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УНИВЕРСИТЕТ»

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Иностранный язык (Professional English/Профессиональный английский язык)

Учебно-методическое пособие по изучению дисциплины для студентов, обучающихся в магистратуре по направлению подготовки 13.04.02 Электроэнергетика и электротехника

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Шкодич, Л.В. English for Students of Electrical Power Engineering: учеб.-методич. пособие по изучению дисциплины «Иностранный язык (Professional English/Профессиональный английский язык)» для студ. магистратуры по напр. 13.04.02 Электроэнергетика и электротехника, профиль «Electrical Power Engineering and Electrical Engineering» / **Л.В. Шкодич**. – Калининград: Изд-во ФГБОУ ВО «КГТУ», 2022. – 47 с.

В учебно-методическом пособии по изучению дисциплины «Иностранный язык (Professional English/Профессиональный английский язык)» представлены учебно-методические материалы по овладению профессионально значимыми речевыми умениями английского языка, включающие список обязательной учебной литературы, тематический план, методические указания для студентов по овладению целевыми речевыми умениями, а также образцы англоязычных профессиональных текстов для индивидуального домашнего чтения.

Табл. 1, список лит. – 4 наименования

Локальный электронный методический материал. Учебно-методическое пособие по изучению дисциплины. Рекомендовано к использованию в учебном процессе методической комиссией института рыболовства и аквакультуры ФГБОУ ВО «Калининградский государственный технический университет» «29» июня 2022 г., протокол №5

Локальный электронный методический материал. Учебно-методическое пособие по изучению дисциплины. Рекомендовано к использованию в учебном процессе методической комиссией института морских технологий, энергетики и строительства ФГБОУ ВО «КГТУ» «30» сентября 2022 г., протокол № 1

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СОДЕРЖАНИЕ

Введение

Целью освоения дисциплины является создание /восстановление/ развитие (в зависимости от стартового уровня владения языком) языковой базы продуктивных умений профессиональной устной и письменной речи на английском языке, а также развитие рецептивных умений точного понимания устного и письменного англоязычного профессионального текста.

По окончании изучения дисциплины студент должен быть способен:

- глубоко понимать содержание прочитанного на английском языке аутентичного профессионального текста и выполнять его точный устный перевод на русский язык;
- передавать основное содержание прочитанного или прослушанного англоязычного профессионального текста на русском и/или английском языке в устной и письменной форме,
- передавать на английском языке устно и письменно основное содержание профессионального текста, прочитанного на русском языке;
- быть компетентным участником процессов профессионального и повседневного общения на английском языке.

Дисциплина Иностранный язык (Professional English/Профессиональный английский язык) является обязательной частью образовательной программы магистратуры по направлению подготовки 13.04.02 – Электроэнергетика и электротехника, профиль «Electrical Power Engineering and Electrical Engineering» и относится к Блоку 1. Дисциплины(модули). Обязательная часть.

Текущий контроль проводится в форме регулярного устного перевода с английского языка аутентичного профессионального текста, а также еженедельных пересказов, изложений, сочинений на английском языке на основе пройденных учебных материалов. Качество перевода, а также изложения, сочинения и пересказы студентов оцениваются преподавателем в баллах (от 2 до 5) в зависимости от точности выражения смысла, полноты содержания и количества допущенных ошибок. Проверенные преподавателем письменные работы студентов требуют выполнения обязательной работы над ошибками, после чего исправленный вариант предъявляется преподавателю в форме подготовленного чтения вслух.

Промежуточная аттестация по дисциплине представляет собой дифференцированный зачет и проводится в форме подготовленных студентами презентаций на английском языке одной из тем, пройденных в течение семестра, с последующим обсуждением каждой презентации на английском языке в группе.

Оценка за семестр (отметка о сдаче дифференцированного зачета – 2, 3, 4 или 5) выставляется с учетом полноты освоения студентом учебного материала семестра (3 – успешно пройдено не менее половины материала, 4 – не менее 75%, 5 – 100% и более), а также учитывая общий уровень владения английским языком и динамику развития речевых умений студента за данный семестр.

Пособие включает четыре основных раздела, содержащих учебно-методическое обеспечение необходимое для изучения дисциплины «Профессиональный английский язык» студентами магистерских курсов по направлению «Электроэнергетика и электротехника», а именно, **Список обязательных учебников и методических материалов для студентов** (раздел 1), **Тематический план** с указанием видов учебной деятельности студентов и ссылками на обязательные для изучения страницы базового учебника и соответствующие методические рекомендации для студентов и материалы (раздел 2), **Методические указания** по развитию базовых речевых умений английского языка в аудитории и в ходе самостоятельной работы студентов (раздел 3), **Методические материалы к занятиям** - тематические списки слов и выражений, а также примеры профессиональных текстов для индивидуального домашнего чтения (раздел 4). Методические указания по выполнению студентами самостоятельной работы включены в раздел подраздел 3.1 «Рекомендации и требования по курсу «Professional English»».

Раздел 1. Учебники и методические материалы для студентов

1. Campbell, Simon. English for the Energy Industry: Express series / Simon Campbell. – Oxford: Oxford University Press, 2015. – 80 с.
2. Шкодич, Л.В. Иностранный язык (английский). Справочник по курсу английского языка: учеб. пособие / Л.В. Шкодич. – Калининград: Издательство ФГБОУ ВО «КГТУ», 2018. – 214 с.
3. Шкодич Л.В. Методические рекомендации и требования по курсу, по написанию сочинений и изложений, подготовке чтения вслух, подготовке пересказа и др. (Раздел 3 данного пособия), а также методические материалы к занятиям (Раздел 4) / Л.В. Шкодич.

Раздел 2. Тематический план

Первый семестр			
Тема (акад.час.)	Вопросы для обсуждения	Реком-е виды уч. деят.	Базовые уч. мат-лы, стр.
1. Introductions (4)	- Getting to know each other - Course objectives, target skills	- discussion, gr. drills	- 2, сс. 19-34;
	- Требования к речевым умениям	-discussion	- 3.1; 3.2; 3.3
	- My Master Degree studies	-discussion, essay	- 4.1; 3.4
2. Fuels and energy sources (8)	- Renewables, fossil fuels	- discussion,	- 1, с. 5
	- Imports and exports in RF and in the world	- essay, reading, dictation	- 3.4; 4.2;4.3
	- Advantages and disadvantages		- 1, с. 8
	-		- 3.2;3.3;3.5
Individual Home Reading № 1 – translation, reading aloud, retelling			
3.Power plant types (16)	- Hydro and solar power plants	-discussion, vocab.	- 1, сс. 6-7;
	- Wind power plants	- drilling, dictation,	- 4.4
	- Gas- and coal-fired plants	- listening-in,	- 1, с. 6-9; 1, с. 64 script 2
	-	- retelling,	- 3.6; 3.7; 4.5; 4.6
	-	- written summary	- 3.4
	- Biomass- fired plants		- 1, с. 9.
Individual Home Reading № 2,3 – trans-n, reading aloud, retelling			
4.Energy industry companies (16)	– ELEC: generation capacity	- reading, discussion	- 1, сс. 10-11
	- company structure	-listening-in, retelling	- 1, сс. 64-65 script 3, - 1, с.12
	- Gas and oil in Europe and US	- reading, discussion, essay,	- 1, сс. 12-13

gr. drills, dictation - 1, сс. 10-11

Individual Home reading №№ 4,5 - translation, reading aloud, retelling

Итого конт. час. - 44

Второй семестр

Тема (акад.час.)	Вопросы для обсуждения	Реком-е виды уч. деят.	Базовые уч. мат-лы, стр.
1.Introduction (2)	- Задачи семестра -Индивидуальные учебные приоритеты студентов - Структура и требования к проф. презентации на англ яз	- discussion, - planning individual learning activities - analysis	- 2, сс.95-101; 2, с.102
2. Partners and clients of energy industry companies (10)	- Residential and industrial customers - ELEC: negotiations with a big new partner	- discussion, essay, - listening-in, translation, discussion, retelling,	- 1, сс. 14-15 - 1, с. 65 script 4; 1, с. 15 - 3.7; 4.6
--- Individual Home Reading №1 - translation, reading aloud, retelling			
3. Graph reading and presenting (6)	- Dynamics of electricity prices and costs	- discussion, vocab. drills, dictation, essay, mini-presentations	- 1, сс. 16-17 - 4.8
- Individual Home Reading №2 - translation, reading aloud, retelling			
4. Accidents in the Electricity Sector	- The crisis between ELEC and its new partner	- listening-in, translation , vocab. drills, disc-n	- 1, с.64 script 5; 1, с.18

