PASSPORT
OF THE INNOVATIVE DEVELOPMENT PROGRAM
OF PJSC INTER RAO UNTIL 2020
WITH AN OUTLOOK FOR 2025

Moscow

2016

CONTENTS

1. VISION, GOALS, AND STRATEGIC DEVELOPMENT BENCHMARKS

GOAL, INNOVATIVE DEVELOPMENT OBJECTIVES OF THE GROUP

Main directions of innovative development of the Inter RAO[1] Group are the achievement of goals established in the PJSC Inter RAO Strategy, the development of scientific and technological potential of the Russian Federation electric power industry and the technological renovation of the Group, the improvement of efficiency, reliability, and safety of assets, and the achievement of leading positions of the Group in the industry.

The Innovative Development Program of the Inter RAO Group until 2020 with an outlook for 2025 (hereinafter referred to as the Program) includes:

- mastering of new technologies – technological innovations;
- development, issuance and market introduction of new products and services – product (including service) and marketing innovations;
- new management approaches – management innovations.

The Program's goal is to achieve technological leadership of the Inter RAO Group through the implementation of innovative high performance energy technologies, provide competitive advantages in the electric power industry not only in the Russian market, but in the international market as well, provide long-term sustainable growth of the Group's value and its competitive ability through the introduction of innovations in all value chain links, as well as to provide continuous, reliable, environmentally safe and high-quality energy supply to customers based on innovative technologies and equipment in accordance with best global practices.

In order to achieve the stated Program goal, the Inter RAO Group must accomplish the following objectives:

In the mid-term period:

- improvement of the technical level, reliability, safety, and operating efficiency of generating assets to the level of best international equivalents;
- improvement of the environmental safety of energy production;

[1] From this point onward in this document the legal entity PJSC Inter RAO and the multitude of subsidiaries under the authority of PJSC Inter RAO are identical in their functions, rights, and obligations in relation to the Innovative Development Program. The name "Group" is also used instead of the name "Inter RAO Group". In some cases the abbreviation "IDP" (Innovative Development Program) is used.

- reduction of production costs;
- energy saving;
- improvement of the quality of services for ultimate energy resource consumers;
- development and promotion of offers on the development of the industry regulatory framework.

In the long-term period:

- assurance of geostrategic interests of the Russian Federation;
- development and implementation of breakthrough technologies and innovative projects of industry-wide significance;
- development of a gas-turbine equipment production with characteristics matching best global alternatives;
- most efficient implementation of foreign trade operations with electric energy generated within Russia and foreign countries;
- organization of an engineering research and production base for innovative development of the Group and the Russian electric power industry;
- provision of an additional economic effect for the Company within the development of new business directions.

Considering the strategic importance of the company in the industry, innovative activity of the Inter RAO Group becomes a significant **factor of innovative development of the Russian electric power industry as a whole**.

MAIN DIRECTIONS OF SCIENTIFIC AND TECHNOLOGICAL DEVELOPMENT OF THE GROUP

Main directions of the Inter RAO Group scientific and technological development are:

I. Development of advanced energy technologies affecting the modern science and technology progress in the industry.

The following objectives are accomplished within this direction:

- Development of new thermal and electric power generation technologies.
- Development and mastering of new main and auxiliary equipment.
- Improvement of heat balance diagrams, thermal power plant design methods and standards.
- Development of new materials.

- Improvement of energy sector construction technologies.
- Improvement of thermal power plant process control systems, resource and asset control systems, intraplant communication facilities.

II. Improvement of the energy efficiency of operating equipment, its reliability and safety, improvement of environmental specifications

The following objectives are accomplished within this direction:

- Improvement of the organization of repair activities and repair technologies.
- Development of diagnostics methods for equipment, buildings, and structures.
- Development of technical solutions for upgrading existing equipment.
- Improvement of operating conditions, including development of technical solutions for cogeneration-based district heating, fuel utilization, oil supply, water chemical conditions, and provision of system reliability assurance services.
- Development and improvement of information security systems for power generating facilities.
- Study of best practices (bench marking) in the area of energy saving, improvement of energy efficiency, process-enabled control of main and auxiliary equipment.
- Improvement of thermal power plant process control systems, resource and asset control systems, intraplant communication facilities.
- Monitoring of thermal power plant environmental impact.
- Development of a normative and methodological framework on the environmental performance indicators for electric power plants.
- Development of environmental protection technologies and equipment.

III. Development of organizational and marketing innovations, including IT innovations. The following objectives are accomplished within this direction:

- Improvement of the personnel training system.
- Optimization of the corporate management structure.
- Study of new markets of electric energy and capacity, thermal energy and capacity, markets of system reliability improvement services, engineering services to expand the Group presence in these markets.

IV. Innovative activity infrastructure

The following objectives are accomplished within this direction:

- Creation of R&D centers for the development and commercialization of innovative technologies and equipment.
- Interaction with development institutes, governmental and non-governmental funds, financial institutions, energy distribution companies to raise finances for the Fund Target Program works.
- Participation in intellectual property implementation projects in the form of creation of testing grounds, certification testing centers, technology transfer centers, including international ones.

LIST OF SUBSIDIARIES PARTICIPATING IN THE IMPLEMENTATION OF THE PROGRAM

Table 1.1. List of the Inter RAO Group subsidiaries participating in the Innovative Development Program implementation

Item No.	Subsidiary name
1.	Inter RAO — Management of Electric Power Plants LLC
2.	JSC Inter RAO — Electric Power Plants
3.	CJSC Nizhnevartovskaya GRES
4.	TGK-11 JSC
5.	JSC Tomsk Generation
6.	JSC Omsk RTS
7.	JSC Tomsk RTS
8.	Bashkir Generation Company LLC
9.	Bash RTS LLC
10.	Moldavskaya GRES CJSC
11.	Khramhesi I JSC
12.	Khramhesi II JSC
13.	JSC Ekibastuz TPP-2
14.	Mosenergosbyt JSC
15.	Altayenergosbyt JSC
16.	PJSC Tambov Power Supply Company
17.	PJSC Saratovenergo
18.	Saint-Petersburg Sale Company JSC
19.	Orel Energy Distribution LLC
20.	PJSC Tomskenergosbyt
21.	Omsk Power Supply Company LLC
22.	RN-Energo Ltd LLC
23.	Energy Without Borders Fund
24.	Inter RAO Engineering LLC
25.	Power Efficiency Center Inter RAO UES LLC
26.	LTD QUARTZ Group

RESEARCH AND DEVELOPMENT PLANS

The R&D Program effectiveness indicators are (numerical values of indicators are given in Table 4.3):

- Number of intellectual property items (IPI).
- Share of the R&D Program co-financing.
- Execution of the Inter RAO Group R&D Program measures in due time in accordance with the time schedule.
- Share of completed R&D projects recommended for implementation at the Inter RAO Group facilities.

