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ALMATY UNIVERSITY OF POWER ENGINEERING AND TELECOMMUNICATIONS

Department
for Language Studies

PROFESSIONAL ORIENTED FOREIGN LANGUAGE

Methodological recommendations for practical application
for students of specialty 5B071700

Almaty 2019

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Methodological instructions are intended for conducting for practical lessons on professional oriented foreign language with the 3d year students of 5B071700 – Heat Power Engineering specialty. In this work, technical texts and lexical-grammar exercises are developed for the improvement of speaking, reading, writing and translation skills considering peculiarities of both languages. These Methodological Recommendations consist of six sections: Energy and Its Types, Solar Energy, Turbines, Types of Turbines, Modern Steam Power Plant, Modern Steam Power Plant, Wind Power.

References – 20 items.

Reviewer: Cand.ph.sc., associate prof. U.B. Serikbaeva

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Introduction

Methodological Recommendations include themes according to the curriculum for teaching Professional oriented foreign language to Bachelor students of the 3d year. Professional technical texts are the basis of these Recommendations. Special attention is drawn to the lexis as well as some English grammar peculiarities which are important for translating.

There are exercises to develop speech activities as reading, speaking, writing, and translating.

These Methodological Recommendations can be used for working in class and for individual work of the students.

Unit 1

Text 1. Energy and Its Types

There are different types of energy present in the universe. In scientific language, energy can be defined as a measure of substance movement. The word energy has an everyday meaning and a scientific one.

The everyday meaning is force, vigor, power, strength, action skills, or determination, decision in everything you do.

At the actual level of knowledge and technical development, it is considered that the Universe which surrounds us exists under two forms: substance and force. Substance is characterized by two fundamental aspects: mass and energy. Mass is the measure of inertia and gravitation, and energy is the scalar measure of substance movement. The word energy is well known, but the concrete content of the notion is not so popular or rigorously analyzed, because of some subtle particularities, characteristic to certain forms of energy. The most general definition presents energy as measure of substance movement. This definition is correct, but it is not very clear, as substance is characterized by more forms of movement.

Energy is the measure of a physical system. It defines the quality of the changes and process which take place in the Universe, beginning with movement and finishing with thinking. The unity and the connection between the movement forms of substance, their lively capacity of mutual transformation, allowed the measuring of different forms of substance through a common aspect: energy.

Energy is one of the most important physical concepts discovered by man. The correct comprehension of the notion is a necessary condition to analyze energetic systems and energetic processes.

The name of energy forms is related to:

1) The way energy is perceived (for example: thermal energy).

2) What carries the energy (for example: nuclear energy, hydraulic energy, wind energy, geothermal energy, and solar energy).

Vocabulary

Universe – Вселенная
to define – определять
substance – вещество
vigor – сила, энергия, мощность
determination – определение
strength – сила
to consider – рассматривать
to surround – окружать
scalar – скалярный/блок установки
rigorously – строго, точно
subtle – едва ощутимый, тонкий
particularity – особенность, специфика

to take place – иметь место
unity – единение, единство
lively – быстро, оживленно, интенсивно
capacity – емкость, объем, мощность
to perceive – воспринимать, осознавать

Exercise 1. Read and translate the text.

Exercise 2. Answer the questions.
1. What types of energy do you know?
2. How can you explain the term “energy”?
3. Why do people need energy?

Exercise 3. Translate the word combinations.
Mathematical abstraction, fundamental law, changing phenomena, amount of energy, energy conservation law, mathematical expressions, forms of substance, substance movement, mutual transformation, a necessary condition, physical concepts discovered by man, origins of energy.

Exercise 4. Determine whether the sentences are true or false.
1. The name of energy forms is related to the way energy is perceived (for example: thermal energy). 2. Substance is characterized by three fundamental aspects: mass, energy and velocity. 3. Mass is the scalar measure of substance movement, and energy is the measure of inertia and gravitation. 4. Energy is the measure of a chemical system. 5. In scientific language, energy can be defined as a measure of substance transformation. 6. The unity and the connection between the movement forms of substance, their lively capacity of mutual transformation, allowed the measuring of different forms of substance through a common aspect: energy. 7. Energy defines the quality of the changes and process which take place in the Universe. 8. The name of energy forms is related to what carries the energy. 9. The Universe which surrounds us exists under two forms: substance and force. 10. Energy is one of the most important medical concepts discovered by man. 11. The word energy is well known, but the concrete content of the notion is not so popular or rigorously analyzed. 12. The correct comprehension of the notion is a necessary condition to analyze energetic systems and energetic processes.

Exercise 5. Make interrogative and negative sentences and special questions.
1. Substance is characterized by two fundamental aspects: mass and energy.
2. A lot of processes take place in the Universe.
3. Energy is one of the most important physical concepts.

Exercise 6. Fill in gaps by the appropriate forms of participles. Read and translate the sentences by using a dictionary.

1. Energy is mathematic abstraction, a measure of movement within (to move) forms changing phenomena.

2. The energy which is available is not always under the form (to expect). In order to obtain the form you want, you must proceed to conversion. Usually, not all the energy available can be (to change) into another form of energy.

3. As energy can't be (to create) or (to destroy), the sum of energies which enter a process must be equal with the sum of energies which result from the process.

Exercise 7. Change the sentences in Active Voice into Passive Voice.

1. The substance movement allowed the introduction of the energy notion.

2. Different types of energy associated different movement forms.

3. The law of conservation and change of energy explain a lot of important notions.

Supplementary Exercises.

Exercise 1. Translate the headings for the research articles. Pay attention to the order of the words.

1. Evaluation of energy renovation strategies for 12 historic building types using LCC optimization.

2. Renewable and non-renewable energy, regime type and economic growth.

3. Which type of energy drove industrial growth in the US from 2000 to 2018?

Exercise 2. Translate the word combinations.

Renewable energy consumption, non-renewable energy consumption, regime type, economic growth, cointegration, LCC (the life cycle cost) optimization, historic buildings, energy renovation, environmental performance, economic growth, nonlinear autoregressive distributed lag approach.

Exercise 3. Read the following abstracts of the research articles from the exercises 4.

1. Find the predicates in the Active and Passive Voices and determine their tense.

2. Pay attention to the prepositions and the order of the words in the abstracts.

3. Determine and write the main directions of the research in the abstracts.

Exercise 4.

1. Choose the appropriate headings to the abstracts from the below-mentioned ones.

2. Choose the appropriate group of keywords to each abstract from the below-mentioned ones.

3. Match the appropriate highlights to the abstracts.

Abstract 1.

The paper analyses the effect of renewable and non-renewable energy consumption as well as the regime type on economic growth in 30 Sub-Saharan African (SSA) countries over the period 1980 – 2012. Using heterogeneous panel cointegration and panel-based error correction tests, we find long-run relationship between the variables. However, short-run results are not robust, which suggest that energy sector investments are long-term in nature. Specifically, the results show that while both renewable and non-renewable energy have significant positive effect on economic growth, non-renewable energy has a greater growth enhancing effect than renewable energy. A 10% increase in renewable energy consumption is associated with an increase in economic growth by 0.27%, while a 10% increase in non-renewable energy consumption leads to an increase in growth by 2.11% ceteris paribus. Further, the findings of the study show that democratic states experience higher growth rates than autocratic states.

