

MINISTRY OF SCIENCE AND HIGHER EDUCATION OF THE RUSSIAN FEDERATION
Federal State Autonomous Educational Institution for Higher Education
«North-Caucasus Federal University»

APPROVED BY

Dean of FPE of NCFU

Candidate of Technical Sciences,

Associate Professor A.E. Verisokin

**EDUCATIONAL AND METHODOLOGICAL COMPLEX OF THE STATE FINAL
ATTESTATION**

Field of study	13.04.02 Electric Power Engineering and Electrical Engineering
Specialization (Profile)	Training Program of Electrical Engineering
Year of commencement of studies	2026
Mode of study	full-time

DEVELOPED BY:

**Head of the Graduating Department of Automated
Electric Power Systems and Power Supply
Kononov Yu.G.**

**Associate Professor of the Department of Automated
Electric Power Systems and Power Supply
Petrov A.V.**

Stavropol, 2026

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PROGRAM OF THE STATE FINAL ATTESTATION

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INTRODUCTION

In accordance with Federal Law of the Russian Federation No. 273-FZ of December 29, 2012 "On Education in the Russian Federation," the Federal State Educational Standard of Higher Education in the field of study 13.04.02 "Electric Power Engineering and Electrical Engineering" (approved by Order No. 147 of the Ministry of Education and Science of the Russian Federation dated February 28, 2018), and the educational program in the field of study 13.04.02 "Electric Power Engineering and Electrical Engineering" (adopted by Minutes No. ____ of the Academic and Methodological Council of FSAEI HE "NCFU" dated ..____), the final stage of master's degree training is the State Final Assessment, which includes:

- state examination in the field of study 13.04.02 "Electric Power Engineering and Electrical Engineering";

- defense of the final qualifying work.

The State Final Assessment Program has been developed in accordance with the requirements of:

- Federal State Educational Standard of Higher Education in the field of study 13.04.02 "Electric Power Engineering and Electrical Engineering" (approved by Order No. 147 of the Ministry of Education and Science of the Russian Federation dated February 28, 2018);

- Educational program in the field of study 13.04.02 "Electric Power Engineering and Electrical Engineering" (adopted by Minutes No. ____ of the Academic and Methodological Council of FSAEI HE "NCFU" dated ..____);

- Federal Law No. 273-FZ of December 29, 2012 "On Education in the Russian Federation" (as currently amended);

- Regulations on the Procedure for Conducting State Final Assessment in Higher Education Programs – Bachelor's, Specialist's, and Master's Programs of the Federal State Autonomous Educational Institution of Higher Education "North Caucasus Federal University" (Minutes No. 4 of December 7, 2017; Minutes No. 7 of December 27, 2018);

- Regulations on Educational and Methodological Support of Higher Education Programs at FSAEI HE "North Caucasus Federal University";

- Regulations on the Procedure for Completing Final Qualifying Works at the Federal State Autonomous Educational Institution of Higher Education "North Caucasus Federal University" (Minutes No. 7 of January 30, 2018).

List of competencies that the student must master as a result of completing the educational program and demonstrate during the State Final Assessment:

№	Content of the Competency	Code
Universal Competencies		
1	Capable of conducting critical analysis of problem situations based on a systems approach and developing an action strategy	YK-1
2	Capable of managing a project at all stages of its life cycle	YK-2
3	Capable of organising and leading a team, developing a team strategy to achieve the set objective	YK-3
4	Capable of applying modern communication technologies, including in foreign language(s), for academic and professional interaction	YK-4
5	Capable of analysing and accounting for cultural diversity in the process of intercultural interaction	YK-5
6	Capable of identifying and realising the priorities of one's own activities and ways of improving them based on self-assessment	YK-6
General Professional Competencies		
7	Capable of formulating research objectives and tasks, identifying task-solving priorities, and selecting evaluation criteria	GPC-1
8	Capable of applying modern research methods, evaluating and presenting the results of completed work	GPC-2
Professional Competencies		

9	Capable of participating in research and development activities in the field of electrical power engineering	PC-1
10	Capable of participating in the design of objects of professional activity	PC-2
11	Capable of managing the power system operating mode of an electrical power supply system using digital technologies	PC-3

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PROGRAM OF THE STATE EXAMINATION

Field of study	13.04.02 Electric Power Engineering and Electrical Engineering
Specialization (Profile)	Training Program of Electrical Engineering
Year of commencement of studies	2026
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1. GOALS AND OBJECTIVES OF THE STATE EXAMINATION

The goal of the state examination is to assess the level of knowledge and the ability of a graduate of FSAEI HE "NCFU" in the field of study 13.04.02 "Electric Power Engineering and Electrical Engineering" to perform professional tasks and to verify compliance of their training with the requirements of the Federal State Standard of Higher Education.

In accordance with the purpose of the state examination, its objectives are as follows:

- to establish the level of formation of general professional and professional competencies in students and determine their readiness for professional activity;
- to establish the level of theoretical knowledge and practical skills of the student in the field of electric power engineering acquired during the entire period of study;
- to establish compliance of the student's training with the requirements of the Federal State Standard of Higher Education;
- to establish the student's readiness to perform professional tasks in the field of electric power engineering acquired during the entire period of study.

2 LIST OF COMPETENCIES, THE LEVEL OF WHICH MUST BE ASSESSED IN THE STATE EXAMINATION

№	Content of the Competency	Code
Universal Competencies		
1	Capable of conducting critical analysis of problem situations based on a systems approach and developing an action strategy	YK-1
2	Capable of managing a project at all stages of its life cycle	YK-2
3	Capable of organising and leading a team, developing a team strategy to achieve the set objective	YK-3
4	Capable of applying modern communication technologies, including in foreign language(s), for academic and professional interaction	YK-4
5	Capable of analysing and accounting for cultural diversity in the process of intercultural interaction	YK-5
6	Capable of identifying and realising the priorities of one's own activities and ways of improving them based on self-assessment	YK-6
General Professional Competencies		
7	Capable of formulating research objectives and tasks, identifying task-solving priorities, and selecting evaluation criteria	GPC-1
8	Capable of applying modern research methods, evaluating and presenting the results of completed work	GPC-2
Professional Competencies		
9	Capable of participating in the design of objects of professional activity	PC-2
10	Capable of managing the power system operating mode of an electrical power supply system using digital technologies	PC-3

3 STRUCTURE OF THE STATE EXAMINATION

By decision of the Department of Automated Electric Power Systems and Power Supply, in accordance with clause 6.6. of the FOS HE in the field of study 13.04.02 "Electric Power Engineering and Electrical Engineering," the state examination is comprehensive in nature and includes the following disciplines:

- Accounting, Control and Management of Energy Resources
- Modern Power Supply Systems
- Planning of Electric Power Operating Modes
- Digital Control of Power Supply Systems
- Improving Energy Efficiency of Electricity Consumers Based on the Smart Grid Concept
- Improving the Cost-Effectiveness of Electrical Grid Operation
- Special Issues in the Development and Operation of Electrical Equipment in Electrotechnical Systems
- Research Methodology
- Team Management and Leadership Strategies
- Sociocultural Adaptation and Integration
- Designing the Trajectory of Professional Growth and Personal Development

The state examination ticket includes three theoretical questions.

The tickets are compiled in accordance with the FOS HE in the field of study 13.04.02 "Electric Power Engineering and Electrical Engineering" and the content of the state examination program. The content of the program and tickets are subject to change and updating in accordance with the latest advances in industry and science.

4. CONTENT OF THE STATE EXAMINATION

Section 4.1 Improving Energy Efficiency of Electricity Consumers Based on the Smart Grid

Concept

Basic concepts of transient processes in complex electric power systems (CEPS). Diagrams and operating modes of CEPS. Requirements for the operating modes of such systems. Feasibility and stability of operating modes. Disturbances in CEPS. Types of stability. Basic assumptions in engineering and numerical studies of stability in CEPS.

Power characteristics with complex connection of a generator to the system. Equivalent circuits of CEPS. Influence of circuit parameters on power characteristics of CEPS.

Problems of steady-state stability of electric power systems and CEPS. General principles for calculating synchronizing power.

Methodological and regulatory guidelines for the analysis of steady-state stability of CEPS. Current mathematical software for personal computers for the analysis of steady-state stability of CEPS.

Evaluation of stability analysis methods by practical criteria. Possible solutions to problems of steady-state stability of electric power systems.

Problems of transient stability of electric power systems and CEPS. Specific features of calculating transient stability in complex systems.

Transient stability calculations in CEPS using the step-by-step method and on personal computers. Equivalent of CEPS. Calculation of transient stability of systems with multiple power plants. Dynamic characteristics of loads.

Necessity and permissibility of increasing the severity of the initial system mode when studying stability. Current mathematical software for personal computers for the analysis of transient stability of CEPS.

Application of the superposition principle for studying transient stability. Influence and consideration of automatic control devices (reclosing and automatic transfer switches), automatic voltage regulators (excitation forcing) in the study of transient stability.

Consideration of prime movers. Consideration of frequency variation. Influence of electromagnetic processes in generators on CEPS stability. Possible solutions to problems of transient stability of electric power systems.

Section 4.2 Accounting, Control and Management of Energy Resources

Role of long-distance power transmission in modern electric power engineering. Types of systems and power transmissions. Advantages of integrating power systems through long-distance EHV transmission lines. Technical and economic issues arising in power transmission and system integration. Development of power systems and long-distance power transmissions.

Issues arising in the selection of main parameters of power transmissions and establishment of their operating modes. Design features of extra-high voltage lines. Clearances of EHV lines and the factors determining them. Influence of phase design on specific electrical parameters of the line and its transmission capacity. Environmental impact of EHV transmission lines.

Consideration of line parameter distribution and wave processes in electric power transmission. Long line equations. Concept of an ideal line. Dependence of the line power transmission limit on its length. Influence of line inductance and capacitance on voltage and current. Concept of natural power. Distribution of voltage and current in the line when transmitting power below and above natural power.

Circle diagrams of power at the sending and receiving ends of the line. Determination of line and power transmission efficiency. Reactive power at line ends under various loads, methods of their compensation.

Equivalent circuits of long-distance power transmissions. Relationship between four-terminal network parameters and parameters of pi- and T-equivalent circuits. Dependence of pi-equivalent circuit parameters on line length. Correction factors and their determination. Consideration of lumped parameter elements.

Tasks of calculating operating modes of long-distance EHV lines. Maximum load mode. Methods of specifying initial data. Calculation of maximum load mode of power transmission, its optimization, selection of power and location of compensating devices. Minimum load mode. Calculation of minimum load mode, loading of generators and synchronous compensators with reactive power flowing from the line. Selection of power and location of shunt reactors.

No-load mode. Determination of special operating modes. Steady-state no-load modes. Methods of voltage limitation and reactive power compensation. Asymmetrical operating modes of power transmissions.

Self-excitation of generators in the mode of one-sided energization of a long transmission line, conditions causing it, and measures for its elimination.

Relations and equivalent circuits used in calculations of asymmetrical modes. Determination of permissible loads of generators and transformers in asymmetrical modes.

General characteristics of methods for increasing transmission capacity. Intermediate synchronous compensators, selection of their power and installation location. Series capacitive compensation, design of series capacitor banks.

Section 4.3 Planning of Electric Power Operating Modes

General provisions. Electric load curves. Long-term planning of operating modes. Short-term planning of operating modes. Means and methods of mode regulation. Maintaining a specified operating mode of the power system.

Frequency and active power flow regulation. Power reserves in the power system. Reactive power balance in power systems.

Under-excitation modes of synchronous generators and compensators. Voltage regulation. Normal and repair connection diagrams of power systems and electrical networks. Management of power system equipment. Start-up modes of main equipment of power plants and substations. Operational organization of equipment testing and their management.

Section 4.4 Digital Control of Power Supply Systems

Purpose of relay protection. Structure of relay protection and information used. Types of faults. Main requirements for protection functions (sensitivity, selectivity).

Relay protection with relative selectivity. Relay protection with absolute selectivity. Measured quantities and measurement criteria used in relay protection. Main requirements imposed by relay protection devices.

Structure of digital measuring elements. Preliminary processing of analog signals. Vector representation of discretized sinusoidal signals. Algorithms for digital signal conversion in relay protection. Calculation of average and RMS values of signals. Calculation of vectors based on instantaneous values of quantities and their derivatives.

Digital measuring elements for directional power. Operating characteristics. Digital measuring elements using orthogonal components of vectors. Directional power measuring elements for symmetrical components.

Input quantities and operating characteristics of distance elements. Per-phase and three-phase distance elements. Digital distance elements based on direct calculation of impedance. Equations and characteristics of digital filters. Dynamic characteristics of digital measuring elements. Factors determining dynamic properties. Digital differential protections based on direct current comparison and differential protections with braking. Specific features of digital differential protections for transformers. Digital differential protections for busbars. Measuring part. Structure. Distance principle in transmission line protection.

Section 4.5 Special Issues in the Development and Operation of Electrical Equipment in Electrotechnical Systems

Design and operating principle of PMU, essence of WAMS/WACS technologies. Concept of vector, block diagram and operating principle of PMU. Methodology and algorithms of vector measurement. Essence of WAMS/WACS technologies and main areas of their application.

Analysis of global experience in the application of WAMS/WACS technologies. Foreign experience in implementing WAMS/WACS technologies. Features and development prospects of WAMS in Russia.

Solving applied problems in electric power systems using PMU data based on WAMS/WACS technologies.

Development of methods for state estimation of electric power systems based on integration of SCADA and PMU data. Application of PMU data in state estimation of electric power systems using the method of check equations. Problem of optimal placement of PMU devices in the power system. Use of WAMS technologies in managing transient processes in long-distance power transmissions for overvoltage limitation. Identification of parameters of electric power system elements using PMU data.

Prospects for the application of WAMS technologies in the implementation of the Smart Grid concept in distribution networks. Prospects for the application of synchronized measurements in Smart Grid. Calculation of distribution network operating modes based on instantaneous values of currents and voltages obtained from PMU devices. State estimation of distribution networks based on PMU-measured instantaneous values of currents and voltages. Calculation of energy losses in distribution networks based on instantaneous values of currents and voltages. Localization of commercial electricity losses in distribution network company grids taking into account PMU device data.

5. LIST OF SAMPLE QUESTIONS FOR PREPARATION FOR THE STATE EXAMINATION

1. General information about electromechanical transient processes
2. Concept of steady-state stability of electric power systems (EPS)
3. Basic criterion of steady-state stability of EPS
4. Power characteristics of the simplest system with a synchronous generator without AVR, with AVR of proportional action and with AVR of strong action
5. Types of steady-state stability violations
6. Concept of transient stability
7. Equal area criterion. Criterion of transient stability
8. Differential equation of motion of the synchronous machine generator rotor
9. Characteristic angles in transient stability analysis: critical angle and limiting clearing angle. Limiting fault clearing time
10. Stability of load nodes. Motor starting and self-starting
11. Concept of asynchronous mode of EPS
12. Current methodological and mathematical support for steady-state stability analysis
13. Current mathematical support for transient stability analysis
14. Design features of long-distance EHV transmission lines and their application for power system integration
15. Advantages of power system integration through long-distance EHV transmission lines
16. Circuit configurations of EHV power transmissions
17. Clearances of EHV lines and factors determining them
18. Influence of phase design on specific electrical parameters of the line and its transmission capacity
19. Consideration of transmission line parameter distribution and wave process of energy transmission
20. Reactive power at line ends under various loads, methods of their compensation
21. Effect of line inductance and capacitance on voltage and current
22. Variation of voltage and current in long-distance power transmissions
23. Processes in long-distance transmission lines with equal voltage at both ends
24. Equivalent circuits of long-distance power transmissions. Representation of long-distance power transmissions as four-terminal networks, pi-equivalent circuits
25. Tasks of calculating operating modes of long-distance power transmissions and methods of specifying initial data. Determination of special modes
26. Self-excitation of generators in the mode of one-sided energization of a long transmission line
27. Asymmetrical operating modes of power transmissions
28. Methods for increasing transmission capacity of long-distance power transmissions
29. Intermediate synchronous compensators, selection of their power and installation location
30. Series capacitive compensation, design of series capacitor banks
31. Specific features of power transmission through direct current lines
32. Active load curves (consumers, substations, power systems, power plants, transmission lines)
33. Daily reactive load curves (consumers, power systems, power plants, transmission lines)
34. Long-term and short-term planning of operating modes
35. Means and methods of mode regulation
36. Power reserves in power systems. Maintenance reserve. Operational reserve. Emergency reserve. Load reserve. Mutual assistance reserve
37. Reserves of primary, secondary, and tertiary regulation
38. Reactive power balance in power systems. Voltage collapse
39. Means of reactive power regulation
40. Voltage regulation
41. Transmission capacity of power lines and network sections
42. Concept of "electrical network section." Ranges of states of electrical network sections
43. Criteria used for assessing power system stability
44. Measures used to improve or maintain stability
45. Standardization of stability levels of power systems
46. Procedure for planning electric power operating modes of the Unified Energy System of Russia
47. Goals and objectives addressed by the System Operator in the operational zones of dispatch centers during long-term and medium-term planning