Table 1.2. R&D Program effectiveness indicators

Indicator	Unit of measurement	2016	2017	2018	2019	2020	2025
Number of intellectual property items (IPI)	units, min	17	20	24	24	58	60
Share of the R&D Program co-financing	%	20	25	30	30	30	32
Execution of the R&D Program measures in due time in accordance with the time schedule	%, min.	82	82	85	85	85	87
Share of completed R&D projects recommended for implementation at the Group facilities	%, min.	75	80	85	85	85	87

In the period of 2016–2020 and further until 2025, the following results of the R&D Program implementation are expected:

- Positioning of the Inter RAO Group as one of the key participants of global technological development.
- Achievement and consolidation of the Inter RAO Group position as a technological and innovation leader in the industry.
- Increase of the capitalization, fundamental value of the Inter RAO Group and other participants of the R&D Program (co-investors).
- Qualitative growth of the Inter RAO Group human capital assets.
- Creation of an innovative activity infrastructure complying with modern global development trends allowing to accomplish the objectives established by the program.

- Increase of the number of innovatively active companies operating in the energy industry of the Russian Federation.
- Promotion of the Russian Federation economy development progress, implementation of the government policy in the electric power industry.
- Development and strengthening of relations with Russian universities.
- Development and strengthening of inter-industry and international scientific and technical relationships of the Inter RAO Group.

The list of prospective R&D measures scheduled for implementation is given in Table 1.3.

Table 1.3. List of prospective R&D Program measures being implemented and scheduled for implementation

No.	Measure	Scheduled implementation date
1	The technology of fast biomass-to-biomethane conversion with the generation of thermal and electric energy in the conditions of increasing requirements to environmentally-friendly processing of Hazard Class 3–4 biological waste.	2016
2	Formation of a virtual electric power plant structure as an integrated electric and heat / cold supply system with the use of innovative technologies of energy sources and storages, network elements, active consumers and development of an intellectual control system for the integrated electric power supply system conditions.	2017
3	Research efforts on the modernization of obsolete coal-fired thermal power plants with the organization of a combined cycle and coal gasification.	2016
4	Performance of applied scientific research studies and experimental developments for the creation of solid fuel gasification units for the electric power industry and the manufacturing industry.	2016
5	Study of natural gas combustion conditions and development of a scientific and technical solution and control methods for gas-turbine unit combustion chambers to improve their energy efficiency and environmental safety.	2016
6	Development of a laboratory scalable planar SOFC manufacturing technology and the concept of construction of SOFC-based electric power plants of various purposes and structure, including hybrid plants, with the manufacturing and testing of a small-scale experimental electric power plant prototype with a capacity of 500–2,000 W.	2016
7	Development of the technology and the control system ensuring stable operation of generators at electric power plants connected to the electric power system (EPS) and equipped with combined-cycle (CCPP) and gas turbine (GTPP) power plants.	2016
8	Construction of a GTE-110 power gas turbine low emission combustion chamber (LECC).	2016
9	Development of standard thermal power plant designs based on a 6FA gas-turbine plant.	2016
10	Development of technological documentation and implementation of a pilot project of a generator-transformer unit relay protection and control system based on the principle of single device system integration.	2016
11	Development and creation of an integrated technology aimed at the improvement of the energy efficiency of electric and thermal energy production through the creation of thermoconductive monomolecular protective coating.	2017

No.	Measure	Scheduled implementation date
12	Development and implementation of a monitoring and diagnostics system for the vibration behavior of a shaft line, flow path blading, thermal stresses, and the cost-effectiveness of operation of turbine-generator set cylinders. Study subject: Omskaya CHPP-5.	2016
13	Development and testing of a new big sleeve-type bearing type with a surface made of a new synthetic material. Study subject: Omskaya CHPP-5.	2016
14	Modernization of ash interception systems at the Inter RAO Group facilities for the achievement of ash emission levels in accordance with the EBRD requirement.	2016
15	Study of the water consumption conditions and plans with the justification of the ability to switch an electric power plant direct-cooling system to a combined cycle with the repeated successive use of cooling water. Study subjects: Permskaya GRES, Kashirskaya GRES, Kostromskaya GRES, Gusinoozerskaya GRES.	2016
16	Development and implementation of technologies for deposit prevention and removal from functional surfaces of waste-heat boilers which are parts of the Ufimskaya CHPP-1 GTES-25P and the Zauralskaya CHPP GTES-16PA.	2016
17	Development of an automated diagnostics system for the TPP pipeline and heating surfaces on the internal surface side without insulation removal.	2017
18	Development of a domestic unit for triboelectric emission of unburned furnace dust carbon and its return for re-combustion.	2017
19	Development of an automated condenser vacuum system air inflow monitoring and control system.	2017
20	Development of pulverized-coal system oscillating valves (flappers) made of flexible synthetic materials.	2017
21	Creation of an operation condition planning system for electric power plants of Bashkir Generation Company LLC (Karmanovskaya GRES, Ufimskaya CHPP-1, Ufimskaya CHPP-3, Salavatskaya CHPP, Kumertauskaya CHPP).	2016
22	Development of a modular interface based on direct current technologies to provide connection of small-scale power generating facilities to electrical networks ensuring continuous operation and reducing requirements to the network retrofitting (utility connection payment). Stage 1 – Research and development.	2016
23	Rationale for the fire-resistant OMTI oil production with an upgrade of production technology.	2016
24	Feasibility study of the use of asynchronized turbine generators in the Siberian electric power system.	2016
25	Creation of an integrated information security system for automated generation facility process control systems (IISS PCS).	2017
26	Creation and operation of R&D Center.	2017–2019
27	Research and development work on the follow-on development of experimental gas-turbine unit prototypes to the level of commercial prototypes (which will include preparation of a gas-generating plant technical documentation package, connection of prototypes to the process cycle of an operating energy enterprise, reception of testing results, performance of market research studies, and development of a business plan).	2019–2020
28	Manufacturing of a standard series of SOFC-based electric power plants with a capacity of 0.5–5 kW (which will include issuance of a full engineering documentation package, manufacturing and testing of prototypes, and process flow documentation on the manufacturing of electric power plants).	2019–2020
29	Development of a fifth-generation gas-turbine engine with a capacity of 4 MW (which will include reception of a complete technical documentation package, and manufacturing and testing of a prototype).	2019–2020

2. INNOVATIVE DEVELOPMENT INDICATORS OF THE GROUP

KEY PERFORMANCE INDICATORS OF THE INNOVATIVE DEVELOPMENT PROGRAM IMPLEMENTATION

Composition and predicted values of key performance indicators (KPI) of the Innovative Development Program of the Group are established based on the benchmarks determined in the Group strategy and based on the results of a comparative study of the Inter RAO Group and leading foreign and Russian energy companies. This was done with consideration for provisions of the following strategic industry documents:

- The Energy Strategy of Russia for the period until 2030 approved by the RF Government Decree No. 1715-r dated November 13, /2009.
- The Innovative Development Strategy of Russia for the period until 2020 approved by the RF Government Decree No. 2227-r dated December 8, 2011.
- The Energy Efficiency and Energy Industry Development RF Government Program approved by the RF Government Decree No. 512-r dated April 3, 2013.
- The list of instructions of the President of Russia given based on the results of the Presidential Commission of the Russian Federation sessions on the modernization and technological development of the economy of Russia dated January 31, 2011 (No. Pr-307 dated February 7, 2011), June–December 2010 (No. Pr-22 dated January 4, 2010), December 25, 2009 (No. 7).
- Minutes of the meeting of the Council of general and chief designers, leading scientists and specialists in the area of high-tech economy sectors under the Prime Minister of the Russian Federation V.V. Putin No. 4 dated December 7, 2009.
- Methodological guidelines on the development and correction of innovative development programs of publicly-owned joint-stock companies, state corporations, state companies, and federal state unitary enterprises (the Russian Federation Prime Minister Instruction No. DM-P36-7563 dated November 7, 2016).
- Recommendations on the composition and justification of the innovative activity key performance indicator target values included in long-term development programs and the systems of key performance indicators used for the motivation

of management of publicly-owned joint-stock companies, state corporations, state companies, and federal state unitary enterprises approved by the Russian Federation Prime Minister D.A. Medvedev Instruction No. DM-P36-7563 dated November 7, 2015.