(12)	-Business letter	- reading, retelling	-1, c.19 - 4.7
	essay, (complaint)	- writing a reply	- 1, c. 20
	- Consumer problems	- reading, retelling	- 1, c. 21
Individual Home Reading №3 - translation, reading aloud, retelling			
5. Energy industry conferences (6)	- Invitation letter: the venue, the agenda, etc.	- vocab. drills, translation, reading aloud, discussion, essay	- 1, c.23; 3.3; 3.7; 3.4
	-Replying to invitations	-business letter writing	-1, c. 23
	-Chair person's welcome address	– transl., discussion, retelling	- 1, c.24
	-Students' conference experience and plans	- discussion, essay	- 3.7
Individual Home Reading №4 - translation, reading aloud, retelling			
6. Business and Scientific presentations (8)	- The structure and links	-discussion, drilling choosing the topics, designing the structure, selecting the links	- 2, cc.95-101; 4.8
	- Slide composition	filling out the slides, analysis of slide designs	-2, c.107
	- Discussion ethics and vocabulary for a business or scientific presentation	- presenting and discussion	- 2, c.108
-Individual Home Reading №5 - translation, presentation of the topic			
Итого конт. час. – 44			

Раздел 3. Методические указания по освоению дисциплины

3.1 Рекомендации и требования по курсу «Professional English» для студентов

Для изучения дисциплины студентам необходимо:

1. Взять в библиотеке и на каждом занятии ***иметь при себе*** рекомендуемые преподавателем учебники и учебные пособия, а также рабочую тетрадь.

2. ***Подробно записывать*** в рабочую тетрадь звучащие в ходе занятия профессиональные термины, а также общеупотребительные слова и словосочетания ***для их дальнейшего использования*** в собственной речи на иностранном языке.

3. Регулярно просматривать сделанные записи. К каждому последующему занятию ***тренировать новые слова***, проговаривая их вслух, предварительно уточнив ***правильное произношение***, обращая особое внимание на ударение.

4. Стараться ***максимально часто использовать новые слова*** в своих еженедельных сочинениях и изложениях на английском языке. См. Требования к сочинениям и изложениям (Essays).

5. Тщательно готовить тексты, предлагаемые преподавателем в качестве ***индивидуального домашнего чтения*** (каждое четвертое занятие курса), а именно:

5.1 готовить ***устный перевод*** текста с опорой на выписанные в ***исходных формах новые слова***, демонстрируя ***понимание структуры*** английских предложений, знание формальных признаков и грамматических значений глагольных и др. форм, а также учитывая особенности профессионального и общего контекста;

5.2 опираясь на список слов к тексту, готовить ***на контроль чтение вслух*** части переведенного текста (См. Рекомендации по подготовке чтения вслух);

5.3 готовить ***устный пересказ и/или письменное изложение*** на английском языке каждого прочитанного текста (См. Рекомендации по подготовке пересказа).

3.2 Понимание английского предложения

1. Читая предложение, выписывайте **все незнакомые слова** с указанием **<u>части речи</u>**, к которой данное слово принадлежит в данном предложении (**n** – существительное, **v** – глагол, **a**(adj) – прилагательное, **adv –** наречие), с **<u>одним</u> значением**, которое проявилось в данном предложении, **с транскрипцией** – для тех слов, которые Вам нужно запомнить.

2. Определяйте **часть речи** нового для Вас слова, учитывая **а/** имеющиеся у слова ***суффиксы*** (н-р, -tion, -ment, ture, - er/or – существительные - **n**; **-**able, -ic, ical – прилагательные -. **a**(adj); - ize/ise, -fy – глаголы - **v**); другие суффиксы см. в разделе 6 Справочника по курсу английского языка, 2018 г.); **б/** учитывая место слова в предложении и задавая к нему вопрос (т.е. определив его функцию в данном предложении), например, She ***criticizes*** everybody – Она ***что делает?-*** глагол-сказуемое «критикует».

При переводе незнакомого слова выбирайте из его значений **именно в** той части речи, которая использована **в данном предложении**.

3. Наибольшую трудность при переводе английского предложения обычно представляют два типа **смысловых групп слов:** ***группа <u>существительного</u> и группа <u>глагола.</u>***

4. Перевод группы существительного - ***<u>начинаем с последнего существительного данной группы.</u>***

4.1. Группа существительного – это существительное, перед которым (слева от него) стоят его определения. Они могут быть выражены прилагательными или существительными.

4.2. О начале группы существительного сигнализируют особые слова – определители существительного, наиболее характерными из которых являются артикли (a, the), предлоги (of, to, by, with, on, in, at, from и др.) притяжательные местоимения (my, your и др.), числительные (one, a thousand и др.).

Об окончании данной группы существительного говорит появление нового артикля, предлога и т.п. (см.4.2) или глагола, например:

<u>Very difficult texts</u> **about** <u>ship structure</u> **are** most useful for him.

<u>A very long text</u> **was** given to us.

4.3. Определив факт наличия **группы существительного**, следует непосредственно **перейти в конец данной группы** и начать **перевод с последнего существительного в ней**, т.к. именно оно является ключевым словом и остается существительным в переводе.

-**<u>a</u>** very long and difficult English **<u>text</u> - текст**

-this year figure skating golden medal **holder** – обладатель

4.4. Слова, расположенные **слева от последнего существительного**, являются **<u>определениями</u>**. Они переводятся последовательно **в обратном порядке** (слева направо, от последнего слова к началу группы), например:

<u>a</u> very long English <u>text</u> - Кто/что? – *текст*

Какой текст? – *английский текст*

Какой английский текст? – *трудный английский текст*

И еще какой? – *очень длинный и трудный английский* ***текст***

Кто/что? – *обладатель*

Обладатель чего? – *обладатель медали*

Обладатель какой медали? – *обладатель золотой медали* и т.д.

4.5. При выборе значения слова учитывайте точный контекст, в котором употреблено это слово в данный момент. Например, **distance** в спортивной ситуации будет переводиться как «дистанция», а в задаче по арифметике – как «расстояние».

5. Группа глагола (сложная форма глагола)

5.1. Найдите **смысловой глагол** – **последнее слово** данной группы. Выбирая значение глагола для перевода, ***обязательно учитывайте*** значения относящихся к данному глаголу существительных.

5.2. Определите **залог.**

Страдательный залог (Passive) = **Be** (**любая** из речевых форм – is, are, was, etc.) **+ Ved** (или, для **неправ** гл., - III осн. форма, н-р, see, saw, **seen**).

Примеры глаголов в Passive : **is translated** – переведен, переводится; **will be published -** будет опубликован, будет публиковаться.

НО **translated, published -** глаголы в действительном залоге, т.е. «перевел»/«переводил», «опубликовал»/«публиковал».

5.3. Определите время **- наст, прош или будущее**: **по первому слову** глагольной группы.

Is translated – настоящее (переведен, переводится); **was translated** - прошедшее (был переведен, переводился).

5.4. Определите **дополнительный оттенок** смысла (Аспект), который выражают сложные формы глагола - времена группы Продолженных времен (Continuous), Завершенных времен (Perfect), Длительно-завершенных времен (Perfect-Continuous). В таких случаях **первое слово** глагольной группы выражает **время** - настоящее, прошедшее или будущее, а **вся группа** (ее **«формула»**) придает дополнительный оттенок смысла, подчеркивая **протекающий процесс или** завершенность/**результат** действия к определенному моменту.

Continuous (Продолженные времена) = **be** (в любой форме)**+ Ving** – *обычно подчеркивают протекающий* ***процесс:*** **was** reading – читал, читала; **will be** writing – будет писать, напишет

Perfect (Завершенные времена) = **have** *(в любой форме)* **+ Ved (**или **III** осн. форма неправ. гл.)

- *обычно подчеркивают достигнутый к определенному моменту* ***результат.***

They **have seen** me today – Они (уже) **видели** меня сегодня.

Perfect-Continuous (Длительно-завершенные времена) = **have been + Ving** – *выражают процессы, протекающие* ***с*** *какого-то времени (****since****) или* ***в течение*** *определенного времени (****for*** *some time).*

3.3. Рекомендации по подготовке чтения английского текста вслух

1. Переведите предложение, опираясь на список выписанных Вами незнакомых слов.