Abstract 2.

The life cycle cost (LCC) optimization is a vital method when performing building energy renovation. The present paper provides an evaluation of cost-optimal energy renovation strategies for historic buildings using LCC optimization software OPERA-MILP. The evaluation is performed based on preset targets depending on LCC (LCC optimum) and energy use (decrease by 50%), where the environmental performance is also addressed. Twelve building types, which are typical of the historic building stock in Visby, Sweden, are used as the study object.

The results show possible decreases of 12 – 38% in LCC when targeting LCC optimum. When targeting a 50% decrease in energy use, the LCC is decreased in 21 of 26 cases compared to before energy renovation. Cost-efficient EEMs on the building envelope are characterized by low renovation costs and additional insulation of building components with poor thermal properties. Furthermore, the environmental performance from the energy renovations is highly dependent on the chosen energy system boundary.

Abstract 3.

The paper analyses the effect of renewable and non-renewable energy consumption as well as the regime type on economic growth in 30 Sub-Saharan African (SSA) countries over the period 1980 – 2012. Using heterogeneous panel cointegration and panel-based error correction tests, we find long-run relationship between the variables. However, short-run results are not robust, which suggest that energy sector investments are long-term in nature. Specifically, the results show that while both renewable and non-renewable energy have significant positive effect on economic growth, non-renewable energy has a greater growth enhancing effect than renewable energy. A 10% increase in renewable energy consumption is associated with an increase in economic growth by 0.27%, while a 10% increase in non-renewable energy consumption leads to an increase in growth by 2.11% ceteris paribus. Further, the findings of the study show that democratic states experience higher growth rates than autocratic states.

Headings:

1) Evaluation of energy renovation strategies for 12 historic building types using LCC optimization.

2) Renewable and non-renewable energy, regime type and economic growth.

3) Which type of energy drove industrial growth in the US from 2000 to 2018?

Groups of keywords:

1) Renewable energy consumption, non-renewable energy consumption, regime type, economic growth, cointegration.

2) OPERA-MILP, LCC optimization, historic buildings, energy renovation, environmental performance.

3) Non-renewable energy consumption, renewable energy consumption, economic growth, nonlinear autoregressive distributed lag approach.

Highlights 1:

1) This study evaluates cost-optimal energy renovation strategies for various historic building types in a Northern European climate using LCC optimization software OPERA-MILP.

2) Twelve building types, which are typical of the historic building stock in Visby, Sweden, are selected as the study object.

3) Decreases of 12 – 38% in LCC can be obtained by selecting various cost-effective energy efficiency measures and a cost-optimal heating system.

4) The environmental performance of the energy renovations is closely connected to the assumptions made about the energy system boundary.

Highlights 2:

1) Investigates the effects of energy consumption on industrial production (IP) for the US over the period 2000:M01–2018:M02.

2) Employs the nonlinear autoregressive distributed lag approach.

3) Yields that there exist asymmetric relationships between different types of energy and IP.

4) Discusses theoretical and practical implications.

Highlights 3:

1) Long-run relationship exists between energy consumption (renewable and non-renewable), capital, labor, political regime and economic growth in 30 Sub-Saharan African countries.

2) Non-renewable energy has a stronger positive effect on growth than renewable energy.

3) The policy regime or regime type is important to understanding the link between energy consumption and economic growth in the region.

Unit 2

Text 2. Solar Energy

Solar energy, radiant light and heat from the sun, has been harnessed by humans since ancient times using a range of ever-evolving technologies. Solar energy technologies include solar heating, solar photovoltaics, solar thermal electricity and solar architecture, which can make considerable contributions to solving some of the most urgent problems the world now faces.

Solar technologies are broadly characterized as either passive solar or active solar depending on the way they capture, convert and distribute solar energy. Active solar techniques include the use of photovoltaic panels and solar thermal collectors to harness the energy. Passive solar techniques include orienting a building to the Sun, selecting materials with favorable thermal mass or light dispersing properties, and designing spaces that naturally circulate air.

The Earth receives 174 petawatts (PW) of incoming solar radiation (insolation) at the upper atmosphere. Approximately 30% is reflected back to space while the rest is absorbed by clouds, oceans and land masses. The spectrum of solar light at the Earth’s surface is mostly spread across the visible and near-infrared ranges with a small part in the near-ultraviolet.

Earth’s land surface, oceans and atmosphere absorb solar radiation, and this raises their temperature. Warm air containing evaporated water from the oceans rises, causing atmospheric circulation or convection. When the air reaches a high altitude, where the temperature is low, water vapor condenses into clouds, which rain onto the Earth’s surface, completing the water cycle. The latent heat of water condensation amplifies convection, producing atmospheric phenomena such as wind, cyclones and anti-cyclones. Sunlight absorbed by the oceans and land masses keeps the surface at an average temperature of 14 C.

Solar energy can be harnessed in different levels around the world. Depending on geographical location the closer to the equator the more “potential” solar energy is available.

Vocabulary
solar – солнечный
radiant – излучающий, излучаемый
harnessed – утилизированный, обработанный
to evolve – возникать, появляться
contribution to – вклад в
urgent – срочный, необходимый
capture – сбор, поглощение
to convert – превращать, преобразовывать

photovoltaic – фотоэлектрический, фотогальванический
incoming – входящий
to reflect back – отражать
spread – распространенный
visible – видимый
to raise – поднять, поставить
containing – содержащий
to amplify – усилить
surface – поверхность
average – средний

Exercise 1. Read and translate the text.

Exercise 2. Answer the questions.

1. What is solar energy?
2. What are the types of solar technologies?
3. Why is the temperature of the oceans and the Earth's surface raised?
4. How do the clouds appear?
5. How can solar energy be harnessed? Give examples.

Exercise 3. Translate the words.

Solar, technologies, architecture, thermal, dispersing, to distribute, designing, radiation, absorbed, to circulate, spectrum, infrared, ultraviolet, latent heat, cyclone, to condense, equator, phenomena, location.

Exercise 4. Translate the word combinations.

The development of affordable, inexhaustible and clean solar energy technologies, countries' energy security, mitigating climate change, the Earth's non-renewable resources of coal.

Exercise 5. Fill in gaps by the appropriate words from the list: benefits, total solar energy, photosynthesis, amount, sunlight, Chinese, common features, local climate.

1. By ________ green plants convert solar energy into chemical energy.
2. The ________ absorbed by Earth's atmosphere, oceans and land masses is approximately 3,850,000 exajoules (EJ) per year.
3. The ________ of solar energy reaching the surface of the planet is very vast.
4. In 2011, the International Energy Agency said that "the development of affordable, inexhaustible and clean solar energy technologies will have huge longer-term _________".
5. __________ has influenced building design since the beginning of architectural history.