- The Priority Science, Technology and Engineering Development Directions in the Russian Federation document and the list of critical technologies of the Russian Federation approved by the Russian Federation Presidential Decree No. 899 dated July 7, 2011.
- The business strategy on the generation of electrical energy, management of reliability and safety of wholesale generating assets.

Adopted KPIs are given in Table 2.1:

Table 2.1. Target Program indicators

No.	Indicator	Unit of measurement	Predicted values					
			2016	2017	2018	2019	2020	2025
Key performance indicators								
1	CO2 emissions per unit of generated electric power	$gCO_2/kW*h$	598.33	591.93	584.68	575.77	565.73	553.22
2	Fuel equivalent consumption per unit of electricity sold	g/kW*h	313.36	306.71	306.01	305.45	290.5	290.0
3	Fuel equivalent consumption per unit of heat sold	kg/Gcal	144.03	143.79	143.96	143.30	141.2	141.0
4	Share of completed R&D projects recommended for implementation at the Group facilities	%, min.	75	80	85	85	85	87
5	Share of innovative solutions implemented by the Group companies of the total number of innovative solutions recommended for implementation[2]	%, min.	-	10.0	11.0	12.1	13.3	14.6
6	Number of intellectual property items (IPI)	units, min	17	20	24	24	58	60
7	Number of applications submitted for R&D projects	units	220	230	240	250	400	500
8	Number of employees per 1 MW of installed capacity	persons/MW	0.82	0.81	0.80	0.78	0.75	0.70
9	Profit from sales of paid services in the retail market	thous. RUB/year	380,000	441,943	514,274	593,563	685,087	838,315
10	Percentage of R&D expenditures in total revenue of the Group[3]	%	0.39	0.39	0.39	0.39	0.39	0.39
11	Group revenues per employee	thous. RUB/year	21,993	24,111	24,190	24,890	27,200	32,471
12	Average operating efficiency	%	39.20	40.05	40.14	40.22	40.63	41.78

[2] The indicator is indicative and is formed pursuant to the instruction of the Strategy and Investment Committee meeting dated April 25, 2016 (Minutes No. 104 dated April 25, 2016, Order No. IRAO/172 dated May 4, 2016).

[3] In accordance with approved scenario conditions with regard to the planning of R&D expenses for the period of 2016–2020

13	Percentage of new advanced technologies in total TPP capacity of the Group	%	14.00	15.10	16.24	17.48	18.83	19.50
	Performance indicators							
14	Number of partner universities	units	5	5	5	6	6	7
15	Number of basic departments in partner universities	units	6	6	6	7	7	8
16	Number of university educational programs sought after by the company	units	74	77	78	81	88	90
17	Number of students sponsored by the company to train in universities	persons	181	183	185	187	190	200
18	Amount of the employer-sponsored student university training financing	thous. RUB	556.2	600.7	648.7	700.6	756.7	800.0
19	Number of the company employees improving their qualification in universities	persons	332	398	375	360	368	400
20	Amount of financing for the company employee qualification improvement in universities	thous. RUB	5,241.20	5,601.58	5,241.20	5,423.44	5,563.96	6,163.40
21	Number of the company employees undergoing retraining in universities	persons	65	67	69	70	72	75
22	Amount of financing for the company employee retraining in universities	thous. RUB	2,787.41	2,853.83	2989.95	3,207.21	3,440.25	3,880.00
23	Number of the company employees participating in the implementation of educational programs in universities	persons	17	17	17	18	18	19
24	Number of postgraduate students and university professors undertaking an internship in the company	persons	1	1	1	1	2	2
25	Number of university students undergoing practical training the company	persons	1,037	1,042	1,043	1,044	1,052	1,085
26	Number of university students hired after practical training	persons	72	73	75	77	82	90
27	Number of R&D contracts fulfilled by universities on the company orders	units	6	6	6	6	7	8
28	Scope of R&D works carried out by universities on the company orders	thous. RUB	64,000	69,800	76,125	83,025	90,550	98,890
29	Scope of R&D works carried out by scientific organizations on the company orders	thous. RUB	352,334	393,653	430,320	468,235	510,670	550,730

INTEGRAL INNOVATIVE INDICATOR

The integral innovative indicator approved[4] as of 2016 is calculated as the sum of four performance indicators with an individual weight of each of them:

$$P_{act.} = 0.2\ I_1 + 0.1\ I_2 + 0.4\ I_3 + 0.3\ I_4$$

Indicator 1. The number of intellectual property items (IPI) of the Inter RAO Group as of the reporting year is calculated according to the formula from the planned value of the Number of Intellectual Items (IPI) indicator:

$$I_1 = P_i/P_\Sigma \times 100\%, \text{ where}$$

P_i is the number of intellectual property items protected by documents of title, including properly completed and duly executed and/or submitted invention patents, utility model patents, industrial machine patents, computer software registration certificates, data base and semiconductor topography registration certificates, trademark and service mark registration certificates, know-how, and other documents.

P_Σ is the planned value of the number of Intellectual Items (IPI) indicator (in IPI units) according to the current innovative development program of the PJSC Inter RAO for the corresponding period.

Indicator 2. Percentage of R&D expenditures in total revenue of the Inter RAO Group's generating assets[5] as of 2016 is calculated according to the formula:

I_2 – Actual percentage of R&D expenditures in total revenue of the [6]Inter RAO Group's generating assets / Planned percentage of R&D expenditures in total revenue of the Inter RAO Group's generating assets x 100 %

The planned percentage of R&D expenditures in total revenue of the Inter RAO Group's generating assets as for 2016 ≥ 0.1 %.

Indicator 3. Percentage of new advanced technologies in total TPP capacity of the Group is calculated according to the formula:

[4] In accordance with the decision of the Inter-Agency Working Group on the Implementation of Innovative Development Priorities of the Presidium of the Presidential Council of the Russian Federation on the Modernization of Economy and Innovative Development of Russia No. AD-P36-247pr dated December 17, 2015.

[5] In accordance with the PJSC Inter RAO Innovative Development Program until 2017 with an outlook for 2021 approved by the Board of Directors of PJSC Inter RAO (Minutes No. 111 dated April 3, 2014).

[6] Generating assets: OJSC Inter RAO — Electric Power Plants, JSC Nizhnevartovskaya GRES, JSC TGC-11, JSC Tomsk Generation, Bash RTS LLC, Bashkir Generation Company LLC.

