NewtOn

Technical Proposal

Implementation of ICV for local compensation of reactive energy and increasing the reliability of the electrical system

CONTENT

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1. INTRODUCTION

LLC "Newton" is a manufacturing company that develops, manufactures, implements and maintains programs to improve the energy efficiency of power supply systems and energy accounting.

LLC "Newton" specializes in various supplies of equipment and materials to industrial and municipal enterprises.

LLC "Newton" cooperates with more than 15 developers of the Russian Federation, CIS, Europe, 2 research institutes

We produce products both independently and have partnerships with other manufacturers.

Increasing the efficiency of a manufacturing enterprise through the use of modern technologies, especially import-substituting technologies, fully corresponds to the development strategy of any domestic manufacturer, and therefore to the interests of Russia in general. By introducing advanced technologies, Newton contributes to the growth of domestic GDP.

Cooperation with LLC "Newton" allows you to reduce costs and increase the efficiency of energy and technological equipment.

2. TECHNICAL PROPOSAL

2.1. Introductory information

Most enterprises have a poor quality of the internal power grid due to internal distortions caused by:
- the operation of various electrical equipment, such as electric drives of mechanisms, frequency converters, soft starters, welding equipment, induction furnaces, pumps, fans;
- modes of inclusion and shutdown;
- sparking bad contacts;
- phase imbalance;
- small cross-section of cables with a newly connected load, etc.

One of the most important causes of power grid pollution is the reactive component of electricity, which sometimes exceeds the active one by several times!

Thus, the quality of the network is determined by the values of the above internal phenomena, the failure to eliminate which leads to severe overheating due to harmful reactive currents and other distortion currents, which can lead to fire and industrial accidents.

Moreover, in the absence of correctly performed compensation of reactive energy inside the enterprise, external power supply networks also suffer, starting with increased losses and ending with rolling outages of consumers. The more strategically important an enterprise is, the more acute this issue becomes.

With the included external classical RPCI (reactive power compensation installation) at the input, the situation is significantly aggravated, because "Locks" distortions in the internal network and causes excessive overheating of the supply cables of the motors and other elements of the electrical network.
The only correct circuit-mode solution to the problem under consideration is the shunting of load current pulses and compensation of the reactive energy of each electrical receiver, leading to an increase in the electrical conductivity of the entire electrical system by reducing the thermal tension and reducing the instantaneous current density, both in networks and in generators.

Unfortunately, modern capacitor devices for shunting load current pulses and compensating for reactive energy have significant disadvantages, the main of which are:
- increased through currents through the dielectric due to the large temperature difference in the internal volume and surface of the capacitor;
- small area of the heat exchange surface relative to the nominal capacity;
- additional heating that occurs during compression of the plates, and the compression force is proportional to the capacity;
- acoustic losses proportional to capacitance, increasing heat losses;

- the real tangent of losses of modern capacitor units, not attributed to ideal operating conditions, fluctuates within 5% - 10% of the amount of pumped reactive energy, and the presence of higher harmonics of current in networks (frequency drive, welding, induction furnaces, arc melting, electronic converters) brings it to the level of emergency mode

For a high-quality solution of shunting load current pulses and compensation of reactive energy, a fundamentally new device for local compensation (DLC) - modular current and voltage integrators has been developed.

2.2. The purpose of the installation.

The ideology of the ICV operation is based on the approach of regulating transient processes occurring in electrical receivers of an inductive nature, in order to reduce magnetization reversal losses when the magnetic induction changes, both in modes with constant load and dynamics. The use of inductance in conjunction with a capacitance makes it possible to solve not only the problems of optimizing transient processes in an electric receiver, but also to limit the charging currents of capacitors to permissible values.

ICV is an installation for individual use and an integral part of an inductive power receiver (induction motors, transformers, etc.)

The main functions of ICV:

- significantly increases the service life, safety and reliability of electrical equipment; - compensates for reactive energy, maintains cos φ = (0.99 ÷ 1);
- reduces the starting currents of asynchronous electric motors by an average of 3 times;
- reduces the operating temperature of electrical conductors and electric motors by 2-3 times;
- increases the dynamic efficiency of power consumers by an average of 4%;
- reduces power consumption by 10 ÷ 40% depending on operating modes;
- limits the charging currents of capacitors when switched on by increasing the time the main charge, which makes it possible to do without special switching equipment; - absorbs harmful harmonics of various frequencies;
- suppresses the generation of acoustic noise;
- shunts the electromotive force of electromagnetic induction during commutations electrical receiver;
- reduces the level of electromagnetic radiation from electrical networks;
- reduces network losses in electrical systems;
- reduces vibration of electric motors as a function of the gyroscopic moment of the rotor with fluctuations in the mains voltage.

ICV applications:

- transformers and electric motors;
- asynchronous electric motors;
- electrical receivers of inductive type, electrical networks in general;

- electric melting and welding systems;
- induction furnaces;
- electric trains and electric locomotives;
- traction substations of railways;
- rectifier units of direct current networks;
- Lightning equipment.

2.3. Device and principle of operation

ICV consists of many parallel-connected LC circuits and is connected in parallel with the power receiver, being its individual addition and an integral part of the device. To achieve the declared effect, the length of the cable from the power receiver to the ICV should not exceed 3m.

The capacitor is assembled on boards consisting of many parallel LC circuits. The tangent of losses of one LC circuit and the ICV itself is not more than 3x10 -4.

100% of ICV components are manufactured at Russian factories.