6. The Geeks and ________ oriented their buildings toward the south to provide light and warmth.

7. The _________ of passive solar architecture are orientation relative to the Sun, compact proportion, selective shading and thermal mass.

8. When these features are tailored to the _________ and environment they can produce well-lit spaces that stay in a comfortable temperature range.

Supplementary Exercises.

Exercise 1. Translate the headings for the research articles. Pay attention to the order of the words.

1. Solar energy systems – Potential of nanofluids.
2. Forecasting the residential solar energy consumption of the United States.
3. Effects of different sizes and dispatch strategies of thermal energy storage on solar energy usage ability of solar thermal power plant.

Exercise 2. Translate the word combinations.

Solar energy, solar energy consumption, solar energy usage efficiency, critical design DNI (direct normal irradiance), TES (thermal energy storage) size, solar multiple, dispatch strategy, efficiency improvement, nanofluid applications, solar collectors, heat transfer enhancement, Grey prediction method, buffer operators, Grey model.

Exercise 3. Read the following abstracts of the research articles from the exercises 4.

1. Find the predicates in the Active and Passive Voices and determine their tense.

2. Pay attention to the prepositions and the order of the words in the abstracts.

3. Determine and write the main directions of the research in the abstracts.

Exercise 4.

1. Choose the appropriate headings to the abstracts from the below-mentioned ones.

2. Choose the appropriate group of keywords to each abstract from the below-mentioned ones.

3. Match the appropriate highlights to the abstracts.

Abstract 1.

Global warming escalation has extended average temperature of earth beyond its safe limit. To avert this environmental-threat, solar energy has acquired substantial attention of remarkable researchers in this century. To effectively utilize solar energy by transforming into thermal and electrical energy, the involvement of nanofluids having intensified thermal, optical and magnetic properties, has become very popular. The foremost objective of this article is to provide a comprehensive review on the applications of nanofluids in solar energy systems like solar collectors, photovoltaic cells, solar stills, and thermal energy storage, which are thoroughly discussed in this paper. The effect of various critical parameters including flow rate of nanofluid, concentration of nanoparticles in base fluid, size, and type of nanoparticles on the efficiency of solar systems is thoroughly analyzed by graphical means. Comparison is made between the performance of nanofluid and base fluid in terms of electrical and thermal efficiency enhancements for all solar energy systems. Effect of nanoparticles on outlet temperature of working fluid, area reduction of solar system, optical efficiency, pumping power and friction factor of working fluid is also analyzed. In addition, the stats of the entire work considering leading investigators, organizations, countries, and journals have also been discussed briefly. Results suggest that nanofluid have a massive impact on heat transfer and system overall efficiency compared to base fluid in solar energy systems. Moreover, various challenges including stability, cost-effectiveness, higher pumping power with the use of nanofluids have also been briefly discussed in this study.

Abstract 2.

The solar energy usage ability is mainly considered in the construction of solar thermal power plant (STPP) which is affected by factors of design direct normal irradiance (DNI), solar multiple (SM), thermal energy storage (TES) size and dispatch fraction (DF). In this paper, a general model is developed in order to obtain the relationship among these factors, the electricity output and the solar energy usage efficiency of STPP. Based on the modeling method, a critical design of DNI is derived and some suggestions for improvement in the design of DNI are presented in order to improve the efficiency, which can result in the reduction of waste solar energy. The effects of SM, TES size and DF on the critical design of DNI are also investigated. It is found that the solar energy usage ability will be only dependent on the TES size when TES size is below 6 h and the solar energy usage ability will be dependent on both TES size and DF when TES size is above 6 h. The increase of TES size and the decrease of DF beyond their corresponding critical design DNI will reduce the solar energy usage ability of STPP. The results obtained can provide an important basis for studying the solar energy utilization capacity of STPP and determine the design parameters of STPP.

Abstract 3.

In recent years, residential solar energy consumption of United States under the effect of a series of encouragement policies has exhibited a growth trend characterized by seasonal leap. To predict it, a new grey model based on data grouping and buffer operator is proposed. The model groups on a monthly or quarterly basis are grouped, which are then buffered separately to cope with prediction error caused by seasonal fluctuations and sudden changes in trend. In addition, a genetic algorithm is used to obtain the most appropriate degree of buffering. And then, the predictive effects of classical grey model, grey model based on data grouping, non-linear autoregressive neural network, echo state network, and the proposed model are compared. The results show that the mean absolute percentage errors of predicted results obtained by using these five models are 32.73%, 30.23%, 46.94%, 39.15%, and 6.17%, respectively, implying that the proposed model confers a significant advantage. Compared with the other four models, the new model can more effectively recognize the seasonal fluctuation and structural mutation of time series data. After conducting out-of-sample forecasting, the results demonstrate that the residential solar energy consumption of United States will maintain its rapid growth with an average annual growth rate of 24%.

Headings:

1) Solar energy systems – Potential of nanofluids.

2) Forecasting the residential solar energy consumption of the United States.

3) Effects of different sizes and dispatch strategies of thermal energy storage on solar energy usage ability of solar thermal power plant.

Groups of keywords:

1) Solar energy usage efficiency, critical design DNI (direct normal irradiance), TES (thermal energy storage) size, solar multiple, dispatch strategy.

2) Solar energy, efficiency improvement, nanofluid applications, solar collectors, heat transfer enhancement.

3) Solar energy consumption, Grey prediction method, buffer operators, Grey model.

Highlights 1:

1) A prediction model based on data grouping and buffer operator is built..

2) The parameters of the model are optimized by using Genetic Algorithm.

3) The solar energy consumption of U.S. residents with leap growth characteristic is accurately forecasted.

Highlights 2:

1) Discussion on the effect of various critical parameters on performance of solar systems.

2) Challenges that hinders the applications of nanofluids in solar systems.

3) Summarized the studies in tables and briefly discussed the stats of the entire work.

4) Comparative studies of the thermal and electrical efficiencies.

5) Productivity of solar still can be maximized by lowering water depth.

6) In solar collectors, maximum efficiency is achieved at lower concentration of nanoparticles in base fluid.

Highlights 3:

1) A fundamental problem of solar thermal power plant is investigated.

2) A developed model is used to calculate the annual total electricity output.

3) A critical design for demonstrating the solar energy usage ability is derived.

4) Effect factors of solar energy usage efficiency are investigated.

Unit 3

Text 3. Turbines

A turbine is a rotary mechanical device that extracts energy from a fluid flow and converts it into useful work. A turbine is a turbomachine with at least one moving part called a rotor assembly, which is a shaft or drum with blades attached. Moving fluid acts on the blades so that they move and impart rotational energy to the rotor. Early turbine examples are windmills and water wheels.