2. Убедитесь в наличии **транскрипции с ударением** для каждого нового для Вас слова.

3. Разделите предложение на **смысловые группы**, обозначив их границы карандашом в тексте.

4. В каждой смысловой группе определите **главное по смыслу слово** и тот **слог**, на который будет падать главное ударение данной смысловой группы слов. Подчеркните их.

5. Тренируйте для каждой смысловой группы **слитное чтение** с выражением. *Служебные слова* (предлоги, союзы, артикли, вспомогательные глаголы и т. п.) при чтении **ударения не имеют.**

6. Найдите **слова**, которые несут **главный смысл** всего предложения. Тренируйте чтение целого предложения с паузами между смысловыми группами слов, **особо выделяя** слова, передающие главный **смысл** данного **предложения**.

7. Интонация: в английском тексте смысловые группы слов в начале предложения обычно произносятся с подъемом голоса на главном слове (так называемый восходящий тон). В конце предложения голос «опускается» (нисходящий тон).

3.4. Требования к сочинениям и изложениям на английском языке

1. Сочинения/изложения на англ яз (**essays**) следует писать ***регулярно не реже одного раза в неделю.***
2. В своих сочинениях Вам необходимо стремиться максимально использовать ***весь языковой материал***, который изучается и/или попутно дается преподавателем на занятиях.
3. При изложении содержания английских текстов ***никогда не заимствуйте*** целых предложений. Стройте каждое предложение ***самостоятельно*** по правилам английского языка, используя формы, которые Вы хорошо понимаете.
4. Вашу исходную мысль на русском языке, как правило, необходимо предварительно ***разбить на несколько простых***, легких для перевода предложений. При подготовке ***пересказа не записывайте полный*** русский или английский текст. Тренируйте память, делайте все преобразования в уме.
5. В каждом собственном английском предложении проверяйте ***правильность формы глагола сказуемого*** и ее ***согласование по числу*** с подлежащим данного предложения.

6. Подготовленный Вами черновик сочинения необходимо ***тщательно проверить, исправить*** обнаруженные ошибки и пометить на полях возникшие у Вас вопросы.

7. Окончательный текст Вашего сочинения следует подготовить на **чтение вслух**, для чего: а/ уточнить и, если надо, отметить правильное ударение или выписать на полях полную ***транскрипцию*** новых слов, б/пометить в тексте карандашом необходимые для осмысленного чтения ***паузы*** между группами слов, а также в/ подчеркнуть ***главные слова*** предложения, которые потребуют интонационного выделения.

8. Готовые сочинения оформляются в тонкой тетрадке и ***сдаются на проверку*** преподавателю, ***либо*** предъявляются устно ***в форме подготовленного чтения*** – по выбору преподавателя.

9. По результатам проверки после каждого сочинения необходимо выполнить ***письменную работу над ошибками*** (н-р, дополнительно составить несколько простых предложений с формой глагола, требующей тренировки).

3.5 Рекомендации по подготовке и критерии оценивания пересказа

1. Пересказ на иностранном языке должен отражать основное содержание прочитанного текста.

2. Пересказ выполняется устно своими словами, используя собственные предложения, длина и сложность которых должны соответствовать уровню владения Вами данным иностранным языком: чем ниже уровень владения языком, тем короче должны быть предложения, тем больше внимания нужно уделять форме глагола-сказуемого и его согласованию по числу и лицу с формой подлежащего.

3. Отметка, выставляемая за пересказ (2,3,4,5), непосредственно зависит от полноты и точности изложения содержания прочитанного текста, а также от грамматической, фонетической правильности и богатства словарного запаса Вашей речи на иностранном языке.

4. **Отметка «5»** выставляется за пересказ, отражающий все основные положения прочитанного текста, демонстрирующий свободное владение наиболее употребительными грамматическими формами данного иностранного языка, показывающий достаточное разнообразие словарного запаса и способность его корректно применять в устной речи (соответствует владению продуктивной речью на уровне В2 или выше).

Отметкой «4» оценивается пересказ, отражающий большинство выраженных в тексте идей и выполненный без большого количества грубых грамматических и лексических ошибок, что примерно соответствует владению продуктивной речью на уровне не ниже В1/В1+.

Отметка «3» выставляется за пересказ, отражающий не менее половины содержания прочитанного текста, выполненный с достаточной степенью грамматической и фонетической правильности, позволяющей без затруднения понимать речь говорящего (уровень качества речи - А2+/В1 или выше).

3.6 How to prepare the retelling of a text

1. ***Translate the text*** understanding the structure of each sentence.
2. Look at it again and pick up ***the key words (the main ideas).***
3. Check and ***learn the pronunciation*** of the key English words.
4. Formulate the main ideas in ***your own*** short, clear and simple sentences.
5. Try and use various ***synonymous*** structures, e.g.:
   - a review of a book about transformers, a book review…
   - There is some information about…, the book gives some facts about…
   - There are different materials for transformers (to produce transformers), various materials are available…
   - Various materials are used … They use various materials
   - in the construction of transformers, to construct transformers, for constructing transformers

3.7 Requirements to your speech (retelling, summaries, oral topics, etc.)

1/ **Your own short** sentences, please.
2/ **Strict control of grammar:** the verb forms, all the other forms you are using.
3/ **Correct** stresses and pronunciation**.**
4/ **No reading** from paper.

4. Методические материалы к занятиям

4.1 Master degree studies

1. I **entered** a Master Degree course in Electrical Engineering.
   When did you enter the course?
   Why … …. at this university?
   How… … … ?
2. I **completed** a Bachelor Degree course in… … … (a Specialist Diploma course)
   Where … ?
   When … …?
   What for … … … ?
3. I **graduated from** the Kaliningrad State Technical University (this year, last year, … years ago).
   Where did you graduate? (from a university or a department; in some city, in some year)

4. What **course are you taking** now?
5. A Master Degree **thesis/dissertation**: When? What about?
6. Research adviser: Who? The **titles and affiliations**. **Research interests**.

4.2 Vocabulary drill: Using different fuels and energy sources

1. Based on exercise 1 on page 5, use the phrases below in your own full sentences
… burn/burns (gas, coal, lignite, nuclear fuel)
…use/uses/utilizes … as its primary fuel/sources of energy
… generate/generates electricity using/utilizing…
Please use **frequency adverbs** when needed: always, never, rarely, often, etc. See p.35 in «Справочник по курсу англ яз».
E.g.: **A** hydro power plant always uses water energy.

2. Characterize all the power plants in Kaliningrad and the region using the above phrases from point 1/ and those given below:
… is a gas-fired power plant
…are coal-fired power plants

3. Give some other examples of power plants which you know about. Characterize each of them.

4.3 Fuels and Energy Sources: *Please discuss the topic, speaking/writing in your own full sentences*

1. What is the difference between a fuel and an energy source (a source of energy)?
2. Looking at the Starter on page 5, which is a fuel and which is an energy source, why? Where and how is it produced/extracted? Where and which way can it be found in nature? How is each kind used?
3. How much do people use fossil fuels today? Why?
4. How and where are fossil fuels produced in our country and abroad?
5. Where and how are renewables (renewable sources of energy) used or can be used?
6. Who and how uses renewables today (in our country, abroad)?
7. What do you know about fuels and energy exports and imports? Who exports/imports them? How much? Which way are they transported (by rail-way, by the sea, by pipelines, etc.)
8. Please think of companies, organizations, households as users of fuels and energy: What fuels and energy sources do they use? What for do they use fuels/energy sources?
    - **<u>For</u>** heating / **<u>to</u>** heat their premises
    - For production (What do they produce? How exactly is fuel used?)
    - For ventilation / air conditioning? **<u>etc.</u>**

4.4. Essay on power plant types

1. The … …. power plant is a plant which….

Such plants are usually built … (where)…
The capacity can be from… to…
The necessary conditions for such a plant include…

2. The main advantage of a …power station is…

Besides, …
…. benefit from such plants.

3. On the other hand,…

One of the drawbacks of these plants is
Another disadvantage is ….
The negative impact on ….