I_3 – Actual percentage of the installed capacity of assets built with the use of new advanced technologies to the total installed TPP capacity of the Group / Planned percentage of the installed capacity of assets built with the use of new advanced technologies to the total installed TPP capacity of the Group according to the current innovative development program of PJSC Inter RAO for the corresponding period x 100 %

Advanced equipment and technologies include:

a) for natural gas and liquid (gas-turbine) fuel combustion:

– combined-cycle gas turbine units of condensation power plants and combined heat power plants with a net condensing mode efficiency of more than 50 %;

– combined-cycle gas turbine units of combined heat power plants with a heat-extraction mode combustion efficiency of 85 % and more and a specific generation with a thermal consumption of 1,200–1,600 KW*h/Gcal;

– highly-maneuverable gas-turbine condensation power plants with an efficiency of 35 % and more;

b) for solid fuel combustion;

– ultra supercritical steam parameter power units with a net efficiency of more than 44 %;

– power units with circulating fluidized bed (CFB) fuel combustion with a net efficiency of more than 40 %;

– power units with closed cycle solid fuel gasification and the use of synthesis gas in a CCPP (CCPP CCG) with a net efficiency of more than 45 %;

– upgraded power units with a net efficiency of 40 % and more;

– hydraulic power plants (non-core Group's assets);

– and others classified as such in accordance with the approved Innovative Development Program.

Definition, planned values, and data are documented in the effective innovative development program. Values can be specified (including when updating the Innovative Development Program).

Indicator 4. The quality of development (updating) of the innovative development program / execution of the innovative development program is assessed as follows: Performance of I_4 = 80 % ("satisfactory quality" assessment) in case of a 40 % ≤ I_4 < 60 % assessment of the development / implementation quality according to the

Regulation on the Development (Updating) of the Quality Assessment and the annual independent Innovative Development Program implementation assessment.

Performance of I_4 = 90 % ("acceptable quality" assessment) in case of 60 % ≤ I_4 < 90 % assessment of the development / implementation quality according to the Regulation on the Development (Updating) of the Quality Assessment and the annual independent Innovative Development Program implementation assessment.

Performance of I_4 = 100 % ("high quality" assessment) in case of 90 % ≤ I_4 < 100 % assessment of the development / implementation quality according to the Regulation on the Development (Updating) of the Quality Assessment and the annual independent Innovative Development Program implementation assessment.

3. MEASURES

Measures taken within the framework of innovative activities of the Inter RAO Group are oriented towards the improvement of energy and economic efficiency and environmental safety of generating assets of the Group with due regard to the operating life reached by various types of equipment and power plants.

Innovative projects carried out within the scope of the Innovative Development Program shall be understood to mean packages of interdependent measures (works) performed in the conditions of time and resource restrictions.

This section reflects main expected results of innovative projects, their achievement periods, the effect of projects on the achievement of key performance indicators, and the amounts and sources of their financing. Economic effects from the implementation of the Innovative Development Program projects have been determined.

ENERGY EFFICIENCY AND ENERGY CONSERVATION

The following measures are planned to be implemented within this direction:

The Group is developing and implementing a mid-term Energy Saving and Energy Efficiency Improvement Program for a five-year period. Subsidiaries are assigned with executives responsible for the preparation, implementation of the Program, and performance reporting.

Main goals of this Program are:

- achievement of target indicators in the area of energy saving and energy efficiency improvement provided for in the Innovative Development Program of the Inter RAO Group;
- assurance of rational utilization of energy resources through the implementation of measures on energy saving and energy efficiency improvement;
- improvement of energy efficiency indicators both of individual energy-intensive production assets and of the Group as a whole with the minimization of expenses on their operation and development;
- construction and improvement of an integral and effective energy saving and energy efficiency management system (energy management system development);
- reduction of negative environmental impact;

- implementation of main provisions of the Energy Strategy of Russia and the Energy Efficiency and Energy Industry Development RF Government Program.

The table covers the most substantial and effective measures of the Inter RAO Group Energy Saving and Energy Efficiency Improvement Program in relation to generating assets linked to a particular power facility and the specification of a planned economic effect from the implementation of the measure (by performance priority).

Table 3.1. Most substantial and effective measures of the Energy Saving and Energy Efficiency Improvement Program for generating assets

Item No.	Production asset name	Measure	Expenses, thous. RUB
		Management of Electric Power Plants	
1.	Verkhnetagilskaya GRES	Modernization of the steam turbine vacuum system No. 10 with replacement of the ejector 10 B	4,791.00
2.	Kostromskaya GRES	Installation of a plate-type heat exchanger at the fuel oil pumping station No. 3	1,064.51
3.	Permskaya GRES	Modernization of the turbine-generator set No. 2 with regard to the installation of honeycomb shroud seals of the K-800-240-5 steam turbine of the power unit No. 2	9,901.33
4.	Urengoyskaya GRES	Modernization of electric pump equipment drives (VFD)	502.81
5.	CJSC Nizhnevartovskaya GRES	Modernization of the power unit No. 1 turbine HP and MP cylinders with the installation of honeycomb shroud seals	30,150.10
6.	CJSC Nizhnevartovskaya GRES	Modernization of the power unit No. 2 turbine HP and MP cylinders with the installation of honeycomb shroud seals	34,762.11
7.	Gorkovskaya GRES	Retrofitting of the power unit No. 2 TsN-2A, TsN-2B circulation pumps with a remote blade turning mechanism	25,361.80
8.	Gorkovskaya GRES	Retrofitting of the power unit No. 3 TsN-3A, TsN-3B circulation pumps with a remote blade turning mechanism	18,976.21
9.	Kostromskaya GRES	Modernization of the power unit No. 9 K-1200-240-3LMZ steam turbine with the replacement of the high-pressure cylinder flow path	226,625.33
10.	Permskaya GRES	Modernization of the power unit No. 4 TGME-206KhL drum boiler, tag No. 1400302. Installation of a modernized RPK-250 valve	6,029.22
11.	Yuzhnouralskaya GRES	Modernization of the power unit No. 9 condenser B with the replacement of tubes	18,774.14
12.	Sochinskaya TPP	Bringing the plant under the heat-extraction operation mode (thermal load increase)	0.00
13.	Severo-Zapadnaya CHPP	Implementation of a ball cleaning system (BCS) of condensers of the power units No. 1, No. 2 (Innovative Development Program – 2015, supply, installation, adjustment – 2016)	35,284.00
14.	Ivanovo CCPP	Retrofitting and upgrading of the GT-21, 22 auxiliary equipment	8,434.79
		TGK-11	
15.	Orskaya CHPP-3	Replacement of pebble lime with slaked lime in the process of preliminary water treatment	600
16.	Orskaya CHPP-3	Cleaning of condensers of the turbines PT-25-90/10 M No. 7, PT-60-90/13 No. 9, PT-60/65-130 No. 11, PT-60-130 No. 12	2,385.00