Gas, steam, and water turbines usually have a casing around the blades that contains and controls the working fluid. Credit for invention of the steam turbine is given both to the British engineer Sir Charles Parsons (1854-1931), for invention of the reaction turbine and to Swedish engineer Gustaf de Laval (1845-1913), for invention of the impulse turbine. The word "turbine" was coined in 1822 by the French mining engineer Claude Burdin from the Latin turbo, or vortex, in a memoir, "Des turbines hydrauliques ou machines rotatoires a grande vitesse", which he submitted to the Academie royale des sciences in Paris. Benoit Fourneyron, a former student of Claude Burdin, built the first practical water turbine.

In 1866, California millwright Samuel Knight invented a machine that took the impulse system to a new level. Inspired by the high pressure jet systems used in hydraulic mining in the gold fields, Knight developed a bucketed wheel which captured the energy of a free jet, which had converted a high head of water to kinetic energy. This is called an impulse or tangential turbine.

In 1879, Lester Pelton (1829-1908), experimenting with a Knight Wheel, developed a double bucket design, which exhausted the water to the side, eliminating some energy loss of the Knight wheel which exhausted some water back against the center of the wheel. In about 1895, William Double improved on Pelton's half-cylindrical bucket form with an elliptical bucket that included a cut in it to allow the jet a cleaner bucket entry. This is the modern form of the Pelton turbine which today achieves up to 92% efficiency.

Vocabulary

rotary – вращающийся, ротационный
to extract – извлекать, удалять, изымать
rotor assembly – ротор в сборе
a shaft – вал
drum – цилиндр, коллектор, резервуар, барабан
a blade – лопасть

fluid – жидкость, рабочая жидкость, текучая среда
windmill – ветряная мельница, ветродвигатель
a casing – обшивка, чехол, кожух
credit – зд. честь, хвала
a bucket – ведро
vortex –вихрь, закрутка
inspired – вдохновленный
jet – реактивная струя
mining – добыча полезных ископаемых
a gold field – золотой прииск
to coin – создать слово, ввести в обращение
to eliminate – устранять, исключать, высвобождать
exhausted – истощенный
a cut – надрез, разрез, насечка

Exercise 1. Read and translate the text.

Exercise 2. Answer the questions.
1. How can you define a turbine?
2. Who invented a steam turbine?
3. Who contributed into developing turbines?

Exercise 3. Translate the word combinations.
A fluid flow, a rotor assembly, high pressure jet systems, hydraulic mining, a bucketed wheel, a double bucket design.

Exercise 4. Change the sentences in Active Voice into Passive Voice.
1. The turbines employ several physical principles to collect the energy.
2. The scientists developed classical turbine design methods in the mid 19th century.
3. It is possible to use velocity triangles to calculate the basic performance of a turbine stage.

Exercise 5. Put the verbs in brackets in correct tense form.
1. Flowing water (to direct) on to the blades of a turbine runner, creating a force on the blades.
2. Energy (to transfer) from the water flow to the turbine.
3. Water turbines (to divide) into two groups: reaction turbines and impulse turbines.

Supplementary Exercises.
Exercise 1. Translate the headings for the research articles. Pay attention to the order of the words.
1. New mode to operate centrifugal pump as impulse turbine.

2. Wake measurements from a hydrokinetic river turbine.
3. A novel wake model for yawed wind turbines.

Exercise 2. Translate the word combinations.

Yawed turbine, yawed wake, wind turbine wake, wake model, pump as turbine, impulse turbine, computational fluid dynamics, hydrokinetic energy, tidal energy, cross-flow turbine, turbine wake, environmental effects, field measurements.

Exercise 3. Read the following abstracts of the research articles from the exercises 4.

1. Find the predicates in the Active and Passive Voices and determine their tense.

2. Pay attention to the prepositions and the order of the words in the abstracts.

3. Determine and write the main directions of the research in the abstracts.

Exercise 4.

1. Choose the appropriate headings to the abstracts from the below-mentioned ones.

2. Choose the appropriate group of keywords to each abstract from the below-mentioned ones.

3. Match the appropriate highlights to the abstracts.

Abstract 1.

During the boreal summer of 2015, a full-scale hydrokinetic turbine was deployed in the Kvichak River (Alaska), delivering electricity to the village of Igiugig. Here, quantification and analysis of the hydrodynamic modifications in the river caused by the turbine are presented. Field observations are used to produce a unique three-dimensional data set of fluid velocities in the vicinity of the turbine before and after turbine deployment. Three dynamic regions are distinguished in the wake. There is an induction zone just upstream of the turbine, where velocities decrease and turbulence increases. There is a near wake just downstream of the turbine, where the reduced velocities recover slightly and the elevated turbulence decays rapidly. Finally, there is a far wake well beyond the turbine, where reduced velocities are persistent and turbulence remains elevated. The results are used in a coarse energy budget for the river, including quantifying the total energy dissipated by turbulence in the near wake. This wake dissipation is found to be almost as large as the energy extracted for electricity generation, even when the turbine is not operational.

Abstract 2.

One of the current major challenges in wind energy is to maximize energy production of wind farms. One approach in this effort is through control of wind turbine wake interactions, since undesirable wake interactions can introduce additional mechanical stresses on turbines, leading to early failures and reduce overall energy production of wind farms. To develop control strategies that can minimize wake interactions, it is essential to simulate wake behaviors accurately and quickly. In this work, a fast and accurate turbine wake model capable of modeling turbine wakes under yaw is presented. This model builds upon the work of existing wake models and is capable of producing results comparable to that of conventional full CFD simulations using a fraction of the computational cost. The accuracy and speed of the proposed model allows for the development of real-time turbine control strategies to maximize power output. The results of the proposed model are validated with previous numerical and experimental data.

Abstract 3.

Centrifugal pumps can be used as "Pump-*as*-Turbine (PaT)" by reversing the flow and operating as a Francis turbine. The proposed concept "Impulse Pump-*as*-Turbine (Impulse PaT)" will use centrifugal pump impeller to be used as hydro turbine by pairing with spear valve injector from impulse hydro turbine. Spear valve injector regulate water inlet flow rate, thus regulate power output of our new concept turbine. Additional benefit from utilized spear valve injector is low loss of turbine efficiency when operate at part-load condition, therefore this new concept turbine can be operated at wide range of flow condition without losing good efficiency while also eliminate risk of turbine damage from cavitation. Flow regulation through spear valve will also simplify control system for this proposed turbine compared to guide vanes. The validation methods from 1-D calculation based on Euler's turbine equation and numerical simulation by commercial CFD package shows that this new proposed concept is feasible with efficiency around 40% and wide operating range from 25% to maximum inlet flow rate. Results from numerical calculation shows that efficiency of this new concept of turbine is limited by number of blades in commercially available pump.

Headings:

1) New mode to operate centrifugal pump as impulse turbine.
2) Wake measurements from a hydrokinetic river turbine.
3) A novel wake model for yawed wind turbines.

Groups of keywords:

1) Yawed turbine, yawed wake, wind turbine wake, wake model.
2) Pump as turbine, impulse turbine, computational fluid dynamics.
3) Hydrokinetic energy, tidal energy, cross-flow turbine, turbine wake, environmental effects, field measurements.