48. Functions, goals and objectives addressed in long-term mode planning. Types of forecasts in long-term mode planning
49. Requirements for short-term mode planning. Goals and objectives of short-term mode planning
50. Concept of the calculation model of the electric power system. Classification of calculation model parameters. Updating of the calculation model
51. Consumption forecast by dispatch management territories
52. Consumption forecast for weekly and daily planning
53. Stages of day-ahead mode planning
54. Stages of forming the preliminary dispatch schedule
55. Stages of forming the trading schedule
56. Equipping electrical networks with compensation means and voltage regulation devices
57. Local voltage regulation devices
58. Organization and procedure for performing switching operations in electrical installations.
- Main types of errors in operational switching
59. Personnel actions in emergency response. Methods of influencing the electric power system in emergency modes
60. Automation of electrical networks. Technical means of automated dispatch control systems.
- Information support for automated dispatch control systems
61. Voltage regulation of transformers with on-load tap changers under reactive power deficiency
62. Composition, form and deadlines for submitting data required for planning
63. Structure of relay protection and information used
64. Main requirements for protection functions. Sensitivity. Selectivity
65. Relay protection with absolute and relative selectivity
66. Main requirements imposed on relay protection devices
67. Main elements of digital relay protection
68. Structure of digital measuring elements
69. Preliminary processing of analog signals and vector representation of discretized sinusoidal signals
70. Algorithms for digital signal conversion in relay protection. Calculation of average and RMS values of signals
71. Calculation of vectors based on instantaneous values of quantities and their derivatives.
- Two-sample algorithm
72. Digital directional power measuring elements. Operating characteristics
73. Digital directional power measuring elements using orthogonal components of quantities
74. Digital directional power measuring elements of symmetrical components
75. Input quantities and operating characteristics of distance elements. Per-phase and three-phase distance elements
76. Digital distance elements based on direct calculation of impedance
77. Equations and characteristics of digital filters
78. Dynamic characteristics of digital measuring elements. Factors determining dynamic properties
79. Digital differential protections based on direct current comparison and differential protections with braking
80. Specific features of digital differential protections for transformers
81. Digital differential protections for busbars. Measuring part. Structure
82. Distance principle in transmission line protection
83. Concept of phasor measurement unit
84. Concept of "SMART-WAMS" system
85. Concept of SMPR and WAMS
86. Principles on which emergency control in electric power systems using WAMS is based
87. Foreign experience in implementing WAMS/WACS technologies
88. Features and development prospects of WAMS in Russia
89. WAMS technologies and main areas of their application
90. State estimation of distribution networks based on PMU measurements
91. Application of PMU data in state estimation of electric power systems using the method of check equations
92. Use of WAMS technologies in managing transient processes in long-distance power transmissions for overvoltage limitation
93. Identification of parameters of electric power system elements using PMU data

94. Calculation of capital costs for construction of long-distance power transmission lines
95. Selection of equipment for EHV long-distance power transmissions
96. Calculation of capital costs for construction of switchgear at power plants and substations of EHV long-distance power transmissions
97. Calculation of energy losses in elements of EHV long-distance power transmissions
98. Calculation of operating costs for EHV long-distance power transmissions
99. Main approaches to the selection of main structural elements of transmission lines: conductors, towers, insulators
100. Network schedule for construction and commissioning of EHV long-distance power transmission facilities
101. Basic principles of the methodology for selecting an option based on determining net present value
102. Concept of design climatic conditions and design operating modes
103. Systematic calculation of conductors
104. Calculation of specific mechanical loads on conductors
105. Method of allowable stresses
106. Critical spans and determination of the initial mode
107. Basic principles of the methodology for selecting an option based on determining net present value
108. Network schedule for construction and commissioning of EHV long-distance power transmission facilities
109. Calculation of mechanical characteristics in emergency modes
110. Write the equation of state of conductor AS-240/56 for the lightning overvoltage mode and determine the stress in the conductor in this mode, if known: length of the design span; modulus of elasticity of the conductor; coefficient of thermal expansion; allowable mechanical stress in the average annual temperature mode; load from the conductor's own weight; average annual temperature. Temperature during lightning overvoltages shall be taken as $+15^{\circ}\text{C}$
111. Calculate the value of the first critical span for conductor AS-150/24, if known: modulus of elasticity of the conductor; coefficient of thermal expansion; average annual temperature; minimum temperature; allowable stress in the conductor in the minimum temperature mode; allowable stress in the conductor in the average annual temperature mode
112. Calculate the value of the first critical span for conductor AS-300/39, if known: load from own weight; load from own weight with ice and wind; modulus of elasticity of the conductor; coefficient of thermal expansion; average annual temperature; minimum temperature; allowable stress in the conductor in the minimum temperature mode; stress in the conductor in the average annual temperature mode. Ice formation temperature shall be taken as -5°C
113. Determine the specific unit load from the weight of the conductor under ice load for steel-aluminum conductor AS-120/19. Initial data: ice wall thickness; value of the coefficient considering the conductor suspension height, take equal to 0.8. Value of the coefficient considering the conductor diameter, take equal to 0.9
114. Determine the specific unit load from the weight of the conductor under ice load for steel-aluminum conductor AS-95/16. Initial data: ice wall thickness 5 mm. Value of the coefficient considering the conductor suspension height, take equal to 0.8. Value of the coefficient considering the conductor diameter, take equal to 1
115. Determine the sag of conductor AS-120/19 in a span of 152 m with given values of load and stress in the conductor
116. Determine the value of the second critical span for conductor A-120 suspended on a 35 kV overhead line. Minimum temperature -40°C , ice temperature -5°C
117. Determine the sag of conductor AS-240/39 in a span of 270 m with given specific load and stress in the conductor
118. Determine the ice wall thickness and wind pressure value for conductor AS-240 suspended on a tower with triangular conductor arrangement. The height of the lower cross-arms relative to the ground level is 25 m; the height of the upper cross-arm is 32 m. The nominal voltage of the overhead line is 220 kV, the insulator height is 167 mm, the number of insulators in the string is 11. The design clearance to the ground shall be taken as 7.0 m. The line passes through terrain classified as region 2 for ice and region 4 for wind
119. Determine the sag of conductor AS-240/39 in a span of 270 m with given values of specific load and stress in the conductor
120. Determine the value of the second critical span for conductor AS-240/56 suspended on a 220 kV overhead line. Minimum temperature -35°C , ice temperature -5°C
121. Determine the value of the second critical span for conductor AS-150/24 suspended on a

110 kV overhead line. Minimum temperature -15°C, ice temperature -5°C

122. Determine the value of the second critical span for conductor AS-150/24 suspended on a 220 kV overhead line. Minimum temperature -35°C, ice temperature -5°C

123. Basic concepts and definitions of the theory of electrical equipment operation
124. Tasks and conditions for rational operation of main types of electrical equipment
125. Causes and patterns of electrical equipment failures
126. System of maintenance and scheduled preventive repair of electrical equipment
127. Organization of electrical installation work
128. Planning of electrical installation work
129. Preparation for the production of electrical installation work
130. Installation of cable lines
131. Inspection of cable lines
132. Preventive measurements and tests
133. Determination of cable line fault locations
134. Installation of power transformers
135. Inspection of power transformers
136. Operating modes of power transformers
137. Calculation of transformer thermal regime
138. Operation of transformer oil
139. Concept of maintenance and routine repair of electrical equipment
140. Frequency of maintenance and routine repairs, its calculation
141. Assessment of the duration of the repair cycle
142. Provision of equipment with spare parts
143. Main regulatory documents in electrical equipment operation
144. Relationship between operation and reliability of electrical equipment
145. Reliability indicators of electrical equipment
146. Assessment of the duration of the maintenance cycle
147. Diagnostics of faults in low-voltage control circuits
148. Diagnostics of cable line faults
149. Diagnostics of transformer faults
150. Thermal imaging inspection of equipment
151. Methods for determining the scope of scheduled work
152. Calculation of required repair and installation personnel
153. Scheduling of maintenance and routine repairs
154. Using a reference book, determine the repair frequency of the electrical equipment specified

in the assignment

155. Calculate the probability of failure-free operation during the year of a power supply system with redundant elements according to the presented diagram

156. Using reference literature, calculate the electrical equipment fund in conventional units

157. Calculate the required staff of electrical repair personnel of the enterprise based on the available electrical equipment fund

158. Calculate the failure rate of equipment consisting of sequential reliability links (diagram) and calculate the mean time between failures

Team Management and Leadership Strategies

159. Theoretical aspects of forming work teams
160. Collective forms of labor organization
161. Influence of various schools and trends of management on the development of theory and practice of work teams

162. Modern approaches to work teams

163. General characteristics of a team, their typology, classification characteristics

164. Main stages and directions of building a professional team

165. Team management in an organization: goals, objectives, necessity of use

166. Specific features of building managerial professional teams

167. Specific features of managing project teams

168. Project office: essence and necessity of use

169. Principles of formation and methods of selecting project team members

170. Project team management system: organizational structure

171. Use of team building principles in the mechanistic model of organization

172. Team building in the organic model of organization

173. Leadership technologies in the formation and development of teams

174. Styles, methods, management tools in an organization

175. Importance of managerial leadership in creating and managing teams
176. Areas of competence of a team leader
177. Types of power in formal and informal groups, management methods
178. Genesis of trait theories, possibility of using theories in teams
179. Behavioral approach to leadership, use of theory tools in team management
180. Situational approaches to leadership
181. Modern concepts of leadership
182. Strategic management: essence, concept, features
183. Typology and types of management decisions
184. Decision-making methods
185. Development and adoption of strategic management decisions
186. Management by objectives and results in work teams
187. Collective forms of labor organization in Russia
188. Work brigades: features of formation and interaction of members
189. Organizational and cultural context of team existence
190. Formation of professional teams in adhocratic and multidimensional organizational structures
191. Team management and its differences from the classical hierarchical management system
192. Motivation in the management team
193. Change management in a team
194. Technologies of project-oriented learning
195. Regional aspects of the technology of organizing a project office in the public sector
196. Decision support system in project team formation
197. Overcoming bureaucracy through building management teams
198. Role of volunteer activities in forming effective teams in the implementation of project management
199. Competency-based approach in forming a management team
200. Volunteer activity as a basis for forming work teams. Improvement of labor organization based on the formation of local management teams.
201. Road mapping method in the activities of management teams.
202. System of benchmarks and project maps in project management.
203. The head of a department of a Federal Ministry has been tasked with forming a work team

for a project and concluding employment contracts with applicants. The first candidate for the project is an experienced employee, 38 years old, married, with two children, with a high level of self-motivation, who has repeatedly performed similar tasks, and is tolerant of different cultures and beliefs. The second is a 24-year-old candidate, belonging to the biker subculture, who has proven himself well at work, but does not have similar experience. The third is a 30-year-old, single candidate, originally from Tajikistan, on a probationary period, with excellent relevant education, who seeks to establish himself in the ministry and prove himself. The manager does not have the opportunity to participate in the project personally and can only exercise interim and final control. Which of the candidates will join the project? By what principle will applicants be selected for the work team? Will social, ethnic, religious, and cultural restrictions influence the selection of candidates for the project in any way?

204. Using M. Beer's four approaches to team formation, fill in the table, taking into account the industry specifics of the construction sector and the housing and communal services sector.

Approach to team formation in the construction sector and the housing and communal services sector	Content of the approach
Goal-setting approach	
Interpersonal approach	
Role-based approach	
Managerial grid approach	

205. Analyze the listed effects of teamwork and determine for which group sizes they are characteristic by filling in the table.

Table – Factors of Teamwork Effectiveness

Teamwork Effect	Group size, persons			
	2	3	5-15	< 15
Cohesion				
False consensus				
Good interaction potential				
Tension				

Conflicts				
Reduced interaction potential				
Satisfaction				
Reduced satisfaction				
Increased formalism				
Increased communication and coordination requirements				

206. The head of the State Unitary Enterprise "Stroitel" was approached by the foreman of crew No. 3 with a complaint about repeated violations of discipline. The reason lies in the fact that the informal leader is an absolutely undisciplined worker who "sows discord" among the other crew members: they either do not show up for work at all, or leave without permission, or consume alcoholic beverages during working hours, etc. The manager says: _____. Justify your answer.

207. Simulate a situation in which a person possesses only one of the following: either power, or influence, or authority, or leadership, but does not possess any of the remaining three qualities listed. Which of the simulated situations is most typical?

208. The head of a department of a Federal Ministry has been tasked with forming a project team and concluding employment contracts with applicants. The first candidate for the project is an experienced employee, 38 years old, married, with two children, with a high level of self-motivation, who has repeatedly performed similar tasks, and is tolerant of different cultures and beliefs. The second is a 24-year-old candidate, belonging to the biker subculture, who has proven himself well at work, but does not have similar experience. The third is a 30-year-old, single candidate, originally from Tajikistan, on a probationary period, with excellent relevant education, who seeks to establish himself in the ministry and prove himself. The manager does not have the opportunity to participate in the project personally and can only exercise interim and final control. Which of the candidates will join the project? Will social, ethnic, religious, and cultural restrictions influence the selection of candidates for the project in any way? How will age, marital status, presence or absence of children, membership in any public associations influence the inclusion of a candidate in the project team and the conclusion of an employment contract?

209. The head of a large department of a federal ministry intends to form a team of professionals for a project important to him. The ministry has implemented the principles of project management. Based on the need for team effectiveness, the manager decided to conduct a team-building training. At the team building, the employees selected for the project got to know each other, began to communicate, and the impression was created that they were now a team. But when they started working on the project, conflicts and misunderstandings began to arise. As a result, the project manager switched to directive management, stopped working with the team and began giving individual assignments to each employee. As a result, the project implementation began to fall behind schedule, and most of its implementation falls on the head of the department. How will the goal-setting principle influence the formation and active work of the team? Why did the team-building technology not produce a lasting effect in the project implementation?

Sociocultural Adaptation and Integration

210. Concepts of social adaptation and cultural integration. The process of integrating a person into society. Multicultural society. Ethnicity. Adaptation, socialization, and cultural learning. Integration as a cultural connection.

211. Sociocultural adaptation as a way of individual interaction with the cultural environment. Intercultural dialogue. Methodology of social adaptation and cultural integration. Theory of cultural integration and adaptation.

212. Structural-functionalist and phenomenological paradigms in the analysis of the problem of personal integration.

213. Main mechanisms and conditions of socio-cultural integration of the individual (identification, socialization, enculturation, acculturation, cultural transmission) and forms of manifestation of personal activity in the social process

214. "Enculturation," "socialization," and "adaptation": correlation of concepts.

215. Main stages and psychological mechanisms of enculturation.

216. Essence of ethnic and cultural identity.

217. Sociocultural adaptation and integration of migrants.

218. National-cultural associations as a tool for adaptation and integration of migrants.

219. Specific features of intercultural interaction of the host population. Migration processes in

Russia

220. Prospects and models of adaptation of migrants to the host community in traditional migration countries.

221. Pedagogical foundations of adaptation of migrant children in a multicultural educational space.

222. Functions of multicultural education.
223. Evolutionist and diffusionist directions. Formation of theoretical concepts. Concepts of "adaptation," "integration," "culture" in the biological direction. "Group psychology." Concepts of interethnic relations.
224. Cultural identity and variability of ideas about personality in culture. Intercultural differences in social behavior. Intercultural differences in values.
225. Value-normative aspects of ethno-cultural identity. Ethnic symbols.
226. Social integration functions of holidays.
227. Secular, business, and ethnic etiquette.
228. Art pedagogy and migration pedagogy.
- Modeling of Processes in Electric Power Systems
229. General information about mathematical modeling
230. Optimization models
231. Classification of system modeling types
232. Static models
233. Nonlinear models of steady-state modes
234. Modeling of electrical network circuits
235. Dynamic "black box" model
236. Dynamic model of composition
237. Forecasting models
238. Modeling of queuing systems
239. Methods of random number generation
240. Specific features of recording and statistical processing of system modeling results
241. Processing of machine experiment results in system synthesis.
242. Construct graphs of voltage, current, and power (active and reactive) along the line at a given load power. The voltage at the beginning of the line (U_1), active and reactive power at the end of the line (P_2 and Q_2) are considered known. Characterize the obtained dependencies.
243. Assess the errors of mathematical models of transmission lines: 1) equations of an ideal line; 2) equations of a line without considering parameter distribution. Take the long line equations as the reference (exact) model.
244. Perform a forecast of the random process of changes in the power load of an electricity consumer.
245. Perform a forecast of the daily load curve
246. Solve a linear programming problem using MS Excel
247. Solve a linear programming problem using Mathcad
248. Solve a transportation problem using MS Excel
249. Solve a transportation problem using Mathcad
250. Solve a nonlinear programming problem using MS Excel
251. Solve a nonlinear programming problem using Mathcad
252. Find the area of a figure bounded by lines using the Monte Carlo method
253. Perform modeling of a lossless queuing system with 1 service device, in which the time interval between incoming requests and the service time of requests are random variables uniformly distributed in the intervals (1;10) and (1;8), respectively.
254. The failure probability of each device in the circuit is shown in the figure. Determine the probability of failure of the entire circuit using simulation modeling.

6. LIST OF RECOMMENDED LITERATURE

6.1. Primary Literature

1. Shneerson, E.M. *Digital Relay Protection* / E.M. Shneerson. – Moscow: Energoatomizdat, 2007. – 548 p. : ill. – Bibliography: pp. 540-541. – ISBN 978-5-283-03256-6
2. Venikov, V.A. *Transient Electromechanical Processes in Electric Power Systems: A Textbook for Universities* / V.A. Venikov. – 4th ed., revised and supplemented. – Moscow: Vysshaya Shkola, 1985. – 536 p. : ill. – Recommended by the Ministry of Education. – Bibliography: p. 529. – Subject index: pp. 530-532
3. Konyukhova, E.A. *Power Supply of Facilities: A Textbook* – Moscow: "Masterstvo," 2002. – 320 p.
4. *Electrical Installation Regulations: All Current Sections of PUE-6 and PUE-7* – Novosibirsk: Siberian University Publishing House DEAN, 2005. – 854 p.
5. Gerasimenko, A.A. *Transmission and Distribution of Electric Energy: A Textbook for Universities in the Field of Study "Electric Power Engineering"* / A.A. Gerasimenko, V.T. Fedin. – 3rd ed., revised. – Moscow: KnoRus, 2012. – 648 p.
6. Lykin, A.V. *Electric Power Systems and Networks: A Textbook* / A.V. Lykin. – Moscow: University Book; Logos, 2008. – 256 p.
7. Andreev, V.A. *Relay Protection of Power Supply Systems in Examples and Problems: A Textbook* / V.A. Andreev. – Moscow: Vysshaya Shkola, 2008. – 251 p.
8. Bass, E.I. *Relay Protection of Electric Power Systems: A Textbook* / E.I. Bass, V.G. Doroguntsev ; ed. by A.F. Dyakov. – 2nd ed., stereotyped. – Moscow: MPEI Publishing House, 2010. – 295 p.
9. Kulikov, Yu.A. *Transient Processes in Electric Power Systems: A Textbook* – Novosibirsk: NSTU, Moscow: Mir: AST Publishing House, 2010.
10. Okolovich, M.N. *Design of Power Plants: A Textbook for Universities* – Moscow: Energoatomizdat, 2010.
11. Balanov, Yu.N., Misrikhanov, M.Sh., Shuntov, A.V. *Power Plant Output Schemes: Methodological Aspects of Formation* – Moscow: Energoatomizdat, 2012.
12. Kobets, B.B., Volkova, I.O. *Innovative Development of Electric Power Industry Based on the Smart Grid Concept* – Moscow: IAC Energia, 2010. – 208 p.
13. Ryzhov, Yu.P. *Long-Distance Extra-High Voltage Power Transmissions: A Textbook for Universities* – Moscow: MPEI Publishing House, 2007. – 488 p. : ill.
14. Kononov, Yu.G. *Application of WAMS/WACS Technologies in Electrical Networks* / Yu.G. Kononov, A.S. Stepanov. – Stavropol: SevKavGTU Publishing House, 2012. – 128 p.

