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NUCLEAR POWER PLANTS IN RUSSIA

TEXTS FOR READING AND DISCUSSION

Training manual in English language

Science and Innovation Center Publishing House
Krasnoyarsk, 2022

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АТОМНЫЕ ЭЛЕКТРОСТАНЦИИ В РОССИИ

ТЕКСТЫ ДЛЯ ЧТЕНИЯ И ОБСУЖДЕНИЯ

Учебное пособие
по английскому языку

Научно-инновационный центр
Красноярск, 2022

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Р е ц е н з е н т ы:

Бондарева Н.В. – канд. фил. наук, доцент кафедры английского языка Филиала ФГБОУ ВО «Государственный морской университет имени адмирала Ф.Ф Ушакова» в г. Севастополь

Браславский Ю.В. – канд. техн. наук, доцент, доцент кафедры «Ядерные энергетические установки» ФГАОУ ВО «Севастопольский государственный университет»

Корж Т.Н. – канд. пед. наук, доцент, заведующий кафедрой «Иностранные языки» ФГАОУ ВО «Севастопольский государственный университет»

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В данном пособии представлены аутентичные тексты об атомных электростанциях России и особенностях их эксплуатации. Каждый текст сопровождается различными упражнениями, которые способствуют формированию навыков понимания и последующего обсуждения воспринятой в текстах информации на английском языке по специальности.

Пособие может быть использовано на практических занятиях по английскому языку для всех уровней образования (бакалавриат, специалитет, магистратура и аспирантура) по направлению «Ядерная энергетика и технологии», а также на курсах повышения квалификации и переподготовки преподавателей и специалистов атомной области.

ISBN 978-5-907208-84-1

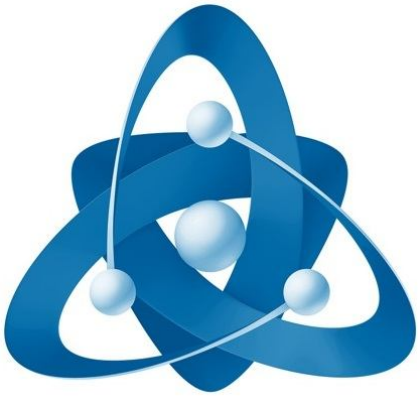
CONTENTS

UNIT 1

NUCLEAR ENERGY IN RUSSIA

PRE-READING

1. Look at these logos. Do you know what companies they belong to? What do you know about these companies?



2. Name as many nuclear power plants in Russia as you can.

READING

1. Skim the text and say: a) how many nuclear power plants (NPPs) are there in Russia? b) how many nuclear power reactors are there in Russia nowadays? c) what companies control NPPs in Russia?

Nuclear Energy in Russia

The Russian Federation is one of the top five countries in the world for total nuclear power generation. Nuclear power in the Russian Federation is a driver for the development of other industries, and nuclear electricity production accounts for 19.7% of the national electricity mix. Currently, the country operates 38 nuclear power reactors and is steadily moving ahead with plans to expand the role of nuclear energy, including the development of new reactor technologies, in addition to the export of nuclear services. It seeks to close the fuel cycle and fast reactors are considered a key component of this.

In total, 38 power units with an installed capacity of 30.3 GW are operated at 11 nuclear power plants (NPPs) in the Russian Federation (Akademik Lomonosov, Balakovo, Beloyarsk, Bilibino, Kalinin, Kola, Kursk, Leningrad, Novovoronezh, Rostov, Smolensk NPPs). These NPPs consist of the following:

- 21 power units with WWER reactors (3 of which are WWER-1200 power units, 13 are WWER-1000 power units and 5 are WWER-440 power units of various modifications);
- 13 power units with channel reactors (10 power units with RBMK-1000 reactors and 3 power units with EGP-6 reactors);
- 2 power units with sodium cooled fast reactors (BN-600 and BN-800).
- 2 nuclear reactors, type KLT-40S, with an electric capacity of 35 MW each.

All NPPs in Russia are controlled by Rosenergoatom. It is a nuclear power plant operator subsidiary of Russia's Rosatom, which as a whole brings together about 400 enterprises and organizations, including the world's only nuclear icebreaker fleet. Rosatom is the largest producer of electricity in Russia, ensuring over 20% of the country's energy needs.

AFTER READING

VOCABULARY PRACTICE

1. Study these words and phrases from the text. Match these words and phrases with their definitions.

1. electricity mix **2. to expand** **3. fuel cycle**

4. fast reactor **5. nuclear icebreaker fleet** **6. subsidiary**

a) A category of nuclear reactor in which the fission chain reaction is sustained by neutrons of kinetic energy greater than 1 MeV.

b) A group of nuclear-powered ships sailing together, engaged in the same activity, or under the same ownership.

c) A company controlled by a holding company.

d) It shows the proportion of total electricity generated by each source in a specific country.

e) It is the series of industrial processes that describe uranium throughout its life cycle: from mining to processing, to generating electricity and, finally, to its reprocessing and waste.

f) To increase in size, number, or importance.

2. Complete each of the following sentences with the appropriate word or phrase from Exercise 1 (Part "After Reading").

1. For _____, there is no need for a neutron moderator, but it requires fuel rich in fissile material.

2. Russia possesses the world's only _____ designed to meet maritime transportation objectives in the Arctic based on the application of advanced nuclear technology.

3. The purpose of a closed _____ is to achieve nuclear power sustainability by further reducing radiotoxicity of the final waste.

4. Rosatom's TVEL _____, Novosibirsk Chemical Concentrates Plant, will supply low-enriched nuclear fuel for all four planned reactors of the plant.

5. Nuclear power plants are just one piece of preserving and _____ our nuclear industry.

6. Renewables accounted for 19.1% of France's _____ in 2020.

COMPREHENSION CHECK

1. Complete the following table with facts and figures using the information from the text.

№	Information	Fact / Figure
1.	Number of main countries in the world for total nuclear power generation	
2.	Number of nuclear power units in Russia	
3.	Types of WWER reactors used in Russia	
4.	A subsidiary of Rosatom controlling NPPs in Russia	
5.	Total number of enterprises and organizations in Rosenergoatom and Rosatom	

2. Indicate which of the following statements are true and which are false.

1. An installed capacity of all nuclear power units in Russia is about 3,000 MW.

2. Russia is the only country possessing nuclear icebreaker fleet.

3. Russia began to switch over to the closed nuclear fuel cycle with fast-neutron reactors.

4. BREST-OD-300 is one of the reactors used in Russia nowadays.

5. All nuclear power plants in Russia are controlled by Rosatom.

3. Answer the following questions.

1. For how many percent does nuclear electricity production of the national electricity mix account in Russia?

2. How many a) WWER reactors; b) channel reactors; c) fast reactors; d) KLT-40S type reactors are there in Russia?

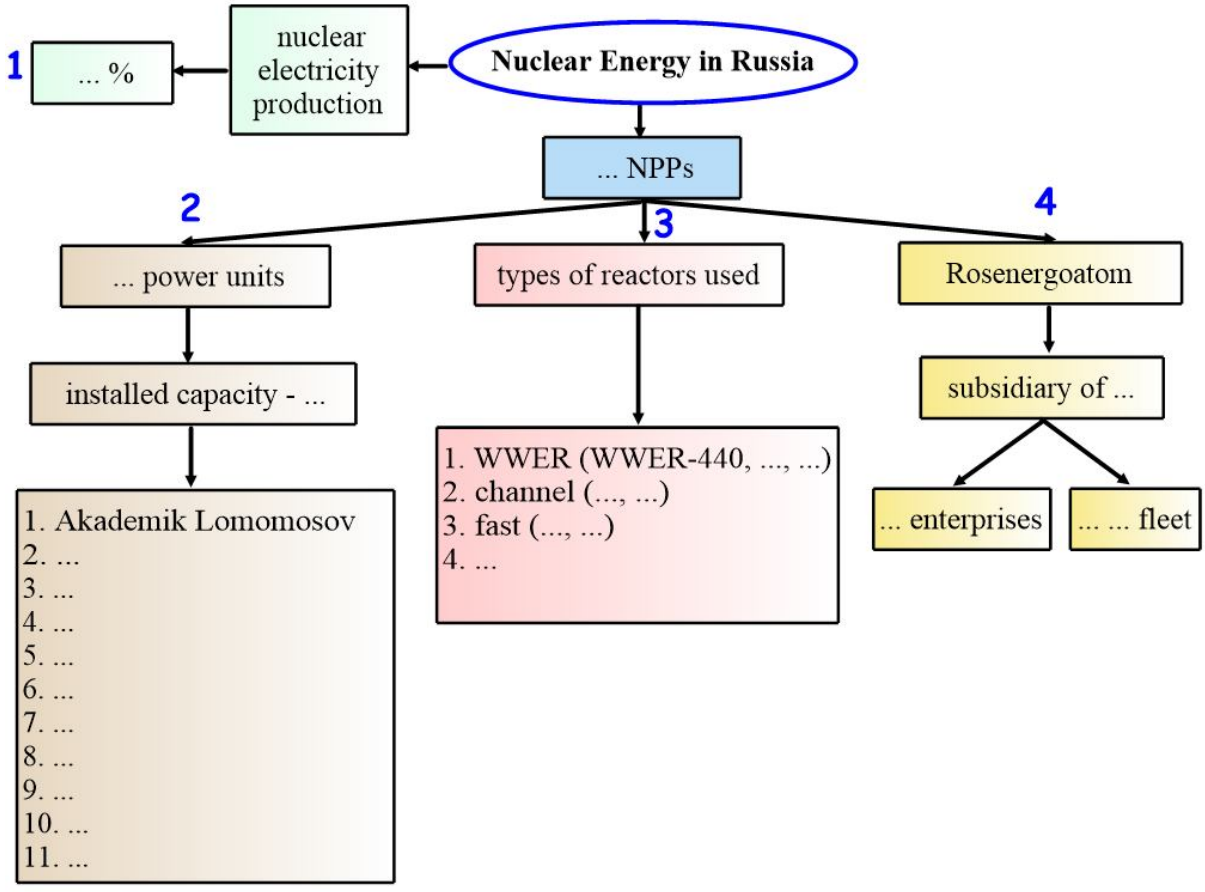
3. Which of the above mentioned reactor type is a low-power reactor? What is it capacity?