Highlights 1:

1) New method of using Pump-*as*-Turbine (PaT) in impulse turbine mode.

2) One-dimensional calculation to prove feasibility and performance optimization of PaT in Impulse mode.

3) Performance validation by using Computational Fluid Dynamics (CFD) method.

4) Broad turbine operation range with high efficiency compared with conventional PaT.

Highlights 2:

1) A fast and accurate wake model for simulating wakes of yawed turbines is proposed.

2) The accuracy of the model has been validated with full CFD simulations and experimental data.

3) The model solves at least 2 orders magnitude faster than full CFD simulations.

Highlights 3:

1) Unique data set of flow conditions around a full-scale hydrokinetic turbine.

2) Persistent turbine wake observed, with no recovery downstream of the turbine.

3) Similar operational and non-operational turbine wakes.

4) River energy loss in the turbine wake is comparable to the energy delivered to the grid by the turbine.

Unit 4

Text 4. Types of Turbines

Steam turbines are used for the generation of electricity in the thermal power plants. They were once used to directly drive mechanical devices such as ships' propellers but most such applications now use reduction gears or an intermediate electrical step, where the turbine is used to generate electricity, which then powers an electric motor connected to the mechanical load. Turbo electric ship machinery was particularly popular in the period immediately before and during World War II due to a lack of sufficient gear-cutting facilities in US and UK shipyards.

Gas turbines are sometimes referred to as turbine engines. Such engines usually feature an inlet, fan, compressor, combustor and nozzle (possibly other assemblies) in addition to one or more turbines.

The gas flow in most turbines employed in gas turbine engines remains subsonic throughout the expansion process. In a transonic turbine the grasflow becomes supersonic as it exits the nozzle guide vanes, although the downstream velocities normally become subsonic. Transonic turbines operate at a higher pressure ratio than normal but are usually less efficient and uncommon.

With axial turbines, some efficiency advantage can be obtained if a downstream turbine rotates in the opposite direction to an upstream unit. However, the complication can be counter-productive. A contra-rotating steam turbine, usually known as the Ljungstrom turbine, was originally invented by Swedish Engineer Fredrik Ljungstrom (1875-1964) in Stockholm, and in partnership with his brother Birger Ljunsgtrom he obtained a patent in 1894. The design is essentially a multi-stage radial turbine offering great efficiency, extremely compact design and the type met particular success in backpressure power plants. Conventional high-pressure turbine blades are made from nickel based alloys and often utilize intricate internal air-cooling passages to prevent the metal from overheating. In recent years, experimental ceramic blades have been manufactured and tested in gas turbines, with a view to increasing Rotor Inlet Temperatures and/or, possibly, eliminating aircooling. Ceramic blades are more brittle than their metallic counterparts, and carry a greater risk of catastrophic blade failure. This has tended to limit their use in jet engines and gas turbines to the stator blades.

Vocabulary
nuclear – ядерный, атомный
directly – прямо
application – применение
load – нагрузка
immediately – сразу, немедленно
sufficient – достаточный
gear-cutting facility – зуборезный станок
a shipyard – верфь
to feature – обладать, являться характерной чертой
an inlet – впускное отверстие
a combustor – камера сгорания
subsonic – дозвуковой
to remain – оставаться
a nozzle guide vane – сопловая лопатка

Exercise 1. Read and translate the text.

Exercise 2. Answer the questions.
1. What types of turbines have been mentioned in the text?
2. Grade the turbines considering their efficiency.
3. Explain the main features of each type of the turbine.

Exercise 3. Translate the word combinations.
Turbo electric ship machinery, the expansion process, higher pressure ratio, extremely compact design, intricate internal air-cooling passages, experimental ceramic blades, eliminating aircooling.

Exercise 4. Make interrogative and negative sentences and special questions.

1. The wires pass through holes drilled in the blades at suitable distances from the blade root and are usually brazed to the blades at the point where they pass through.

2. Lacing wires reduce flutter in the central part of the blades.

3. The introduction of lacing wires substantially reduces the instances of blade failure in large or low-pressure turbines.

Exercise 5. Change the sentences in Active Voice into Passive Voice.

1. Reciprocating piston engines such as aircraft engines can use a turbine powered by their exhaust to drive and intake-air compressor.

2. Very high efficiency steam turbines harness about 40% of the thermal energy, with the rest exhausted as waste heat.

3. Most jet engines rely on turbines to supply mechanical work from their working fluid and fuel.

Supplementary Exercises.

Exercise 1. Translate the headings for the research articles. Pay attention to the order of the words.

1. Development of an ultra-low head siphon hydro turbine using computational fluid dynamics.

2. The optimization and the application for the wind turbine power-wind speed curve.

3. Evaluation of microstructural degradation in a failed gas turbine blade due to overheating.

Exercise 2. Translate the word combinations.

Wind turbine, low-wind-speed, *P-v* curve, transmission system, operation mode, turbine blade, equiaxed-cast superalloy, overheating, microstructural degradation, failure analysis, ultra-low head, siphon hydro turbine, numerical simulation, performance improvement, distributor.

Exercise 3. Read the following abstracts of the research articles from the exercises 4.

1. Find the predicates in the Active and Passive Voices and determine their tense.

2. Pay attention to the prepositions and the order of the words in the abstracts.

3. Determine and write the main directions of the research in the abstracts.

Exercise 4.

1. Choose the appropriate headings to the abstracts from the below-mentioned ones.

2. Choose the appropriate group of keywords to each abstract from the below-mentioned ones.

3. Match the appropriate highlights to the abstracts.

Abstract 1.

Gas turbine blades may undergo overheating, which could cause serious microstructural degradation and even failure of turbine components. Nonetheless, limited published investigations focus on the evaluation of the microstructural degradation in overheated turbine blades. In this study, a high-pressure turbine blade was investigated, which comprised of equiaxed-cast superalloy substrate and an Al—Si coating. The blade failed due to material loss at the airfoil tip of the leading edge. A systematic microstructural investigation of the failed blade was conducted, and the results were compared with those of thermally exposed samples. By taking several microstructural degradation parameters as references, the microstructural degradation of the failed blade was evaluated and the equivalent maximum service temperature was estimated. The results indicated that most locations of the failed blade had been operating under normal conditions. However, the airfoil tip of the leading edge had suffered serious overheating, and the overheating temperature was almost 200 °C above the normal service temperature. The overheating led to incipient melting of the substrate and material loss of the serviced blade. This study provides a guidance on the evaluation of microstructural degradation and failure analysis in conventionally cast turbine blades.

Abstract 2.