4.5. Sample plan for a written summary or retelling of a conversation

(based on listening script 2 on page 64)

1. Introduction: What kind of text is it?

E.g.: This is a conversation between X. and Y. . X. is … . She is working for… Y. is … . He is responsible for…

2. What does the initiator of the conversation want to know (asks about, would like to learn about)? Why?
3. The first issue, matter, question, etc. they are discussing is …

4. Give the answer, render the reply in your own words.

E.g.: ELEC has…
They are used for…

Fossil fuel plants: lignite-fired, gas-fired, nuclear plants; are used for…/ to produce…; load ranges

5. The next part of their conversation was about emissions.

6. After that C. asks M. to give him some exact figures, but…
7. The largest of ELEC's power plants is… It is located … It produces…

8. ELEC's older power plants.

9. ELEC's policy and attitude concerning wind power.

4.6. Some useful phrases for written and oral summaries:

1. **The text|/passage/article tells us about…/ is about…**
2. It ‘analyzes …
3. It discusses the problem of …, the possibility of using … for…
4. According to the Author/s, …
5. The Author claims (утверждает, заявляет) that…
6. The authors classify…
7. The text contains some information concerning/regarding (касающуюся, относительно) something or somebody
8. **As to** / **concerning** something/somebody … (Что касается…)
9. Besides that, - кроме этого
10. There are some figures (characterizingю...sth)
11. A comprehensive (глубокий, исчерпывающий) analysis is given of … (something)
12. Nevertheless – тем не менее
13. The Author’s conclusion is that…
14. The researcher points at… (указывает на)
15. He/she emphasises - подчеркивает

4.7. Some prompts for a written summary or retelling of a business letter

(based on the letter of complaint on page 19)

1. A letter of complaint from X to Y
2. X is… : Y is… (positions in their companies)
3. Situation description
4. The reasons of the accident **according to** ELEC’s engineers (*surges and outages)*
5. No severe damages due to…
6. What is ELEC’s team doing to correct the situation?
7. Force majeure or not?
8. … is concerned about the situation
9. …is not sure if ELEC…
10. … suggests to hold a meeting (where and when)

4.8. Presentation structure

1. **Introduce the topic. *Explain* why you have chosen it.**
2. **Demonstrate the plan (3-5 main points).**
3. **Disclose each point one by one. *Use connectors*.**
4. **Summarize your presentation. Make your general conclusions.**
5. **Invite questions.**

The slide

Only ***the key words*** *(notions), names and dates.*

No long text!

Schemes *and|or* ***pictures*** *– If and when needed.*

5. Примеры профессиональных текстов для индивидуального домашнего чтения (Home reading)

5.1 Electricity generation in the USA

https://www.publicpower.org/policy/electricity-generation

Electricity is created from the conversion of a fuel or other source of energy into electrons. This process occurs on a large scale at an electricity generating plant, and on a smaller scale through distributed energy resources. Even with continuing advances in, and increased deployment of, energy storage technology, most electricity must be generated the instant it is used, requiring forms of generation that must always be available to "keep the lights on." Electricity in the United States is generated by a range of fuels and technologies, including natural gas, coal, nuclear, hydropower, and non-hydropower renewable resources, such as solar, wind, biomass, and geothermal power. Each fuel source and generating technology has advantages and disadvantages, which is why having a diverse portfolio of fuels is a priority for electric utilities.

Of total U.S. power generation in 2020, natural gas produced 1.6359 billion megawatt-hours (MWh) of electricity, coal produced 773.4 million MWh, nuclear produced 789.9 million MWh, hydro produced 280 million MWh, non-hydro renewables (wind, solar, biomass, geothermal, and other sources) produced 497.7 million MWh, and oil provided 17.3 million MWh.

For generation owned by public power utilities in 2020, 124.3 million MWh of electricity were produced from natural gas, 91 million MWh of electricity were generated from coal, 75.1 million MWh were generated from hydro, 61.5 million MWh were generated from nuclear, and 7.1 million MWh were generated from non-hydro renewables.

It is important to note, however, that public power utilities supply approximately 15 percent of electricity to end-users in the United States, but they only produce approximately 9.3 percent of the MWh generated. Collectively, end-use public power utilities are net purchasers of power from other sources (i.e., investor-owned utilities, independent power producers, rural electric cooperatives, federal power marketing administrations, and the Tennessee Valley Authority).

The two leading fuel sources used to generate electricity in the U.S. are natural gas and coal – in 2020, natural gas was responsible for 40.8 percent of total U.S. generation and 34.4 percent of total generation owned by public power, and coal accounted for 19.3 percent of the nation's generation and 25.2 percent of generation owned by public power. Oil was responsible for 0.4 percent of total U.S. generation and 0.045 percent of generation owned by public power in 2020.

The demand for natural gas in the electric sector has grown immensely in recent years. This is partly a result of large amounts of natural gas capacity built by merchant generators in areas served by regional transmission organizations because of lower capital costs and faster build time. The increased demand is also due to the lower carbon dioxide (CO_2) emissions profile of natural gas (it produces approximately half the CO_2 emissions as that produced by coal, on average). Despite these benefits, concerns with natural gas include significant historic price volatility; the need for additional pipeline construction in certain parts of the country; limitations on natural gas storage capabilities; and emissions.

For many decades, coal was the leading fuel used to generate electricity because it was cheaper than other fuels and it provides reliable baseload generation. Its use has steadily declined due to several factors, such as lower natural gas prices and the cost of compliance with current and proposed environmental regulations on CO_2 and criteria pollutant (such as sulfur dioxide (SO_2) and nitrogen oxides (NOx)) emissions resulting from coal combustion. Coal also faces the major obstacle of its CO_2 content and the current lack of affordable technology to capture and sequester CO_2 on a commercial scale from power plants. The major unknown going forward is the viability of carbon capture and sequestration or another, unknown technology that may reduce the CO_2 emitted from coal combustion.

Oil is primarily used for emergencies, peak shaving, and as a source of backup generation in times of high electricity demand. It is also used as baseload generation in areas that have limited access to other generation resources, such as Alaska and Hawaii, and the territories of the U.S. (Note however, that the latter are not included in EIA's data.)

Nuclear

Nuclear was responsible for 19.7 percent of total U.S. generation and 17.0 percent of total generation owned by public power utilities in 2020. Nuclear power is an extremely reliable source of baseload generation that produces no CO2 or other air emissions (e.g., SO_2 and NOx). The main challenge associated with existing nuclear facilities is the disposal of nuclear waste. Nuclear facilities also have high capital costs given the complexity of the units and safety features that must be included and monitored on an ongoing basis.

The construction of new, large-scale, nuclear facilities is challenging due to financing difficulties and rigorous regulatory hurdles. In addition, continued low natural gas prices make construction of combined cycle natural gas turbines far less expensive than constructing a nuclear power plant. The most recently completed plant is the Watts Bar 2 nuclear power plant, which started operation in October 2016. Construction is ongoing on new reactor units Vogtle 3 and 4 in Georgia.

A promising new technology in nuclear is small modular reactors. These smaller scale plants are less expensive and require less infrastructure. Because of the potential benefits, the Department of Energy has provided significant funding to accelerate the development and commercialization of this technology. Several APPA members are actively engaged in the development and deployment of this technology.

Hydropower

Hydropower is the nation's second largest source (behind wind) of emissions-free, renewable electricity, accounting for approximately 36.0 percent of domestic renewable generation and 7 percent of total electricity generation in 2020. For generation owned by public power utilities in 2020, hydro was responsible for 20.8 percent of total generation. It is a reliable source of baseload energy.

While hydropower is expanding into exciting new areas like tidal and in-stream, large dams still provide the bulk of the resource, and the impacts of those dams on fish and other wildlife will continue to be a concern for some stakeholders. Furthermore, as environmental mitigation measures have been addressed, hydropower output from these large dams has been reduced. Federal permitting has been, and will continue to be, a hurdle to any new hydropower development, large or small. With less than three percent of the nation's more than 80,000 dams generating electricity, this is problematic.

Non-Hydro Renewables

Non-hydro renewables were responsible for 12.4 percent of total U.S. generation and 2.0 percent of total generation owned by public power utilities in 2020. The main challenges facing non-hydro power renewables are the intermittent nature of wind and the sun; the need to have them backed up with baseload generation (typically natural gas); limited access to transmission lines; and financing. Concerns about integrating wind have arisen because the wind often blows when demand is not high, which thereby requires a ratcheting down of other resources that can often be uneconomic and cause stresses to the operation of a regional or sub-regional system. Some of these challenges may be mitigated in the future as more energy storage technologies are deployed. The benefits of renewable resources include that most of them do not emit pollutants or CO2 and their ongoing fuel costs are low or non-existent.