4. What Russian nuclear power plants can you name?

5. What is the largest producer of electricity in Russia?

SPEAKING PRACTICE

1. Complete the missing information in the mind map below and retell the text about nuclear energy in Russia.



2. Search in the Web for additional information about what has recently changed in the sphere of nuclear energy in Russia (e.g., number of NPPs or power units, installed capacity or types of rectors used). Add this new information into your story about nuclear energy in Russia and retell it.

UNIT 2

AKADEMIK LOMONOSOV

PRE-READING

1. Look at the picture below. Do you know anything about this ship? How is it connected with the sphere of nuclear energy production in Russia?

READING

1. Skim the text and say: a) when did "Akademik Lomonosov" begin commercial operation? b) how many nuclear power reactors is "Akademik Lomonosov" equipped with? c) what is an installed capacity of the floating nuclear power plant?

Floating Nuclear Power Plant "Akademik Lomonosov"

Akademik Lomonosov is the world's first floating nuclear power plant (FNPP), which is located in the Kamchatka region of Far East Russia. It began commercial operation in the Russian Arctic city of Pevek on 22 May, 2020. The FNPP is expected to become the main power generation facility in Chukotka following the proposed phased decommissioning of the 36 MW Bilibino NPP and the 34 MW Chaunskaya Co-Gen plant.

Named after Mikhail Lomonosov, an 18th-century Russian scientist, the 70 MW floating power unit (FPU) is equipped with two small modular reactors. It utilizes low-enriched uranium, containing less than 20% of Uranium-235, as the nuclear fuel for the power generation.

The FPU comprises two KLT-40S pressurized-water nuclear reactors having a capacity of 35MW each. The KLT-40S reactor plant uses a thermal neutron spectrum, pressurized water reactor and has a thermal capacity of 150 MW. The reactor core, measuring 1,220 mm in diameter and 1,200 mm high, features a total of 121 fuel assemblies placed in the angles of a regular triangular lattice with a pitch of 100 mm.

The electricity generated by the offshore facilities of the Akademik Lomonosov FNPP is evacuated to the coastal infrastructure situated at Pevek. The onshore power transmission system comprises a three-phase alternating current generator, main switchgear, and standby diesel generators.

The FNPP is expected to be a steady source of energy for the city of Pevek, as well as the entire Chukotka region in the future.

AFTER READING

VOCABULARY PRACTICE

1. Study these words and phrases from the text. Match these words and phrases with their definitions.

1. decommissioning	**2. offhore**	**3. standby**
4. floating	**5. onshore**	**6. switchgear**

a) The apparatus used for controlling, regulating and switching on or off the electrical circuit in the electrical power system.

b) Being buoyed up on water or other liquid.

c) On land, especially within the area adjoining a port.

d) Away from or at a distance from the land.

e) The act of officially taking a factory or other industrial building out of use.

f) Something that is always ready for use, especially if a regular one fails.

2. Complete each of the following sentences with the appropriate word or phrase from Exercise 1 (Part "After Reading").

1. China General Nuclear Power Group said the development of small-scale _____ and _____ nuclear power reactors will complement its large-scale plants and provide more diverse energy options.

2. _____ provides all types of electric systems and equipment with reliable power switching, control, disconnection/isolation and protection.

3. _____ liquid control system is a back-up system designed to shut down the reactor under the most reactive conditions.

4. The _____ process involves removing the used nuclear fuel from the reactor; dismantling systems or components containing radioactive products; and cleaning up or dismantling contaminated materials from the facility.

5. A _____ nuclear power plant is a site with one or more nuclear reactors, located on a platform at sea.

COMPREHENSION CHECK

1. Complete the following table with facts and figures using the information from the text.

№	Information	Fact / Figure
1.	KLT-40S reactor capacity	
2.	Type of neutrons used by KLT-40S reactor	
3.	Number of fuel assemblies in a KLT-40S reactor	
4.	Percent of fuel enrichment used in a KLT-40S reactor	
5.	Total capacity of Bilibino NPP and Chaunskaya Co-Gen plant	

2. Indicate which of the following statements are true and which are false.

1. Akademik Lomonosov is located in the Far West Russia.

2. Akademik Lomonosov will operate together with Bilibino NPP and Chaunskaya Co-Gen plant.

3. Akademik Lomonosov uses highly enriched Uranium as nuclear fuel.

4. Floating power unit uses fast neutron spectrum.

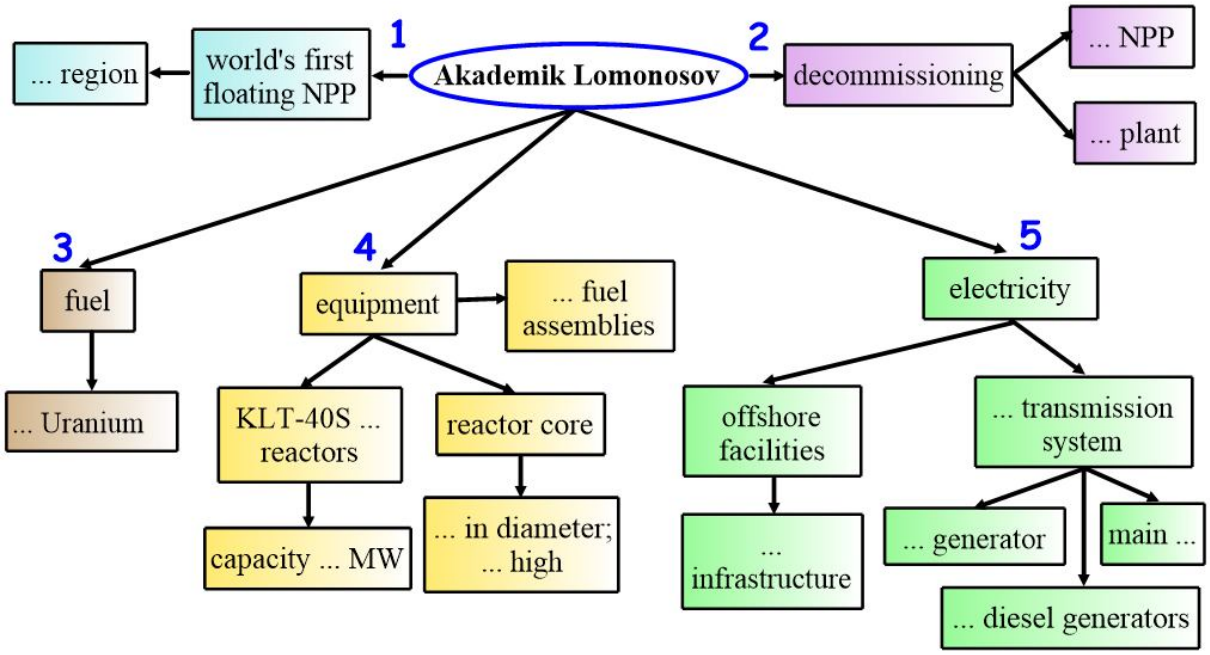
5. Akademik Lomonosov comprises both onshore and offshore facilities.

3. Answer the following questions.

1. What city did Akademik Lomonosov begin its commercial operation?
2. What type of reactor is KLT-40S?
3. What is thermal capacity of a KLT-40S reactor plant?
4. Where is electricity generated by Akademik Lomonosov transported to?
5. What does the onshore power transmission at Pevek system consist of?