Structural simplification and efficient hydraulic performance are key to effectively utilizing ultra-low head water power resources and reducing hydroelectric unit costs. In this study, a computational fluid dynamics (CFD) method was used to predict hydraulic performance of an axial turbine at the Gaoliangjian power station. CFD results agreed well with field test data. Using the same numerical method, a new siphon turbine was then designed based on the original distributor and turbine runner equipment. This study investigated the effect of different siphon outlet passage geometry parameters, runner blade shapes, and distributors on the hydraulic performance of the siphon turbine. The maximum hydraulic efficiency increased to 87.9% under a head of 2.87 m. Finally, the hydraulic performance of the turbine was compared for four different distributor designs after adding an intake sump at the turbine entrance. The bell-shaped distributor with four guide vanes resulted in the highest power output at the lowest head. Therefore, the siphon turbine is a good option for energy conversion in ultra-low water head settings.

Abstract 3.

An optimized wind turbine power-wind speed curve (*P*-*v* curve) was presented in this paper to solve the problems in the low-wind-speed regions like the large wind speed variation and the low wind turbine efficiency. When the wind speed was lower than the cut-in wind speed, the operation mode of the wind turbine was changed by the extra power supplied by the motor excitation source to keep the wind turbine operating. The application condition of the optimized *P-v* curve was derived and calculated. The effects of various wind speeds on the powers and the power generation of the wind turbine were analyzed by comparison with and without the improvement. The results indicated that the prolonged working period, the improved efficiency of the wind turbine and the incremental power generation were induced by the usage of the optimized *P-v* curve. The cut-in wind speed was declined by 42.8%. The power generation was enhanced by 73.4% at the actual wind condition of some wind field. The motor power was augmented with the huge amplitude of the wind speed. Compared with the traditional *P-v* curve, the optimized *P-v* curve was more suitable for the lower average and larger amplitude of the wind speed.

Headings:

1) Development of an ultra-low head siphon hydro turbine using computational fluid dynamics.

2) The optimization and the application for the wind turbine power-wind speed curve.

3) Evaluation of microstructural degradation in a failed gas turbine blade due to overheating.

Groups of keywords:

1) Wind turbine, low-wind-speed, *P-v* curve, transmission system, operation mode.

2) Turbine blade, equiaxed-cast superalloy, overheating, microstructural degradation, failure analysis.

3) Ultra-low head, siphon hydro turbine, numerical simulation, performance improvement, distributor.

Highlights 1:

1) An optimized wind turbine power-wind speed curve was presented for capturing more low-wind-speed wind energy.

2) The application condition was derived and calculated.

3) The cut-in wind speed was declined, the power generation was enhanced by applying the optimized *P-v* curve.

4) An improved transmission structure was present for applying the optimized *P-v* curve to the double-fed wind turbine.

Highlights 2:

1) An Ultra-Low Head Siphon Hydro Turbine was developed.

2) The hydraulic performance of the tail pipe was optimized by orthogonal experiment.

3) The best blade design can both improve the efficiency of the impeller and reduce hydraulic losses in the outlet passage.

4) The 4-guide vane of the bell-shaped distributor possesses the best inflow condition for the runner.

Highlights 3:

1) The microstructural evolution mechanism of both Al—Si coating and substrate are analyzed for the serviced blade.

2) The quantitative microstructural degradation parameters are determined for the serviced blade.

3) The equivalent maximum service temperature at different locations of the serviced blade are evaluated based on microstructural characterization.

4) The failure mechanism of the serviced blade caused by overheating is analyzed by the evaluation of microstructural degradation.

Unit 5

Text 5. Modern Steam Power Plant

The steam turbine continues to be a major factor in electric power generation throughout the world. Even nuclear power plants use the heat from a controlled nuclear chain reaction to produce needed steam. In the United States, more than 88 percent of all electricity is produced by steam turbines.

There are basically three stages of matter: solid, liquid and gas. Each stage is held together by a different level of molecular force. With water, gaseous stream takes up space due to its molecules being furthest apart. However, when enough pressure is applied to steam, an amazing thing happens. The molecules are forced together to the point that the water becomes more like a liquid again, while retaining the properties of a gas. It is at this point that it becomes a supercritical fluid.

Many of today’s power plants use supercritical steam, with pressure and temperature at the critical point. This means supercritical steam power plants operate at much higher temperatures and pressures than plants using subcritical steam. Water is actually heated to such a high pressure that boiling does not even occur.

The resulting high-pressure fluid of supercritical steam provides excellent energy efficiency. With the aid of high pressure, supercritical steam turbines can be driven to much higher speeds for the same amount of heat energy as traditional steam power. They also release less CO2 exhaust into the atmosphere. Additionally, new high-pressure boilers built with rocket technology are being developed to further control the levels of CO2 emitted. Some boilers will even cool the steam back into a liquid and channel it into the ground to capture emissions.

The future is bright for steam on other fronts as well. In the search for alternative automobile fuel systems, some scientists continue to pursue the 15^{th} century dream of a car driven on steam power.

Vocabulary
steam – пар
major – главный, основной
chain reaction – цепная реакция
matter – вещество, материя
liquid – жидкость
stage – ступень, этап
gaseous – газообразный
to take up – занимать, охватывать
space – пространство
to apply to – применять
amazing – удивительный, потрясающий
to happen – случаться, происходить
to force – ускорять, вытеснять
to retain – удерживать
properties – свойства
to capture – захватывать
boiling – кипящий
to occur – происходить, возникать
aid – помощь
amount – количество
to release – выпускать
to emit – выбрасывать, излучать, испускать
a power plant – силовая установка, теплостанция
to pursue – следовать, продолжать

Exercise 1. Read and translate the text.

Exercise 2. Answer the questions.
1. What is the purpose of a steam turbine?
2. What does steam inside the turbine?
3. What is supercritical steam?
4. Why are supercritical steam turbines more popular now?

Exercise 3. Translate the word combinations.
Three stages of matter, gaseous steam, boiling does not even occur, the resulting high-pressure fluid of supercritical steam, new high-pressure boilers built with rocket technology.

Exercise 4. Make interrogative and negative sentences and special questions.
1. In the 1830s, British physicist Michael Faraday created an early electric generator called the dynamo.
2. In 1884, British engineer Charles Algernon Parsons put new steel technology to use.

3. He created a turbine capable of using compounded steam that turned a dynamo at 18,000 revolutions a minute.

Exercise 5. Change the sentences in Active Voice into Passive Voice.

1. Combustion turbines and steam turbines have relation to machinery such as pumps and compressors.

2. The military have recently used military jet engines as primary flight controller in post-stall flight using jet deflections that are also called thrust vectoring.

3. The Space Shuttle's main engines use turbopumps to feed the propellants (liquid oxygen and liquid hydrogen) into the engine's combustion chamber.

Supplementary Exercises.

Exercise 1. Translate the headings for the research articles. Pay attention to the order of the words.

1. Upgrading existing gas-steam combined cycle power plants through steam injection and methane steam reforming.

2. Transient analysis of attemperator enthalpy balance based on the commissioning data of a coal-fired steam power plant.

3. Potential analysis and technical-economic optimization of conversion of steam power plant into combined water and power.

Exercise 2. Translate the word combinations.