The ICV is activated via circuit breakers and has an external warning light. The device is designed for any degree of protection (for example, in an explosion-proof design, with a self-ventilation effect), up to a voltage of 35 kV.

Calculation of the parameters of LC chains (welding, arc melting, induction furnace, variable load of the electric motor, etc.) takes into account the operating modes of the electric receiver and its technical parameters.

The inductances of each section are collected on a common magnetic circuit (ferrite, ferrometal), providing damping of both charging currents and the power supply voltage of the electrical receiver. Changing the ICV capacitance is carried out by the voltage resonance method with control over the secondary circuit of the choke. The regulation of the current cos φ is carried out by connecting the capacitors in a delta, but the cos φ is regulated for each phase. The regulation algorithm is know-how.

2.4. Comparative characteristics

Comparative characteristics of ICV and relatively competitive products:

Parameter	ICV	ACU (automatic condenser unit)	GRPC (general reactive power compensator)	ICRP (individual compensator of reactive power)	FC (frequency converter)	NR (network reactor)	ICRM + SR
Reduction of active power,%, max.	**40**	-	-	-	-	-	-
Increase in cos φ, max.	**1**	0,95	0,85	0,98	-	-	0,98
Reduction of reactive power,%, max.	**100**	95	85	98	-	-	98
Reduction of higher harmonics,%, max.	**100**	-	-	-	-	90	90
Decrease in starting currents,%, max.	**70**	20	-	50	100	-	-
tg own losses,%, max.	**$3x10^{-4}$**	0,8	1,1	0,8	1,2	1	1
Reduction of voltage drops,%, max.	**80**	80	80	80	-	90	90
Reaction time, sec, max.	**0,001**	1	1	2	5	1	1
Decrease in temperature of heating equipment,%, max.	**90**	10	-	50	-	-	50
Increase in efficiency,%, max.	**100**	-	-	50	100	-	50
Payback, years, max.	**2**	5	-	4	8	10	8

2.5. Examples of using

A number of examples with measurements of reducing energy consumption:

Enterprises, on which ICVs are installed	Rated power el. receiver, kW	Annual energy saving, kW · h	**Decrease consumption active** electric power,%	Reduction of consumption of full electric power,%
LLC "Basset", Ufa	30	12 740	30,3	61,1
LLC "Basset", Ufa	200	63 269	15,455	25,1
Modulneftegazkomplekt OJSC, Samara	200	63 268	15,45	25,1
OJSC "Modulneftegazkomplekt"	200	104 208	32,2	55,2
OJSC "Modulneftegazkomplekt"	45	16 500	42,8	72,3
MP "Samara Metro"	75	41 577	37	60,35
MP "Samara Metro"	55	21 999	24,7	40,2
MP "Samara Metro"	90	57 111	17,2	29,0
PE "Victoria-N", Nizhny Novgorod	90	45 612	12,53	22,2
PE "Victoria-N", Nizhny Novgorod	75	56 877	15	22,8
PE "Victoria-N", Nizhny Novgorod	45	50 116	21,1	39,0
PE "Victoria-N", Nizhny Novgorod	14	26 280	17,9	28,7
Novocherkassk plant for the production of graphite rods	75	71 440	19,1	35,5
Novocherkassk plant for the production of graphite rods	75	31 555	44,1	60,1
Water channel, Samara	75	77 120	19,8	29,8
Water channel, Samara	55	23 784	28,0	47,6
Water channel, Samara	90	54 663	15,3	22,9
Bakhchisaray cement plant	45	27 665	21,9	40,0
Bakhchisaray cement plant	37	14 998	35,5	51,2
Bakhchisaray cement plant	22	13 887	21,6	34,5
Mining and processing plant, Poltava	110	47 112	11,0	16,8
Mining and processing plant, Poltava	37	18 997	31,1	58,2
Ufa plywood mill	110	53 361	14,1	22,1
Ufa plywood mill	30	23 089	40,0	57,1
JSC "RusHydro-Zhigulevskaya HES"	750	458 980	31,4	50,9
JSC "RusHydro-Zhigulevskaya HES"	750	410 200	30,1	49,7
JSC "RusHydro-Zhigulevskaya HES"	750	420 030	29,7	33,3
JSC "RusHydro-Zhigulevskaya HES"	90	45 612	12,53	22,2
JSC "RusHydro-Zhigulevskaya HES"	75	56 877	15	22,8
Mining and processing plant, Kazakhstan	45	50 116	21,1	39,0
Mining and processing plant, Kazakhstan	14	26 280	17,9	28,7
Combine products plant, Tula	75	71 440	19,1	35,5
Combine products plant, Tula	132	45 898	29,4	50,9
Combine products plant, Tula	160	41 666	30,1	49,7
Izmeritel plant, Smolensk	160	49 496	12,1	19,9
Izmeritel plant, Smolensk	37	33 220	20,9	34,3
LLC "Lesobalt", Kaliningrad	200	63 268	15,45	25,1
LLC "Istok", Belebey	200	104 208	32,2	55,2

2.6. Warranty period and service

The warranty period is 2 years from the date of signing the Certificate of Completion.

3. Feasibility study

The expected technical and economic effect of ICV application is as follows: - reduction of power consumption by 15 - 40%;
- increase in efficiency and productivity by 4% of drive motors;
- increasing fire and energy safety;
- reducing the failure and cost of repairing electrical equipment.

The payback period for implementing ICV at the enterprise is about 2 years.

4. CONTACT INFORMATION

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