6.2. Additional Literature

15. Tikhomirov, P.M. *Calculation of Transformers: A Textbook for Universities* / P.M. Tikhomirov. – 4th ed., revised and supplemented. – Moscow: Energia, 1976. – 544 p. : ill. – Recommended by the Ministry of Education. – Bibliography: p. 536
 16. *Handbook on the Design of Electrical Networks* / I.G. Karapetyan et al. ; ed. by D.L. Faibisovich. – 4th ed., revised and supplemented. – Moscow: ENAS, 2012. – 376 p.
 17. *Electrical Engineering Handbook: In 4 Volumes: Vol. 3. Production, Transmission and Distribution of Electric Energy* / Under the general editorship of professors of MPEI V.G. Gerasimov et al. (editor-in-chief A.I. Popov). – Moscow: MPEI Publishing House, 2009. – 964 p.
 18. Shekhovtsov, V.P. *Reference Manual on Electrical Equipment and Power Supply* – Moscow: Forum-Infra, 2008.
 19. Shabad, M.A. *Calculations of Relay Protection and Automation of Distribution Networks* / M.A. Shabad. – 3rd ed., revised and supplemented. – Leningrad: Energoatomizdat, 1985. – 296 p.
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7. ORGANIZATION AND CONDUCT OF THE STATE EXAMINATION

The graduating department of Automated Electric Power Systems and Power Supply annually, no later than six months before the start of the State Final Assessment, develops (updates) and approves in accordance with the established procedure the State Final Assessment Program in the field of study 13.04.02 "Electric Power Engineering and Electrical Engineering," which includes the state examination program and the requirements for the final qualifying work and the procedure for its completion, criteria for assessing the results of the state examination and the defense of final qualifying works (the assessment tools for the State Final Assessment), and creates educational and methodological complexes for the state final assessment of graduates, developed in accordance with the Regulations on Educational and Methodological Support of Higher Education Programs at FSAEI HE "North Caucasus Federal University."

Prior to the state examination, consultations are held for students on issues included in the state examination program in the field of study 13.04.02 "Electric Power Engineering and Electrical Engineering," and review lectures are organized on the main sections of the state examination.

One month before the state examination, the head of the Department of Automated Electric Power Systems and Power Supply forms and approves the examination tickets at a department meeting.

The state examination in the field of study 13.04.02 "Electric Power Engineering and Electrical Engineering" is conducted orally. The results of the state assessment test conducted orally are announced on the day it is held.

The state examination is conducted at an open meeting of the examination committee. Representatives of the institute's administration and the rector's office may be present at the committee meeting. Before the start of the state examination, the chairman of the State Examination Committee (SEC), or upon his/her order, the deputy chairman or a member of the SEC, distributes the examination tickets.

During the state examination, no more than 12 students are permitted to be present in the room. Each student independently selects an examination ticket once by random selection. The ticket number is recorded by the SEC secretary in the relevant protocol. The student is given 30 to 60 minutes to prepare an answer to the examination ticket.

During preparation, the student has the right to use the state examination program, as well as reference literature with the permission of the SEC. Students who use other educational literature, communication devices, and electronic computing equipment (except for a calculator) during preparation for the answer are removed from the state examination. A student removed from the state examination for violating the procedure for conducting the state examination is given a grade of "Unsatisfactory" in the examination sheet.

Upon completion of the student's answer, the chairman and members of the committee may ask additional questions (as a rule, no more than three). In general, the student's answer to the examination ticket and additional questions should not exceed 30 minutes.

Upon completion of the answers of the students in the academic group, a meeting of the examination committee is announced, attended only by committee members. At the meeting, the answers of each student to the ticket assignments and additional questions are discussed. Based on the discussion, the corresponding grade is recorded in the protocol for each student. The committee secretary fills out the examination sheet based on the results of the state examination.

After the committee meeting, the students of the academic group are invited into the room. The chairman of the committee informs the students of the results of the state examination.

Students who have not passed the State Final Assessment due to failure to appear for the state assessment test for a valid reason (temporary disability, performance of public or state duties, court summons, transport problems (flight cancellation, lack of tickets), weather conditions, or other exceptional circumstances) have the right to take it within 6 months after the completion of the State Final Assessment.

The student must submit a document confirming the reason for their absence. An application for postponement of the State Final Assessment (with the original or a duly certified copy of documents confirming the valid reasons for not passing the State Final Assessment within the established timeframe) is submitted by the student (or his/her authorized representative) no later than one calendar week after the completion of the State Final Assessment to the administration of the Institute of Electric Power Engineering, Electronics and Nanotechnologies.

In the event of failure to submit the said application and documents confirming the valid reasons for not passing the State Final Assessment during this period, the student is expelled from NCFU in accordance with the established procedure.

Based on the student's application, coordinated with the Director of the Institute of Electric Power Engineering, Electronics and Nanotechnologies, and documents confirming the valid reasons for not passing the State Final Assessment, an order of the Rector of NCFU is issued to postpone the State Final Assessment deadlines.

The student is required to personally acknowledge, against signature, the date to which the State

Final Assessment has been postponed at the administration of the institute (branch).

A student who has not passed one state assessment test for a valid reason is permitted to take the next state assessment test (if applicable).

Students who have not passed the state assessment test due to failure to appear for the state assessment test for an unexcused reason or due to receiving a grade of "Unsatisfactory," as well as students who have not passed the state assessment test within the established timeframe (due to failure to appear for the state assessment test or receiving a grade of "Unsatisfactory"), are expelled from NCFU with the issuance of a certificate of study as having failed to fulfill their obligations for the conscientious completion of the educational program and the academic plan.

A person who has not passed the State Final Assessment may retake the State Final Assessment no earlier than one year and no later than five years after the date of the State Final Assessment that the student did not pass.

**8. DESCRIPTION OF INDICATORS AND CRITERIA FOR ASSESSING
COMPETENCIES, AS WELL AS ASSESSMENT SCALES
8.1 DESCRIPTION OF INDICATORS**

Levels of Competency and Indicator Formation	Descriptors			
	Minimum level not achieved (Unsatisfactory) – 2 points	Minimum level (Satisfactory) – 3 points	Medium level (Good) – 4 points	High level (Excellent) – 5 points
YK-1. Capable of conducting critical analysis of problem situations based on a systems approach and developing an action strategy ID-1YK-1. Searches for the required information, performs its critical analysis, and consolidates the analysis results to solve the assigned task; ID-2YK-1. Analyses a problem situation and performs its decomposition into individual tasks; ID-3YK-1. Develops a strategy for solving the assigned task. YK-2. Capable of managing a project at all stages of its life cycle ID-1YK-2. Participates in project management at all stages of the project life cycle. YK-3. Capable of organising and leading a team, developing a team strategy to achieve the set objective ID-1YK-3. Demonstrates understanding of teamwork principles (knows roles within a team, types of leaders, and methods of workforce management); ID-2YK-3. Leads team members to achieve the assigned task YK-4. Capable of applying modern communication technologies, including in foreign language(s), for academic and professional interaction ID-1YK-4. Engages in academic and professional interaction, including in a foreign language; ID-2YK-4. Translates academic texts (abstracts, annotations, reviews, articles, etc.) from or into a foreign language; ID-3YK-4. Uses modern information and communication tools for communication. YK-5. Capable of analysing and accounting for cultural diversity in the process of intercultural interaction ID-1YK-5. Demonstrates understanding of the characteristics of different cultures and nations; ID-2YK-5. Builds social interaction taking into account the commonalities and distinctions of different cultures and religions.	1. The main content of the educational material is not covered; 2. Ignorance or misunderstanding of the greater or most important part of the educational material is revealed; 3. Errors have been made in defining concepts and using terminology, which were not corrected after leading questions; 4. Competencies, skills, and abilities are not formed.	1. The content of the material is disclosed incompletely or inconsistently, but a general understanding of the issue is shown and sufficient skills for the mastered material are demonstrated; 2. There were difficulties or errors in defining concepts and using terminology, which were corrected after leading questions; 3. With incomplete knowledge of the theoretical material, insufficient formation of competencies, skills, and abilities is revealed; the student cannot apply theory in a new situation.	The answer generally meets the requirements for a grade of "5," but has the following shortcomings: 1. Minor gaps in presentation that do not distort the content of the answer; 2. One or two minor omissions have been made when covering the main content of the answer, corrected at the examiner's remark; 3. An error or more than two omissions have been made when covering secondary issues, which are easily corrected at the examiner's remark.	1. The content of the material in the ticket is fully covered; 2. The material is presented competently, in a certain logical sequence, with precise terminology; 3. The ability to illustrate theoretical principles with specific examples and apply them in a new situation is demonstrated; 4. Mastery of previously studied related issues, as well as the formation and stability of competencies, skills, and abilities, is demonstrated.

YK-6. Capable of identifying and realising the priorities of one's own activities and ways of improving them based on self-assessment ID-1YK-6. Assesses one's own resources and their limits (personal, situational, temporal), and uses them optimally to successfully complete an assigned task; ID-2YK-6. Identifies the priorities of personal growth and ways to improve one's own activities based on self-assessment. GPC-1. Capable of formulating research objectives and tasks, identifying task-solving priorities, and selecting evaluation criteria ID-1GPC-1. Formulates research objectives and tasks; ID-2GPC-1. Determines the sequence for solving tasks; ID-3GPC-1. Formulates decision-making criteria. GPC-2. Capable of applying modern research methods, evaluating and presenting the results of completed work ID-1GPC-2. Selects the appropriate research method to solve the assigned task; ID-2GPC-2. Conducts analysis of the obtained results; ID-3GPC-2. Presents the results of the completed work. PC-2. Capable of participating in the design of objects of professional activity ID-1. Performs calculation and analysis of the economic and technical characteristics of the object being designed; ID-2. Evaluates the feasibility of implementing an investment project and selects the most optimal investment alternative. PC-3 Capable of managing the power system operating mode of an electrical power supply system using digital technologies ID-1. Performs calculations of the performance indicators of electrotechnical equipment and its systems; ID-2. Ensures the required operating modes and specified parameters of the technological process for elements of power supply systems; ID-3. Applies knowledge of digital technologies in the processes of generation, transmission, and distribution of electrical energy; ID-4. Applies knowledge of the specific features of installation, start-up and commissioning, adjustment, testing, and acceptance into service of various types of electrical power and electrotechnical equipment.				5. The answer was given independently, without leading questions; 6. One or two inaccuracies were made when covering secondary issues, which are corrected at the examiner's remark.
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The results of the state examination are determined by grades of "Excellent," "Good," "Satisfactory," and "Unsatisfactory." Grades of "Excellent," "Good," and "Satisfactory" indicate successful completion of the state assessment test.

When assessing a student's answer in the state examination, the level of competency formation is taken into account according to the following proposed criteria:

- ability to use theoretical and practical knowledge within a specialized part of a field;
- ability to integrate knowledge from new or interdisciplinary areas for research diagnostics of problems;
- ability to analyze and compare different approaches to solving the stated problem;
- the student's readiness to answer additional questions on the substance of the examination ticket;
- other requirements set forth by the assessment tools for the final assessment, developed by the graduating department for each educational program.

"Excellent" is awarded provided that the student has fully answered all questions of the examination ticket, additional questions from committee members, solved two practical tasks, and has demonstrated a high level of theoretical and practical training.

"Good" is awarded provided that the student has answered the questions of the examination ticket, additional questions from committee members, solved one practical task, and demonstrated a good level of training.

"Satisfactory" is awarded provided that the student has demonstrated a sufficient level of training necessary for practical activity, but made inaccuracies in the answer during the state examination.

"Unsatisfactory" is given to a student who has demonstrated significant gaps in knowledge of the main program material, which do not allow them to begin practical activity without additional training.

8.2 CRITERIA FOR ASSESSING COMPETENCIES IN THE STATE EXAMINATION

The grade "Excellent" is awarded to a student who has fully answered all questions of the examination ticket, additional questions from committee members, solved two practical tasks, and has demonstrated a high level of theoretical and practical training.

The grade "Good" is awarded to a student who has answered the questions of the examination ticket, additional questions from committee members, solved one practical task, and demonstrated a good level of training.

The grade "Satisfactory" is awarded to a student who has demonstrated a sufficient level of training necessary for practical activity, but made inaccuracies in the answer during the state examination.

The grade "Unsatisfactory" is awarded to a student who has demonstrated significant gaps in knowledge of the main program material, which do not allow them to begin practical activity without additional training.

8.3 DESCRIPTION OF THE ASSESSMENT SCALE

The state examination is assessed on a 5-point scale. Grades of "Excellent," "Good," and "Satisfactory" indicate successful completion of the state assessment test.

MINISTRY OF SCIENCE AND HIGHER EDUCATION OF THE RUSSIAN FEDERATION
Federal State Autonomous Educational Institution for Higher Education
«North-Caucasus Federal University»

APPROVED BY

Dean of FPE of NCFU

Candidate of Technical Sciences,

Associate Professor A.E. Verisokin

**REQUIREMENTS FOR FINAL QUALIFYING WORKS (BY TYPE) AND THE PROCEDURE
FOR THEIR COMPLETION**

Field of study	13.04.02 Electric Power Engineering and Electrical Engineering
Specialization (Profile)	Training Program of Electrical Engineering
Year of commencement of studies	2026
Mode of study	full-time

DEVELOPED BY:

Associate Professor of the Department
of Automated Electric Power Systems
and Power Supply, Candidate of
Technical Sciences
Kostyukov D.A.

Stavropol, 2026

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1 INTRODUCTION

In accordance with Federal Law of the Russian Federation No. 273-FZ of December 29, 2012 "On Education in the Russian Federation," the Federal State Educational Standard of Higher Education in the field of study 13.04.02 "Electric Power Engineering and Electrical Engineering" (approved by Order No. 147 of the Ministry of Education and Science of the Russian Federation dated February 28, 2018), and the educational program in the field of study 13.04.02 "Electric Power Engineering and Electrical Engineering," the final stage of master's degree training is the State Final Assessment, which includes:

- a state interdisciplinary examination in the field of study 13.04.02 "Electric Power Engineering and Electrical Engineering";
- defense of the final qualifying work.

The final qualifying work is an independent work of the student and is carried out in accordance with the curriculum for the master's degree program in the field of study 13.04.02 – Electric Power Engineering and Electrical Engineering.

The presence of diverse material in educational literature creates certain difficulties in the design and formatting of works. These educational and methodological guidelines are intended to assist students in the completion of the final qualifying work.

Reference Documents

These methodological guidelines have been developed in accordance with the following regulatory documents:

- Federal Law No. 273-FZ of December 29, 2012 "On Education in the Russian Federation";
- Order of the Ministry of Science and Higher Education of the Russian Federation No. 882 dated August 5, 2020, and Order of the Ministry of Education of the Russian Federation No. 391 dated August 5, 2020 "On the Organization and Implementation of Educational Activities in the Network Form of Implementing Educational Programs";
- Order of the Ministry of Science and Higher Education of the Russian Federation No. 885 and Order of the Ministry of Education of the Russian Federation No. 390 dated August 5, 2020 "On Practical Training of Students";
- Order of the Ministry of Education and Science of the Russian Federation No. 245 dated April 6, 2021 "On Approval of the Procedure for the Organization and Implementation of Educational Activities in Higher Education Programs – Bachelor's, Specialist's, and Master's Programs" (Registered with the Ministry of Justice of the Russian Federation on August 13, 2021, No. 64644);
- Order of the Ministry of Education and Science of the Russian Federation No. 1061 dated September 12, 2013 "On Approval of the Lists of Specialties and Fields of Study of Higher Education" (as currently amended);
- Federal State Educational Standards of Higher Education and independently approved educational standards of NCFU (hereinafter referred to respectively as FSES, SES, collectively referred to as "educational standards");
- Regulations on Practical Training of Students of the Federal State Autonomous Educational Institution of Higher Education "North Caucasus Federal University" dated December 24, 2020;
- other regulatory legal acts of the Russian Federation in the field of education;
- local regulatory acts of NCFU.

Notations and Abbreviations

FQW – Final Qualifying Work;

HE – Higher Education;

SFA – State Final Assessment;

SEC – State Examination Commission;

Teaching Staff – Professorial and Teaching Staff;

GOST – State Standard.

General Provisions

The final qualifying work is an independently completed written work by students, containing a solution to a problem or the results of an analysis of a problem that is significant for the relevant field of professional activity.

Students who have successfully completed the full theoretical and practical course of study and completed all types of practice in the field of study (specialty) of Higher Education are permitted to undertake the FQW.

Admission to the completion of the FQW is formalized by order of the Rector of the University in accordance with the requirements set forth in the instructions on the procedure for preparing documents for the State Final Assessment of graduates.

The FQW containing information that constitutes a state secret is prepared and stored at the University in compliance with the requirements stipulated by the legislation of the Russian Federation and regulatory legal acts in the field of state secret protection.

The author of the FQW bears full responsibility for all decisions made and presented in the FQW.

2 GOALS AND OBJECTIVES OF THE FINAL QUALIFYING WORK

The final qualifying work is a work completed by a student (or several students jointly), demonstrating the level of preparedness of the graduate for independent professional activity.

The final qualifying work is a qualifying, comprehensive, scientific study that is the final stage of students' training in the professional program.

The completion of the FQW has the following goals and objectives:

- systematization, consolidation, and expansion of theoretical knowledge and practical skills in the specialty (field of study) and their application in solving professional tasks;
- development of skills in independent scientific work and mastery of the methodology for conducting experimental research;
- preparation of students for research, teaching, and expert-analytical work in conditions of real professional activity;
- completion of the formation of the graduate's general cultural and professional competencies.

In the process of working on the FQW, the student must demonstrate abilities:

- to comprehend, systematize, consolidate, and expand the acquired theoretical knowledge and practical skills;
- to apply known techniques and methods for solving issues arising in the process of completing the FQW;
- to adopt a creative approach in addressing the stated problems based on new technologies.

The decision to award the graduate the qualification (degree) in the field of study (specialty) and issue a diploma is made by the State Assessment Commission based on the positive results of the final state assessment.

Final qualifying works under the Higher Education Educational Program for the master's program are carried out in the form of a master's thesis.