Distributed Generation

As of October 2021, approximately 37,000 MWs of distributed solar capacity have been installed in the United States.2 DG is power produced at the point of consumption. More than 90 percent of DG is rooftop solar, but it can include small wind turbines, combined heat and power, fuel cells, microturbines, and other sources. Under a policy called net-metering, customers with on-site generation are credited for the amount of kilowatt-hour sales sold back to the distribution grid. This rate can vary per utility, but is generally set at the retail rate, as opposed to the wholesale rate, which is the rate utilities use to purchase power for their customers.

Due to this rate structure, concerns have arisen that net metering customers are not paying their fair share of the costs of keeping the grid operating safely and reliably. DG also has operational issues that pose challenges for utilities, such as maintenance of electric grid system balance, safety issues for line-workers, load forecasting impairment, and increased strain on the distribution system. Potential benefits of DG include the need to build less new generation, reduced air pollution and greenhouse gas emissions, and in some cases, mitigation against outages on the distribution grid. For more information on DG, see APPA's issue brief, "Distributed Energy Resources."

Every fuel type has its advantages and disadvantages that require substantial risk management planning. Therefore, it is very important for today's electric utilities (where possible) to have a balanced generating portfolio with multiple fuel types, particularly dispatchable resources. An over-reliance on one fuel can and will create potential risk that could substantially increase prices to consumers and reduce reliability.

5.2 Electric power transmission. Parts A - H

Part A (3 passages)

Ссылка на звуковое воспроизведение текстов A-G из Electric power transmission

https://www.youtube.com/watch?v=hg70clk2R-A&list=PLWkHFSV9QchCT6U1n5ZHfNElngLKXmp4M&index=3

Electric power transmission is the bulk movement of electrical energy from generating power plants to electrical substations located near demand centers. This is distinct from the local wiring between high-voltage substations and customers, which is typically referred to as electric power distribution. Transmission lines, when interconnected with each other, become *transmission networks*. The combined transmission and distribution network is known as the "power grid" in the United States,or just "the grid". In the United Kingdom the network is known as the National Grid.

A wide area synchronous grid, also known as an "interconnection" in North America, directly connects a large number of generators delivering AC power with the same relative phase, to a large number of consumers. For example, there are three major interconnections in North America (the Western Interconnection, the Eastern Interconnection, and the Electric Reliability Council of Texas (ERCOT) grid), and one large grid for most of continental Europe.

Historically, transmission and distribution lines were owned by the same company, but starting in the 1990s, many countries have liberalized the regulation of the electricity market in ways that have led to the separation of the electricity transmission business from the distribution business.

System

Most transmission lines are high-voltage three-phase alternating current (AC), although single phase AC is sometimes used in railway electrification systems. High-voltage direct-current (HVDC) technology is used for greater efficiency at very long distances (typically hundreds of miles) or in submarine power cables (typically longer than 30 miles (50 km)). HVDC links are also used to stabilize and control problems in large power distribution networks where sudden new loads, or blackouts, in one part of a network can otherwise result in synchronization problems and cascading failures.

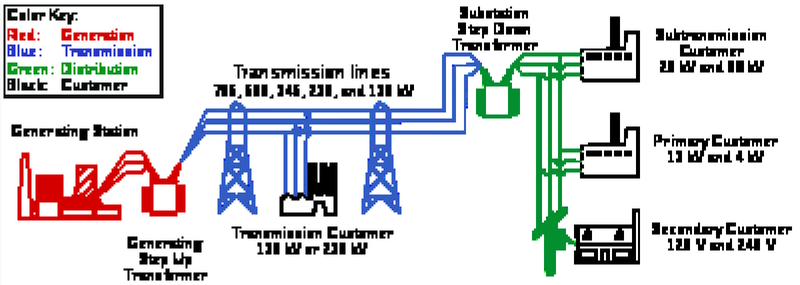


Diagram of an electric power system; transmission system is in blue.

Electricity is transmitted at high voltages (120 kV or above) to reduce the energy losses in long-distance transmission. Power is usually transmitted through overhead power lines. Underground power transmission has a significantly higher cost and greater operational limitations but is sometimes used in urban areas or sensitive locations. A key limitation of electric power is that, with minor exceptions, electrical energy cannot be stored, and therefore must be generated as needed. A sophisticated control system is required to ensure electric generation very closely matches the demand. If the demand for power exceeds the supply, generation plant and transmission equipment can shut down, which in the worst case may lead to a major regional blackout, such as occurred in the US Northeast blackout of 1965, 1977, 2003 and other regional blackouts in 1996 and 2011. It is to reduce the risk of such failure that electric transmission networks are interconnected into regional, national or continent wide networks thereby providing multiple redundant alternative routes for power to flow should such equipment failures occur. Much analysis is done by transmission companies to determine the maximum reliable capacity of each line (ordinarily less than its physical or thermal limit) to ensure spare capacity is available should there be any such failure in another part of the network.

Overhead transmission

High-voltage overhead conductors are not covered by insulation. The conductor material is nearly always an aluminum alloy, made into several strands and possibly reinforced with steel strands. Copper was sometimes used for overhead transmission, but aluminum is lighter, yields only marginally reduced performance and costs much less. Overhead conductors are a commodity supplied by several companies worldwide. Improved conductor material and shapes are regularly used to allow increased capacity and modernize transmission circuits. Conductor sizes range from 12 mm^2 (#6 American wire gauge) to 750 mm^2(1,590,000 circular mils area), with varying resistance and current-carrying capacity. Thicker wires would lead to a relatively small increase in capacity due to the skin effect, that causes most of the current to flow close to the surface of the wire. Because of this current limitation, multiple parallel cables (called bundle conductors) are used when higher capacity is needed. Bundle conductors are also used at high voltages to reduce energy loss caused by corona discharge.

Today, transmission-level voltages are usually considered to be 110 kV and above. Lower voltages, such as 66 kV and 33 kV, are usually considered subtransmission voltages, but are occasionally used on long lines with light loads. Voltages less than 33 kV are usually used for distribution. Voltages above 230 kV are considered extra high voltage and require different designs compared to equipment used at lower voltages.

Since overhead transmission wires depend on air for insulation, design of these lines requires minimum clearances to be observed to maintain safety. Adverse weather conditions of high wind and low temperatures can lead to power outages. Wind speeds as low as 23 knots (43 km/h) can permit conductors to encroach operating clearances, resulting in a flashover and loss of supply. Oscillatory motion of the physical line can be termed gallop or flutter depending on the frequency and amplitude of oscillation.

Underground transmission

Electric power can also be transmitted by underground power cables instead of overhead power lines. Underground cables take up less right-of-way than overhead lines, have lower visibility, and are less affected by bad weather. However, costs of insulated cable and excavation are much higher than overhead construction. Faults in buried transmission lines take longer to locate and repair.

Underground lines are strictly limited by their thermal capacity, which permits less overload or re-rating than overhead lines. Long underground AC cables have significant capacitance, which may reduce their ability to provide useful power to loads beyond 50 miles (80 kilometres). Long underground DC cables have no such issue and can run for thousands of miles.

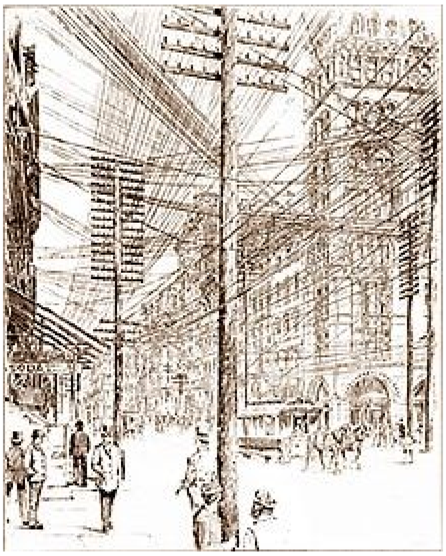
Electric power transmission. **Part B** (2 passages)

Ссылка на звуковое воспроизведение текстов A-G из Electric power transmission

https://www.youtube.com/watch?v=hg70clk2R-A&list=PLWkHFSV9QchCT6U1n5ZHfNElngLKXmp4M&index=3

History

New York City streets in 1890. Besides telegraph lines, multiple electric lines were required for each class of device requiring different voltages.