SPEAKING PRACTICE

1. Complete the missing information in the mind map below and retell the text about the first floating nuclear power plant.



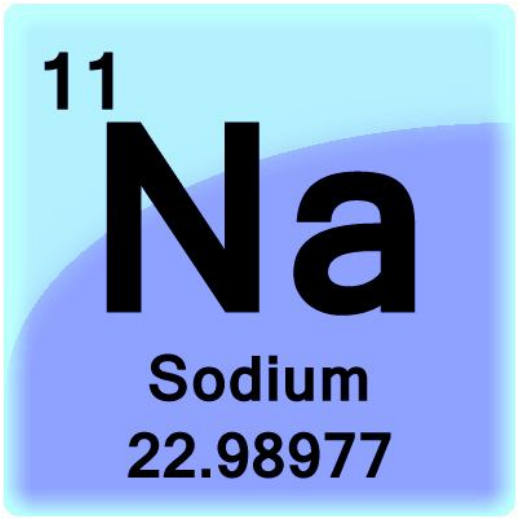
2. Search in the Web for additional information about Akademik Lomonosov. Add this new information into your story about the first floating NPP in the world and retell it.

UNIT 3

BELOYARSK NUCLEAR POWER PLANT

PRE-READING

1. Look at the picture below. What do you know about this chemical element? For what purpose could it be used at a nuclear power plant?



READING

1. Skim the text and say: a) what types of reactors were used at Beloyarsk NPP? b) what types of reactors are used at Beloyarsk NPP nowadays? c) what is an installed capacity of these reactors?

Beloyarsk Nuclear Power Plant

Beloyarsk NPP is situated by the city Zarechnij, in the Sverdlovsk region. The power plant was the first to put graphite-moderated reactors into operation, to produce electrical power. These reactors have now been shut down. Nowadays, Beloyarsk NPP has the world's largest fast breeder reactor in operation.

The plant was constructed in three stages: Stage 1 – power units No.1 and No.2 with AMB reactors; Stage 2 – power unit No.3 with BN-600 reactor; Stage 3 – power unit No.4 with a new BN-800 reactor featuring 885 MW installed capacity.

The two first reactors at Beloyarsk NPP were put into operation in 1964 and 1967, respectively. They were shut down in 1983 and 1989. These were of

the AMB-100 and AMB-200 type, which are an earlier version of RBMK graphite-moderated reactors.

One of the two reactors that are operational today at Beloyarsk NPP is a BN-600 fast breeder reactor (600 MW installed capacity). The construction of the BN-600 commenced in 1966, and the reactor was put into operation in 1980.

The second reactor in operation at Beloyarsk NPP is BN-800 fast breeder reactor (885 MW installed capacity), that was put into commercial operation on October 31, 2016.

BN reactors may be fueled with either highly-enriched uranium dioxide or mixed oxide (MOX) fuel consisting of plutonium blended with uranium.

The reactor core is 1.03 meters tall and has a diameter of 2.05 meters. It has 369 fuel assemblies, each consisting of 127 fuel pins with an enrichment of 17-26% ^{235}U. BN reactors use liquid sodium as coolant. There are three turbines connected to the reactor.

AFTER READING

VOCABULARY PRACTICE

1. Study these words and phrases from the text. Match these words and phrases with their definitions.

1. fast breeder reactor **2. installed capacity** **3. to commence**

4. to put into operation **5. fuel pin** **6. liquid sodium**

a) Fuel rod having a length of 4 m, with a diameter of around 1 cm.

b) A liquid metal like mercury.

c) The amount of energy that a power station is able to produce.

d) A reactor in which the neutrons causing fission are not slowed by any moderator.

e) To begin to use something.

f) To start doing something.

2. Complete each of the following sentences with the appropriate word or phrase from Exercise 1 (Part "After Reading").

1. The Polish Energy Policy assumes that the first nuclear power plant unit will be _____ in 2033.

2. The boiling point of _____is higher than the temperature produced by the nuclear reaction itself, so the reactor will not overheat.

3. The construction of a 300 MW nuclear power unit with an innovative lead coolant BREST-OD-300 _____ has begun in Seversk.

4. The Palo Verde NPP in Arizona is the largest nuclear power plant in the United States with three reactors and a / an _____ of about 3,937 MW.

5. The construction work for units 5 and 6 of the Kudankulam Nuclear Power Plant _____ today with the first concrete pouring into the foundation plate of the reactor building.

COMPREHENSION CHECK

1. Complete the following table with facts and figures using the information from the text.

№	Information	Fact / Figure
1.	Types of power units No.3 and No.4 at Beloyarsk NPP	
2.	Type of fuel used at BN reactors	
3.	Dimensions of the BN-800 reactor	
4.	The number of fuel assemblies and fuel pins at BN reactors	
5.	Installed capacity of the BN-800 reactor	

2. Indicate which of the following statements are true and which are false.

1. Beloyarsk NPP was the first one where graphite was used as a moderator.

2. AMB reactor is an earlier version of WWER reactor.

3. BN reactors use thermal neutrons.

4. There are two BN reactors of different capacity at Beloyarsk NPP.

5. MOX fuel consists of plutonium.

3. Answer the following questions.

1. Where is Beloyarsk NPP situated?

2. In how many stages was Beloyarsk NPP constructed?

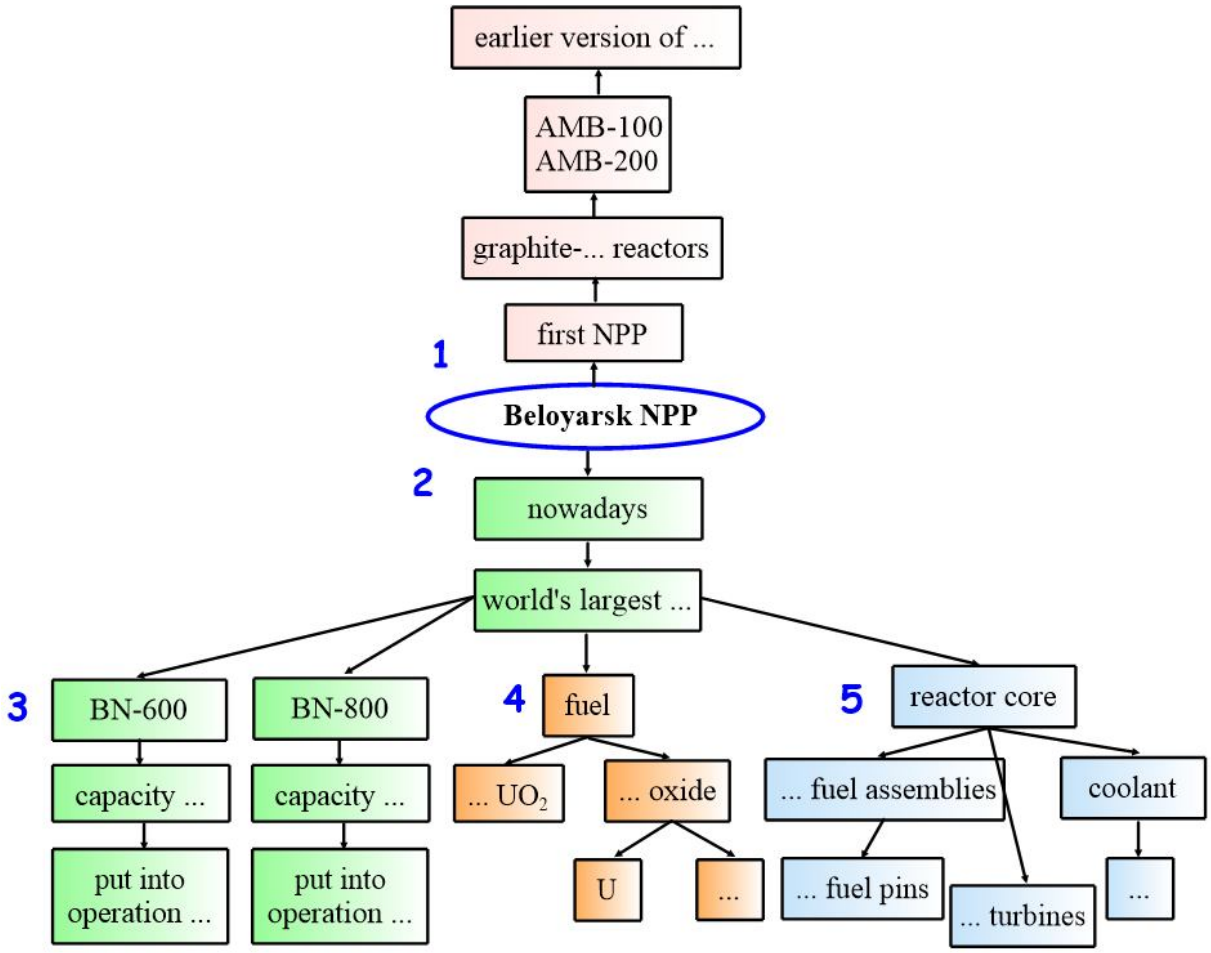
3. When did the construction of BN reactors commence at Beloyarsk NPP?