The master's thesis includes: theoretical substantiation, analytical and (or) experimental confirmations, substantiation of the chosen research methodology and decision-making methodology, and the obtained results. The formulation of the goal and objectives must be specific, arise from the current state of the research issue, and be based on the results of the analysis of relevant scientific and applied works. The solutions proposed by the student to the problem as a whole and to specific tasks, in particular, must be strictly argued and critically evaluated in comparison with known solutions within the research framework.

A master's thesis is a completed research work or a completed and practically applied development, carried out under the supervision of a professor or associate professor in the relevant field, containing a new solution to an urgent scientific problem, a critical analysis of scientific sources on the research topic, and innovative approaches and methods.

The master's thesis includes the author's scientific propositions, their theoretical substantiation and (or) experimental confirmations, substantiation of the chosen research methodology and methodology for making engineering decisions, and the obtained results. The formulation of the problem must be specific, arise from the current state of the issue, and be substantiated by an analysis of relevant scientific and applied works. The solutions to the problem as a whole and to specific tasks proposed by the author of the thesis must be strictly argued and critically evaluated in comparison with known solutions in all aspects, including efficiency. The main task of a master's graduate is to demonstrate the level of their qualification, the ability to independently conduct scientific research and solve specific scientific and practical problems.

The type of final qualifying work, the requirements for it, the procedure for its completion, and the criteria for its evaluation are established by the higher education educational program in accordance with the requirements of the standard regarding the requirements for state final assessment and the educational and methodological documentation developed by the departments based on the standards and the Higher Education Educational Program in the field of study or specialty. The content of the final qualifying work must take into account the requirements of the standards and the Higher Education Educational Program in the field of study or specialty.

The master's final qualifying work may be a diploma project, a diploma thesis, a comprehensive work, or a work in the form of a startup.

A diploma thesis is an independent scientific and practical study in which it is necessary to demonstrate knowledge of specialized literature, the ability to independently analyze it and make generalizations. The purpose of completing a diploma thesis is to systematize and deepen knowledge in the specialty, apply it in solving practical tasks, apply independent work skills, and master the methodology of research, generalization, and logical presentation of material. The work is carried out on the basis of an in-depth study of literary sources (archival and published).

The research nature of the diploma scientific work is ensured by a comprehensive analysis or

scientific research on one of the new issues of a theoretical or experimental nature, which, as a rule, are the final stage of research conducted by the student during the training period, reflected in articles and abstracts of reports of scientific conferences, as well as performed by means of calculation and modeling.

When writing a diploma thesis, materials obtained by the student during the pre-graduation practice, reflecting the activities of enterprises, organizations, etc., are used. The diploma thesis may contain a calculation and graphic part, which represents a partial fulfillment of the sections provided for in the structure of the diploma project of the relevant specialty.

A diploma project is a type of final qualifying work, the basis of which should be factual materials collected by the student during the work (pre-graduation) practice, the results of their office processing and laboratory research, as well as information obtained from information sources.

When writing a diploma project, materials obtained by the student during the work (pre-graduation) practice and reflecting the activities of enterprises, organizations, etc., must be used. The diploma project must contain an explanatory note and a graphic part. The explanatory note to the diploma project must clearly and concisely reveal the creative concept of the project, contain research methods, accepted calculation methods and the calculations themselves, a description of the experiments conducted, their analysis and conclusions, a feasibility comparison of options and, if necessary, be accompanied by illustrations, graphs, sketches, diagrams, schematics, etc. In cases where projects contain complex mathematical calculations, computer technology is generally used for their execution. Each project must have an appropriate economic justification and a section devoted to issues of safety and environmental friendliness of the project.

When solving a large problem, it is possible to complete a comprehensive final qualifying work developed by a team of authors, in which each student performs their specific task in accordance with the overall task.

Such a final qualifying work may be carried out by students of different fields of study or specialties. In this case, a unified state examination commission for these fields of study is created, including specialists from different fields.

It is recommended that the FQW be carried out on a real-world topic.

A final qualifying work is considered to be carried out on a real-world topic if:

- there is an application from an enterprise for the completion of the FQW indicating the topic, or a request from the enterprise for full or partial transfer of FQW materials for their implementation;
- there is a patent application or a positive decision on its issuance, a certificate for a rationalization proposal, the essence of which is reflected in the main part of the final qualifying work;
- the solution of the final qualifying work is a technical development of a patented idea;
- the materials of the final qualifying work are used in a contract-based or state-funded research work;
- there is confirmation of the approbation of the results and conclusions of the work in the form of reports at scientific conferences, publications in journals, collections of scientific articles, or implementation in production.

When solving a large problem, it is possible to complete a comprehensive final qualifying work developed by a team of authors, in which each student performs their specific task in accordance with the overall task.

A comprehensive work is a type of final qualifying work focused on the study of a single topic on one (if necessary, several) object of pre-graduation (pre-qualification) practice and carried out by a group of students studying in one or different educational programs.

The main purpose of a comprehensive work is for students to master the skills of project and research activities in their chosen professional field, as well as independent decision-making. The completion and defense of a comprehensive work by students is aimed at verifying the formation of competencies established by the federal state educational standards of higher education, educational standards developed and approved by NCFU independently.

Work on the final qualifying work may be carried out by the student at an enterprise, organization, scientific, design, and other institutions, and directly at the University or its branches.

A startup (FQW-S) is a type of final qualifying work that involves a business project carried out by a student (independently or as part of a team) for the development and/or commercialization of the results of research and development activities, demonstrating the level of preparedness of the graduate for independent professional activity and the formation of competencies established by the FSES HE or the Educational Standard of Higher Education.

The FQW-S is carried out with the aim of developing, formalizing, and advancing a startup prepared in accordance with the requirements of the Regulations for the Completion of FQW-S, and also, if necessary, with the requirements of the organization to which it will be (or has been) submitted for investment, and demonstrating the level of preparedness of each student who completed the FQW in the form of a startup for

independent professional activity.

The completion of the FQW-S has the following objectives:

- systematization, consolidation, and expansion of theoretical knowledge and practical skills in the field of study or specialty and their application in solving professional tasks;
- implementation of students' skills in innovation activities through participation in scientific and technical activities and the creation of small innovative enterprises necessary for the commercialization of scientific research results;
- development of teamwork skills and mastery of the methodology for conducting experimental research;
- mastering methods of self-realization of students in professional activities;
- preparation of students for real professional activity;
- completion of the formation of the graduate's competencies established by the standard, and competencies additionally established by the University (in the case of establishing such competencies).

Work on the final qualifying work may be carried out by the student at an enterprise, organization, scientific, design, and other institutions, and directly at the University or its branches.

The texts of final qualifying works, except for the texts of final qualifying works containing information constituting a state secret, are placed in the electronic library system of NCFU and checked for the volume of borrowing in the "Antiplagiat VUZ" system in accordance with the Regulations for the Use of the "Antiplagiat" System at FSAEI HE "North Caucasus Federal University."

When submitting the final qualifying work to the department, the student fills out and signs a statement in the established form, which confirms the absence of borrowings from printed and electronic sources of third parties without appropriate references, and the student's awareness that the final qualifying work will not be allowed for defense if plagiarism is detected. Failure to submit the statement confirming the originality of the work automatically entails the rejection of the final qualifying work or scientific report for defense.

The department maintains a record of the verification of final qualifying works by the "Antiplagiat" system, with entries made in the corresponding log.

The verification is carried out using the following main software "Antiplagiat":

1. Software system for detecting text borrowings in academic and scientific works "Antiplagiat.VUZ" – this is the Citation module;
2. Module "Software package for searching text borrowings in open Internet sources "Antiplagiat-Internet" in Russian – this is the Internet Search module;
3. Services for ensuring the search for text borrowings in the collection of dissertations and abstracts of the Russian State Library (RSL) – this is the RSL Collection;
4. Services for ensuring the search for text borrowings in the collection of regulatory and legal documentation LEXPRO – this is the LEXPRO Collection;
5. Services for ensuring the search for text borrowings in the collection of the Scientific Electronic Library eLIBRARY.RU – this is the eLIBRARY.RU Collection.

A certificate of the results of the FQW verification for borrowings, with a mandatory QR code, is printed from the "Antiplagiat" system, signed by the FQW supervisor, and endorsed by the head of the graduating department.

If the student disagrees with the decision of the FQW supervisor based on the results of the verification of the final qualifying work by the "Antiplagiat" system, the head of the department in which the final qualifying work is being completed appoints a commission for a repeat verification of the work for plagiarism.

After the FQW has been checked for plagiarism, the final decision on its admission to defense is made at a meeting of the department in which the FQW is being completed. A final qualifying work is admitted to defense if it contains at least 60% of original text for bachelor's final qualifying works.

A student who is not admitted to the defense of the final qualifying work or the presentation of the scientific report is considered to have not fulfilled the academic plan and is subject to expulsion from the University.

The results of the verification of the final qualifying work or scientific report by the "Antiplagiat" system are taken into account when assigning a grade for the state final assessment to the student and are attached to the supervisor's review.

Access of persons to the texts of final qualifying works must be ensured in accordance with the legislation of the Russian Federation, taking into account the exclusion of production, technical, economic, organizational, and other information, including information about the results of intellectual activity in the scientific and technical field, about methods of carrying out professional activities that have actual or potential commercial value due to their unknownness to third parties, in accordance with the decision of the copyright holder.

The author of the final qualifying work bears full professional, moral, and legal responsibility for all information presented in the final qualifying work, the procedure for its use in compiling factual material and other information, and the validity (reliability) of the conclusions and defended propositions, in accordance with the legal and (or) local regulatory acts in force in the Russian Federation and at NCFU.

3 LIST OF COMPETENCIES, THE LEVEL OF WHICH MUST BE ASSESSED DURING THE DEFENSE OF THE FINAL QUALIFYING WORK

№	Content of the Competency	Code
	<i>Professional Competencies</i>	
1	Capable of participating in research and development activities in the field of electrical power engineering	PC-1
2	Capable of participating in the design of objects of professional activity	PC-2

4. STRUCTURE AND SCOPE OF THE FINAL QUALIFYING WORK (BY TYPE), INCLUDING THE SCOPE OF EACH SECTION OF THE FINAL QUALIFYING WORK

Requirements for the structure, content, and scope of the FQW are determined by the relevant methodological guidelines developed by the graduating departments on the basis of the FSES HE and recommendations of the relevant educational and methodological associations.

The FQW must fully correspond to the approved research topic, contain elements of novelty, be relevant, and have theoretical and practical significance.

The master's FQW is evaluated not only by its theoretical scientific value, the relevance of the topic, and the applied significance of the results obtained, but also by the level of general methodological preparation of this scientific work, which is primarily reflected in its composition.

Each author is free to choose any structure and order of organizing scientific materials in order to achieve the external arrangement and internal logical connection in the form that they consider best and most convincing for revealing their creative concept. The main elements of the FQW in the order of their arrangement are as follows:

1. Title page
2. FQW assignment with extended appendix to the assignment
3. Schedule
4. Abstract
5. Table of contents
6. Introduction
7. Chapters of the main part
8. Conclusion
9. List of sources used
10. Appendices
11. Supplementary indexes

The following requirements are imposed on the content of individual structural elements of the FQW:

1. The title page contains the following details: Ministry of Science and Higher Education of the Russian Federation, Federal State Autonomous Educational Institution of Higher Education "North Caucasus Federal University," name of the institute, department, title of the FQW topic, last name, first name, patronymic of the author of the work indicating the course, group, mode of study; academic degree, title, position, initials and last name of the scientific supervisor, consultants (co-supervisors), reviewer, the fields "Date of Defense," "Grade," place and year of defense.

2. The abstract indicates the object, subject, and research methods, the results obtained, and the effectiveness of the project developments. It must contain information about the volume (number of pages) of the FQW, the number of illustrations, sources used, and appendices. The abstract does not exceed one page in length.

3. The table of contents includes the introduction, a list of all sections and subsections according to the work plan, conclusion, list of sources used, appendices with page numbers indicating where these elements begin. The word "Contents" is written as a heading (centered).

4. The introduction contains a justification of the problem, its relevance, the goal and objectives of the design, and the determination of the theoretical and/or practical significance of the work. The recommended length is 2 pages of typewritten text.

5. The list of sources used is formatted in accordance with the requirements of GOST for bibliography; it includes all sources of scientific and technical literature and documentation used by the student.

6. The appendices include tables, diagrams, graphs, charts, questionnaires, and other materials illustrating or confirming the main theoretical propositions and conclusions.

The content of each of the sections included in the structure of the final qualifying work is discussed in detail in Section 5.

4.1 Scope of the Final Qualifying Work

The final qualifying work consists of a calculation and explanatory note (A4 format) and a graphic part (A1 format).

For the final qualifying work in master's degree programs, the recommended scope is at least 60 and no more than 120 pages of printed text, containing 6-8 sheets of graphic material, or 10-12 slides.

The list of sources used in the final qualifying work for master's degree programs must contain at least 20 items.

5 CONTENT OF THE FINAL QUALIFYING WORK (BY TYPE), INCLUDING THE CONTENT OF EACH SECTION INCLUDED IN THE STRUCTURE OF THE FINAL QUALIFYING WORK

The following requirements are imposed on the content of individual structural elements of the FQW:

1. The title page is the first page of the master's thesis and is filled out according to strictly defined rules.

After the title page, the table of contents is placed, which lists all the headings of the dissertation work (except for subheadings given in the text) and indicates the pages on which they begin. The headings in the table of contents must exactly match the headings in the text. They cannot be abbreviated or given in a different formulation, sequence, or subordination compared to the headings in the text.

2. The abstract indicates the object, subject, and research methods, the results obtained, and the effectiveness of the project developments. It must contain information about the volume (number of pages) of the FQW, the number of illustrations, sources used, and appendices. The abstract does not exceed one page in length.

3. The table of contents includes the introduction, a list of all sections and subsections according to the work plan, conclusion, list of sources used, appendices with page numbers indicating where these elements begin. The word "Contents" is written as a heading (centered).

4. The introduction to the diploma thesis or diploma project for the master's degree program. Here, as a rule, the relevance of the chosen topic is justified, the goal and content of the set tasks are formulated, the object and subject of the research are defined, the chosen research method (or methods) are indicated, the theoretical significance and applied value of the results obtained are reported, and the propositions to be defended are noted.

Thus, the introduction is a very important part of the dissertation, since it not only guides the reader in the further disclosure of the topic but also contains all the necessary qualification characteristics.

Relevance is a mandatory requirement for any diploma thesis or diploma project for the master's degree program. Therefore, it is quite understandable that its introduction should begin with a justification of the relevance of the chosen topic.

In application to the diploma thesis or diploma project for the master's degree program, the concept of "relevance" has one peculiarity. The diploma thesis or diploma project for the master's degree program is a qualifying work containing scientific novelty, and how its author is able to characterize the chosen topic and how correctly they understand and evaluate this topic from the point of view of timeliness and social significance characterizes their scientific maturity and professional preparedness.

The coverage of relevance should be concise. There is no particular need to start describing it from afar. It is sufficient within 1–2 pages to show the main thing – the essence of the problematic situation, from which the relevance of the topic will be clear.

Thus, if the master's student is able to show where the boundary between knowledge and ignorance about the subject of research lies, then it is not difficult for them to clearly and unambiguously define the scientific problem, and consequently, to formulate its essence.

The diploma thesis or diploma project for the master's degree program must necessarily contain a literature review, which should lead to the conclusion that this particular topic has not yet been disclosed (or has been disclosed only partially or in a different aspect) and therefore needs further development.

The literature review on the topic should demonstrate the master's student's thorough acquaintance with the specialized literature, their ability to systematize sources, critically examine them, highlight the essential, evaluate what has been done previously by other researchers, and determine the main points in the current state of knowledge of the topic. The materials of such a review should be systematized in a certain logical connection and sequence.

From the formulation of the scientific problem and proof that the part of this problem that is the topic of this diploma thesis or diploma project for the master's degree program has not yet received its development and coverage in the specialized literature, it is logical to move on to formulating the goal of the research being undertaken, as well as to indicate the specific tasks that are to be solved in accordance with this goal. This is usually done in the form of a list (to study..., to describe..., to establish..., to identify..., to derive a formula..., etc.).

The formulation of these tasks must be done as carefully as possible, since the description of their solution should constitute the content of the chapters of the diploma thesis or diploma project for the master's degree program. This is also important because the headings of such chapters are derived precisely from the formulations of the tasks of the research being undertaken.

An obligatory element of the introduction is the formulation of the object and subject of the research. The object is a process or phenomenon that gives rise to a problematic situation and is chosen for study. The subject is that which is within the boundaries of the object. The object and subject of research as categories of the scientific process relate to each other as general and particular. In the object, that part of it which serves as the subject of research is distinguished. It is precisely on this that the main attention of the master's student is focused; it is the subject of research that determines the topic of the diploma thesis or diploma project for the master's degree program, which is indicated on the title page as its title.

An obligatory element of the introduction of the diploma thesis or diploma project for the master's degree program is also the indication of the research methods that serve as a tool in obtaining factual material, being a necessary condition for achieving the goal set in such a work.

The introduction also describes other elements of the scientific process. These include, in particular, an indication of the specific material on which the work itself was carried out. Here, a description of the main sources of information (official, scientific, literary, bibliographic) is also given, and the methodological foundations of the conducted research are indicated.

At the end of the introductory part, it is desirable to reveal the structure of the diploma thesis or diploma project, i.e., to provide a list of its structural elements and justify the sequence of their arrangement.

1. In the chapters of the main part of the diploma thesis or diploma project for the master's degree program, the methodology and techniques of the research are examined in detail and the results are summarized. All materials that are not essential for understanding the solution of the scientific problem are placed in appendices.

The main text should be presented, as a rule, with theoretical and empirical sections. There should be at least two of them. Each section presents an independent issue of the topic under study. The FQW must be logically structured, the component parts must be interconnected, and the sections must end with conclusions.

The content of the chapters of the main part must exactly correspond to the topic of the work and fully disclose it. These chapters should demonstrate the master's student's ability to present material concisely, logically, and with argumentation.

2. The concluding part presupposes the presence of a generalized final assessment of the work done. At the same time, it is important to indicate what its main meaning is, what important results have been obtained, and what new tasks arise in connection with the research conducted.

The concluding part should not be a simple list of the results obtained from the research conducted, but their final synthesis, i.e., the formulation of what is new that its author has contributed to the study and solution of the problem.