In the early days of commercial electric power, loads restricted the distance between generating plant and consumers. In 1882, generation was with direct current (DC), which could not easily be increased in voltage for long-distance transmission. Different classes of loads (for example, lighting, fixed motors, and traction/railway systems) required different voltages, and so used different generators and circuits.

Due to this specialization of lines and because transmission was inefficient for low-voltage high-current circuits, generators needed to be near their loads. It seemed, at the time, that the industry would develop into what is now known as a distributed generation system with large numbers of small generators located near their loads.

In 1886 in Great Barrington, Massachusetts, a 1 kV AC distribution system was installed. That same year, AC power at 2 kV, transmitted 30 km, was installed at Cerchi, Italy. At an AIEE meeting on may 16,1888, Nikola tesla delivered a lecture entitled A New System of Alternating Current Motors and Transformers, describing the equipment which allowed efficient generation and use of polyphase alternating currents. The transformer, and Tesla's polyphase and single-phase induction motors, were essential for a combined AC distribution system for both lighting and machinery. Ownership of the rights to the tesla patents was a key advantage to the Westinghouse Company in offering a complete alternating current power system for both lighting and power.

Regarded as the most influential electrical innovations, the universal system used transformers to step-up voltage from high-voltage transmission lines, and then to step-down voltage to local distribution circuits or industrial customers. By a suitable choice of utility frequency, both lighting and motor loads could be served. Rotary converters and later mercury-arc valves and other rectifier equipment allowed DC to be provided where needed. Generation stations and loads using different frequencies could be interconnected using rotary converters. By using common generating for every type of load, important economies of scale were achieved, lower overall capital investment was required, load factor on each plant was increased allowing for higher efficiency, a lower cost for the consumer and increased overall use of electric power.

By allowing multiple generating plants to be interconnected over a wide area, electricity production cost was reduced. The most efficient available plants could be used to supply the varying loads during the day. Reliability was improved and capital investment cost was reduced, since stand-by generating capacity could be shared over many more customers and a wider geographic area. Remote and low-cost sources of energy, such as hydroelectric power or mine-mouth coal, could be exploited to lower energy production cost.

The first transmission of three-phase alternating current using high voltage took place in 1891 during the international electricity exhibition in Frankfurt. A 25 kV transmission line, approximately 175 km long, connected Lauffen on the Neckar and Frankfurt.

Voltages used for electric power transmission increased throughout the 20th century. By 1914, fifty-five transmission systems each operating at more than 70 kV were in service. The highest voltage then used was 150 kV.

The rapid industrialization in the 20th century made electrical transmission lines and grids a critical infrastructure item in most industrialized nations. Interconnection of local generation plants and small distribution networks was greatly spurred by the requirements of World War I, with large electrical generating plants built by governments to provide power to munitions factories. Later these generating plants were connected to supply civil loads through long-distance transmission.

Electric power transmission. **Part C** (2 passages)

Bulk power transmission

Ссылка на звуковое воспроизведение текстов A-G из Electric power transmission https://www.youtube.com/watch?v=hg70clk2R-A&list=PLWkHFSV9QchCT6U1n5ZHfNElngLKXmp4M&index=3

A transmission substation decreases the voltage of incoming electricity, allowing it to connect from long distance high voltage transmission, to local lower voltage distribution. It also reroutes power to other transmission lines that serve local markets. This is the PacifiCorpHale Substation, Orem, Utah, USA

Engineers design transmission networks to transport the energy as efficiently as possible, while at the same time taking into account the economic factors, network safety and redundancy. These networks use components such as power lines, cables, circuit breakers, switches and transformers. The transmission network is usually administered on a regional basis by an entity such as a regional transmission organization or transmission system operator.

Transmission efficiency is greatly improved by devices that increase the voltage (and thereby proportionately reduce the current), in the line conductors, thus allowing power to be transmitted with acceptable losses. The reduced current flowing through the line reduces the heating losses in the conductors. According to Joule's Law, energy losses are directly proportional to the square of the current. Thus, reducing the current by a factor of two will lower the energy lost to conductor resistance by a factor of four for any given size of conductor.

The optimum size of a conductor for a given voltage and current can be estimated by Kelvin's law for conductor size, which states that the size is at its optimum when the annual cost of energy wasted in the resistance is equal to the annual capital charges of providing the conductor. At times of lower interest rates, Kelvin's law indicates that thicker wires are optimal; while, when metals are expensive, thinner conductors are indicated: however, power lines are designed for long-term use, so Kelvin's law has to be used in conjunction with long-term estimates of the price of copper and aluminum as well as interest rates for capital.

The increase in voltage is achieved in AC circuits by using a *step-up transformer*. HVDC systems require relatively costly conversion equipment which may be economically justified for particular projects such as submarine cables and longer distance high capacity point-to-point transmission. HVDC is necessary for the import and export of energy between grid systems that are not synchronized with each other.

A transmission grid is a network of power stations, transmission lines, and substations. Energy is usually transmitted within a grid with three-phase AC. Single-phase AC is used only for distribution to end users since it is not usable for large polyphase induction motors. In the 19th century, two-phase transmission was used but required either four wires or three wires with unequal currents. Higher order phase systems require more than three wires, but deliver little or no benefit.

The price of electric power station capacity is high, and electric demand is variable, so it is often cheaper to import some portion of the needed power than to generate it locally. Because loads are often regionally correlated (hot weather in the Southwest portion of the US might cause many people to use air conditioners), electric power often comes from distant sources. Because of the economic benefits of load sharing between regions, wide area transmission grids now span countries and even continents. The web of interconnections between power producers and consumers should enable power to flow, even if some links are inoperative.

The unvarying (or slowly varying over many hours) portion of the electric demand is known as the *base load* and is generally served by large facilities (which are more efficient due to economies of scale) with fixed costs for fuel and operation. Such facilities are nuclear, coal-fired or hydroelectric, while other energy sources such as concentrated solar thermal and geothermal power have the potential to provide base load power. Renewable energy sources, such as solar photovoltaics, wind, wave, and tidal, are, due to their intermittency, not considered as supplying "base load" but will still add power to the grid. The remaining or 'peak' power demand, is supplied by peaking power plants, which are typically smaller, faster-responding, and higher cost sources, such as combined cycle or combustion turbine plants fueled by natural gas.

Long-distance transmission of electricity (thousands of kilometers) is cheap and efficient, with costs of US$0.005–0.02 per kWh (compared to annual averaged large producer costs of US$0.01–0.025 per kWh, retail rates upwards of US$0.10 per kWh, and multiples of retail for instantaneous suppliers at unpredicted highest demand moments). Thus distant suppliers can be cheaper than local sources (e.g., New York often buys over 1000 MW of electricity from Canada). Multiple **local sources** (even if more expensive and infrequently used) can make the transmission grid more fault tolerant to weather and other disasters that can disconnect distant suppliers.

Long-distance transmission allows remote renewable energy resources to be used to displace fossil fuel consumption. Hydro and wind sources cannot be moved closer to populous cities, and solar costs are lowest in remote areas where local power needs are minimal. Connection costs alone can determine whether any particular renewable alternative is economically sensible. Costs can be prohibitive for transmission lines, but various proposals for massive infrastructure investment in high capacity, very long distance super grid transmission networks could be recovered with modest usage fees.

Electric power transmission. **Part D** (3 passages)

Ссылка на звуковое воспроизведение текстов A-G из Electric power transmission

https://www.youtube.com/watch?v=hg70clk2R-A&list=PLWkHFSV9QchCT6U1n5ZHfNElngLKXmp4M&index=3

Grid input

At the power stations, the power is produced at a relatively low voltage between about 2.3 kV and 30 kV, depending on the size of the unit. The generator terminal voltage is then stepped up by the power station transformer to a higher voltage (115 kV to 765 kV AC, varying by the transmission system and by country) for transmission over long distances.