4. What is the enrichment of fuel used at BN reactors?

5. What information is given in the text about graphite-moderated reactors at Beloyarsk NPP?

SPEAKING PRACTICE

1. Complete the missing information in the mind map below and retell the text about Beloyarsk NPP.



2. Search in the Web for additional information about BN-1200, which is to be put into operation in 2035 at Beloyarsk NPP. Add this new information into your story about Beloyarsk NPP and retell it.

UNIT 4

KURSK NUCLEAR POWER PLANT

PRE-READING

1. Look at the picture of the building site of a nuclear power plant and try to guess the device given. What is it? What is it used for?

READING

1. Skim the text and say: a) where is Kursk NPP situated? b) how many reactors are there at Kursk NPP? c) what reactor design is used at Kursk II NPP?

Kursk Nuclear Power Plant

Kursk NPP is situated 40 km west of Kursk, on the bank of Seim River with the satellite-city Kurchatov located 3 km from the plant. Kursk NPP is one of the three biggest NPPs and one of the four biggest electricity producers in Russia (along with Balakovo and Leningrad NPPs).

The decision on the construction of Kursk NPP was made in the mid-1960s. The project was started in 1971. The 1st unit was launched in 1976, the 2nd in 1979, the 3rd in 1983 and the 4th in 1985.

Kursk NPP has four RBMK-1000 reactors (1000 MW each) and new ones are being built at Kursk II NPP, which will replace two ageing reactor units of the existing Kursk NPP. Kursk II NPP will comprise two advanced pressurized water reactor (PWR) units of 1.25 GW capacity each. It will be the world's first NPP to use WWER-TOI reactor design. WWER-TOI (T – typical;

O – optimized; I – information-based), also known as V-510, is a Gen III+ PWR reactor with design improvements to the reactor vessel and steam generator of the WWER-1200 reactor. The design offers improved safety measures, including an increased margin of safety from extreme impacts and ability to withstand earthquakes, and is equipped with modern control systems and diagnostics.

One more unique development of Russian nuclear scientists and one of the most important nuclear safety systems is comprised into the WWER-TOI design – the core catcher, or core melt trap. This technical means of passive protection is designed to trap liquid and solid radioactive materials in the hypothetical case of the accidental destruction of a reactor.

AFTER READING

VOCABULARY PRACTICE

1. Study these words and phrases from the text. Match these words and phrases with their definitions.

1. to launch	**2. core catcher**	**3. to trap**
4. to withstand	**5. accidental destruction**	**6. reactor vessel**
7. safety measures	**8. ageing**	**9. improvement**

a) Activities taken in order to prevent something bad or dangerous from happening.

b) Damage happening by chance or caused by natural phenomena.

c) Relating to getting older.

d) To start or set in motion.

e) The process of making something better or of getting better.

f) To remain undamaged or unaffected by.

g) To stop or hold something.

h) A device designed to localize and cool the molten core material in case of a meltdown accident.

i) A container surrounding and protecting the core of a nuclear reactor.

2. Complete each of the following sentences with the appropriate word or phrase from Exercise 1 (Part "After Reading").

1. The personnel of NPP is being constantly trained in case of any _____ of a reactor.

2. Nuclear power plants have multiple_____ which are designed to protect public health and environment.

3. Since the 1970's, one of the larger areas of cooperation on nuclear safety is research and experience with _____ mechanisms.

4. The new floating nuclear reactor is to be _____ this year.

5. The _____ in design of nuclear power reactors are constantly being developed internationally.

6. Today, all new Russian-designed reactors are equipped with _____ in the bottom of the containment building in case of a melt-down.

7. The _____ is the first layer of shielding around the nuclear fuel and usually is designed to _____ most of the radiation released during a nuclear reaction and to _____ high pressures.

COMPREHENSION CHECK

1. Complete the following table with facts and figures using the information from the text.

№	Information	Fact / Figure
1.	Kursk NPP location	
2.	Number of nuclear power units at Kursk NPP and the time of their launching	
3.	Type of reactors at Kursk NPP	
4.	Design of WWER-TOI reactor	
5.	Safety measures of WWER-TOI reactor	
6.	Function of a core catcher	

2. Indicate which of the following statements are true and which are false.

1. It is Kursk NPP that is one of the greatest electricity producers in Russia.

2. Kursk NPP comprises six reactor units.

3. Kursk II NPP is the first to utilize WWER-TOI reactor design in the world.

4. The design of V-510 includes improved protection against extreme impacts.

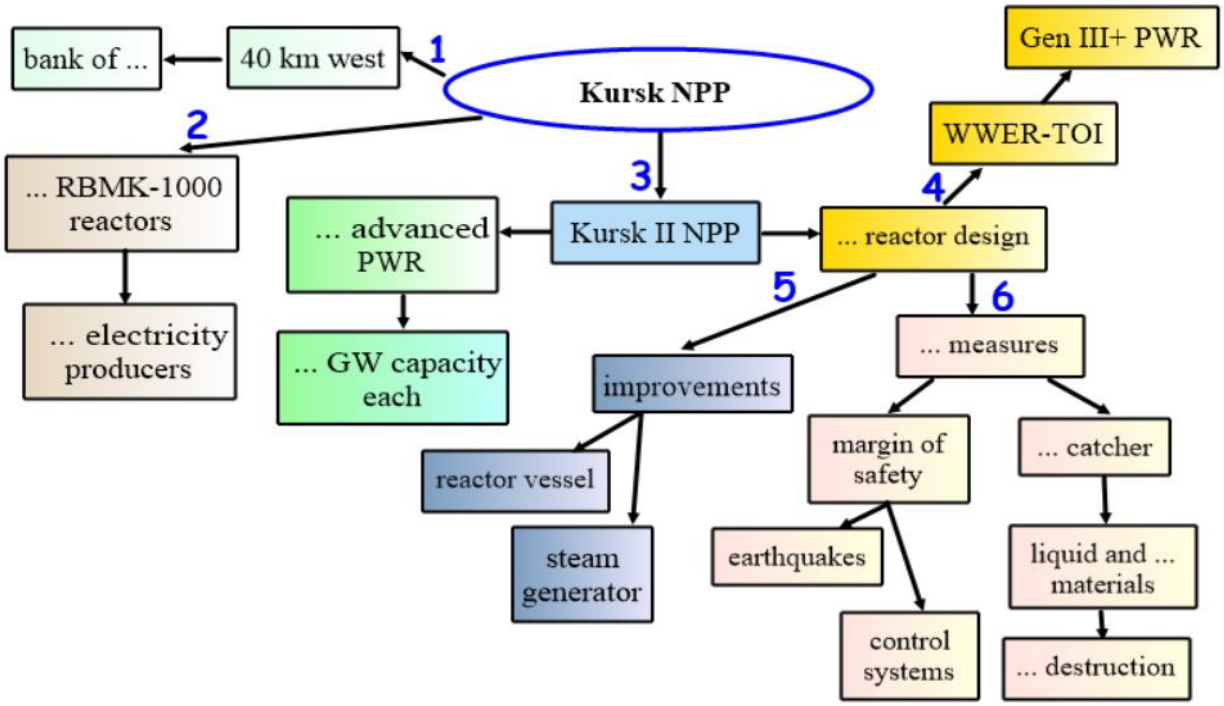
5. The core catcher is a concrete layer designed to protect the personnel.

3. Answer the following questions.

1. Why is Kursk II NPP being built?
2. What reactor type will be used at Kursk II NPP?
3. What are the main improvements of Kursk II NPP?
4. What does the design of WWER-TOI offer?
5. What is the design of WWER-TOI equipped with?

SPEAKING PRACTICE

1. Complete the missing information in the mind map below and retell the text about Kursk NPP.



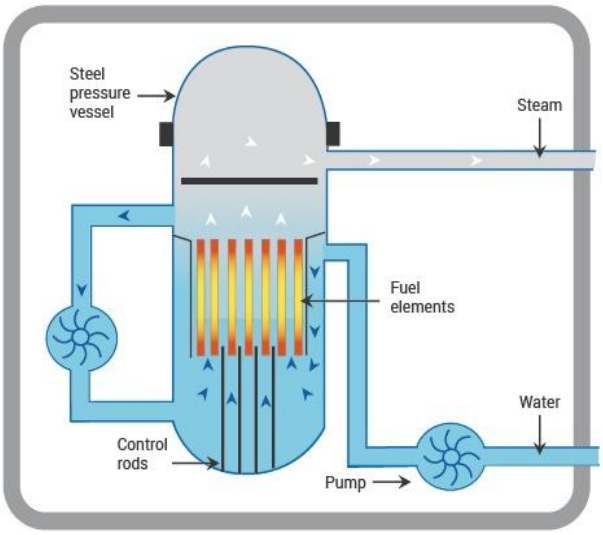
2. Search in the Web for additional information about core catchers and their usage at NPPs all over the world. Add this new information into your story and retell it.