3. The list of sources used is formatted in accordance with the requirements of GOST for bibliography; it includes all sources of scientific and technical literature and documentation used by the student.

4. The appendices include tables, diagrams, graphs, charts, questionnaires, and other materials illustrating or confirming the main theoretical propositions and conclusions.

The connection between the main text and the appendices is made through references, which are used with the word "see"; it is usually abbreviated and enclosed together with the code in parentheses.

The diploma thesis or diploma project for the master's degree program should preferably be supplied with supplementary indexes, which are placed after the appendices or in their place if the latter are absent. The most common are alphabetical subject indexes, which are a list of the main concepts encountered in the text that are directly related to it, indicating the pages.

A title page for the archive is glued to the hard cover of the FQW.

When completing the FQW in the form of a diploma thesis or comprehensive work, the content must correspond to the following approximate structure:

- justification of the choice of subject and formulation of the research task, carried out on the basis of a literature review, including taking into account periodical scientific publications and the results of a patent search;
- theoretical and (or) experimental parts, including research methods and tools;
- mathematical models, calculations, design, and (or) technological parts;
- results obtained during the preparation of the FQW, having scientific novelty, theoretical, applied, or scientific-methodological significance;
- approbation of the obtained results and conclusions in the form of reports at scientific conferences or prepared publications in scientific journals and collections;

- conclusions and recommendations.

When completing the FQW in the form of a startup, the content must correspond to the following approximate structure:

- general description of the project, including basic concepts;
- description of trends and the market (target audience, competitors, analogues), the developed product/technology;
- business model;
- financial plan and scaling/marketing potential of the project;
- results of individual work in the project in accordance with the FQW-S assignment.

6. FORMATTING OF THE FINAL QUALIFYING WORK (BY TYPE)

Compliance with the requirements for the formatting of the FQW (i.e., conformity with the norms and requirements of applicable state, international, industry standards and other regulatory documents, formatting of the text, the list of references, drawings, etc.) is monitored by the standards controller.

Professors and highly qualified teachers of the graduating department and other departments of the university, as well as researchers and specialists of relevant institutions, may be appointed as standards controllers; the FQW supervisor may also perform the functions of a standards controller. When conducting standards control, one should be guided by: indexes (catalogs, lists) of state, international, and industry standards, technical specifications, etc.; current regulatory documents applicable to the standardization object; terminological dictionaries (reference books, collections); files of implementation of regulatory documents; systematization tables, etc.

The standards controller has the right to return the FQW in cases of non-compliance with requirements, careless execution, absence of necessary signatures, absence of documents referenced in the work, etc.; to require explanations and additional materials from the student on issues arising during the verification; not to sign the FQW in cases of failure to comply with requirements.

6.1 Formatting of the Explanatory Note

The explanatory note to the final qualifying work is classified as a text document and must comply with the requirements of GOST 2.105-95.

The text of the FQW is executed using a computer on one side of a sheet of white paper, A4 format, font – Times New Roman size 14, line spacing – 1.5. The page number is placed in the lower right corner of the sheet. Pages of the text material shall be numbered with Arabic numerals, observing consecutive numbering throughout the entire document. The title page of the text document is included in the overall page numbering. The page number is not printed on the title page. The distance from the paper edge to the text boundaries shall be: at the beginning of lines – 30 mm; at the end of lines – 15 mm; from the top or bottom line of text to the top or bottom edge of the paper – 20 mm. The paragraph indentation shall be identical throughout the entire text of the work and equal to 12.5 mm.

The text of the calculation and explanatory note of the FQW is divided into sections and subsections, which must contain a heading corresponding to the content of the work.

Each section and main structural parts of the work: introduction, conclusion, list of sources used, and appendices should begin on a new page. After the heading, the text of the calculation and explanatory note begins with a paragraph indentation (1.25 cm).

Sections must have sequential numbers within the entire FQW, designated by Arabic numerals. The page number in the stamp of the section title page is not written, but the number of pages in the section is indicated.

Subsections must be numbered within each section. Subsection numbers consist of the section number and subsection number, separated by a dot. There is no dot at the end of the subsection number.

Sections and subsections must have headings. Headings should be written with a capital letter without a dot at the end. Word hyphenation in headings is not permitted. No dot is placed at the end of the heading. If the heading consists of two sentences, they are separated by a dot. Underlining of the heading is not permitted. The heading of sections and subsections is placed symmetrically to the text with a paragraph indentation (1.25 mm), with a capital letter, without a dot at the end, not underlined, and separated from the text by an interval of one line. The distance between the heading and the text should be 18 pt or one empty line. The distance between the headings of a section and a subsection on a new line is without additional intervals.

Each section of the explanatory note is recommended to begin on a new page (the introduction, conclusion, list of references, appendices, etc. are equated to sections).

Numbering of items should consist of the section number, subsection number, and item number, separated by a dot. Items, if necessary, are divided into sub-items. After the last digit of the subsection, item, or sub-item number, no dot is placed, for example: 4.2, 4.2.1, etc. Four-digit numbering is the maximum.

For example:

Indent 1.25 cm:

a. Determination of the time of use of the maximum load

Interval of 18 pt

This final qualifying work (FQW) addresses the task

of.....

Interval of 18 pt

1.2 Active Power Balance and Placement of Compensating Devices

1.2.1 Load Calculation

Interval of 18 pt

The initial data for the design are the maximum winter active

loads.....

Interval of 18 pt

1.2.2 Active Power Balance

Interval of 18 pt

The power supply source for the designed district network is the busbars of the nodal substation.....

Damage to sheets, erasures, or corrections in the text or graphic part are not permitted. The explanatory note must be bound by a printing method in a hard cover.

Within items or sub-items, enumerations may be given, which are separated from each other by a semicolon. A hyphen or a lowercase letter of the Russian alphabet followed by a parenthesis should be placed before each enumeration item. For further detailing of enumerations, Arabic numerals followed by a parenthesis should be used, and the entry is made with a paragraph indentation.

For example:

Technical conditions include the selection of cross-sections:

a) by voltage losses in normal and post-emergency modes;

б) by heating:

1) from prolonged heat release by the rated current;

2) from short-term heat release by short-circuit current (thermal withstand to short-circuit currents).

uuu

At the plant, consumers of categories I and II in terms of power supply reliability prevail, such as:

- compressor room, boiler house, and foundry – category I;
- main production workshops

Enumerations are written in lowercase letters; a semicolon is placed at the end of each, and a period is placed at the end of the last one.

The numbers indicating the numbers of subsections, items, sub-items, and enumerations are written with a paragraph indentation.

The page number is placed in the lower right corner of the sheet. Pages of the text material shall be numbered with Arabic numerals, observing consecutive numbering throughout the entire document. When numbering, pages are counted from the first (the title page of the FQW), and numbering is placed starting from the table of contents.

When referencing in the text to a source whose description is included in the bibliographic list, in the text of the explanatory note, after mentioning it, the number under which it appears in the bibliographic list is placed in square brackets and, if necessary, the pages, for example: [3], [12], [26, p. 125].

Presentation of the text of the explanatory note. The text of the note must be concise, clear, and not allow for various interpretations.

The text should use scientific and technical terms, designations, and definitions established by relevant standards, and in their absence, those generally accepted in scientific and technical literature.

In the text of the explanatory note, the following is not permitted:

- to use colloquial turns of phrase;
- to use different scientific-technical terms that are close in meaning (synonyms) for the same concept, as well as foreign words and terms if equivalent Russian words and terms exist;
- to abbreviate designations of physical quantity units if they are used without numerals, except for physical quantity units in table headings and side headings, and in explanations of letter symbols appearing in formulas;
- to use word abbreviations, except those established by the rules of Russian orthography and punctuation, as well as by relevant state standards (abbreviations commonly accepted in the Russian language under GOST 2.315-68);
- to use mathematical signs, e.g., (-), before numerical values. Instead of the sign, the word "minus" should be written;
- to use mathematical signs without numerals, e.g., < (less than or equal to), > (greater than or equal to), signs № (number), % (percent), etc.;
- to use standard indices (GOST, OST, RST, STP, ST, CMEA) without registration numbers.

Standardized units of physical quantities, their names, and designations shall be used in accordance with GOST 8.417-81.

Alongside SI units, if necessary, units of previously used systems permitted for use shall be indicated in parentheses. The use of different systems for designating physical quantities within a single document is not permitted.

Numerical values of quantities in the text shall be given with the degree of precision necessary to ensure the required properties, while aligning the number of decimal places within a series of quantities.

Rounding of numerical values of quantities to the first, second, third, etc. decimal place for different sizes, grades, etc. of products of the same name must be uniform. If a range of numerical values of a physical quantity expressed in the same unit of physical quantity is given in the document, the designation of the physical quantity unit is indicated after the last numerical value of the range, for example: "From 10 to 50 kVA", "From 10 to 100 kW", "From plus 10 to minus 40°C".

It is not permissible to separate the unit of a physical quantity from its numerical value (i.e., to break them across different lines or pages), except for units of physical quantities placed in tables produced by typewriting.

Formatting of formulas. In formulas, the symbols established by the relevant standards shall be used. When using a computer, the use of a formula editor is mandatory. Explanations of the symbols and numerical coefficients included in the formula, if not explained previously, shall be provided directly below the formula. Explanations for each symbol shall be given on a new line in the sequence in which they appear in the formula. The first line of the explanation shall begin with the word "where" in lowercase (small) letters without a colon after it, without a paragraph indentation.

For example :

If the formula is without calculations, center alignment is used:

The selection of cross-sections by heating is carried out based on the calculated current in normal and post-emergency modes using the following expressions:

in normal mode:

$$I_p = \frac{S_p}{n \cdot \sqrt{3} \cdot U_H}; \quad (1.36)$$

in post-emergency mode:

$$I_{\max p} = \frac{S_p}{\sqrt{3} \cdot U_H}, \quad (1.37)$$

where S_p – is the calculated line power, kVA;

n – is the number of lines;

U_H – is the rated network voltage, kV.

If the formula is presented with calculations, left alignment with a 1.25 cm indent is used:

Hence, the economically feasible cross-section

$$F_{\text{ЭК}} = \frac{I_{\text{PH}}}{j_{\text{ЭК}}} = \frac{77,26}{1,7} = 45,45 \text{ mm}^2.$$

The obtained cross-section is rounded to the nearest standard value $F_{\text{табл.}}$
 $= 50 \text{ mm}^2.$

Formulas that follow one another and are not separated by text shall be separated by a comma..

Transferring a formula to the next line is permitted only at the signs of the operations being performed, and the sign at the beginning of the next line shall be repeated. When transferring a formula at the multiplication sign, the "×" sign is used. Transfers at the division sign are not permitted.

Formulas, except those placed in appendices, shall have consecutive numbering in Arabic numerals, which are written on the same level as the formula on the right in parentheses. A single formula is designated as (1). Numbering of formulas within a section is permitted, e.g., (3.1) – the first formula of the third section.

Formulas in appendices shall be numbered with Arabic numerals within each appendix, prefixing the numeral with the appendix designation, e.g., formula (B.1).

References in the text to the sequential numbers of formulas are given in parentheses, for example: ... in formula (2).

If the number does not fit on the same line as the formula, it is placed on the next line below the formula. When a formula is continued on another line, the number is placed level with its last line.

Calculations performed using formulas shall be presented in the following order:

- 1) write the formula;
- 2) explain its symbols;
- 3) substitute the numerical data in the order of the symbols;
- 4) write the final result with an indication of the dimension.

The designation of units of the same parameter within the explanatory note must be consistent.

Formatting of illustrations. Illustrations (drawings, graphs, diagrams, sketches, photographs) shall be positioned so that they can be viewed conveniently without rotation or with a clockwise rotation.

Each illustration must correspond to the text, and the text to the illustration. Necessary qualities of any illustration are clarity, graphic expressiveness, and lucidity. The drawings, diagrams, and graphs used must meet the requirements of the state standards that are part of the Unified System for Design Documentation (ESKD).

The number of illustrations shall be sufficient to explain the text presented. Illustrations may be placed either within the text (as close as possible to the relevant parts of the text), or at the end of the document, or given in an appendix.

Figures are numbered within the section. In this case, the illustration number consists of the section number and the sequential number of the illustration, separated by a dot. Illustrations shall be placed centered on the page immediately after the text in which they are first mentioned, or on the next page. All illustrations must be referenced in the text of the FQW.

Captions under figures should be placed horizontally, without frames, near the element to which they relate. Each figure must have a brief descriptive title, which is placed under the figure, centered, in the following order: the illustration designation "Figure", the sequential number in numerals without the symbol "No.", and then the title of the illustration. The title of the figure begins with a capital letter; no dot is placed at the end of the title. After presenting the figure in the text of the FQW, an empty line or a spacing of 18 pt is left.

For example:

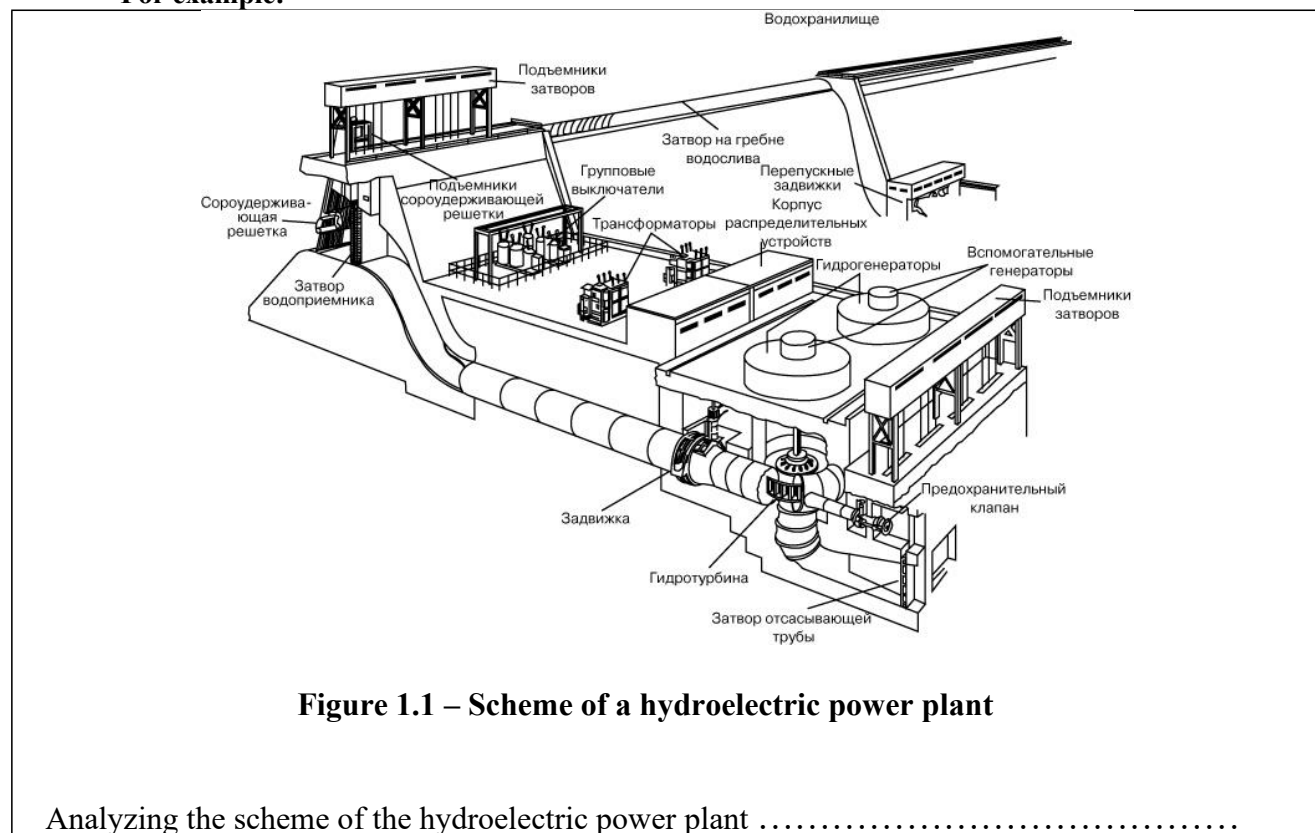


Figure 1.1 – Scheme of a hydroelectric power plant

Analyzing the scheme of the hydroelectric power plant

Construction of Tables. Numerical material is generally presented in the form of tables. Tables are verbal-numerical material organized into vertical columns and horizontal rows, forming a specific grid, each element of which is a component part of both a column and a row.

Depending on its size, the table shall be placed below the text where the reference to it first appears, or on the next page, or, if necessary, in an appendix to the document.

It is permissible to place a table along the long side of a document sheet.

Tables, except for tables in appendices, shall be numbered consecutively with Arabic numerals. Numbering tables within a section is permitted. In this case, the table number consists of the section number and the sequential number of the table, separated by a dot, for example, the fifth table in the first section – Table 1.5.

Tables of each appendix are designated by separate numbering in Arabic numerals, adding the appendix designation before the numeral.

The word "Table" is indicated once (on the left according to GOST 2.105-95) above the first part of the table. If the rows or columns of the table extend beyond the sheet format, the table is divided into parts, which, depending on the table's features, are transferred to other sheets or placed on the same sheet next to each other or one below the other. Above the continuation of the table on a new page, a header of the type "Continuation of Table 3.4" is placed on the left.

The thematic heading of the table is written in lowercase letters (except for the first capital letter) and placed in the middle of the table. The heading must be precise, brief, and fully reflect the content of the table. The thematic heading above the continuation of the table on a new page is not repeated.

If the rows or columns of the table extend beyond the page format, it is divided into parts, placing one part below another or next to each other, repeating the table head and side head in each part. When dividing a table into parts, it is permissible to replace its head or side head with the corresponding column or row numbers, respectively; in this case, the columns and/or rows of the first part of the table are numbered with Arabic numerals.

All tables must be referenced in the text, for example: "... in Table 1.1". The reference to the table should be placed after the first mention of its data. Subsequent references to the table are made with the word "See", for example: (see Table 1.1). An example of a table layout is presented in Table 9.1. In the text of the FQW, an indent equal to one empty line or 18 pt is left before and after the table.

For example:

..... **Table 1.1 shows the electrical loads of the plant.**

Table 9.1 – Electrical loads of the equipment manufacturing plant ...

