uploads/2018/04/1.-Stan-rozvytku-smart-grid.pdf> Status and prospects of development of technologies of "intelligent" power grids, demand management and control systems in the conditions of development of renewable energy sources in the foreign energy sphere. Kyiv - 03/2018. Access mode: <https://ua.energy/wp-content/uploads/2018/04/1.-Stan-rozvytku-smart-grid.pdf> New energy strategy of Ukraine until 2035: "SECURITY, ENERGY EFFICIENCY, COMPETITIVENESS". Access mode: <http://mpe.kmu.gov.ua/minugol/doccatalog/document?id=245213112>
  10. Нова енергетична стратегія України до 2035 року: «БЕЗПЕКА, ЕНЕРГОЕФЕКТИВНІСТЬ, КОНКУРЕНТОСПРОМОЖНІСТЬ». Режим доступу: <http://mpe.kmu.gov.ua/minugol/doccatalog/document?id=245213112>
  11. Звіти з оцінки відповідності (достатності) генеруючих потужностей НЕК «Укренерго». Режим доступу: <https://ua.energy/peredacha-i->

dyspetcheryzatsiya/zvit-z-otsinky-vidpovidnosti-dostatnosti-generuyuchyh-potuzhnostej/#1596701774919-04e9ab60-f849 / Reports on conformity assessment (adequacy) of generating capacities of NEC Ukrenergo. Access mode: <https://ua.energy/peredacha-i-dyspetcheryzatsiya/zvit-z-otsinky-vidpovidnosti-dostatnosti-generuyuchyh-potuzhnostej/#1596701774919-04e9ab60-f849>

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engineering and electromechanics

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Editorial by the author

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