UNIT 5

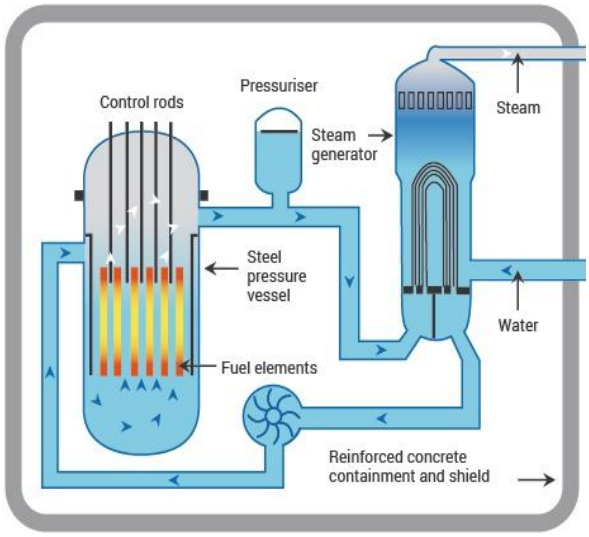
LENINGRAD NUCLEAR POWER PLANT

PRE-READING

1. Look at the pictures of the BWR and the PWR and revise their main components. What is the difference between these two reactor types? Do you know any NPPs in Russia where both types of reactors are used?



Pic.1. BWR



Pic.2. PWR

READING

1. Skim the text and say a) where is Leningrad NPP located? b) how many reactors are installed at Leningrad NPP? c) how many reactors are there at Leningrad NPP-2?

Leningrad Nuclear Power Plant

Leningrad NPP is situated 80 km west of St. Petersburg on the southern shore of the Gulf of Finland, the Baltic Sea. Today, Leningrad NPP covers more than 55% of energy needs of St. Petersburg and Leningrad region, which constitutes 30% of the electricity generation in the North-West of Russia. Leningrad NPP with an installed capacity of 4,400 MW is the most powerful nuclear power plant in Russia and the largest power plant in the North-West of Russia.

Leningrad NPP is the only plant in Russia where there are two different types of nuclear reactors – RBMK and WWER. It operates two uranium-

graphite channel-type RBMK-1000 reactors and two pressurized water-type third-generation WWER-1200 reactors. The power units No.1 and 2 were decommissioned in 2018 and 2020, respectively. The RBMK-1000 reactor unit No.3 and unit No.4 with an installed capacity of 1,000 MW each are currently in operation.

WWER-1200 reactors are installed at Leningrad NPP-2. Leningrad NPP-2 is a new NPP located adjacent to Leningrad NPP-1. Construction of the fifth unit of Leningrad NPP-2 began in October 2008, while the connection to the national grid happened for the first time in March 2018. The commercial launch of the sixth WWER-1200 started in July 2020 when the first fresh fuel assembly was loaded into the reactor core, and it was commissioned in March 2021.

The water-powered WWER-1200 power reactors belong to the newest generation of third-generation plus reactors that meet all the post-Fukushima requirements.

AFTER READING

VOCABULARY PRACTICE

1. Study these words and phrases from the text. Match these words and phrases with their definitions.

1. to meet requirements **2. to constitute** **3. to cover**

4. adjacent **5. grid** **6. to decommission**

a) To lay or spread something over.

b) To officially take (a nuclear reactor or weapon) out of use and make the area safe.

e) To make up, to form, to compose.

f) Very near, next to, or touching.

g) To satisfy the condition.

h) A system of wires through which electricity is connected to different power stations across a region.

2. Complete each of the following sentences with the appropriate word or phrase from Exercise 1 (Part "After Reading").

1. Turbo generators are located in the hall _____ to the reactor building.

2. Russia has a single synchronous electrical _____ surrounding much of the country.

3. Belarus NPP is built to the standards which fully _____ all post-Fukushima _____, international standards and recommendations of the IAEA.

4. Pressurized water reactors _____ most western nuclear power plants.

5. Kursk NPP _____ 52% of the total output of all electric power plants of Black Earth Belt.

6. Most reactors were _____ because there was no longer any economic justification for running them.

COMPREHENSION CHECK

1. Complete the following table with facts and figures using the information from the text.

№	Information	Fact / Figure
1.	Electricity generation of Leningrad NPP in the North-West Russia	
2.	Nuclear reactors at Leningrad NPP: - their types - their capacity	
3.	Characteristics of Leningrad NPP-2 - its location - its reactor type	

2. Indicate which of the following statements are true and which are false.

1. Leningrad NPP is the most powerful nuclear plant in the South-West of Russia.

2. The PWR at Leningrad NPP belongs to the second-generation WWER-1000 reactors.

3. The installed capacity of both reactor units No.3 and No.4 constitutes 1,000 MW.

4. The commercial launch of the fifth unit of Leningrad NPP-2 began in July 2020.

5. The third-generation plus reactors include the WWER-1200 power reactors.

3. Answer the following questions.

1. How much energy needs does Leningrad NPP cover?

2. Why is Leningrad NPP known to be unique?

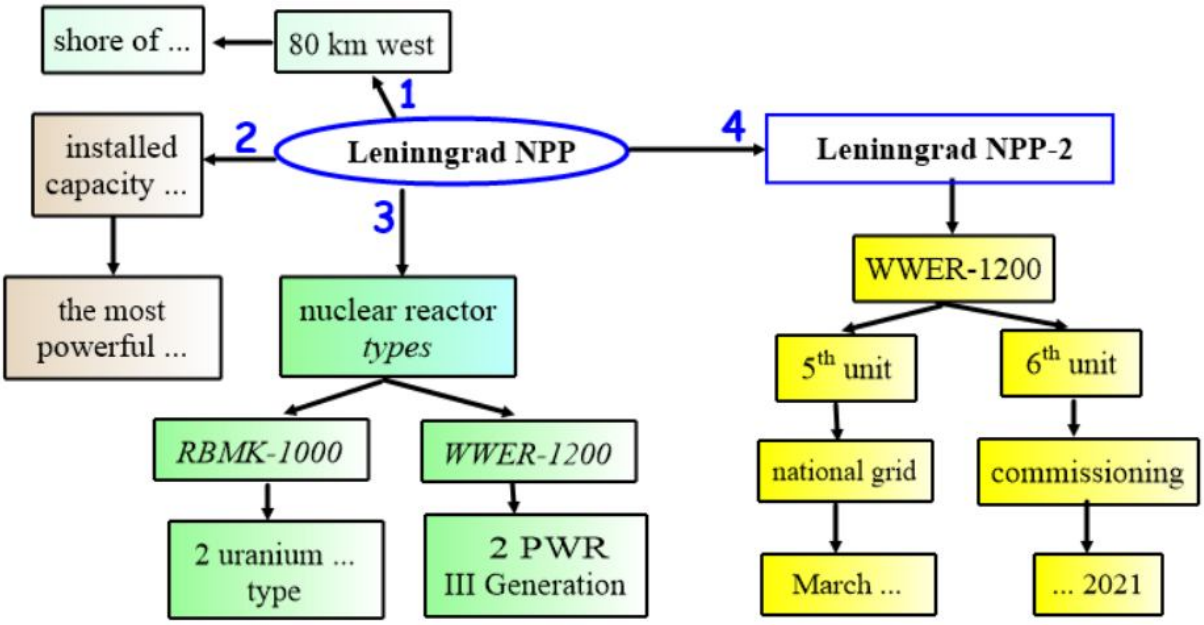
3. What's happened to the first and second power units of Leningrad NPP?