№№	Name of Shops and Sections	Installed power at 0.4 kV voltage	
		P _{устр} , кВт	cosφ
1	2	3	4
1	Foundry	1500	0,75
2	Forging and pressing shop	2340	0,7

Continuation of Table 9.1

1	2	3	4

Formatting of Appendices. Material that supplements the text of the explanatory note may be placed in appendices. The following are formatted as appendices: lists of elements, specifications, program texts, large-format tables, etc. References to all appendices must be given in the text of the document. Appendices are arranged in the order of references to them.

An appendix is generally executed on A4 sheets. It is permissible to use A3 format.

Each appendix should begin on a new page, with the word "Appendix" and its designation indicated at the top in the middle of the page. The appendix must have a title, which is written symmetrically with respect to the word "Appendix" in capital letters on a separate line.

For example:

Appendix A

Table A.1 – Data on

Appendix B

Electrical load curves

Operating modes of electricity consumers

All appendices must be listed in the table of contents with their designations and titles.

Bibliographic references. Bibliographic references are formatted in accordance with the requirements of GOST R 7.0.5.

Bibliographic references are used:

- when quoting;
- when borrowing propositions, formulas, tables, illustrations;
- when it is necessary to refer to another publication where the issue is more fully expounded;
- when analyzing published works in the text.

There are two types of bibliographic references: in-text and footnotes.

In-text references are placed directly in the line after the text to which they refer. They are formatted in square brackets indicating the number in the reference list, e.g., [31]. References to several specific works of an author may be given, for example, in the form [12-17, 19].

When quoting, as well as in cases requiring the indication of a specific page of the source, the page is additionally indicated in parentheses [12. P. 7] or pages "from – to" [19. P. 7 – 9].

For example:

When a particle flies near the nucleus, it is acted upon by a Coulomb repulsive force [14, P. 51].

Footnotes are placed at the bottom of the page, below the lines of the main text, and have consecutive numbering throughout the entire document.

For example:

The literary scholar Levidov A.M. wrote that "it is not the number of books read that serves as an indicator of reading culture, but the quality of their consumption."¹

¹ Levidov A.M. Literature and Reality / A.M. Levidov. – M.: Academy, 1987. – P. 409.

List of sources used. The bibliographic list is formatted in accordance with the requirements of GOST 7.1 and GOST 7.80. An example of formatting is given below.

Books

– Book by one, two, or three authors:

1. Fedotov, Yu.V. *Methods and Models for Constructing Empirical Production Functions* / Yu.V. Fedotov. – St. Petersburg : St. Petersburg State University Press, 1997. – 220 p.

2. Furubotn, E.G. *Institutions and Economic Theory: The Achievements of the New Institutional Economic Theory* / E.G. Furubotn, R. Richter; trans. from English ed. by V.S. Katkalo, N.P. Drozdova. – St. Petersburg : St. Petersburg State University Publishing House, 2005. – XXXIV, 702 p.

3. Horngren, Ch.T. *Accounting: A Managerial Aspect* / Ch.T. Horngren, J. Foster; ed. by Ya.V. Sokolov. – M. : Finance and Statistics, 2004. – 416 p.

4. Williamson, O.E. *The Mechanisms of Governance* / O.E. Williamson. – New York : Oxford University Press, 1996. – 429 p.

– Book with more than three authors:

Real Estate Economics and Finance / D.L. Volkov [et al.]; ed. by Yu.V. Pashkus. – St. Petersburg : St. Petersburg State University Press, 1999. – 186 p.

– Collection edited by:

The Seven Notes of Management / ed. by V. Krasnova, A. Privalov. – 3rd ed., supplemented. – M. : Expert Journal, 1998. – 424 p.

Legal and Regulatory Acts

1. *Constitution of the Russian Federation*: official text. – M. : Marketing, 2001. – 39 p.

2. *Family Code of the Russian Federation*: [federal law: adopted by the State Duma on Dec. 8, 1995: as of Jan. 3, 2001]. – St. Petersburg : Staun-country, 2001. – 94 p.

Standards

1. GOST R 7.0.53-2007 *System of Standards on Information, Librarianship and Publishing. Publications. International Standard Book Number. Use and Publishing Presentation*. – M. : Standartinform, 2007. – 5 p.

Deposited Scientific Works

1. Razumovsky, V.A. *Management of Marketing Research in the Region* / V.A. Razumovsky, D.A. Andreev. – M., 2002. – 210 p. – Deposited at INION of the Russian Academy of Sciences 02/15/02, No. 139876.

Dissertations

1. Lagkueva, I.V. *Peculiarities of Labor Regulation for Creative Workers of Theaters*: diss. ... Candidate of Juridical Sciences: 12.00.05 / Lagkueva Irina Vladimirovna. – M., 2009. – 168 p.

2. Pokrovsky, A.V. *Removable Singularities of Solutions of Elliptic Equations*: diss. ... Doctor of Physical and Mathematical Sciences: 01.01.01 / Pokrovsky Andrey Vladimirovich. – M., 2008. – 178 p.

Dissertation Abstracts

1. Sirotko, V.V. *Medico-Social Aspects of Urban Trauma in Modern Conditions*: abstract of diss. ... Candidate of Medical Sciences: 14.00.33 / Sirotko Vladimir Viktorovich. – M., 2006. – 17 p.

2. Lukina, V.A. *The Creative History of I.S. Turgenev's "A Sportsman's Sketches"*: abstract of diss. ... Candidate of Philological Sciences: 10.01.01 / Lukina Valentina Alexandrovna. – St. Petersburg, 2006. – 26 p.

Research Reports

1. *Methodology and Methods for Studying the Military-Professional Orientation of Adolescents*: research report / Zagoryuev A.L. – Yekaterinburg : Ural Institute of Practical Psychology, 2008. – 102 p.

Electronic Resources

1. *Art Encyclopedia of Foreign Classical Art* [Electronic resource]. – M. : Great Russian Encyclopedia, 1996. – 1 electronic optical disc (CD-ROM).

2. Nasyrova, G.A. *Models of State Regulation of Insurance Activities* [Electronic resource] / G.A. Nasyrova // Bulletin of the Financial Academy. – 2003. – N 4. – Access mode: [http://vestnik.fa.ru/4\(28\)2003/4.html](http://vestnik.fa.ru/4(28)2003/4.html).

3. Shirkovets A.I., Sarin L.I., Ilyinykh M.V., Podyachev V., Shalin A. *Resistive Neutral Grounding in 6-35 kV Networks with XLPE Cables* // Electrical Engineering News. 2008. No. 2(50) pp. 3-6. [Electronic resource] // URL: <http://www.news.elteh.ru/arh/2008/50/14.php> (accessed: 03.03.2017)

Articles

– Article from a journal by one, two, or three authors:

1. Raskov, N.V. *Macroeconomic Deformations and Economic Policy Guidelines* / N.V. Raskov // World Economy and International Relations. – 1998. – No. 2. – P. 115-120.

2. Libo, M.G. *Telework as a New Form of Personnel Management in Virtual-Type Organizations* / M.G. Libo, S.V. Kosheleva // Bulletin of St. Petersburg University. Series 8. Management. – 2004. – Issue 3. – P. 117-137.

3. Kushch, S.P. *Marketing Aspects of Interfirm Network Development: Russian Experience* / S.P. Kushch, A.A. Afanasiev // Russian Management Journal. – 2004. – Vol. 2, No. 1. – P. 33-52.

– Article from a journal with more than three authors:

1. *Financial Dynamics and Neural Network Analysis: A Study of the Business Environment* / S.V. Kotelkin [et al.] // Bulletin of St. Petersburg University. Series 8. Management. – 2002. – Issue 3. – P. 120-143.

– Article from a collection (authored):

1. Raskov, N.V. *Formation of Financial-Industrial Groups in the Perspective of Economic and Political Problems in Russia* / N.V. Raskov // Russian Banks Today / ed. by D.L. Volkov [et al.]. – St. Petersburg, 1997. – P. 70-75.

2. Katkalo, V. *Institutional Structure and Innovation in the Emerging Russian Software Industry* / V. Katkalo, D. Mowery // The International Computer Software Industry / ed. by D.C. Mowery. – New York, 1996. – P. 240-271.

6.2 Formatting of the Graphic Part

Technical documentation is executed on sheets of specific sizes, which are called formats (GOST 2.301-68). Sheet formats are determined by the dimensions of the outer frame of the sheet. Formats are divided into basic and additional.

The following are adopted as basic formats:

A0 – 841×1189 mm\

1 – 594×841 mm;

A2 – 420×594 mm;

A3 – 297×420 mm;

A4 – 210×297 mm.

The graphic part of the FQW is executed on A1 format sheets.

All technical documentation is accompanied by a title block. Title blocks are placed in the lower right corner of technical documents. On A4 format sheets, title blocks are placed along the short side of the sheet.

Title blocks, additional columns, and frames are executed with solid thick lines and solid thin lines. In the columns of the title block (GOST 2.104-68) (column numbers in Figure 9.2 are given in parentheses), the following is indicated:

- 1 – name of the product in accordance with GOST 2.109-73, or name of the drawing;
- 2 – document designation (FQW-NCFU-13.03.02-grade book No.-defense year);
- 3 – name of the document (topic of the final qualifying work);
- 4 – letter designation in accordance with GOST 2.103-68 (U);
- 5 – mass of the product in accordance with GOST 2.109-73 (if applicable);
- 6 – scale (in accordance with GOST 2.302-68 and GOST 2.109-73);
- 7 – sequential number of the sheet (on documents consisting of a single sheet, this column is not filled in);
- 8 – total number of sheets of the document;
- 9 – name or distinguishing index of the enterprise issuing the document (number of the academic group);
- 10, 11, 12 – nature of the work, surnames and signatures of the persons who developed the document;
- 13 – date of signing the document.

By decision of the graduating department, the graphic part of the FQW may be presented in the form of a presentation of 10–12 slides.

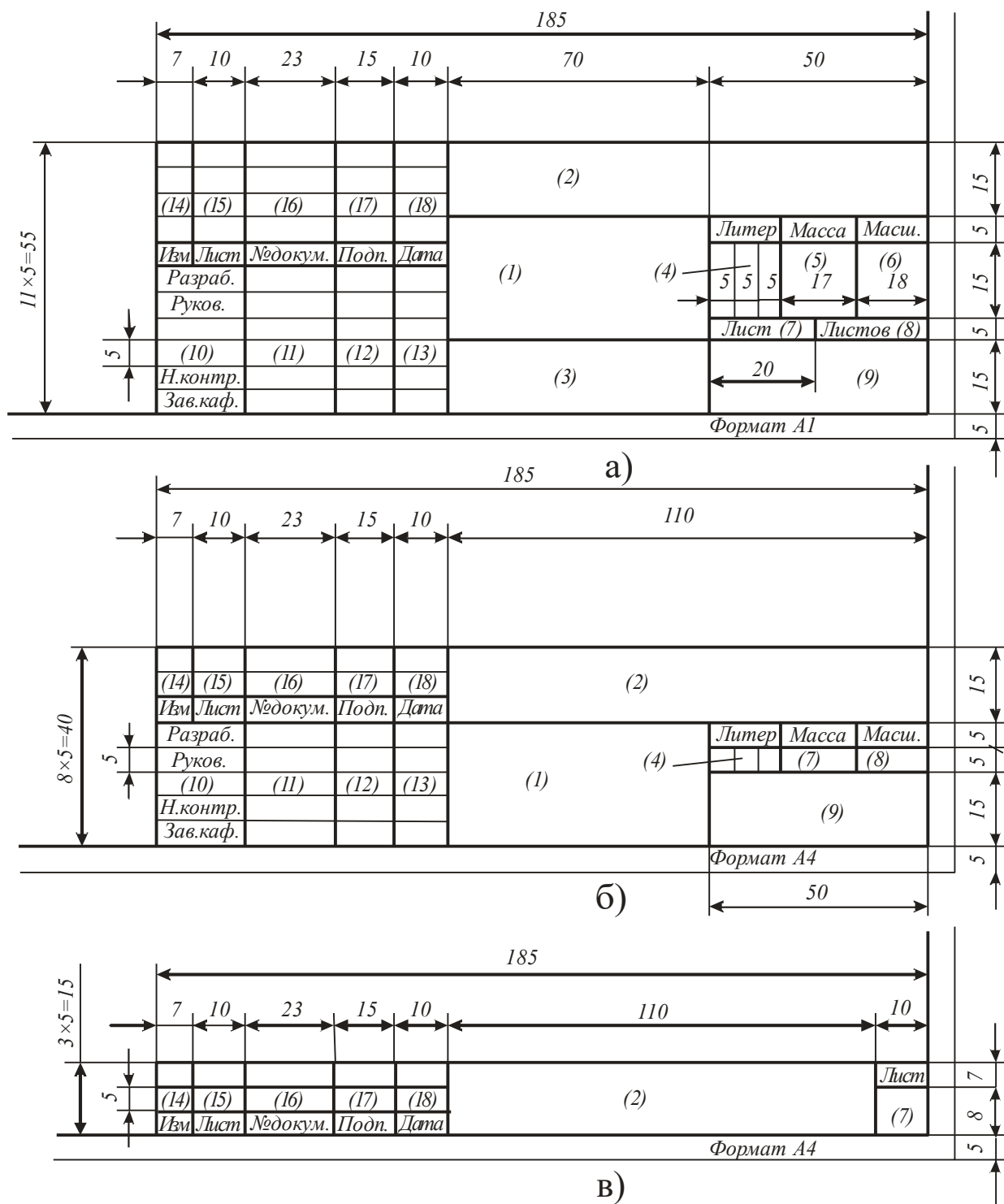


Figure 6.2 – Title block:
a) – for drawings and diagrams;
б) – for text documents;
в) – for subsequent sheets of drawings, diagrams, and text documents.

7. PROCEDURE FOR COMPLETING THE FINAL QUALIFYING WORK (BY TYPE) AND PROCEDURE FOR PREPARING THE FINAL QUALIFYING WORK FOR DEFENSE (BY TYPE)

The procedure for completing the final qualifying work (in the form of a diploma project, diploma thesis, comprehensive work, or work in the form of a startup) and the procedure for preparing the final qualifying work for defense (in the form of a diploma project, diploma thesis, comprehensive work, or work in the form of a startup) are regulated by the basic requirements developed by the educational institution: "Regulations on the Procedure for Completing Final Qualifying Works at the Federal State Autonomous Educational Institution of Higher Education 'North Caucasus Federal University'" and "Regulations on the Procedure for Conducting State Final Assessment in Higher Education Programs – Bachelor's, Specialist's, and Master's Programs at the Federal State Autonomous Educational Institution of Higher Education 'North Caucasus Federal University'," "Regulations for Completing Final Qualifying Works in the Form of a Startup in Higher Education Programs – Bachelor's, Specialist's, and Master's Programs at the Federal State Autonomous Educational Institution of Higher Education 'North Caucasus Federal University'," "Regulations for Completing Final Qualifying Works (Comprehensive Works) in Higher Education Programs – Bachelor's, Specialist's, and Master's Programs at the Federal State Autonomous Educational Institution of Higher Education 'North Caucasus Federal University'" (new edition).

7.1 Selection of the Topic of the Final Qualifying Work, Supervisor, and Consultants for Sections

For the period of work on the FQW, a supervisor and consultants for individual sections are assigned to the student within the time limit allocated for the FQW. The student has the right to independently choose an FQW supervisor from the list of teaching staff proposed by the graduating department of Automated Electric Power Systems and Power Supply.

Supervisors of qualifying works are appointed from among the professorial and teaching staff of this university, as a rule, professors and associate professors, as well as researchers and highly qualified specialists of this university and other institutions and enterprises.

7.1.1 Procedure for Determining the Topic

The topics of qualifying works are determined by the student's specialized training in the profile of the graduating department and must correspond to promising areas of development of science and technology. The list of topics of final qualifying works offered to students (hereinafter referred to as the list of topics) is determined by the graduating departments, reviewed annually at meetings of the graduating departments, approved by the Academic Council of the institute, and brought to the attention of students no later than six months before the start date of the State Final Assessment.

The choice of topic is influenced by the following factors:

- the presence of scientific schools of leading specialists of the graduating department;
- the presence of contract-based and budget-funded research and development topics, as well as grants obtained by scientists and specialists of the department;
- participation in youth innovation projects; the NCFU technopark; the NCFU business incubator; the student scientific association; the council of young scientists and specialists; the student research and innovation association; the student design bureau; student information societies, etc.;
- the student's scientific interest, the topics of their research work during the training period, their publications, etc.

The topics of final qualifying works must be relevant, correspond to the profile of the field of study (specialty), take into account the industry specifics and focus of NCFU's activities, and the current state and prospects for the development of science.

The student is given the right to choose the topic of the final qualifying work. Upon the written application of the student (or several students completing the final qualifying work jointly), the graduating department may, in accordance with the established procedure, provide the student(s) with the opportunity to prepare and defend a final qualifying work on a topic proposed by the student(s), if the feasibility of its development for practical application in the relevant field of professional activity or at a specific object of professional activity is justified.

Students are given the right to choose the topic of the qualifying work. When choosing the topic of the qualifying work, the student may be guided by their own scientific interests, its relevance, and the interests of the enterprise on the basis of which the work is carried out. The topics of qualifying works and their supervisors are approved by order of the director of the institute upon the recommendation of the head of the department. The graduating departments bring the list of FQW topics to the attention of students no later than 1 month before the start of the pre-graduation practice.

The student may propose their own topic for the qualifying work. In this case, they must submit a written application to the head of the department justifying the feasibility of the work. If the issue is resolved positively, the topic of the qualifying work is included in the list of topics of the department.

The choice of the FQW topic is made by the student after consultation with the supervisor. Having agreed on the FQW topic, the student writes an application for the assignment of the FQW topic and supervisor addressed to the head of the department.

The list of topics chosen by students is subject to agreement with the head of the Department of Automated Electric Power Systems and Power Supply and approval by order of the Rector of the University.

The heads of the graduating departments of NCFU, no later than 15 calendar days before the start of the pre-graduation practice, on the basis of the personal applications of students, assign to the student(s) at a department meeting the topics of final qualifying works, supervisors from among professors and associate professors of the graduating department, and in exceptional cases, in accordance with a petition of the department and a decision of the Educational and Methodological Council of the University, senior lecturers with at least 5 years of experience at the University or at least 3 years of experience in the relevant professional field.

7 calendar days before the start of the pre-graduation practice, by order of the director of the institute, on the basis of submissions from the heads of the graduating departments, the topics of final qualifying works (indicating the type of final qualifying work) and supervisors (consultants) with their academic degree, title, and position are approved for final-year students.