Losses

Transmitting electricity at high voltage reduces the fraction of energy lost to resistance, which varies depending on the specific conductors, the current flowing, and the length of the transmission line. For example, a 100 mi (160 km) span at 765 kV carrying 1000 MW of power can have losses of 1.1% to 0.5%. A 345 kV line carrying the same load across the same distance has losses of 4.2%. For a given amount of power, a higher voltage reduces the current and thus the resistive losses in the conductor. For example, raising the voltage by a factor of 10 reduces the current by a corresponding factor of 10 and therefore the losses by a factor of 100, provided the same sized conductors are used in both cases. Even if the conductor size (cross-sectional area) is reduced ten-fold to match the lower current, the I2R losses are still reduced ten-fold. Long-distance transmission is typically done with overhead lines at voltages of 115 to 1,200 kV. At extremely high voltages, more than 2,000 kV exists between conductor and ground, corona discharge losses are so large that they can offset the lower resistive losses in the line conductors. Measures to reduce corona losses include conductors having larger diameters; often hollow to save weight, or bundles of two or more conductors.

Transmission and distribution losses in the USA were estimated at 6.6% in 1997, 6.5% in 2007. By using underground DC transmission these losses can be cut in half. Underground cables can be larger diameter because they do not have the constraint of light weight that overhead cables have, being 100 feet in the air.

In general, losses are estimated from the discrepancy between power produced (as reported by power plants) and power sold to the end customers; the difference between what is produced and what is consumed constitute transmission and distribution losses, assuming no utility theft occurs.

As of 1980, the longest cost-effective distance for direct-current transmission was determined to be 7,000 kilometres (4,300 miles). For alternating current it was 4,000 kilometres (2,500 miles), though all transmission lines in use today are substantially shorter than this.

In any alternating current transmission line, the inductance and capacitance of the conductors can be significant. Currents that flow solely in ‘reaction’ to these properties of the circuit, (which together with the resistance define the impedance) constitute reactive power flow, which transmits no ‘real’ power to the load. These reactive currents, however, are very real and cause extra heating losses in the transmission circuit. The ratio of 'real' power (transmitted to the load) to 'apparent' power (sum of ‘real’ and ‘reactive’) is the power factor. As reactive current increases, the reactive power increases and the power factor decreases. For transmission systems with low power factor, losses are higher than for systems with high power factor. Utilities add capacitor banks, reactors and other components (such as phase-shifting transformers; static VAR compensators; physical transposition of the phase conductors: and flexible AC transmission systems, FACTS) throughout the system help to compensate for the reactive power flow, reduce the losses in power transmission and stabilize system voltages. These measures are collectively called 'reactive support'.

Subtransmission

Subtransmission is part of an electric power transmission system that runs at relatively lower voltages. It is uneconomical to connect all distribution substations to the high main transmission voltage, because the equipment is larger and more expensive. Typically, only larger substations connect with this high voltage. It is stepped down and sent to smaller substations in towns and neighborhoods. Subtransmission circuits are usually arranged in loops so that a single line failure does not cut off service to many customers for more than a short time.

There is no fixed cutoff between subtransmission and transmission, or subtransmission and distribution. The voltage ranges overlap somewhat. Voltages of 69 kV, 115 kV, and 138 kV are often used for subtransmission in North America. As power systems evolved, voltages formerly used for transmission were used for subtransmission, and subtransmission voltages became distribution voltages. Like transmission, subtransmission moves relatively large amounts of power, and like distribution, subtransmission covers an area instead of just point-to-point.

Transmission grid exit

At the substations, transformers reduce the voltage to a lower level for distribution to commercial and residential users. This distribution is accomplished with a combination of sub-transmission (33 to 132 kV) and distribution (3.3 to 25 kV). Finally, at the point of use, the energy is transformed to low voltage (varying by country and customer requirements). See Mains electricity by country.

Electric power transmission. **Part E** (2 passages)

Ссылка на звуковое воспроизведение текстов A-G из Electric power transmission

https://www.youtube.com/watch?v=hg70clk2RA&list=PLWkHFSV9QchCT6U1n5ZHfNElngLKXmp4M&index=3

High-voltage direct current

High-voltage direct current (HVDC) is used to transmit large amounts of power over long distances or for interconnections between asynchronous grids. When electrical energy is to be transmitted over very long distances, the power lost in AC transmission becomes appreciable and it is less expensive to use direct current instead of alternating current. For a very long transmission line, these lower losses (and reduced construction cost of a DC line) can offset the additional cost of the required converter stations at each end.

HVDC is also used for long submarine cables over about 30 km (19 mi) lengths *when/where* AC cannot be supplied. In these cases special high-voltage cables for DC are used. Submarine HVDC systems are often used to connect the electricity grids of islands, for example, between Great Britain and mainland Europe, between Great Britain and Ireland, between Tasmania and the Australian mainland, between the North and South Islands of New Zealand. Submarine connections up to 600 kilometres (370 mi) in length are presently in use.

HVDC links can be used to control problems in the grid with AC electricity flow. The power transmitted by an AC line increases as the phase angle between source end voltage and destination ends increases, but too large a phase angle will allow the systems at either end of the line to fall out of step. Since the power flow in a DC link is controlled independently of the phases of the AC networks at either end of the link, this phase angle limit does not exist, and a DC link is always able to transfer its full rated power. A DC link therefore stabilizes the AC grid at either end, since power flow and phase angle can then be controlled independently.

As an example, to adjust the flow of AC power on a hypothetical line between Seattle and Boston would require adjustment of the relative phase of the two regional electrical grids. This is an everyday occurrence in AC systems, but one that can become disrupted when AC system components fail and place unexpected loads on the remaining working grid system. With an HVDC line instead, such an interconnection would:

1. Convert AC in Seattle into HVDC;
2. Use HVDC for the 3,000 miles (4,800 km) of cross-country transmission; and
3. Convert the HVDC to locally synchronized AC in Boston,

(and possibly in other cooperating cities along the transmission route). Such a system could be less prone to failure if parts of it were suddenly shut down. One example of a long DC transmission line is the Pacific DC Intertie located in the Western United States.

Transposition (*No sound track!)*

Current flowing through transmission lines induces a magnetic field that surrounds the lines of each phase and affects the inductance of the surrounding conductors of other phases. The mutual inductance of the conductors is partially dependent on the physical orientation of the lines with respect to each other. Three-phase power transmission lines are conventionally strung with phases separated on different vertical levels. The mutual inductance seen by a conductor of the phase in the middle of the other two phases will be different than the inductance seen by the conductors on the top or bottom. An imbalanced inductance among the three conductors is problematic because it may result in the middle line carrying a disproportionate amount of the total power transmitted. Similarly, an imbalanced load may occur if one line is consistently closest to the ground and operating at a lower impedance. Because of this phenomenon, conductors must be periodically transposed along the length of the transmission line so that each phase sees equal time in each relative position to balance out the mutual inductance seen by all three phases. To accomplish this, line position is swapped at specially designed transposition towers at regular intervals along the length of the transmission line in various transposition schemes.

Electric power transmission. **Part F** (3 passages)

Ссылка на звуковое воспроизведение текстов A-G из Electric power transmission

https://www.youtube.com/watch?v=hg70clk2R-A&list=PLWkHFSV9QchCT6U1n5ZHfNElngLKXmp4M&index=3

High-voltage direct current

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(and possibly in other cooperating cities along the transmission route). Such a system could be less prone to failure if parts of it were suddenly shut down. One example of a long DC transmission line is the Pacific DC Intertie located in the Western United States.

Capacity

The amount of power that can be sent over a transmission line is limited. The origins of the limits vary depending on the length of the line. For a short line, the heating of conductors due to line losses sets a thermal limit. If too much current is drawn, conductors may sag too close to the ground, or conductors and equipment may be damaged by overheating. For intermediate-length lines on the order of 100 kilometres (62 miles), the limit is set by the voltage drop in the line. For longer AC lines, system stability sets the limit to the power that can be transferred. Approximately, the power flowing over an AC line is proportional to the cosine of the phase angle of the voltage and current at the receiving and transmitting ends. Since this angle varies depending on system loading and generation. It is undesirable for the angle to approach 90 degrees. Very approximately, the allowable product of line length and maximum load is proportional to the square of the system voltage. Series capacitors or phase-shifting transformers are used on long lines to improve stability. High-voltage direct current lines are restricted only by thermal and voltage drop limits, since the phase angle is not material to their operation.

Up to now, it has been almost impossible to foresee the temperature distribution along the cable route, so that the maximum applicable current load was usually set as a compromise between understanding of operation conditions and risk minimization.