Item No.	Production asset name	Measure	Expenses, thous. RUB
17.	Orskaya CHPP-3	Cleaning (annealing) of the high-pressure superheater tube circuit	2,379.10
18.	Orskaya CHPP-3	Installation of a T-120 turbine instead of the PT-50-130 turbine No. 10	2,638,739.00
19.	Orskaya CHPP-4	Modernization of the cooling tower No. 2	70,041.00
20.	Orskaya CHPP-4	Retrofitting of the T-100-130 steam turbine No. 6 (installed capacity increase by 13 MW)	544,793
21.	Orskaya CHPP-4	Modernization of the cooling tower No. 4	92,714
22.	Orskaya CHPP-5	Retrofitting of the PT-80/100-130/13 steam turbine No. 2 (installed capacity increase by 18 MW)	511,679
23.	Orskaya CHPP-5	Modernization of the cooling tower No. 2	86,341.00
24.	Orskaya CHPP-5	Mechanical cleaning of turbine condensers in the period of major, intermediate and current repairs	11,718.71
		Tomsk Generation	
25.	TGRES-2	Retrofitting of the cooling tower No. 4	87,358.00
26.	TGRES-2	Retrofitting of the cooling tower No. 3	85,587.00
27.	Tomskaya CHPP-3	Installation of a flue gas dehydration unit on the boiler 1B at the Tomskaya CHPP-3	26,042.00
		Bashkir Generation Company	
28.	Karaganda GRES	Introduction of the TG-3 condenser BCS	26,061.00
		Modernization of the nitrogen-oxygen plant	4,951.00
29.	Ufimskaya CHPP-1	Introduction of a domestic waste water treatment plant	5,228.00
		Modernization of a circuit of lime milk dosing into clarifiers based on control valves	1,041.00
		Introduction of a silicon controlled rectifier heating surface gas pulse cleaning system	4,219.00
30.	Ufimskaya CHPP-2	Installation of a ball cleaning system for the T 110/120-130 turbine No. 7 condenser	17,250.00
		Installation of a Dr.n-s-7A (Dr.n-s-7B) VFD, 1 pcs	183.00
		Installation of a Dr.n-s-4A VFD, 1 pcs	347.00
		Installation of a VFD for the lower limit switches 1, 2, 3, 1 pcs	259.00
		Installation of a filter press for clarifier slime waters	16,331.00
		Installation of VFDs for the desalinated water transfer pumps No. 2, 4	863.00
		Replacement of brass tubes on the TA-8 condenser external halves	14,464.00
		Modernization of Ufimskaya CHPP-2 with the replacement of the overaged TG-3 turbine generator with a more powerful steam turbine	377,813.00
31.	Ufimskaya CHPP-3	Modernization of the PT-30-90/10 turbine plant No. 5	71,388.00
		Modernization of (polyurethane foam-based) heat insulation	241.00
		on the in-house tank No. 2 (HT No. 2)	
		Modernization of the Ufimskaya CHPP-3 cycle arrangement with the installation of a steam screw-rotor machine	43,775.00
32.	Ufimskaya CHPP-4	Modernization of the PK-14 steam boiler automatic control system with its connection to the master regulator	758.00
		Modernization of the PK-8 steam boiler automatic control system with the replacement of the controller and connection to the master regulator	879.00
		Modernization of the PK-8 steam boiler superheated steam temperature controllers	519.00

Item No.	Production asset name	Measure	Expenses, thous. RUB
		Modernization of the PK-16 steam boiler regenerative air heater with the replacement of packing with a modernized one	6,270.00
		Retrofitting of the chimney-type cooling tower No. 4	27,769.00
		Retrofitting of the chimney-type cooling tower No. 3	18,128.00
		Modernization of the PK-16 steam boiler automatic control system	688.00
		Modernization of the PK-14, 16 steam boilers superheated steam temperature controllers	1,336.00
33.	Salavatskaya CHPP	Supplementation of the steam boiler automatic control system with an automatic optimum air excess maintenance option with controlled incomplete combustion of the steam boiler No. 14	823.00
		Modernization of the TG-9 turbine generator with the organization of 35 at steam extraction from the fifth high pressure cylinder overload valve	8,298.00
34.	Sterlitamakskaya CHPP	Modernization of the PE-580-185 pumping unit with the replacement of the 4AZM-5000/6000 electric motor	7,520.00
		Modernization of the turbine generator high-pressure regenerative unit with the inclusion into the PVD-7 high-pressure superheater circuit	1,609.00
		Modernization of the I3.4-0.6 parallel-current ion-exchange filters with a switch to the technology of counter-current filtering with hydraulic precoat hold-down	11,555.00
		Replacement of the PK-6 steam boiler RVP-54 regenerative air heater hot and cold bed packing	7,182.00
		Modernization of the TG-9 turbine generator PND-4 low-pressure superheater with the replacement of brass tubes	1,241.00
		Retrofitting of the cycle arrangement with the installation of a steam screw-rotor machine	27,014.00
35.	Novosterlitamakskaya CHPP	Modernization of the cooling tower No. 2 with the replacement of fillers with polymer ones	21,462.00
		Installation of the recirculation line heat-exchange apparatus in the turbine generator condenser No. 3	6,782.00
		Modernization of the steam boiler No. 1 convection superheaters 3, 4	41,864.00
		Retrofitting of the PK-4 steam boiler regenerative air heater with the replacement of packing	8,491.00
		Modernization of the water treatment plant	166,792.00
		Installation of a VFD to the electrical submersible centrifugal pump No. 3	22,422.00
36.	Priufimskaya CHPP	Modernization of the water treatment plant with the introduction of a reverse osmosis unit and a heat supply make-up circuit	127,100.00
		Installation of a VFD to the PNP-1 transfer pump	6,145.00
37.	Novo-Ziminskaya CHPP	Construction of the CHPP-5 CCPP in the Ufa District of the Republic of Bashkortostan	20,349,000.00

In the period of implementation of the five-year Energy Saving and Energy Efficiency Improvement Program, the Group plans to achieve the following indicators:

- saving of reference fuel – 5,518,241.0 tons of reference fuel;
- thermal energy saving for balance-of-plant needs – 43,228.5 Gcal;
- electric energy saving for balance-of-plant needs – 8,167,754.8 thous. kWh;
- water saving for balance-of-plant needs – 394,977.1 thous. m^3.

IMPROVEMENT OF THE ENVIRONMENTAL SAFETY OF PRODUCTION

Development and implementation of new technologies will be naturally accompanied by the improvement of the indicators of energy efficiency and environmental safety of electric and thermal energy production.

The Group has developed and carries out a special-purpose Environment Program for the period until 2020 oriented towards the solution of the production environmental safety improvement objectives in the following directions:

- search and application of new technologies for the improvement of environmental production indicators upon its modernization;
- replacement of equipment containing hazardous and toxic substances;
- increased growth of the share of clean energy sources;
- modernization / introduction of environmental management systems, etc.

The table below gives current and potential regulatory requirements to the level of environmental safety, environmental aspects and indicators of the enterprises of the Group.

Table 3.2. Current and potential regulatory requirements to the level of environmental safety, environmental aspects and indicators of the enterprises of the Group

Item No.	Regulatory requirement	Environmental aspect	Document containing requirements
	Thermal power plants and boiler rooms		
1	Observance of conditions of documents authorizing pollutant emissions into the atmosphere, primarily the non-exceedance of the permissible pollutant emission load (t/year). If there are excess emissions present, a natural resource user is obliged to implement the agreed upon plan of measures on the achievement of the maximum permissible emission level.	Atmospheric emissions of pollutants from steam and hot-water thermal power plant boilers and fossil fuel boilers of subsidiaries.	An emission permit (RF, PMR), a complex permit (Kazakhstan, Georgia).