No later than the start of the pre-graduation practice, the FQW supervisor issues an assignment to the student corresponding to the chosen topic. The student, together with the FQW supervisor, agrees with the consultants on sections of the FQW on the list of issues to be considered included in the FQW assignment.

Changing or adjusting (refining) the topic is permitted in exceptional cases at the request of the FQW supervisor, with subsequent approval by the Rector of the University. In this case, upon the recommendation of the head of the department, an amendment to the order "On Approval of FQW Topics and Supervisors" is issued.

7.1.1 Topics of Final Qualifying Works

Topics included in the list of relevant research works of PAO "Rosseti":

1. Best practices in the field of import substitution in the Russian Federation and abroad (by industry and country).
2. Analysis and forecast of the state of the market for main electrical equipment and the capabilities of the domestic industry for import substitution (by equipment groups).
3. Organizational and economic mechanisms for implementing the policy of import substitution of electrical equipment.
4. Analysis of approaches to assessing the level of localization of electrical product manufacturing.
5. Assessment of the social impact of grid companies on the development of territorial industrial complexes.
6. Analysis of strategic risks and assessment of their impact on the implementation of import substitution policy in the electric power industry.
7. Management of investment projects in grid companies in the interests of import substitution.
8. Analysis of mechanisms for the participation of grid companies in the development of electrical equipment manufacturing technologies.
9. Organizational and economic mechanisms for facilitating the entry of electrical products of domestic manufacturers into foreign markets.
10. Mechanism for insurance of liability for quality and reliability of power supply as a way to solve the problem of "cross-subsidization."
11. Energy service contracts in addressing issues of placement of static reactive power compensators (SRPC) in networks of multiple owners.
12. Innovative development. Mechanisms for interaction between infrastructure companies and regulatory authorities, business, and educational institutions.
13. Possible schemes for optimizing operating modes using the "Virtual Power Plant" concept.
14. Power supply devices for diagnostic and control equipment at conductor potential.
15. Automated methodology for selecting surge arresters (SA) at substations (CAD).
16. Automated methodology for selecting lightning protection and grounding at substations (CAD).
17. Automated methodology for selecting lightning protection and grounding on high-voltage lines, including surge arresters (CAD).
18. Automated methodology for calculating the aperiodic component of current in the automatic reclosing (AR) cycle (CAD).

19. Automated methodology for calculating electromagnetic compatibility (EMC) of substations (CAD).
20. Calculation methods for evaluating the efficiency and optimizing the placement of surge arresters and lightning arresters on transmission lines.
21. Application of on-load tap-changer (OLTC) reactors for loss reduction and improved regulation quality. Comparison of cost and reliability of design with shunt reactor (SR) and controlled shunt reactor based on thyristor-reactor groups (CSR(T)).
22. Influence of surge arresters and lightning arresters on wave characteristics of overhead lines.
23. Calculated parameters of modern types of cables considering their installation.
24. Identification of failures on polymer insulators. Detection methods and indicators.
25. High-frequency overvoltages in gas-insulated switchgear.
26. Calculation methods and protection against overvoltages in single-phase automatic reclosing cycles of overhead lines.
27. Protection against switching overvoltages using switching device synchronization methods.
28. Calculations of ferroresonance conditions for various schemes and layouts of switchgear 330–500.
29. Assessment of the effectiveness of using modern neutral grounding devices.
30. Assessment of global experience in the operation and installation of cross-linked polyethylene cables.
31. New switching equipment technologies.
32. Reliability indicators of a digital substation.
33. Calculation of digital substation reliability indicators depending on the structure.
34. Technical and economic indicators of the application of wave protections.
35. Methods for detecting short circuits and ensuring automatic reclosing of cable-overhead lines.
36. Technical and economic indicators of wave fault location systems for overhead lines of various configurations (cable-overhead lines, overhead lines with branches, long overhead lines, etc.).
37. Data synchronization algorithms for non-synchronous operation (in the absence of GPS/GLONASS connectivity) of wave fault location devices for overhead lines.
38. Structure of digital data streams in the 61850 protocol.
39. Comparison of relay protection and automation for medium-voltage networks with isolated and resistively grounded transformer neutrals.
40. Comparison of reliability indicators for variants of microprocessor relay protection and automation: traditional, using protocol 61850 8-1, and using 61850 9-2.
41. Methodology for monitoring measurement paths of relay protection and automation for various substation circuit variants.
42. Standard databases required for servicing relay protection and automation devices, creation of a relay protection and automation device passport, and interaction with other services.
43. Standard programs for commissioning, testing, and putting into operation of relay protection and automation devices for various circuit variants and types of reconstruction.
44. Computer-aided design system for the substation relay protection and automation complex (CAD).
45. Automated system for selecting settings and functions of substation relay protection and automation (CAD).
46. "Dead zones" in switchgear of substations. Statistical data and probability of short circuits in the "dead zone." Feasibility of implementing special measures to eliminate them.
47. Modern circuit and technical solutions for ensuring operational interlocking at existing and new substations.
48. Development of measures for managing electrical network operating modes based on information from overhead line condition sensors.
49. Development of approaches to optimizing schedules of scheduled outages of network equipment, taking into account possible reduction in power quality in repair network configurations.
50. Development of approaches for automatic voltage regulation using on-load tap-changers of (auto-) transformers in backbone networks.
51. Development of methods for determining the causes of power quality deterioration in electrical networks based on readings from an automated power quality monitoring system.
52. Development of principles for voltage regulation at a backbone substation with several types of voltage regulation and reactive power compensation means.
53. Development of algorithms for accounting for risks of disruption of reliable power supply to consumers when planning outages of backbone network equipment.
54. Assessment of the loss reduction potential of various measures for mode optimization and

equipment replacement.

55. Multivariable controllers for voltage regulation at a substation.
56. Multi-agent technology for optimization and voltage regulation in electrical networks.
57. Modern methods for assembling and validating topological models and network models based on multi-agent technologies and vector (synchronized) measurements.
58. Use of synchronized measurements for updating network parameters.
59. Modern intelligent algorithms for measurement validation.
60. Use of synchronized measurements for updating generator and load parameters.
61. Methods for accurate determination of corona losses.
62. Use of synchronized measurements for assessing and identifying inconsistencies in metrological characteristics of measuring equipment.
63. Cybersecurity of power system control systems. Ensuring data integrity, attack detection, and response measures.
64. Intelligent algorithms for automatic network restoration after emergencies.
65. Voltage regulation at power plants taking into account corona losses in the adjacent network.
66. Reliability assessment in optimizing substation switchgear configurations.
67. Application of synchronized measurements for detecting emergencies in electrical networks.
68. Criteria for the feasibility of using controlled shunt reactors in EHV networks under various circuit and operational conditions.
69. Assessment of the economic effect of using voltage regulation and power quality improvement means at facilities with traction asymmetrical loads.
70. Automated methodology for calculating a series of operating modes and selecting main equipment during optimization and reliability considerations of substation circuit and technical solutions (CAD).
71. Analysis of the application of standard series towers from the 1970s–1980s in the design of transmission lines according to the 7th edition of the Electrical Installation Regulations.
72. Scope of application of new types of conductors in transmission line design. Regulatory "vacuum," selection problems, and technical effect.
73. "Big transition." Technical and economic comparison of options for using modern types of conductors. Technical feasibility and economic effect.
74. Corrosion effects on overhead line elements, current regulatory framework, and analysis of the effectiveness of protective measures. Domestic and foreign experience.
75. Analysis of the economic and technical efficiency of using modern reinforced concrete towers for transmission line construction.
76. Study of global experience and effectiveness of using polymer insulation on overhead lines.
77. Automated methodology for determining design climatic loads based on zoning maps and observations (CAD).
78. Construction of a regulatory document map and formation of a requirements database for transmission line design (CAD).
79. Study of information models of common CAD systems and assessment of the possibility of applying ISO 15926 for forming a cross-platform information exchange model in design (CAD).
80. Effectiveness of using gas-insulated switchgear.
81. Automated methodology for calculating and selecting the DC auxiliary power system of a substation (CAD).
82. Automated methodology for calculating and selecting circuit and technical solutions for substation auxiliary needs (CAD).
83. Construction of a regulatory document map and formation of a requirements database for transmission line design (CAD).
84. Assessment of the effectiveness of using gas-insulated bus ducts in substation construction.
85. Analysis of failure rates of 220–750 kV power transformers.
86. Analysis of failure rates of gas-insulated switchgear.
87. Use of intelligent search tools for processing data on failure rates of electrical equipment.
88. Assessment of the effectiveness of using unmanned aerial vehicles for servicing transmission lines and substations.
89. Assessment of the effectiveness of using stationary IR and UV spectrum diagnostic sensors.
90. Assessment of the effectiveness of modern methods for diagnosing substation equipment.
91. Application of synchronized measurements for diagnostics of electrical equipment.
92. Application of navigation and radio frequency identification means to increase labor productivity and improve work safety.

93. Methods for increasing the service life of substation auxiliary battery banks.
94. Promising methods for ensuring operational interlocking using new types of sensors.
95. Assessment of the effectiveness of grounding methods in DC auxiliary circuits.
96. Analysis of failure rates and identified defects of high-voltage bushings.
97. Automation of formation and monitoring of consumables inventory for maintenance and repair.
98. Foreign experience in forming emergency reserves (stocking standards, interaction with manufacturers).
99. Analysis of the frequency and composition of standard assemblies used by design institutes in the design of 220–500 kV substations.
100. Analysis of experience and feasibility of reusing substation projects without full revision. Solution methods.
101. Analysis of the negative impact of capacitive voltage transformers on bushings with RIP insulation. Search for alternative solutions.
102. Study of global experience in applying polymer insulation for substation equipment.
103. Analysis of switchgear schemes used in 2006–2014 in the construction of Unified National Electric Grid substations. Current regulatory and technical documentation and recommendations for adjustment.
104. Feasible neutral grounding mode in 10–35 kV networks. Technical features.

7.2 Organization and Monitoring of the Completion of the Final Qualifying Work

The organization and monitoring of the completion of the FQW are carried out by the graduating department and the institute's administration.

The list of topics of final qualifying works offered to students (hereinafter referred to as the list of topics) is determined by the graduating departments, reviewed annually at meetings of the graduating departments, approved by the Academic Council of the institute, and brought to the attention of students no later than six months before the start date of the State Final Assessment.

The graduating department develops and provides students with methodological guidelines containing:

- requirements for the structure, content, scope, and formatting of final qualifying works applicable to the specialty (field of study);
- criteria for evaluating final qualifying works approved by the methodological council of the institute.

The FQW assigned to the student is carried out in accordance with the assignment for the study of the object and subject of the research and the collection of material for the work. The FQW assignment is approved by the head of the department with an indication of the deadline for its completion (Appendices A, D, E).

The duties of the FQW supervisor include:

- preparation and issuance of the FQW assignment no later than the start of the pre-graduation practice (Appendices D, E);
- preparation of a schedule;
- monitoring the completion of the FQW;
- providing recommendations on the selection and use of sources and literature on the FQW topic;
- consulting the student on issues of FQW completion in accordance with the consultation schedule established for the semester;
- analysis of the FQW content and provision of recommendations for its revision on individual chapters (sections), subsections, and as a whole;
- informing about the procedure and content of the defense process;
- consultation in the preparation of the presentation and selection of visual aids for the defense;
- preparation of a written review of the FQW, which reflects: the relevance of the FQW, the degree of achievement of the FQW goals, the presence of elements of methodological and practical novelty, the correctness of the FQW formatting (its structure, style, language of presentation, as well as the use of tabular and graphic means of presenting information), the author's possession of professional, general professional, and general cultural competencies, shortcomings of the FQW, the results of the anti-plagiarism check, recommendations for the defense, and an overall assessment of the FQW.

Upon the recommendation of the FQW supervisor, if necessary, the graduating department is granted the right to invite consultants (co-supervisors) for individual sections of the work, within the time limit allocated for the supervision of the FQW. When completing an FQW on an interdisciplinary topic, professors and highly qualified teachers of other departments of the university, as well as researchers and specialists of specialized institutions of the region, may be appointed as consultants (co-supervisors). Consultants (co-supervisors) check the relevant part of the completed FQW and affix their signature to it. In this case, on the title page of the FQW, after the data on the scientific supervisor, similar data on the consultant (co-supervisor) are provided.

At meetings of the graduating department, at least twice a year, reports from FQW supervisors or students on the degree of readiness of the work are heard. After the completion of the pre-graduation practice, a public preliminary defense of the work is held, the results of which are recorded in the minutes of the graduating department meeting.

The completed FQW, signed by the student and the consultant, and the standards controller, is submitted to the supervisor. After the FQW has been examined (including for the volume of borrowing in accordance with the Regulations for the Use of the "Antiplagiat" System at FSAEI HE "North Caucasus Federal University"), the supervisor signs it and, together with their written review of the student's work during the preparation of the final qualifying work and the co-supervisor's review, submits the work to the head of the department. The review provides a characterization for all sections of the work. On the basis of these materials, after a department meeting, the head of the department makes a note on the FQW regarding the student's admission to the defense. If the student is not admitted to the defense of the work, this issue is considered at a department meeting with the participation of the supervisor. The minutes of the department meeting are submitted to the institute's administration.

The FQW admitted to defense by the graduating department is sent for external review no later than 10 days before the defense before the State Assessment Commission (for a bachelor's work, internal reviewing is permitted). The composition of reviewers from among specialists of scientific and production institutions in the specialty profile, as well as from among the professorial and teaching staff of the University not working at the graduating department, or from other higher educational institutions, is approved by order of the director of the institute (branch) upon the recommendation of the graduating department. The review must note the relevance of the chosen topic, the degree of its justification, the expediency of setting the research objectives, the completeness of their implementation, the argumentation of conclusions, the scientific novelty, the theoretical and practical significance of the work, and provide an overall assessment of the work.

The graduating department makes a decision on the need for reviewing the FQW of students in bachelor's degree programs.

7.3 Preparation for Defense and Review of the Final Qualifying Work

The student is obliged to report on the work performed to the supervisor, who, based on the schedule, determines the degree of readiness of the work as a percentage of the total volume. The supervisor provides methodological and organizational guidance for the student's work.

The completed final qualifying work is signed by the student and the consultants, the supervisor, and the person performing the standards control. The work is then reviewed, signed by the head of the department, and submitted together with the supervisor's written review.

No later than one week before the defense, the student undergoes a preliminary defense procedure at the graduating department. The composition of the commission for the preliminary defense includes at least three members from among the department's teaching staff and is approved by the head of the department. Based on the results of the preliminary defense, the department reserves the right to refuse the student admission to the defense. This issue is considered at a department meeting with the participation of the supervisor. The minutes of the department meeting are submitted to the institute's administration, where the final decision on the student's admission to the defense is made.

7.3.1 Supervisor's Review

The completed qualifying work, signed by the student and the consultants, is submitted to the supervisor, who prepares a review of it.

The supervisor's review should note:

- the relevance of the topic of the work;
- the degree to which the set task has been solved;
- the degree of independence and initiative of the student;

- the student's ability to use specialized literature;
- the student's capabilities in engineering or research work;
- the possibility of using the obtained results in practice;
- the possibility of awarding the graduate the appropriate qualification;
- admission of the qualifying work to the defense.

7.3.2 Reviewing of the Work

Final qualifying works admitted to defense by the graduating department are sent for review.

Reviewers of final qualifying works are approved by the director of the institute upon the recommendation of the head of the department no later than one month before the defense, from among the professorial and teaching staff of other departments, production and research institution specialists, and teaching staff of other universities. The list of reviewers is approved by order of the university.

The review should note:

- the relevance of the topic of the work;
- the degree of compliance of the work with the assignment;
- the presence of a literature review on the topic, its completeness and sequence of analysis;
- the completeness of the description of the calculation methodology or research conducted, the presentation of the author's own calculation, theoretical, and experimental results, and an assessment of the reliability of the obtained expressions and data;
- the presence of well-argued conclusions based on the results of the work;
- the practical significance of the completed work and the possibility of using the obtained results;
- the shortcomings and weak points of the work;
- comments on the formatting of the work and the style of presentation;
- assessment of the work: "Excellent," "Good," "Satisfactory," "Unsatisfactory."

The reviewer has the right to request from the student – the author of the project – additional materials concerning the essence of the work performed. The student must be familiarized with the review before the defense of the work before the State Examination Commission.

7.4 Procedure for the Defense of the Final Qualifying Work

The procedure for the defense of the FQW corresponds to clauses 4.11.1 – 4.11.10 of the "Regulations on the Final State Assessment of Graduates of the Federal State Autonomous Educational Institution of Higher Education 'North Caucasus Federal University'."

The requirements for the FQW defense procedure include the use of information technologies, drawings and posters (ESKD), demonstration of working samples, models, and software modules developed, manufactured, and debugged during its completion.

The defense of the final qualifying work is held at an open meeting of the SEC according to the schedule. The professorial and teaching staff of the department and faculty, representatives of factories, enterprises, and scientific institutions, students, and all interested persons are invited to the defense of final qualifying works before the SEC.

The order of defense is announced by the SEC secretary.

The duration of the defense of one student, as a rule, should not exceed 45 minutes, including 10 minutes allotted to the student for presenting the content of their work.

For the work of the examination commission, the SEC secretary submits the following documents: the order of the Rector of NCFU on admitting students to the SFA, certificates of completion of the academic plan for each student admitted to the SFA in accordance with the admission order, examination sheets for the defense of the FQW, the order of the director of the institute on approving the topics of final qualifying works of students, scientific supervisors (consultants) and reviewers, a certificate of verification of the final qualifying work for the volume of borrowing (Antiplagiat.Vuz), a referral for defense and the department's conclusion on admission to the defense of the FQW, a form for SEC members to assess the level of competency formation (Assessment Sheet).

The defense begins with the SEC secretary announcing the last name, first name, and patronymic of the defending student, the topic of the work, the names of the supervisor and reviewer, and giving the floor to the student for a presentation on the work. The student is given no more than 10 minutes (15 minutes for a master's graduate) for a report on the main provisions of the final qualifying work. Within 10 minutes, the diploma student must present the main idea of the work, list the difficulties encountered during the work, and describe the ways to overcome them; the achieved results – technical and economic indicators of the product (or the significance, including economic, of the research conducted), design features of the proposed machine, technological process, or calculation method (research) are presented. In the presentation, it is necessary to summarize the work: clearly formulate the conclusions or findings and indicate the prospects for further development. During the presentation, the student must highlight: the relevance of the chosen topic, the object and subject of the research, the goal and main objectives, the scientific development and novelty, and the theoretical and practical results of the research. It is essential to highlight the main points and, without getting bogged down in details, convey the most important information to the audience. Therefore, each student must carefully prepare their presentation in advance.