4. How much energy do reactor units No.3 and Unit No.4 produce?

5. What generation does the WWER-1200 power reactor belong to?

SPEAKING PRACTICE

1. Complete the missing information in the mind map below and retell the text about Leningrad NPP.



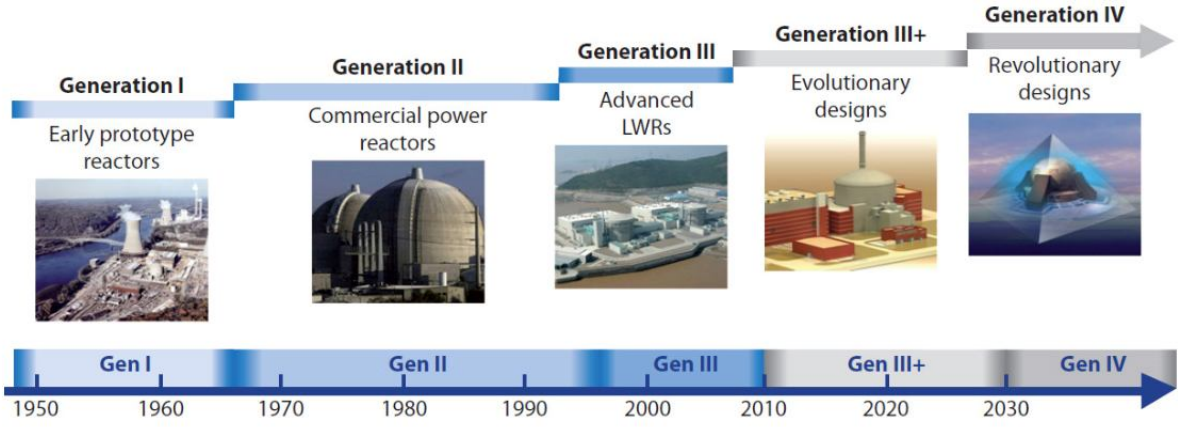
2. Search in the Web for additional information about the Generation III and the Generation III+ nuclear power reactors in the world (their expected development, evolution, operation, characteristics, etc.). Add this new information into your story and retell it.

UNIT 6

NOVOVORONEZH NUCLEAR POWER PLANT

PRE-READING

1. Look at the picture and discuss the evolution of reactor generations in the world. Can you give examples of reactor types of each generation used in Russia? What generation nuclear reactors create the base of nuclear power industry in the world nowadays?



READING

1. Skim the text and say a) what type of nuclear reactors does Novovoronezh NPP have? b) how many reactors are there at Novovoronezh NPP? c) what type of nuclear reactors are to be built at Novovoronezh NPP II?

Novovoronezh Nuclear Power Plant

Novovoronezh NPP is one of the oldest enterprises in the Russian Federation nuclear power industry. Novovoronezh plant supplies power to Voronezh Oblast, Belgorod, Lipetsk, and Tambov regions. It is the first Russian NPP to have WWER reactors.

During more than forty years of the Novovoronezh plant history, five power units with WWER-type reactors were built and commissioned (WWER-210, WWER-365, two units with WWER-440 type, WWER-1000). The first and second units were permanently decommissioned in 1988 and 1990. Unit No.3 of the plant was decommissioned in 2016, while unit No.4 was shut down for modernization works and has resumed operation. Unit No.5 of the

plant has recently undergone upgrade. It has advanced features similar to those of a generation III reactor and will operate until 2035.

Novovoronezh NPP is also the first GenIII+ NPP in Russia. This type of reactors is installed at Novovoronezh NPP II, which is being developed at the site of existing Novovoronezh NPP. Novovoronezh NPP II is planned to have four generating units featuring WWER-1200 reactors. Two of the reactors are being constructed as part of phase one, while the other two are still in the design stage. The first unit was commissioned in February 2017, while the pilot commercial operations of the unit No.2 were started in June 2019.

WWER-1200 is planned to have a lifetime of approximately 60 years. WWER technology refers to a series of pressurized water reactor designs originally developed in Russia. Distinctive features of WWER include the horizontal steam generators, hexahedral fuel assemblies, and the high-capacity pressurizers that provide a large reactor coolant inventory.

AFTER READING

VOCABULARY PRACTICE

1. Study these words and phrases from the text. Match these words and phrases with their definitions.

1. lifetime **2. coolant inventory** **3. to install**

4. site **5. to resume** **6. enterprise**

a) A place where something is (was, or will be) built, or where something happened (is happening, or will happen).

b) To start again after a pause or interruption.

c) The period of time during which something exists.

d) An organization, a company, or a business.

e) To put something in place so that it is ready for use.

f) A quantity or supply of coolant kept for use as needed.

2. Complete each of the following sentences with the appropriate word or phrase from Exercise 1 (Part "After Reading").

1. Kansai Electric in Japan _____ operations of its Mihama No.3 reactor which has been offline for more than a decade.

2. Rosatom comprises more than 360 _____, including scientific research organizations, the nuclear weapons complex, etc.

3. It was Russian crews that _____ reactor pressure vessel at Bangladesh's first nuclear power plant.

4. The control of the reactor _____ in normal operation is performed by the control system.

5. Most nuclear power plants have operating _____ of between 20 and 40 years.

6. The selection of a _____ suitable for a nuclear installation is a very important process.

COMPREHENSION CHECK

1. Complete the following table with facts and figures using the information from the text.

№	Information	Fact / Figure
1.	Territory supplied by Novovoronezh NPP	
2.	Number of nuclear power units at Novovoronezh NPP, their launching and decommissioning	
3.	Generating units of Novovoronezh NPP II	
4.	Characteristics of WWER technology	

2. Indicate which of the following statements are true and which are false.

1. Novovoronezh NPP is the newest nuclear power plant in the Russian Federation.

2. The first and second units of Novovoronezh NPP are temporarily shut down.

3. Unit No.4 of the plant underwent modernization.

4. Three reactor units are planned to be installed at Novovoronezh NPP II.

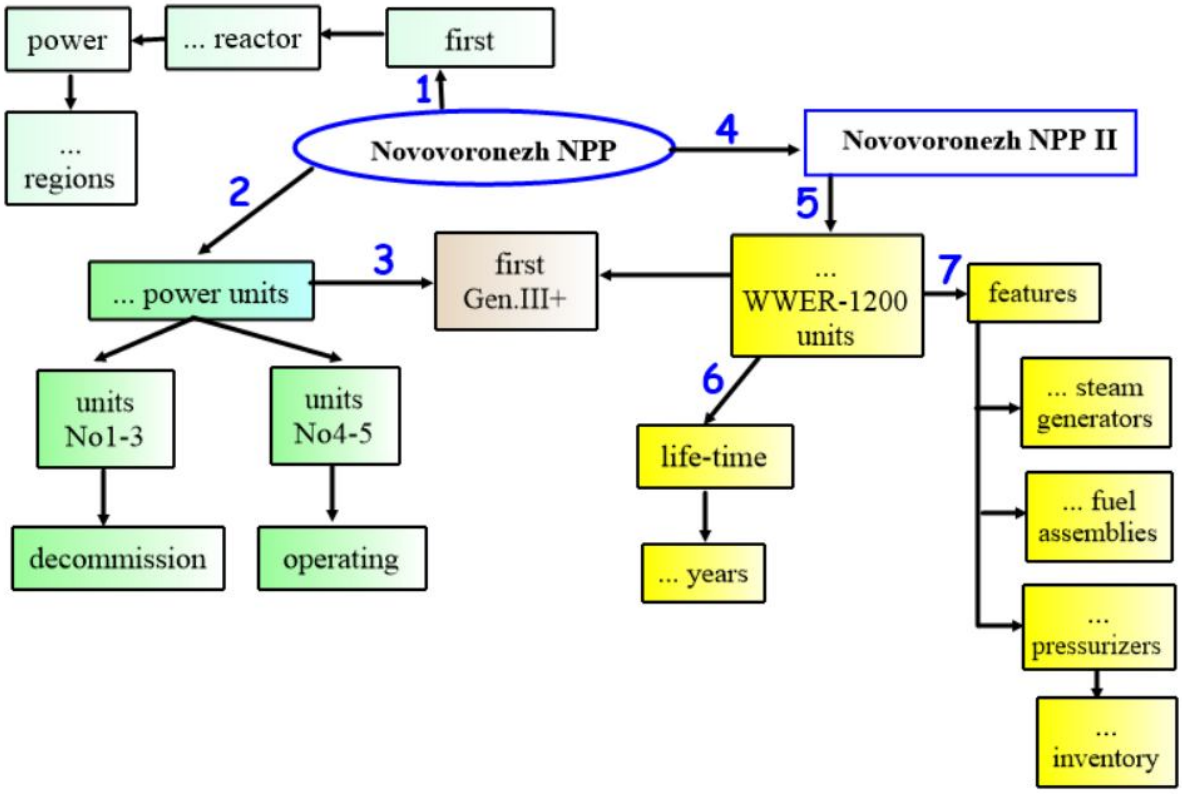
5. All reactors are already in operation at Novovoronezh NPP II.

3. Answer the following questions.

1. Are all Novovoronezh NPP power units still operating?
2. What is the lifetime of the unit No.5?
3. What type of reactors is installed at Novovoronezh NPP II?
4. What is the generating capacity of Novovoronezh NPP II?
5. What is the lifetime of WWER-1200?