Item No.	Regulatory requirement	Environmental aspect	Document containing requirements
2	Following the annual dust-and-gas cleaning plant (DGCP) performance monitoring results, the DGCP performance indicators shall correspond with design values or values received from adjustment works and agreed upon with the DGCP design developer. In case of a discrepancy between the plant operation parameters with design values, it is required to plan and take measures on the plant adjustment, retrofitting or replacement.	Atmospheric emissions of pollutants from steam and hot-water thermal power plant boilers and fossil fuel boilers of subsidiaries.	Gas cleaning plant operation rules approved by the Ministry of Chemical and Oil Engineering of USSR on November 28, 1983.
3	Power plants with a thermal capacity higher than 300 MW shall be equipped with constant emission monitoring systems (CEMS). By December 2015 CEMSs shall be installed on 50 % of the total generating capacity, by December 2018, on at least 75 % of the total generating capacity.	Atmospheric emissions of pollutants from steam and hot-water thermal power plant boilers and fossil fuel boilers of subsidiaries.	Cl. A.1 of the Social and Economic Development Program.
4	Power plant emissions shall comply with the dust and NOx emission requirements of the EU Directive for Large Combustion Plants 2001/80/EC or national standards in case they are more strict. By 2023, at least 75 % of the total boiler generating capacity shall comply with the dust and NOx emission requirements of the EU Directive 2001/80/EC.	Atmospheric emissions of pollutants from steam and hot-water thermal power plant boilers and fossil fuel boilers of subsidiaries.	Cl. A.3 of the Social and Economic Development Program.
5	Develop and implement a dust emission reduction program for existing coal-fired power plants with an input thermal capacity of more than 300 MW to achieve an average specific emission level of 100 mg/m^3. By 2023, 75 % of the total generating capacity of coal-fired power stations shall comply with the level of specific emissions of 100 mg/m^3.	Atmospheric emissions of pollutants from steam and hot-water thermal power plant boilers and fossil fuel boilers of subsidiaries.	Cl. A.6 of the Social and Economic Development Program.
6	Develop an emission reduction program for Stantsiya Ekibastuzskaya GRES-2. It shall include a goal of achieving less than 100 mg/m^3 of dust emissions per each boiler starting from 2016.	Atmospheric emissions of pollutants from steam and hot-water thermal power plant boilers and fossil fuel boilers of subsidiaries.	Cl. B.42 of the Social and Economic Development Program.

Item No.	Regulatory requirement	Environmental aspect	Document containing requirements
7	For 8 years from the future date of ratification of the Protocol of Heavy Metals to the Convention on Long-Range Transboundary Air Pollution, emissions of operating power plants of the Group in the Kaliningrad and Leningrad Regions in the Russian Federation, and in Kazakhstan, shall comply with the requirements of the Protocol.	Atmospheric emissions of pollutants from steam and hot-water thermal power plant boilers and fossil fuel boilers of subsidiaries.	The Protocol on Heavy Metals (Aarhus, 1998) to the Convention on Long-Range Transboundary Air Pollution (Geneva, 1979).
8	For 15 years from the future date of ratification of the Gothenburg Protocol and the Convention on Long-Range Transboundary Air Pollution, emissions of operating power facilities of the Group in the Kaliningrad and Leningrad Regions in the Russian Federation, and in Kazakhstan, shall comply with the requirements of the Protocol, including requirements with regard to the equipment of coal-fired power units with desulfurization units.	Atmospheric emissions of pollutants from steam and hot-water thermal power plant boilers and fossil fuel boilers of subsidiaries.	The Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (Gothenburg, 1999) to the Convention on Long-Range Transboundary Air Pollution (Geneva, 1979).
9	Reduction of specific atmospheric pollutant emission indicators by Russian energy sector enterprises (as a percentage over 2005): at the first stage – 25 %; at the second stage – 40 %, at the third stage (by 2030) – 50 %.	Atmospheric emissions of pollutants from steam and hot-water thermal power plant boilers and fossil fuel boilers of subsidiaries.	The Energy Strategy of Russia for the period until 2030 approved by the RF Government Decree dated 13.11.2009, No. 1715-r.
10	In the Russian Federation, boiler units commissioned after construction or retrofitting shall comply with the requirements of GOST R 50831-95 Boiler Units. Thermal and Mechanical Equipment. General Technical Requirements.	Atmospheric emissions of pollutants from steam and hot-water thermal power plant boilers and fossil fuel boilers of subsidiaries.	GOST R 50831-95 Boiler Units. Thermal and Mechanical Equipment. General Technical Requirements.
11	In the Russian Federation, emissions from gas-turbine plants commissioned after January 1, 1995 shall not exceed 50 mg/m^3 for gaseous fuel and 100 mg/m^3 for liquid fuel.	Atmospheric emissions of pollutants from steam and hot-water thermal power plant boilers and fossil fuel boilers of subsidiaries.	GOST 29328-92 Gas-Turbine Units to Drive Turbine Generators. General Technical Requirements.

Item No.	Regulatory requirement	Environmental aspect	Document containing requirements
12	Fulfill the conditions of documents authorizing the use of water bodies, including: – do not exceed maximum amounts of water withdrawal; – take measures on water-control practice plans approved annually by governmental bodies; – maintain operated treatment facilities and waterworks and other structures located on the water body; – equip water intake structures with metering instruments, if there are such requirements, in the accounting procedure for water resource withdrawal (extraction) from water bodies agreed upon with the authorized body.	Use of water bodies for technical needs of subsidiaries.	A water use agreement (Russian Federation), a special water use permit (PMR), a complex permit (Kazakhstan, Georgia).
13	Develop an environmental impact management and reduction program for used water cooling systems.	Use of water bodies for technical needs of subsidiaries.	Cl. A.14 of the Social and Economic Development Program.
14	No later than 2016, perform retrofitting of the cement duct with a length of approximately 12 km connecting the Neva channel water intake structure with the station.	Use of water bodies for technical needs of subsidiaries.	Cl. B.10 of the Social and Economic Development Program.
15	Waste water shall only be discharged into water bodies in accordance with authorization documents. Fulfillment of requirements of documents authorizing the discharge of waste water into natural water bodies. If there are excess discharges present, a water user is obliged to implement the agreed upon plan of measures on the achievement of the permissible discharge rate.	Disposal of industrial, surface and domestic sewage water	Natural water body waste water disposal authorization documents
16	When waste water is disposed from mineral oil facilities, residual oil facilities, motor transport sections, or when drain water is disposed from main thermal power plant buildings, coal storage yards, fuel feeders, this waste water shall be subjected to preliminary local treatment.	Disposal of industrial, surface and domestic sewage water.	Federal Law On Water Supply and Water Disposal; RF Government Decree No. 644 dated July 29, 2013; RF Government Decree No. 393 dated April 30, 2013.

