

**TERRITORIAL GENERATING COMPANY-4 OJSC  
BRANCH OF «VORONEZH REGIONAL GENERATION»**

2 Lebedeva street, 394014 Voronezh, tel.: (4732) 44-92-59, fax: (4732) 48-67-15  
e-mail: rg@voronezh.tgk-4.ru

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«Northern Interindustry Company  
«The Alternative» Ltd  
For the attention of Chief Engineer  
V.I. Mankovsky

**About the test results of boiler No.15 at CHP-plant-1**

Dear Vladimir Igorevich,

I forward you the conclusion and the appraisal report on the main parameters concerning test results of BK3-160-100ГМ boiler unit No.15 at Voronezh CHP-plant-1 carried out before and after major repair period during which installation of CMKA<sup>®</sup> heat exchange elements for regenerative air heaters produced by «Northern Interindustry Company «The Alternative» Ltd was executed.

Enclosures: mentioned in 3 sheets.

Sincerely yours,

**Chief Engineer**

**V.F. Ozhogin**

O.A. Zykov  
Tel.: 007 (4732) 44-93-65

## CONCLUSION

concerning condition of БК3-160-100 ГМ boiler No.15, according to acceptance test after the replacement of RAH heat exchange elements by CMKA<sup>®</sup> ones during major repair period.

On November 27, 2008, the stuff of setup and tests department of heat-mechanic equipment of production and technical department in cooperation with the stuff of boiler workshop carried out acceptance tests at БК3-160-100 ГМ boiler No.15 to estimate technical condition of the boiler after major repair period. These tests were supposed to determine technical and economic indices of the boiler functioning after the replacement of RAH heat exchange elements that had been used over their service life by the improved CMKA<sup>®</sup> heat exchange elements produced by «Northern Interindustry Company «The Alternative» Ltd (Severodvinsk city).

These tests were carried out at rated boiler load of 160 t/h following the steam parameters required ( $T=520^{\circ}\text{C}$ ,  $P=95\text{kgf/cm}^2$ ). There were 8 gas burners. Analysis of flue gases behind boiler superheater has shown that the boiler unit functions while excess air coefficient equals 1.07 that meets the standard figure ( $a=1.08$ ). Neither disbalance in oxygen content nor traces of chemical underburning were discovered. According to test results air suction into furnace lowered from 18 to 7%. This made it possible to bring excess air in control points to standard values.

General air suction into a boiler (in the area «behind steam superheater - behind smoke exhaust») lowered by 7% in comparison with the data before carried out modernization (47%) and got 40% that is greater than the norm as before.

At the same time in the area «behind steam superheater - behind RAH» air suction lowered from 31% (before repair) to 27% (the norm is 22%) mainly due to the reduction of leakage air in RAH from 19% to 13%.

According to the measurement the value of the hot air temperature got  $239^{\circ}\text{C}$  that was  $20^{\circ}\text{C}$  greater than the value before repair ( $219^{\circ}\text{C}$ ). An average temperature of released gases got  $110^{\circ}\text{C}$  ( $137^{\circ}\text{C}$  before the replacement of heat exchange elements of RAH). Air heating in RAH got  $217^{\circ}\text{C}$ , reduction of flue gas temperature got  $150^{\circ}\text{C}$  ( $197^{\circ}\text{C}$  and  $125^{\circ}\text{C}$  before heat exchange elements replacement respectively). Given values proved the improvement RAH heat exchange due to the installation of improved CMKA<sup>®</sup> heat exchange elements.

Taking into account amendments, boiler gross efficiency got 94.69% (92.98% before repair). Power consumption for traction and blast got 5.8 kWatt-hour/Gcal while the standard was 5.95 kWatt-hour/Gcal (6.77 kWatt-hour/Gcal before repair.) Reduction of power consumption for traction and blowing was mainly achieved by significant reduction of air leakage into furnace.

### Conclusions:

Improved CMKA<sup>®</sup> heat exchange elements installation and replacement of gaskets made it possible to reduce leakage air into RAH, increase heat exchange that led to lowering of the temperature of released gases and rising both of hot air temperature and boiler gross efficiency.

Head of Production and Technical Department

A.P. Akulov

Head of Setup and Test Subdivision of  
Production and Technical Department

M.A. Boev

Engineer of Setup and Test Subdivision of  
Production and Technical Department

A.V. Polyakov

**List of the main technical condition parameters of БКЗ -160-100 ГМ boiler No. 15 before and after replacement of heat exchange elements during major repair period**

No.	Parameter	Dimension	Operation tests data		
			according to normative and technical documentation	before major repair period	after major repair period
1	Fuel, its characteristics	kcal/kg	gas 8000	gas 8207	gas 8198
2	Number of operating burners	pieces	8	8	8
3	Excess air coefficient behind steam superheater		1.08	1.10	1.07
4	Steam capacity (steam capacity reduced to the rated parameters is in brackets) P = 95 while T = 520 °C	t/h	160	159 (162)	160 (160)
5	Temperature of superheated steam	°C	520	520	520
6	Pressure of superheated steam	kgf/cm <sup>2</sup>	95	98	95
7	Temperature of feed water	°C	210	202	204
8	Temperature in checkpoints of water-steam circuit of high pressure				
	Temperature of saturated steam	°C		312	311
	Temperature of superheated steam before desuperheater of the first stage	°C	-	445	445
	Temperature of superheated steam behind desuperheater of the first stage	°C	-	375	375
	Temperature of superheated steam before desuperheater of the second stage	°C	-	470	480
	Temperature of superheated steam behind desuperheater of the second stage			465	465
	Temperature of superheated steam in the steam collecting box	°C	-	520	520
9	Maximum temperature of coils walls of heating surfaces in typical places (steam superheater coils)	°C	40	20	25
10	Cold air suction into furnace	%	10	18	7
11	Air inleakage into convective gas ducts of boiler; Including the area - «at RAH inlet-at RAH outlet)	%	22	31	27
		%		19	13
12	Air inleakage into gas ducts from RAH to smoke exhaust	%	8	16	13

13	Vacuum before smoke exhaust	mm of water column	230		170
14	RAH resistance by gas	mm of water column	-		60
15	Rate of opening of smoke exhaust guide vanes	%	-		35/35
16	Rate of opening of fan guide vanes	%	-		35
17	Cold air temperature	°C	30 (30*)		22
18	Hot air temperature	°C	(223*)		239
19	Temperature of released gases	°C	127 (112*)		110
20	Gas temperature at RAH inlet	°C	(269*)		260
21	Heat loss with released gases	%	5.20		4.86
22	Heat loss into surrounding atmosphere	%	0.60		0.60
23	Boiler gross efficiency	%	94.20 (94.78*)		94.54
24	Boiler gross efficiency taking into account amendments	%	-		94.69
25	Power consumption for traction and blast	kWatt-hour/Gcal	5.95		5.8
26	NO <sub>x</sub> content in flue gases reduced to NO <sub>2</sub> (α=1.4)	Mg/m <sup>2</sup>	284		260

\* – project data while boiler's running by gas at rated

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