SPEAKING PRACTICE

1. Complete the missing information in the mind map below and retell the text about Novovoronezh NPP.



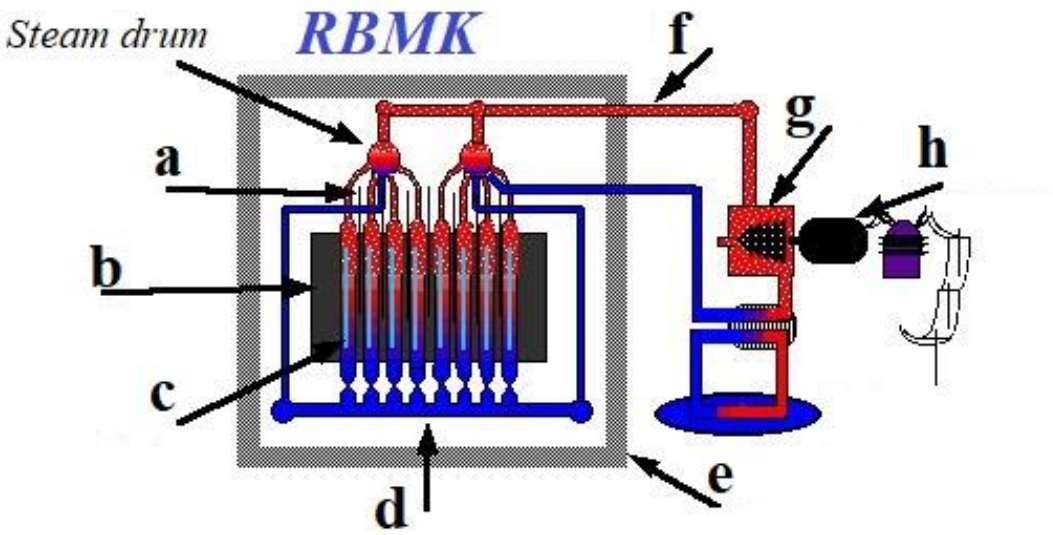
2. Search in the Web for additional information about the Generation IV reactors in the world (their expected development, evolution, operation, characteristics, etc.). Add this new information into your story about Novovoronezh NPP and retell it.

UNIT 7

SMOLENSK NUCLEAR POWER PLANT

PRE-READING

1. Look at the picture of RBMK reactor and revise its main parts (a-h) and their functions. Name those NPPs where RBMK reactors are still in use.



READING

1. Skim the text and say a) what is the total capacity of Smolensk NPP? b) how many reactors are there at Smolensk NPP? c) what reactor design is going to be used at Smolensk II NPP?

Smolensk Nuclear Power Plant

Smolensk NPP is the biggest power generating company of the north-western region of the united energy system of the Russian Federation. Its capacity is 3000 MW. The three RBMK-1000 reactors of Smolensk NPP were commissioned in 1982-1990 (1st – 24 Dec 1982, 2nd – 30 Mar 1985 and 3rd – 30 Jan 1990). Smolensk plant covers 75% of electricity supply to the region and 13% of all of the country's nuclear power generation.

The reactors of Smolensk NPP are the improved versions of RBMK with a number of innovative safety systems. The RBMK (reaktor bolshoy moshchnosty kanalny, high-power channel reactor) is a one-circuit, water-cooled reactor with individual fuel channels and using graphite as its moderator. As this design had several shortcomings, Rosatom decided to upgrade and

extend the operating life of the Smolensk 1-3 RBMK units. In 2019, Rosatom announced completion of life-extending modernization work at unit No.3 of Smolensk NPP. The other two units have already been set for an extended period of operation of 15 years.

As the service lifetime of these RBMK reactors will end in the next decade, in June 2020, Rosenergoatom signed a decree on the construction of two new power units at Smolensk NPP. The new Smolensk II plant – featuring two WWER-TOI (typical optimised, with enhanced information) reactors with a total capacity of 2510 MWe – will be built 6 km from the existing Smolensk plant. Smolensk II is to replace the three RBMK reactors at Smolensk I, which are expected to remain in operation until the new plant starts operating.

AFTER READING

VOCABULARY PRACTICE

1. Study these words and phrases from the text. Match these words and phrases with their definitions.

1. improved	**2. shortcoming**	**3. to annonunce**
4. to replace	**5. to feature**	**6. decree**
7. to sign	**8. united**	**9. completion**

a) To write one's name usually on a written or printed document to identify oneself as the writer or sender.

b) An official statement that something must happen.

c) To include someone or something as an important or characteristic part.

d) Joined together as a group for a common purpose.

e) Having become or been made better.

f) The act of finishing something that you are doing or making.

g) To put something in the place of something else.

h) A fault or failure to meet a certain standard.

i) To make something known or tell people about something officially.

2. Complete each of the following sentences with the appropriate word or phrase from Exercise 1 (Part "After Reading").

1. The RBMK design had serious _____, which contributed to the 1986 Chernobyl accident.

2. In 2009, the _____ for the construction of the Baltic NPP was _____ by the President.

3. Rosenergoatom has announced the _____ of construction of floating nuclear power plant, named Akademik Lomonosov that _____ two KLT-40S reactor units capable of producing 70MW generation capacity.

4. Kursk NPP is an important part of the _____ Energy System of Russia.

5. _____ designs of nuclear power reactors are constantly being developed internationally.

6. The new Natrium nuclear power plant will be located in Kemmerer, officials _____ on Tuesday, and will _____ a coal-fired plant that is to be closed in 2025.

COMPREHENSION CHECK

1. Complete the following table with facts and figures using the information from the text.

№	Information	Fact / Figure
1.	Smolensk NPP location	
2.	Types of reactors at Smolensk NPP	
3.	Features of the RBMK reactor at Smolensk NPP: - number of circuits; - coolant used; - moderator used;	
4.	Reactor type of the Smolensk II NPP and its features	

2. Indicate which of the following statements are true and which are false.

1. Smolensk NPP reactors have a lot of advanced safety systems.

2. The Smolensk RBMK reactor is a gas-cooled reactor.

3. The reactor units No.1 and No.2 of Smolensk NPP were modernized in 2019.

4. Two new RBMK reactors will be built at Smolensk II NPP.

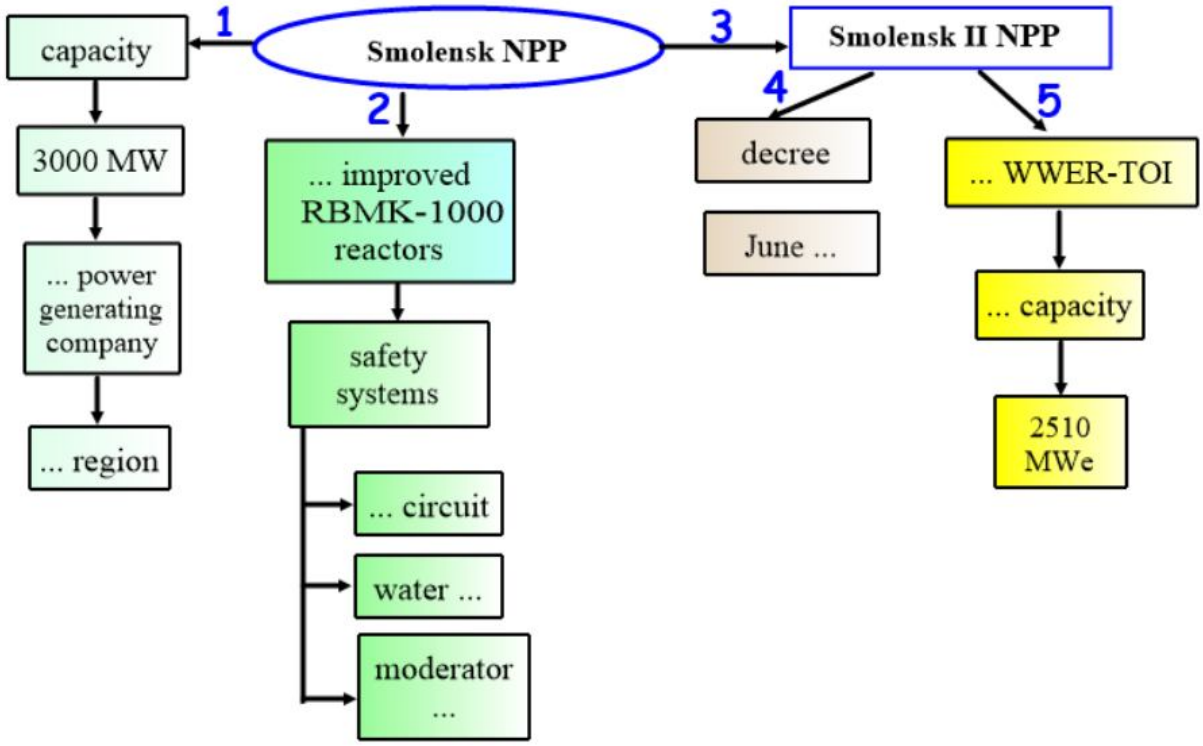
5. Smolensk I plant will operate until the commissioning of the Smolensk II NPP.