Item No.	Regulatory requirement	Environmental aspect	Document containing requirements
17	Waste water shall only be disposed into water bodies under a water disposal agreement and a discharge permit. If case of excess discharges into centralized water disposal systems, a water user is obliged to implement the agreed upon plan of measures on the achievement of the permissible discharge rate.	Disposal of industrial, surface and domestic sewage water.	Federal Law On Water Supply and Water Disposal; RF Government Decree No. 644 dated July 29, 2013; RF Government Decree No. 393 dated April 30, 2013.
18	No later than 2016, perform retrofitting of the Severo-Zapadnaya CHPP waste water treatment system to ensure the compliance of waste water discharged into the municipal sewerage with established limits	Disposal of industrial, surface and domestic sewage water.	Cl. B.9 of the Social and Economic Development Program.
19	No later than 2017, perform retrofitting of the Kostromskaya GRES waste water treatment facilities.	Disposal of industrial, surface and domestic sewage water.	Cl. B.52 of the Social and Economic Development Program.
20	Reduction of specific indicators of polluted waste water discharge into water reservoirs by Russian energy sector enterprises (as a percentage over 2005): at the first stage – 25 %; at the second stage – 40 %, at the third stage (by 2030) – 50 %.	Disposal of industrial, surface and domestic sewage water.	The Energy Strategy of Russia for the period until 2030 approved by the RF Government Decree dated November 13, 2009, No. 1715-r.
21	Reduction of specific indicators of waste generation by Russian energy sector enterprises (as a percentage over 2005): at the first stage – 25 %; at the second stage – 40 %, at the third stage (by 2030) – 50 %.	Handling ash and slag waste, operation of TPP and boiler room waste disposal facilities.	The Energy Strategy of Russia for the period until 2030 approved by the RF Government Decree dated November 13, 2009, No. 1715-r.
22	Waste disposal facilities (WDF) shall use environmental measures preventing the pollution of surface and underground water bodies, atmospheric air, soils, including environment monitoring facilities located within the WDF impact area, in the scope provided for in the WDF designs, as well as safety declarations for hydraulic structures.	Handling ash and slag waste, operation of TPP and boiler room waste disposal facilities.	Federal Law On Production and Consumption Wastes; Federal Law On Safety of Hydraulic Structures; Resolution of the Federal Mining and Industrial Inspectorate of Russia No. 6 dated January 28, 2002.
23	After a waste disposal facility is decommissioned, it shall be reclaimed in accordance with a special project.	Handling ash and slag waste, operation of TPP and boiler room waste disposal facilities.	Land Code of the Russian Federation No. 136-FZ dated January 25, 2001; RF Government Decree No. 140 dated February 23, 1994.

Item No.	Regulatory requirement	Environmental aspect	Document containing requirements
24	No later than 2016, prepare a retrofitting project for the ash-disposal area No. 2 of the Verkhnetagilskaya GRES for drain water collection.	Handling ash and slag waste, operation of TPP and boiler room waste disposal facilities.	Cl. B.33 of the Social and Economic Development Program.
25	Electric utilities shall implement measures on the prevention of oil product spill incidents and the rectification of spill consequences provided for in oil spill contingency plans.	Potential pollution of the environment by oil products as a result of oil-filled equipment accidents.	RF Government Decree No. 613 dated August 21, 2000; RF Government Decree No. 240 dated April 15, 2002; Order of the Emergency Ministry of the Russian Federation No. 621 dated December 28, 2004
26	Develop and implement a measurement equipment installation program for the monitoring of the content of oil products in waste water for all power plants of the Group.	Potential pollution of the environment by oil products as a result of oil-filled equipment accidents	Cl. A.16 of the Social and Economic Development Program
27	When withdrawing water from natural water bodies, water users shall take measures on the prevention of death of aquatic biological resources. The specific scope of measures on the prevention of death of aquatic biological resources is determined by the water intake structure project agreed upon with specially authorized government bodies. The design estimated efficiency of fish protection devices (FPD) shall be at least 70 % for commercial fish bigger than 12 mm.	Potential damage to biological resources during the use of surface water bodies.	Federal Law On Fishing and Preservation of Aquatic Biological Resources, RF Government Decree No. 997 dated August 13, 1996, RF Government Decree No. 380 dated April 29, 2013, SNiP 2.06.07-87.
28	Introduction and certification of environmental management systems based on the recommendations of ISO 14001:2004.	Organization of environmental activity.	Directive of the Federal Agency for State Property Management No. GN-13/2414 dated February 1, 2012, decisions of subsidiary governing bodies, Cl. A.5 of the Social and Economic Development Program.
29	Decommissioning until 2025 and destruction until 2028 of equipment and materials containing PCBs.	Operation of equipment and materials containing PCBs.	Perspective requirements related to the execution of the Stockholm Convention on Persistent Organic Pollutants.

In order to ensure compliance with the regulatory requirements specified in Table 3.2, the Program provides for the performance of the following measures in the medium and long term.

Table 3.3. Measures aimed at the improvement of environmental safety of production, fulfillment of regulatory requirements on the level of environmental safety, environmental aspects and indicators of the enterprises of the Group

Item No.	Measure name	Planned financing, mln RUB	Implementation period
	Mid-term outlook		
1	Modernization of the water treatment plant with the introduction of a reverse osmosis unit and a heat supply make-up circuit of the Priufimskaya CHPP.	40.06	2016–2017
2	Installation of a filter press in the chemistry department (Novosterlitamakskaya CHPP site).	23.36	2016
3	Installation of a continuous emission monitoring system at the Kostromskaya GRES, Ufimskaya CHPP-4, Sterlitamakskaya CHPP, Novosterlitamakskaya CHPP, Priufimskaya CHPP.	68.85	2016
4	Introduction of modernized burners and the PK-1A.B steam boiler three-stage combustion circuit at the Kumertauskaya CHPP.	57.56	2016–2017
5	Installation of low-NOx burners with flue gas recirculation and tertiary air injection on the PK-14 steam boiler (Novosterlitamakskaya CHPP site).	27.43	2016
6	Installation of low-NOx burners with flue gas recirculation and tertiary air injection on the PK-6 steam boiler (Novosterlitamakskaya CHPP site).	30.29	2017
7	Installation of low-NOx burners with flue gas recirculation and tertiary air injection on the PK-2 steam boiler (Novosterlitamakskaya CHPP site).	31.79	2018
8	Installation of low-NOx burners and organization of staged air feed to the top furnace part on the PK-7 steam boiler at the Ufimskaya CHPP-2.	20.86	2016
9	Retrofitting of gas-cleaning equipment of the boiler unit No. 9 (with the installation of a bag filter instead of the electrostatic precipitator) at the Omskaya CHPP-5.	120.93	2016
10	Construction of treatment facilities with a capacity of 6,000 m^3/day at the CHPP-5 business unit.	472.81	2016–2017