Steam power plant, combined water and power, technical-economic optimization, potential analysis, economic investigation, power plant, attemperator, spray, thermowell, transient analysis, enthalpy balance, upgrading, repowering, natural gas combined cycle, steam injection, methane steam reforming, marginal performances.

Exercise 3. Read the following abstracts of the research articles from the exercises 4.

1. Find the predicates in the Active and Passive Voices and determine their tense.

2. Pay attention to the prepositions and the order of the words in the abstracts.

3. Determine and write the main directions of the research in the abstracts.

Exercise 4.

1. Choose the appropriate headings to the abstracts from the below-mentioned ones.

2. Choose the appropriate group of keywords to each abstract from the below-mentioned ones.

3. Match the appropriate highlights to the abstracts.

Abstract 1.

The current study deals with a technical-economic analysis of conversion of a steam power plant into a combined water and power (CWP) system. To this end, a steam power plant with nominal capacity of 166 MW is considered and a multi-effect desalination unit is employed for water production. Turbine steam extraction lines are used as motive steam in thermal water desalination process. To thermodynamically analyze the considered system and its components, a mathematical model is presented by describing the equilibrium equations of energy and mass associated with various elements. Then, by considering the total water flow rate and thermodynamic conditions of various points, the steam flow rate of each extraction turbine lines are computed in the design point. After that, the calculated steam flow rates as the input data are utilized to examine the power plant for different conditions of converting to CWP units. A parametric study is performed to analyze the effect of the steam extracted from each turbine extraction on the operation of the power plant and amount of water production. The results show that the high and medium pressure lines corresponding to the production of 8400 and 2000 cubic meters of fresh water per day have the highest and lowest water production capacity, respectively. Moreover, these lines result in losing up 11 and 5.5 MW in net power plants, respectively. Furthermore, an economic analysis is carried out to estimate the cost of water under different production conditions. Finally, by considering the net power and water selling prices as the objective functions, a multi objective optimization is performed to obtain the optimal conditions for each turbine line in the simultaneous production of water and power.

Abstract 2.

The growth in worldwide energy demand currently faces the difficulty of installing new power generation facilities due to limited funding and the strengthening of environmental regulations. Owing to the increasing role of natural gas combined cycles (NGCCs) in the power generation infrastructure, it is important to assess the energy and economic feasibility of upgrading their capacity to cope with future energy requirements.

This study aims to investigate a new concept for upgrading existing NGCCs by integrating an additional unit based on gas turbine. The additional unit allows the production of steam to be injected into the NGCC combustor (Option A) or syngas from methane steam reforming to be fed into the existing power plant (Option B) or even into the additional gas turbine (Option C). The power output augmentation arises from the capacity of the additional gas turbine and the increase in power production of both gas cycle and bottoming steam section of the NGCC. A preliminary sensitivity analysis assesses the influence of operating conditions of the additional unit on the energy and economic performances of marginal power production. Considering commercial gas turbines, further investigations address the design of upgrading options and the comparison of their techno-economic performances referred to the additional or the overall power productions. Finally, focusing on Option A, the part-load operation of the additional gas turbine is examined to evaluate penalties on marginal efficiency and marginal cost of electricity.

Simulation results revealed that for a power augmentation lower than 50%, Option A provides the best economic performance combined with the highest operational simplicity, while Option C is the preferred technical solution for a greater increase in plant capacity.

Abstract 3.

In an attemperator, spray water is injected into superheated steam to control its temperature. Since the temperature measured by the thermowell installed at the attemperator outlet is used for the feedback control of the spray water, it is important that the spray water is completely evaporated before the thermowell. This ensures that the thermowell measures the temperature of desuperheated steam.

In this study, measurements from the commissioning test of a coal-fired steam power plant were analyzed using transient analyses. These analyses compensated for delayed temperature measurement at thermowells with large heat capacities and the temperature change of spray water extracted far from the attemperator. By using these results for the enthalpy balance in the attemperator, the spray water flow could be calculated accurately enough to verify whether the spray-injected steam was completely desuperheated before the outlet thermowell or not, even during operations with changing the generator load. Temperature readings from thermowells depend on the subcritical and supercritical conditions and the validity of the various simplifications used in the transient analysis were discussed. According to the transient analysis of the commissioning data, the thermowell distance in one of the attemperators could be judged as being too short to ensure complete desuperheating of the spray-injected steam, and thus, this should be considered in the control logic.

Headings:

1) Upgrading existing gas-steam combined cycle power plants through steam injection and methane steam reforming.

2) Transient analysis of attemperator enthalpy balance based on the commissioning data of a coal-fired steam power plant.

3) Potential analysis and technical-economic optimization of conversion of steam power plant into combined water and power.

Groups of keywords:

1) Steam power plant, combined water and power, technical-economic optimization, potential analysis, economic investigation.

2) Power plant, attemperator, spray, thermowell, transient analysis, enthalpy balance.

3) Upgrading, repowering, natural gas combined cycle, steam injection, methane steam reforming, marginal performances.

Highlights 1:

1) A new concept for upgrading existing natural gas combined cycles was investigated.

2) The concept relies on the integration of an additional unit based on gas turbine.

3) Three options were compared in terms of energy and economic marginal performances.

4) Upgrading based on steam injection is the best option at medium-low power increase.

5) A higher power increase is obtained injecting syngas from methane steam reforming.

Highlights 2:

1) Technical-economic analysis of conversion of steam power plant into CWP.

2) Solving the coupled energy and mass balance equations.

3) Studying the effect of thermodynamic condition and steam flow on the produced water.

4) Performing an economic estimation on the selling water price.

5) Performing the multi-objective optimization of CWP.

Highlights 3:

1) Control logic for spray water uses thermowell measurements at attemperator outlet.

2) Thus, spray injected steam should be desuperheated before the outlet thermowell.

3) Enthalpy balance in the attemperator using steady-state analysis is not accurate.

4) A transient analysis methodology using a lumped capacitance model is presented.

5) Commissioning data of the attemperator in the steam power plant was analyzed.

Unit 6

Text 6. Wind Power

Wind power is the conversion of wind energy into a useful form of energy, such as using: wind turbines to make electricity, windmills for mechanical power, windpumps for water pumping or drainage, or sails to propel ships.

A large wind farm may consist of several hundred individual wind turbines which are connected to the electric power transmission network. Offshore wind farms can harness more frequent and powerful winds than are available to land-based installations and have less visual impact on the landscape but construction costs are considerably higher. Small offshore wind facilities are used to provide electricity to isolated locations and utility companies increasingly buy back surplus electricity produced by small domestic wind turbines.

Wind power, as an alternative to fossil fuels, is plentiful, renewable, widely distributed, clean, produces no greenhouse gas emissions during operation and uses little land. Any effects on the environment are generally less problematic than those forms other power sources. As of 2011, 83 countries around the world are using wind power on a commercial basis. As of 2010 wind energy was over 2.5% of total worldwide electricity usage, growing at more than 25% per annum. The monetary cost per unit of energy produced is similar to the cost for new coal and natural gas installations. Although wind power is a popular form of energy generation, the construction of wind farms is not universally welcomed due to aesthetics.