3. Answer the following questions.

1. What does "RBMK" stand for?
2. How much electricity supply does Smolensk NPP cover?
3. Why did Rosatom decide to improve Smolensk reactor units?
4. What is the operation life of Smolensk NPP?
5. Why will Smolensk II NPP be built?

SPEAKING PRACTICE

1. Complete the missing information in the mind map below and retell the text about Smolensk NPP.



2. Search in the Web for additional information about WWER-TOI (its general characteristics, safety measures, construction design, operation, etc.). Add this new information into your story about Smolensk NPP and retell it.

APPENDIX 1

Useful Phrases

Giving opinion

Personal Point of View	General Point of View
In my opinion … From my point of view … To my mind … I would say that …	Some people say that … Many people think \ believe that … It's often said that … Everybody knows that …

Asking for Opinion

- What do you think of...?
- What do you think about...?
- What do you reckon (about...)?
- What is your opinion of...?
- What are your views on...?
- Where do you stand (on...)?
- What would you say to... / if we...?
- How do you feel (about...)?
- Are you aware of.....?
- Do you have any idea?
- Do you know/see what I mean?
- Do you agree with me?
- Don't you think (that) … ?
- Would you go along with that?
- What are your thoughts on that?

Agreement or Disagreement

Agreement	Partial Agreement	Disagreement
• I agree with you … • I'm of the same opinion. • I completely / absolutely agree with you. • I think so too.	• That's true, but … • I agree with you in part, but … • it's only partly true that … • I agree with you to an extent, however, …	• I completely disagree with you … • I don't think so. • I don't agree with you. • I'm of a different opinion because …

APPENDIX 2

Abbreviations

AMB	***a**tom **m**irny **b**olshoy (peaceful atom big)*
BN	***b**istryy **n**eitron (fast neutron)*
BREST-OD	***b**ystryj **r**eaktor so **s**vincovym **t**eplonositelem – **o**pytno-**d**emonstracionnyj (lead-cooled fast reactor – pilot and demonstration)*
BWR	***b**oiling **w**ater **r**eactor*
EGP	***e**nergeticheskij **g**eterogennyj **p**etlevoj reactor (energetic heterogeneous loop reactor)*
FNPP	***f**loating **n**uclear **p**ower **p**lant*
FPU	***f**loating **p**ower **u**nit*
GW	***g**iga**w**att*
GWh	***g**iga**w**att **h**ours*
HEP	***h**ydro**e**lectric **p**lant*
IAEA	***I**nternational **A**tomic **E**nergy **A**gency*
KLT	***k**orabel'nyj dlya **l**edokolov tipa "**T**ajmyr"*
MOX	***m**ixed **ox**ide*
MeV	***m**ega**e**lecton **v**olt*
MW	***m**ega**w**att*
MWe	***m**ega**w**atts of **e**lectric power*
NPP	***n**uclear **p**ower **p**lant*
PWR	***p**ressurized **w**ater **r**eactor*
RBMK	***r**eaktor **b**olshoy **m**oshchnosty **k**analny (high-power channel-type reactor)*
U	***U**ranium*
WWER	***w**ater-**w**ater **e**nergetic **r**eactor*
WWER-TOI	***w**ater-**w**ater **e**nergetic **t**ypical **o**ptimized **i**nformation-**b**ased **r**eactor*

APPENDIX 3

Proper Names

Black Earth Belt	*Черноземье*
Chaunskaya Co-Gen plant	*Чуанская ТЭЦ*
China General Nuclear Power Group	*Китайская генеральная корпорация атомной энергетики*
Gulf of Finland	*Финский залив*
IAEA	*МАГАТЭ (Международное агентство по атомной энергии)*
Kansai Electric	*Кансай электрик*
Kemmerer	*г. Кеммерер*
Kola	*Кольский*
Kudankulam Nuclear Power Plant	*АЭС Куда̀нкула̀м*
Mihama	*АЭС Михама*
Novosibirsk Chemical Concentrates Plant	*Новосибирский завод химконцентратов*
Pevek	*г. Певек*
The Polish Energy Policy	*проект «Энергетическая стратегия Польши»*
TVEL	*топливная компания «ТВЭЛ»*

VOCABULARY

A

aberrations	*отклонения*
accidental destruction	*повреждение при происшествии*
account for	*насчитывать*
adjacent to	*рядом с ч-л.*
advanced	*усовершенствованный*
ageing	*старый, изношенный*
alternating current	*переменный ток*
angle	*угол*
announce	*сообщать, оповещать*
annual	*ежегодный*
assume	*предполагать*
auxiliary	*вспомогательный*

B

back-up	*резервный*
bank	*берег*
bitumen	*битум*
blend	*смешивать*
breeder reactor	*реактор-размножитель*

C

capacity	*мощность*
cater	*поставлять*
closed circuit	*замкнутый контур*
coastal	*береговой*
commence	*начинаться, стартовать*
comprise	*включать (в состав)*
consecutively	*последовательно*

constitute	*составлять*
containment	*гермооболочка*
core catcher / core melt trap	*ловушка расплава активной зоны*
cover	*покрывать*
currently	*на сегодняшний день*

D

decommission	*выводить из эксплуатации*
decree	*распоряжение, постановление*
dismantling	*демонтаж*
distinctive feature	*отличительная черта*

E

earthquake	*землетрясение*
electricity mix	*энергетический баланс*
encompass	*содержать, заключать, окружать*
enhance	*увеличивать, повышать*
enterprise	*предприятие*
exhaust steam	*отработанный пар*
expand	*увеличивать, расширять*
extension	*увеличение*

F

facility	*объект, сооружение*
fast reactor	*реактор на быстрых нейтронах*
feature (v)	*быть оборудованным, обладать*
feed water	*питательная вода*
floating	*плавучий*
fuel assembly	*тепловыделяющая сборка*
fuel pins	*ТВЭЛ в виде тонкого стержня*
full-scale	*полномасштабный*

G

gulf	*залив*

H

hall	*реакторный зал*
hexahedral	*шестигранный*

I

improvement	*улучшение, усовершенствование*
install	*устанавливать*
installed capacity	*проектная мощность*
inventory	*запас*

L

lattice	*решётка*
launch	*запускать*
lifetime	*продолжительность эксплуатации*
limitation	*ограничение*
liquid	*жидкий*
loop	*петля*

M

main switchgear	*главное распределительное устройство*
major overhaul	*глубокая модернизация, радикальная переработка*
margin of safety	*запас прочности*
minor	*несущественный*
mixed oxide fuel	*смешанное оксидное уран-плутониевое топливо*
modular reactor	*модульный реактор*
move ahead	*двигаться вперёд*

N

Natrium nuclear power plant	*реактор с натриевым теплоносителем*
net capacity	*чистая мощность*
nuclear icebreaker fleet	*атомный ледокольный флот*
nuclear weapons complex	*ядерный оружейный комплекс*

O

offshore facility	*объект на море*
onshore	*находящийся на суше*
operating lifetime	*период эксплуатации*

P

permanently	*навсегда*
pipeline	*трубопровод*
pitch	*шаг*
power generation facility	*объект по производству электроэнергии*
power grid	*энергосеть*
preserve	*сохранять, сберегать*
pressurizer	*компенсатор давления*
pre-stressed	*предварительно напряженный*
processing	*переработка*

R

reactor plant	*реакторная установка*
reactor vessel	*корпус реактора*
regular	*правильный*
reinforced ferro-concrete	*армированный железобетон*
remote	*удалённый*
replace	*заменить*

reservoir	*1) цистерна; 2) водохранилище*
respectively	*соответственно*
resume	*возобновить*
sodium	*натрий*

S

sealed	*герметичный*
seek to smth.	*ориентироваться на ч-л.*
settlement	*поселение*
shore	*берег*
shortcoming	*недостаток*
shut down	*останавливать (прекращать работу)*
sign	*подписывать*
similar	*похожий*
site	*место*
solidify	*отвердевать*
spent fuel	*отработанное топливо*
standby	*резервний*
steadily	*уверенно, стабильно*
storage	*хранение*
storage pool	*бассейн выдержки*
subsidiary	*подразделение, дочерняя компания*
supply	*питать, подавать (электроэнергию)*
suspend	*откладывать*

T

temporarily	*временно*
thermal neutron spectrum	*спектр тепловых нейтронов*
three-tier	*трёхуровневый*

tough	*жёсткий*
trap	*захватывать, ловить*
treatment facilities	*очистительные сооружения*
triangular	*треугольный*
turbine set	*турбоустановка*

U

Unified Energy System	*единая энергосистема*
upgrade	*модернизировать*

V

valid	*быть действительным*

W

waste	*отходы*
wastewater	*отработанная вода*
withstand	*выдерживать*
work out	*разрабатывать*

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тел. +7 (923) 358-10-20
Электронная почта: monography@nkras.ru
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