Item No.	Measure name	Planned financing, mln RUB	Implementation period
11	Retrofitting and upgrading of gas-cleaning equipment of the BK3-420-140-5 boiler unit No. 5 (conversion of the electrostatic precipitator into a bag filter) at the Omskaya CHPP-5.	305.38	2016–2018
12	Retrofitting of the boiler No. 10 gas supply system at the Tomskaya GRES-2.	99.25	2016
13	Retrofitting of the boiler No. 12 gas supply system at the Tomskaya GRES-2	113.03	2018
14	Retrofitting of silencers and main safety valves at the boiler units Nos. 5, 7 at the Tomskaya GRES-2.	9.84	2016–2018
15	Retrofitting of the boiler No. 6 gas supply system at the Tomskaya CHPP-1.	57.37	2016
16	Retrofitting of the boiler No. 5 gas supply system at the Tomskaya CHPP-1.	69.45	2017
17	Installation of local stormwater runoff treatment facilities at the Tomskaya CHPP-1.	5.35	2018
18	Retrofitting of electrostatic precipitators of the power unit No. 6 at the Gusinoozerskaya GRES.	164.42	2018
19	Development of a project, outfitting of the chemical water treatment reagent depot equipment with instrumentation, hazardous substance concentration switch alarms at the Kashirskaya GRES.	9.1	2016
20	Retrofitting of delivery, overflow, and spillway process water supply channels at the Kostromskaya GRES branch.	365.26	2016–2018
21	Configuration of a fish protection device at the on-shore pumping station of the Kharanorskaya GRES.	68.8	2016
	Long-term outlook		
1	Installation of low-NOx burners with staged air feed and decked fuel redistribution on the PK-4 steam boiler.	29.35	2019
2	Installation of low-NOx burners with flue gas recirculation and tertiary air injection on the PK-3 steam boiler (Novosterlitamakskaya CHPP site).	33.32	2019
3	Construction of treatment facilities at the Omskaya CHPP-3.	578.54	2016–2019
4	Retrofitting of the chemistry department process pipelines with the use of PVC pipelines at the Tomskaya CHPP-3.	10.70	2016–2021
5	Development and implementation of the recirculating water supply blow-down water treatment circuit.	18.82	2018–2019

MEASURES ON MODERNIZATION OF OPERATING CAPACITIES

As part the mid-term Investment Program of the Inter RAO Group for 2015–2019, it is planned to implement large-scale projects on the modernization and construction of new generating capacities providing a 2,496 MW installed capacity gain until 2018 The commissioning list of new capacities performed under Capacity Provision Agreements (CPA), as well as the commissioning list of new capacities outside of CPAs (provided for in the mid-term Investment Program of the Group for 2015–2019), are given in Table 3.4.

Table 3.4. Projects implemented by the Group at its own generating facilities until 2018.

No.	Electric power plant	Type of equipment (power unit No./fuel)	Commissioning by year, MW		
			2016	2017	2018
List of facilities commissioned under CPAs					
1	Permskaya GRES	PGU-800 (No. 4/gas)		800	
2	Omskaya CHPP-3	T-120-130 (No. 10/gas)	120		
3	Omskaya CHPP-5	PT-80-130 (No. 2/gas)			
4	Ufimskaya CCPP CHPP-5[7]	PGU-220 (No. 1/gas)		220	
		PGU-220 (No. 2/gas)		220	
5	Verkhnetagilskaya GRES	PGU-420 (No. 12/gas)		420	
IN TOTAL under CPAs			**120**	**1,660**	**0**

In the period until 2020, as one of the possible generation efficiency improvement options the Group considers the possibility of decommissioning morally and physically obsolete generating equipment of Verkhnetagilskaya GRES, Kashirskaya GRES, Cherepetskaya GRES, Yuzhnouralskaya GRES, Omskaya CHPP-3, Tomskaya GRES-2.

Selection of an optimal composition of generating equipment planned for decommissioning is based on the correlation of the money flow generated by a power plant in the event of this equipment decommissioning with the basic option implying the indefinite retention of the entire generating equipment in operation.

Asset decommissioning feasibility is affected by:

- the inefficiency of operation in the electricity and capacity market due to a high fuel factor and high semi-fixed costs;

[7] In accordance with the project certificate approved by the Court of the PJSC Inter RAO (Minutes No. 420 dated March 14, 2013)

- unsatisfactory technical condition of equipment (high service hours, low reliability, big number of failures) leading to additional financial losses from penalties;
- significant capital expenses on maintaining the equipment in working order.

The decision on the decommissioning of existing generating equipment is based on the analysis of the following factors:

- demand for generating equipment in the electricity market;
- attitude of JSC SO UES with respect to scheme and condition issues occurring during equipment decommissioning;
- correspondence with accepted electricity and capacity market regulations related to equipment commissioning dates;
- condition of equipment, its reliability indicators;
- social aspect – recruitment of released personnel, supply of heat to settlements and cities where thermal power plants are located.

Such big innovative projects of industrial significance cannot be limited by corporate financing which is proven by international practices. Considering high industrial significance and consequent distribution of benefits from the implementation of pilot projects, it is necessary to reduce risks of this Program for the Group through their redistribution between other beneficiaries, including the state.

4. PROGRAM FINANCING

SPENDING PLAN

The mid-term implementation plan for the Innovative Development Program of the Group for 2016–2018 provides for the allocation of RUB 45 bln for the program financing.

The dynamics and structure of expenses broken down by the Program directions are given in Table 4.1.

Table 4.1. Planned financing of the Program measures, thous. RUB

Program direction	Planned financing by year, mln RUB					
	total	2016	2017	2018	2019	2020
Planned R&D financing share in the Group revenue[8], %	0.39	0.39	0.39	0.39	0.39	0.39
Approved innovative measures of subsidiaries and business units[9], including:	45,454.97	24,709.99	18,365.10	2,379.88	2,231.13	2,163.6
Innovative projects and measures	42,591.68	22,951.82	17,538.41	2,101.45	1,952.72	1,885.17

The amount of financing of R&D measures is updated annually upon the preparation of the R&D Program of the Inter RAO Group for the planned period.

INDUSTRY-SPECIFIC FUND PARTICIPATION

In response to the initiative of SC Rosnano and the RF Ministry of Energy No. AT-9657/02 dated August 27, 2015, the Inter RAO Group has supported the initiative on the formation of a special-purpose fuel and energy complex innovation development support fund in the Investment Partnership organizational form providing for the financing and management of specific flow-separated projects and programs.

When forming the specified fund, it was proposed to consider the experience of already existing R&D financing funds created by government-sponsored companies implementing innovative development programs. In order to achieve the established goals, the Energy Without Borders Fund prepares and implements special-purpose scientific research, research and development, research and technological works, and innovative activity, which results promote not only the achievement of the PJSC Inter RAO technological leadership, but the solution of innovation problems of the entire

[8] In accordance with the approved scenario conditions related to the planning of R&D expenses for the period of 2016–2020.

[9] Special-purpose financing of innovative measures is provided in accordance with the Mid-Term Implementation Plan for the Innovative Development Program of the Group for 2016–2018.

Russian economy. The Fund is funded on a special-purpose basis upon the approval of the corresponding mid-term R&D Program, including the requirements on co-financing of projects within the scope of state partnership.

When organizing the activity and financing of special-purpose sector-specific funds in the electric power industry, it is also required to observe principles of public-private partnership on approved national projects in the fuel and energy complex area.

When making relevant decisions, the Energy Without Borders Fund for the Support of Scientific, Scientific and Technological and Innovative Activity can act as both an industrial partner in the co-financing of approved national projects and in any of the three statutory industrial partnership statuses: an investor, a manager and an authorized manager agent.