Although very consistent from year to year, wind power has significant variation over shorter timescales. The intermittency of wind seldom creates problems when used to supply up to 20% of total electricity demand, but as the proportion increases, a need to upgrade the grid, and a lowered ability to supplant conventional production can occur. Power management techniques such as having excess capacity storage, backing supplies (usually natural gas), storage such as pumped-storage hydroelectricity, exporting and importing power to neighboring areas or reducing demand when wind production is low, can greatly mitigate these problems.

Vocabulary

conversion – превращение, преобразование
windpumps – насос, работающий от ветряного двигателя
drainage – дренаж, осушение
supplant – вытеснять, занимать место, замещать
offshore – предбрежный
to harness – обрабатывать, утилизировать
an impact – воздействие
landscape – ландшафт
wind facilities – зд. ветряной парк
mitigate – смягчать, уменьшать, ослаблять
utility companies – коммунальные предприятия
intermittency – периодичность, прерывистость
fossil fuels – природное топливо
greenhouse gas emissions – выбросы газов, вызывающих парниковый эффект
per annum – в год, ежегодно
monetary cost – денежная стоимость, затрата
surplus – излишек, избыток
to welcome – приветствовать
to propel – продвигать вперед

Exercise 1. Read and translate the text.

Exercise 2. Answer the questions.

1. What is wind power?
2. How can you define a wind farm?
3. What is better: fossil fuels or wind power? Give your reasons.

Exercise 3. Translate the word combinations.

To propel ships, powerful winds, land-based installations, to provide electricity to isolated locations, due to aesthetics.

Exercise 4. Make interrogative and negative sentences and special questions.

1. We've used the wind as an energy source for a long time.
2. Isolated places such as farms may have their own wind generators.
3. The propellers are large to extract energy from the largest possible volume of air.

Exercise 5. Change the sentences in Active Voice into Passive Voice.

1. Wind turbine production has expanded to many countries and wind power (to expect) to grow worldwide in the twenty-first century.
2. Many largest operational onshore wind farms (to locate) in the US.
3. The land between the turbines (may, to use) for agricultural purposes.

Supplementary Exercises.

Exercise 1. Translate the headings for the research articles. Pay attention to the order of the words.

1. Study of assessment on capability of wind power accommodation in regional power grids.
2. Prediction of wind power ramp events based on residual correction.
3. Analysis of wind power intermittency based on historical wind power data.

Exercise 2. Translate the word combinations.

Wind power, wind power accommodation, peak power regulation, wind power characteristic, wind curtailment, wind power ramp events, ramp prediction, residual correction, MSAR (Markov-Switching-Auto-Regression) model, intermittency, duty ratio, ramp event, characteristics, forecasting.

Exercise 3. Read the following abstracts of the research articles from the exercises 4.

1. Find the predicates in the Active and Passive Voices and determine their tense.

2. Pay attention to the prepositions and the order of the words in the abstracts.

3. Determine and write the main directions of the research in the abstracts.

Exercise 4.

1. Choose the appropriate headings to the abstracts from the below-mentioned ones.

2. Choose the appropriate group of keywords to each abstract from the below-mentioned ones.

3. Match the appropriate highlights to the abstracts.

Abstract 1.

Wind power depends on environmental conditions that vary and are imperfectly forecastable. This intermittency could increase the desired flexibility of fossil fuel generation, impacting emissions. This paper finds that various types of wind generation intermittency are associated with a shift towards natural gas generation and decreasing CO_2 emissions. The environmental effects of wind intermittency should be considered when determining the overall impact of intermittency-related activities such as expanded grid storage or turbine siting decisions.

Abstract 2.

With the development of large-scale wind power integration, wind curtailment appears around the world, especially in China. It is essential to perform the assessment on capability of wind power accommodation (ACWPA) by calculating the maximum admissible wind power which plays an important role in system planning and operation. This paper proposes a long-term assessment on the maximum level of wind power installed capacity in future years based on peak power regulation, with consideration of potential wind curtailment. Meanwhile, a short-term assessment based on wind power forecasting is developed through day-ahead unit commitment to get admissible zone of wind power in grid operation. In particular, the extreme wind variation scenario (EWVS) calculated by quadratic programming (QP) is applied to optimize upper limit of admissible zone. Case studies are carried out to analyze wind power characteristics in a province in Southern China. Results show that the proposed approaches can effectively and accurately evaluate the capability of wind power accommodation in regional power grids.

Abstract 3.

Wind power ramps cause large-amplitude power fluctuation which harmfully affects the stability of power system’s operation. As a new issue in wind power integration, the existing ramp forecasting methods still has some imperfection, e.g., harmonization on long-term trend and short-term precision. Therefore, an advanced method is proposed in this paper, mainly focus on improving the performance of wind power ramp prediction. This method utilizes wind power curve to build a primary model which can capture the trend of wind power variation. Then, prediction residual of the primary model is corrected by a MSAR (Markov-Switching-Auto-Regression) model which combining the advantages of AR models and Markov chain. Finally, an improved swinging door algorithm is applied to extract linear segments, and ramp definitions are used to detect ramp events. Actual wind farm data is used to test the proposed method. Comparison with traditional methods are presented, the numerical results validate that the proposed approach has improved performance not only on wind power prediction but also on ramp prediction.

Headings:

1) Study of assessment on capability of wind power accommodation in regional power grids.

2) Prediction of wind power ramp events based on residual correction.

3) Analysis of wind power intermittency based on historical wind power data.

Groups of keywords:

1) Wind power accommodation, peak power regulation, wind power characteristic, wind curtailment.

2) Wind power, intermittency, duty ratio, ramp event, characteristics, forecasting.

3) Wind power ramp events, ramp prediction, residual correction, MSAR model.

Highlights 1:

1) A novel quantified index of wind power intermittency is proposed..

2) The intensity of wind power intermittency is compared with wind speed intermittency.

3) Wind power intermittency at different scales are analyzed.

4) The temporal variation patterns of intermittency are obtained.

5) The intensity of wind power intermittency is forecasted based on the proposed index.

Highlights 2:

1) An advanced approach is proposed to improve ramp prediction.

2) The approach contains wind power prediction, residual correction, ramp detection.

3) Primary models capture trend of wind power variation.

4) Details precision are corrected by MSAR correction prediction residual.

Highlights 3:

1) Assess capability of wind power accommodation (ACWPA) by calculating the maximum admissible wind power.

2) The extreme wind variation scenario calculated by quadratic programming to optimize upper limit of admissible zone.

3) A long-term ACWPA on planning of wind power installed capacity is developed based on peak power regulation.

4) A short-term ACWPA is proposed for system operation considering wind power forecasting.

5) The proposed approaches can effectively and accurately evaluate the ACWPA in regional power grids.

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