The availability of industrial distributed temperature sensing (DTS) systems that measure in real time temperatures all along the cable is a first step in monitoring the transmission system capacity. This monitoring solution is based on using passive optical fibers as temperature sensors, either integrated directly inside a high voltage cable or mounted externally on the cable insulation. A solution for overhead lines is also available. In this case the optical fiber is integrated into the core of a phase wire of overhead transmission lines (OPPC). The integrated Dynamic Cable Rating (DCR) or also called Real Time Thermal Rating (RTTR) solution enables not only to continuously monitor the temperature of a high voltage cable circuit in real time, but to safely utilize the existing network capacity to its maximum. Furthermore, it provides the ability to the operator to predict the behavior of the transmission system upon major changes made to its initial operating conditions.

To ensure safe and predictable operation, the components of the transmission system are controlled with generators, switches, circuit breakers and loads. The voltage, power, frequency, load factor, and reliability capabilities of the transmission system are designed to provide cost effective performance for the customers.

Electric power transmission. **Part G** (3 passages)

Ссылка на звуковое воспроизведение текстов A-G из Electric power transmission

https://www.youtube.com/watch?v=hg70clk2R-A&list=PLWkHFSV9QchCT6U1n5ZHfNElngLKXmp4M&index=3

Load balancing

The transmission system provides for base load and peak load capability, with safety and fault tolerance margins. The peak load times vary by region largely due to the industry mix. In very hot and very cold climates home air conditioning and heating loads have an effect on the overall load. They are typically highest in the late afternoon in the hottest part of the year and in mid-mornings and mid-evenings in the coldest part of the year. This makes the power requirements vary by the season and the time of day. Distribution system designs always take the base load and the peak load into consideration.

The transmission system usually does not have a large buffering capability to match the loads with the generation. Thus generation has to be kept matched to the load, to prevent overloading failures of the generation equipment.

Multiple sources and loads can be connected to the transmission system and they must be controlled to provide orderly transfer of power. In centralized power generation, only local control of generation is necessary, and it involves synchronization of the generation units, to prevent large transients and overload conditions.

In distributed power generation the generators are geographically distributed and the process to bring them online and offline must be carefully controlled. The load control signals can either be sent on separate lines or on the power lines themselves. Voltage and frequency can be used as signaling mechanisms to balance the loads.

In voltage signaling, the variation of voltage is used to increase generation. The power added by any system increases as the line voltage decreases. This arrangement is stable in principle. Voltage-based regulation is complex to use in mesh networks, since the individual components and setpoints would need to be reconfigured every time a new generator is added to the mesh.

In frequency signaling, the generating units match the frequency of the power transmission system. In droop speed control, if the frequency decreases, the power is increased. (The drop in line frequency is an indication that the increased load is causing the generators to slow down.)

Wind turbines, vehicle-to-grid and other locally distributed storage and generation systems can be connected to the power grid, and interact with it to improve system operation.

Failure protection

Under excess load conditions, the system can be designed to fail gracefully rather than all at once. Brownouts occur when the supply power drops below the demand. Blackouts occur when the supply fails completely.

Rolling blackouts (also called load shedding) are intentionally engineered electrical power outages, used to distribute insufficient power when the demand for electricity exceeds the supply.

Communications

Operators of long transmission lines require reliable communications for control of the power grid and, often, associated generation and distribution facilities. Fault-sensing protective relays at each end of the line must communicate to monitor the flow of power into and out of the protected line section so that faulted conductors or equipment can be quickly de-energized and the balance of the system restored. Protection of the transmission line from short circuits and other faults is usually so critical that common carrier telecommunications are insufficiently reliable, and in remote areas a common carrier may not be available. Communication systems associated with a transmission project may use:

- Microwaves
- Power-line communication
- Optical fibers

Rarely, and for short distances, a utility will use pilot-wires strung along the transmission line path. Leased circuits from common carriers are not preferred since availability is not under control of the electric power transmission organization.

Transmission lines can also be used to carry data: this is called power-line carrier, or PLC. PLC signals can be easily received with a radio for the long wave range.

Optical fibers can be included in the stranded conductors of a transmission line, in the overhead shield wires. These cables are known as optical ground wire (*OPGW*). Sometimes a standalone cable is used, all-dielectric self-supporting (*ADSS*) cable, attached to the transmission line cross arms.

Some jurisdictions, such as Minnesota, prohibit energy transmission companies from selling surplus communication bandwidth or acting as a telecommunications common carrier. Where the regulatory structure permits, the utility can sell capacity in extra dark fibers to a common carrier, providing another revenue stream.

Electric power transmission. Part H (*No sound track)* *(*3 passages)

Losses

Transmitting electricity at high voltage reduces the fraction of energy lost to resistance, which varies depending on the specific conductors, the current flowing, and the length of the transmission line. For example, a 100 mi (160 km) span at 765 kV carrying 1000 MW of power can have losses of 1.1% to 0.5%. A 345 kV line carrying the same load across the same distance has losses of 4.2%. For a given amount of power, a higher voltage reduces the current and thus the resistive losses in the conductor. For example, raising the voltage by a factor of 10 reduces the current by a corresponding factor of 10 and therefore the losses by a factor of 100, provided the same sized conductors are used in both cases. Even if the conductor size (cross-sectional area) is decreased ten-fold to match the lower current, the losses are still reduced ten-fold. Long-distance transmission is typically done with overhead lines at voltages of 115 to 1,200 kV. At extremely high voltages, more than 2,000 kV exists between conductor and ground, corona discharge losses are so large that they can offset the lower resistive losses in the line conductors. Measures to reduce corona losses include conductors having larger diameters; often hollow to save weight, or bundles of two or more conductors.

Factors that affect the resistance, and thus loss, of conductors used in transmission and distribution lines include temperature, spiraling, and the skin effect. The resistance of a conductor increases with its temperature. Temperature changes in electric power lines can have a significant effect on power losses in the line. Spiraling, which refers to the way stranded conductors spiral about the center, also contributes to increases in conductor resistance. The skin effect causes the effective resistance of a conductor to increase at higher alternating current frequencies. Corona and resistive losses can be estimated using a mathematical model.

Transmission and distribution losses in the USA were estimated at 6.6% in 1997, 6.5% in 2007 and 5% from 2013 to 2019. In general, losses are estimated from the discrepancy between power produced (as reported by power plants) and power sold to the end customers; the difference between what is produced and what is consumed constitute transmission and distribution losses, assuming no utility theft occurs.

As of 1980, the longest cost-effective distance for direct-current transmission was determined to be 7,000 kilometres (4,300 miles). For alternating current it was 4,000 kilometres (2,500 miles), though all transmission lines in use today are substantially shorter than this.[21]

In any alternating current transmission line, the inductance and capacitance of the conductors can be significant. Currents that flow solely in ‘reaction’ to these properties of the circuit, (which together with the resistance define the impedance) constitute reactive power flow, which transmits no ‘real’ power to the load. These reactive currents, however, are very real and cause extra heating losses in the transmission circuit. The ratio of 'real' power (transmitted to the load) to 'apparent' power (the product of a circuit's voltage and current, without reference to phase angle) is the power factor. As reactive current increases, the reactive power increases and the power factor decreases. For transmission systems with low power factor, losses are higher than for systems with high power factor. Utilities add capacitor banks, reactors and other components (such as phase-shifting transformers; static VAR compensators; and flexible AC transmission systems, FACTS) throughout the system help to compensate for the reactive power flow, reduce the losses in power transmission and stabilize system voltages. These measures are collectively called 'reactive support'.

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Transmission grid exit

At the substations, transformers reduce the voltage to a lower level for distribution to commercial and residential users. This distribution is accomplished with a combination of sub-transmission (33 to 132 kV) and distribution (3.3 to 25 kV). Finally, at the point of use, the energy is transformed to low voltage (varying by country and customer requirements). See Mains electricity by country.

Advantage of high-voltage power transmission

High-voltage power transmission allows for lesser resistive losses over long distances in the wiring. This efficiency of high voltage transmission allows for the transmission of a larger proportion of the generated power to the substations and in turn to the loads, translating to operational cost savings.

Заключение

В результате освоения дисциплины студенты развивают речевые умения точного понимания профессионального английского текста в области электроэнергетики и электротехники и умения продуктивной речи на английском языке в наиболее распространенных, а также наиболее актуальных для студентов ситуациях профессионального и повседневного общения.

В ходе изучения дисциплины «Профессиональный английский язык» студенты овладевают речевой технологией профессиональной презентации на английском языке и осваивают принятые сегодня в международном сообществе корректные способы ведения профессиональной дискуссии на английском языке.

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