The requirements for the FQW defense procedure include the use of information technologies, drawings and posters, demonstration of working samples, models, and software modules developed, manufactured, and debugged during the completion of the final qualifying work.

After the student's presentation, committee members ask questions. After the student's response to the questions, the supervisor's review and the review of the work are read (the supervisor and reviewer may speak during the student's defense). The student is given the right to respond to the reviewer's comments. The committee secretary records the questions and a general description of the student's response to the questions and reviewer's comments in the minutes.

The duration of the defense is generally 30 minutes.

Upon completion of the defense of final qualifying works, a meeting is announced, attended only by committee members. At the meeting, the final qualifying work and the defense of each student are discussed. Based on the discussion, grades are entered into the minutes and the grade sheet.

When assessing the final qualifying work, the level of competency formation (in accordance with the educational standard and educational program) is taken into account according to the following proposed criteria:

- the level of theoretical and research development of the problem;
- the quality of the problem analysis;
- the completeness and problem-oriented nature of the proposals made on the issue under consideration;
- the level of approbation of the work and publications;
- the scope of experimental research and the degree of implementation in production;
- the independence of the development;
- the degree of proficiency in modern software products and computer technologies;

- skills in public discussion, defense of one's own scientific ideas, proposals, and recommendations;
- the quality of the presentation of the work results;
- the general level of communication culture with the audience;
- readiness for practical activity;
- the supervisor's review and the reviewer's assessment of the work, and other requirements set forth by the assessment tools for the final assessment developed by the graduating department for each educational program.

7.5 Summing Up the Results of the Defense of Final Qualifying Works

Based on the results of the examination committee meeting, the students are informed of the results of the defense of final qualifying works. The committee has the right to note the best graduates and give recommendations to continue work on the topic of the final qualifying work in the form of dissertation research in postgraduate studies (for students in specialist's and master's programs) or in master's programs (for students in bachelor's and specialist's programs).

The results of the defense of final qualifying works are determined by grades of "Excellent," "Good," "Satisfactory," and "Unsatisfactory" and are announced immediately after the defense of the FQW and the completion of the minutes of the meetings of the State Assessment Commission in accordance with the established procedure and the filling out of students' grade record books. The summing up of the results of the FQW defense corresponds to the "Regulations on the Final State Assessment of Graduates of the Federal State Autonomous Educational Institution of Higher Education 'North Caucasus Federal University'."

In cases where the defense of the final qualifying work is recognized as unsatisfactory, the SEC decides whether to give the student the opportunity to re-defend the same work after revision or to indicate the need to develop a new topic, which is established by the graduating department. The decision is recorded in the SEC minutes.

7.6 Description of Indicators and Criteria for Assessing Competencies

The State Final Assessment is conducted with objectivity and mutual respect between the student and members of the State Assessment Commission. The main principles of the procedure for assessing the student's response by members of the State Assessment Commission during the defense of the final qualifying work are: professionalism, objectivity, independence, impartiality, lack of bias, and goodwill.

The main task of the State Assessment Commission is to determine the compliance of the graduates' training with the qualification requirements of the Federal State Educational Standard of Higher Education in the field of study 13.04.02 "Electric Power Engineering and Electrical Engineering."

The final grade at the defense of the final qualifying work is given on the basis of the presentation of the bachelor's work, responses to questions, and the reviews of the supervisor and reviewer. Points are awarded based on an assessment of the compliance of the response with established criteria. At the same time, both the positive aspects of the response and the existing shortcomings (errors or inaccuracies) are necessarily taken into account. When assessing the defense of the student's bachelor's work, the commission may add one point to the final grade for the correct presentation of the answer plan in English or another foreign language studied by the student, or two points for a correct detailed presentation of the answer in English or another foreign language studied by the student, using the appropriate scientific and technical terminology.

When assessing the defense of the final qualifying work of bachelors, members of the State Assessment Commission are guided by a system of criteria:

- the level of theoretical and research development of the problem;
- the independence of the development;
- the degree of proficiency in modern software products and computer technologies;
- skills in public discussion, defense of one's own scientific ideas, proposals, and recommendations;
- the quality of the presentation of the work results;
- the general level of communication culture with the audience;
- readiness for practical activity in a market economy, and the ability to change, if necessary, the direction of professional activity within the subject area of knowledge and practical skills;
- the supervisor's review and the reviewer's assessment of the work, and other requirements set forth by the assessment tools for the final assessment developed by the graduating department for each educational program.

7.7 Procedure for Appealing the Results of State Assessment Tests

Based on the results of state assessment tests, the student has the right to appeal.

The student has the right to submit a written appeal to the appeals commission regarding a violation, in their opinion, of the established procedure for conducting the state assessment test and/or disagreement with the results of the state assessment test.

The appeal is submitted personally by the student to the appeals commission no later than the next working day after the announcement of the results of the state assessment test.

For the consideration of the appeal, the secretary of the State Examination Commission sends to the appeals commission the minutes of the meeting of the State Examination Commission, the conclusion of the chairman of the State Examination Commission on compliance with procedural issues during the state assessment test, as well as the student's written answers (if available) (for consideration of an appeal regarding the conduct of the state examination) or the final qualifying work, the review, and the review(s) (for consideration of an appeal regarding the conduct of the defense of the final qualifying work).

The appeal is considered no later than 2 working days from the date of filing the appeal at a meeting of the appeals commission, which is attended by the chairman of the State Examination Commission and the student who filed the appeal.

The decision of the appeals commission is recorded in the minutes and brought to the attention of the student who filed the appeal within 3 working days from the date of the meeting of the appeals commission. The fact that the student who filed the appeal has been familiarized with the decision of the appeals commission is confirmed by the student's signature.

When considering an appeal about a violation of the procedure for conducting the state assessment test, the appeals commission makes one of the following decisions:

- to reject the appeal if the information contained in it about violations of the procedure for conducting the student's State Final Assessment has not been confirmed and/or did not affect the result of the state assessment test;
- to grant the appeal if the information contained in it about violations of the procedure for conducting the student's State Final Assessment has been confirmed and affected the result of the state assessment test.

In the case specified in the third paragraph of this clause, the result of the State Final Assessment is subject to annulment, and therefore the minutes of the consideration of the appeal are transferred to the State Examination Commission no later than the next working day for the implementation of the decision of the appeals commission. The student is given the opportunity to take the state assessment test within the time limits established by NCFU.

When considering an appeal about disagreement with the results of the state assessment test, the appeals commission makes one of the following decisions:

- to reject the appeal and maintain the result of the state assessment test;
- to grant the appeal and issue a different result of the state assessment test.

The decision of the appeals commission is transferred to the State Examination Commission no later than the next working day. The decision of the appeals commission is the basis for annulling the previously issued result of the state assessment test and issuing a new one.

The decision of the appeals commission is final and not subject to revision.

The repeated conduct of the state assessment test is carried out in the presence of one of the members of the appeals commission no later than July 15.

An appeal against the repeated conduct of the state assessment test is not accepted.

8 LIST OF RECOMMENDED LITERATURE AND INFORMATION SOURCES

Literature for the Completion of the Final Qualifying Work

1. Idelchik, V.I. *Electric Power Systems and Networks: A Textbook for Universities* – Moscow : Energoatomizdat, 1989 – 592 p.
2. *Reference Book on the Design of Electric Power Systems* / V.V. Ershevich, A.N. Zeiliger, G.A. Illarionov et al.; Ed. by S.S. Rokotyan and I.M. Shapiro. – 3rd ed., revised and supplemented. – Moscow : Energoatomizdat, 1985. – 352 p.
3. *Guide to Course and Diploma Design for Electric Power Specialties of Universities: A Textbook for Students of Electric Power Specialties of Universities* / 2nd ed., Ed. by V.M. Blok. – Moscow : Vysshaya Shkola, 1990. – 383 p.
4. *Rules for Execution, Conventional Graphic and Positional Designations in Electrical Diagrams. Methodological Guidelines for Course and Diploma Design, Control and Calculation and Graphic Works for Students of Specialties 0303, 0612, 0627.* – Stavropol, StPI, 1987.
5. Rozhkova, L.D., Kozulin, V.S. *Electrical Equipment of Power Plants and Substations.* – Moscow : Energoatomizdat, 1987.
6. *Reference Book on the Design of Electrical Networks* / Ed. by D.L. Faibisovich. – Moscow : NC ENAS Publishing House, 2006. – 320 p. : ill.
7. Makarov, E.F. *Reference Book on 0.4–35 kV Electrical Networks. In Six Volumes* / Ed. by I.T. Goryunov et al. – Moscow : Papyrus Pro, 2005.
8. *Electrical Section of Power Plants and Substations: Reference Materials for Course and Diploma Design* / Ed. by B.N. Neklepaev. – Moscow : Energoatomizdat, 1987.
9. *Electrical Engineering Handbook: In 4 Volumes. Vol. 3. Production, Transmission and Distribution of Electric Energy* / Under the general editorship of professors of MPEI V.G. Gerasimov et al. (editor-in-chief A.I. Popov). – 8th ed., revised and supplemented. – Moscow : MPEI Publishing House, 2002.
10. *Reference Book on the Design of Electric Power Systems* / Ed. by S.S. Rokotyan and I.M. Shapiro. – Moscow : Energoatomizdat, 1988.
11. *Electrical Installation Regulations.* – Moscow : ZAO Energoservis, 2005.
12. *Rules for the Technical Operation of Consumer Electrical Installations and Safety Rules for the Operation of Consumer Electrical Installations.* – Moscow : Energia, 2002.
13. *Guidance Technical Material "Instructions for the Calculation of Electrical Loads" (RTM 36.18.32.4-92)* / Moscow : VNIPI Tyazhpromelektroproekt, 1992.
14. *Collection of Safety Rules for the Production of Electrical Installation Works.* – Moscow : Energoatomizdat, 1999.
15. Knyazevsky, B.A., Chekalin, N.A. *Safety and Fire Prevention in Electrical Installations.* – Moscow : Energia, 1998.
16. Kashchaev, V.S., Mustafaev, Kh.M. *Methodological Guidelines for the Completion of the Diploma Project Section "Safety and Environmental Friendliness of the Project" for Students of Specialties 100200 (140205) "Electric Power Systems and Networks," 100400 (140211) "Power Supply (by Industry)"* – Stavropol : Publishing House of the State Educational Institution of Higher Professional Education "North Caucasus State Technical University," 2005.

For the Formatting of Graphic Materials of the Project

17. Tsvirinko, I.A., Korovina, V.D. *Methodological Recommendations for the Formatting of Diploma and Course Projects (Works).* – Stavropol : SevKavGTU, 2001. – 27 p.
18. GOST 2.105-95 ESKD. *General Requirements for Text Documents.*
19. GOST 7.1-2003. *Bibliographic Description of a Document.*
20. GOST 2.701-84 ESKD. *Diagrams. Types and Varieties. General Requirements for Execution.*
21. GOST 2.702-75 ESKD. *Rules for the Execution of Electrical Diagrams.*
22. GOST 2.723-68 ESKD. *Conventional Graphic Designations in Diagrams. Inductors, Chokes, Transformers, and Magnetic Amplifiers.*
23. GOST 2.727-68 ESKD. *Conventional Graphic Designations in Diagrams. Arresters. Fuses.*
24. GOST 2.728-74 ESKD. *Conventional Graphic Designations in Diagrams. Resistors. Capacitors..*

9. DESCRIPTION OF INDICATORS AND CRITERIA FOR ASSESSING COMPETENCIES, AS WELL AS ASSESSMENT SCALES

9.1 Description of Indicators

Levels of Competency and Indicator Formation	Descriptors			
	Minimum level not achieved (Unsatisfactory) – 2 points	Minimum level (Satisfactory) – 3 points	Medium level (Good) – 4 points	High level (Excellent) – 5 points
<i>PC-1. Capable of participating in research and development activities in the field of electrical power engineering</i>				
ID-1. Performs analysis and processing of scientific and technical information on the research subject from domestic and foreign sources; ID-2. Conducts experiments according to a given methodology; processing and analyses research results; ID-3. Compiles reports and presents the results of completed work; ID-4. Prepares applications for industrial property objects.	The analysis of scientific and technical information on the research topic is minimal. The experiments conducted according to the given methodology are not fully reflected and do not reveal the essence of the research. The prepared report on the work performed lacks structure and a logical sequence of information presentation.	The analysis of scientific and technical information on the research topic is carried out exclusively using domestic sources. Experiments are conducted according to the given methodology, but their effect is not fully justified / partially applicable / more effective solutions exist. The prepared report on the work performed has structure, graphics, and systematization. Low quality of formatting.	The analysis of scientific and technical information on the research topic is carried out using domestic and partially foreign sources. The results of experiments according to the given methodology are processed. In the prepared report on the work performed, the solution is well designed. The design and graphics facilitate visualization, and the information is structured.	The analysis of scientific and technical information on the research topic is complete and comprehensive. The results of experiments according to the given methodology are processed and analyzed. Appropriate conclusions are drawn, and possible research directions for further development of the study are outlined. In the prepared report on the work performed, the graphic part is executed in a unified style. All drawings have a clear and understandable structure.
<i>PC-2. Capable of participating in the design of objects of professional activity</i>				
ID-1. Performs calculation and analysis of the economic and technical characteristics of the object being designed; ID-2. Evaluates the feasibility of implementing an investment project and selects the most optimal investment alternative.	The technological effect is minimal. Implementation is not effective.	The technological solution allows for a real effect. However, the effect is not fully justified / partially applicable / more effective solutions exist.	The proposed solution allows for the maximum technological effect. The solution is competently and correctly justified. Key and additional influencing factors are taken into account.	The proposed solution allows for the maximum technological effect. The solution is competently and correctly justified. Key and additional influencing factors are taken into account.

9.2 Criteria for Assessing Competencies in the Defense of the Final Qualifying Work

When assessing students' responses, members of the State Assessment Commission note the merits of the responses, if any, their compliance with the specified criteria, and identify the following types of discrepancies in the form of inaccuracies or errors (if any):

Inaccuracy:

- When presenting theoretical material – a minor deviation that does not distort the meaning of the material presented, the absence of references to specific authors of theories and studies in the response, presentation of theories or studies without indicating the time of research or the creation of concepts relevant to the question.

- When presenting experimental material – indication of approximate measurement parameters instead of precise ones, incompleteness in the description of experimental research procedures.

- When using terminology – an incomplete understanding of the content of concepts. Periodic use of everyday terminology instead of scientific and technical terminology with correct presentation of theoretical and experimental material.

- When presenting one's own theoretical constructions – weak argumentation of one's position, insufficient confirmation of one's own theoretical constructions with known facts.

Error:

- When presenting theoretical material – gross distortions in the description of scientific theories and concepts, inadequate disclosure of the content of the theory or fact being presented, omissions of important semantic elements of the material.

- When presenting experimental material – inadequate use or ignorance of methods, techniques, tests, measurement parameters and procedures for conducting experimental research, essential characteristics of the sample, inadequate interpretation of the obtained main results and conclusions.

- When using terminology – inability to operate with the categorical apparatus, ignorance of basic scientific and technical terms and concepts; use of terms and concepts in the response whose content does not correspond to their interpretation; systematic replacement of scientific concepts with everyday ones.

- When presenting one's own theoretical constructions – lack of argumentation for one's point of view, impossibility of verifying the author's position, inability to justify the novelty, theoretical or practical significance of one's ideas, weakness of methodological justifications, inability to relate one's own theoretical ideas to existing theories, concepts, laws and regularities, ignoring already identified regularities.

The grade "Excellent" is awarded to the student if:

- The proposed solution allows for the maximum technological effect.

- The solution is competently and correctly justified.

- Key and additional influencing factors are taken into account.

- Demonstrates successful skills in self-organization and self-education.

- Modern software products and computer technologies are used in the completion of the FQW. Understanding of the methodologies on which the software methods are based.

- A high level of public speaking, argumentation, discussion, and polemic skills is demonstrated; the material is presented competently, in a certain logical sequence.

- The graphic part is executed in a unified style.

- All drawings have a clear and understandable structure.

- Readiness to solve practical tasks of increased complexity, non-standard tasks, and to make professional and managerial decisions under conditions of incomplete certainty, with insufficient documentary, regulatory, and methodological support is demonstrated.

The grade "Good" is awarded to the student if:

- The proposed solution allows for the maximum technological effect.

- The solution is competently and correctly justified.

- Key and additional influencing factors are taken into account.

- Demonstrates knowledge of self-organization and self-education.

– Modern software products and computer technologies are used in the completion of the FQW.

– A good level of public speaking, argumentation, discussion, and polemic skills is demonstrated.

– The solution is well designed.

– The design and graphics facilitate visualization, and the information is structured.

– Proficiency in solving standard tasks, making professional and managerial decisions according to known algorithms, rules, and methodologies is demonstrated.

The grade "Satisfactory" is awarded to the student if:

– The technological solution allows for a real effect. However, the effect is not fully justified.

– Partially applicable / more effective solutions exist.

– Capable of self-organization and self-education.

– Software products are used in the completion of the FQW.

– The presentation is not fully developed.

– The presentation has structure, graphics, and systematization.

– Low quality of formatting.

– Has a general understanding of the type of activity, the main patterns of functioning of professional activity objects, methods and algorithms for solving practical tasks.

The grade "Unsatisfactory" is awarded to the student if:

– The technological solution allows for a real effect. However, the effect is not fully justified.

– Partially applicable / more effective solutions exist.

– Capable of self-organization and self-education.

– Software products are used in the completion of the FQW.

– The presentation is not fully developed.

– The presentation has structure, graphics, and systematization.

– Low quality of formatting.

– Has a general understanding of the type of activity, the main patterns of functioning of professional activity objects, methods and algorithms for solving practical tasks.

9.3 Description of the Assessment Scale

The defense of the final qualifying work is assessed on a 5-point scale.

10. Appendices, which must necessarily include forms of the title page of the FQW (by type), FQW assignments (by type), schedules (by type), supervisor's review(s), review(s), a list of topics of final qualifying works (by type) offered to students, a schedule for completing the final qualifying work, etc., in accordance with the Regulations on the Procedure for Completing Final Qualifying Works at the Federal State Autonomous Educational Institution of Higher Education "North Caucasus Federal University," are presented in the appendices to this document.

