



Efficiency of power plants

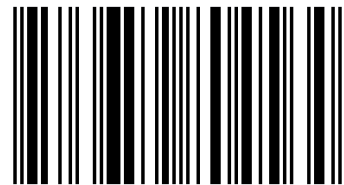
In the monograph the latest Innovative direction on increase in energy efficiency of thermal and nuclear power plants of combined heat and power plant, state district power station, the NPP with use of the self-organizing Smart-MES "MES-T2 2020" System is given in real time. The Theory of Accidents and ideology of Self-organization of IT System which is capable to provide energy efficiency and fail-safety of power plants is described. The technology of creation of the Self-organizing Information Smart-MES System, and also an axiom of the Theory of Accidents, the logician of the prevention of Accidents, a paradigm of the Self-organizing IT System, structure, intellectuality and a multiagentnost of Smart-MES system is described. The book is addressed to students, scientists, experts power and IT industries, to the management of the Ministry of Energy and the Generation companies, everything who is interested in problems of economy of fuel. The no-cost technology of economy of fuel will allow the Generation companies to have additional many milliard profit.

Vladimir Chernov  
Igor Chernov

# Energy efficiency of power plants with use of Smart-MES System

Research of technology of economy of fuel by means of the Self-organizing Smart-MES "MES-T2 2020" System

Chernov V.F., CEO "Firm InformSystem", Ekaterinburg, Russia. He graduated from ULTI. Worked in SNIILP, Beloyarsk NPP, PKB ASU, 4-year in Czech NPP Dukovany. In 2002 with Chernov I.V. has created a Company "Firm InformSystem" and has developed a Self-organizing Information System Smart-MES and power effective technology for power plant



978-3-659-80456-4

Chernov, Chernov



**Vladimir Chernov**  
**Igor Chernov**

**Energy efficiency of power plants with use of Smart-MES System**

**Vladimir Chernov  
Igor Chernov**

# **Energy efficiency of power plants with use of Smart-MES System**

**Research of technology of economy of fuel by  
means of the Self-organizing Smart-MES "MES-T2  
2020" System**

**LAP LAMBERT Academic Publishing**

## **Impressum / Imprint**

Bibliografische Information der Deutschen Nationalbibliothek: Die Deutsche Nationalbibliothek verzeichnet diese Publikation in der Deutschen Nationalbibliografie; detaillierte bibliografische Daten sind im Internet über <http://dnb.d-nb.de> abrufbar.

Alle in diesem Buch genannten Marken und Produktnamen unterliegen warenzeichen-, marken- oder patentrechtlichem Schutz bzw. sind Warenzeichen oder eingetragene Warenzeichen der jeweiligen Inhaber. Die Wiedergabe von Marken, Produktnamen, Gebrauchsnamen, Handelsnamen, Warenbezeichnungen u.s.w. in diesem Werk berechtigt auch ohne besondere Kennzeichnung nicht zu der Annahme, dass solche Namen im Sinne der Warenzeichen- und Markenschutzgesetzgebung als frei zu betrachten wären und daher von jedermann benutzt werden dürften.

Bibliographic information published by the Deutsche Nationalbibliothek: The Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available in the Internet at <http://dnb.d-nb.de>.

Any brand names and product names mentioned in this book are subject to trademark, brand or patent protection and are trademarks or registered trademarks of their respective holders. The use of brand names, product names, common names, trade names, product descriptions etc. even without a particular marking in this work is in no way to be construed to mean that such names may be regarded as unrestricted in respect of trademark and brand protection legislation and could thus be used by anyone.

Coverbild / Cover image: [www.ingimage.com](http://www.ingimage.com)

Verlag / Publisher:

LAP LAMBERT Academic Publishing

ist ein Imprint der / is a trademark of

OmniScriptum GmbH & Co. KG

Heinrich-Böcking-Str. 6-8, 66121 Saarbrücken, Deutschland / Germany

Email: [info@lap-publishing.com](mailto:info@lap-publishing.com)

Herstellung: siehe letzte Seite /

Printed at: see last page

**ISBN: 978-3-659-80456-4**

Copyright © 2015 OmniScriptum GmbH & Co. KG

Alle Rechte vorbehalten. / All rights reserved. Saarbrücken 2015

## Оглавление

<i>1. Introduction.....</i>	<i>3</i>
<i>2. Dynamics of an excessive consumption of fuel at power plant.....</i>	<i>7</i>
<i>3. Perversity of optimization of resources of a thermal power plant.....</i>	<i>19</i>
<i>4. A failure of the Russian power industry without Smart-MES.....</i>	<i>23</i>
<i>5. The electrical power Etude in crimson tones .....</i>	<i>37</i>
<i>6. The Smart-MES system liquidates fuel theft.....</i>	<i>51</i>
<i>7. Commercial innovative accounting of an excessive consumption of fuel.....</i>	<i>63</i>
<i>8. Compulsory motivation of economy of fuel.....</i>	<i>73</i>
<i>9. True energy efficiency of power plant.....</i>	<i>77</i>
<i>10. Cloudy Technology of economy of fuel of power plant.....</i>	<i>93</i>
<i>11. A subjective excessive consumption of fuel at power plant.....</i>	<i>99</i>
<i>12. Stubborn Analytics of an excessive consumption of fuel of power plants .....</i>	<i>111</i>
<i>13. The parallel mythical worlds in power industry.....</i>	<i>121</i>
<i>14. 17 moments Smart-MES and Energy efficiency of thermal power plant.....</i>	<i>131</i>
<i>15. Without criteria the Energy audit of power plants - fiction.....</i>	<i>141</i>
<i>16. Intellectual regulation by energy efficiency .....</i>	<i>155</i>
<i>17. Integrated evaluation of an excessive consumption of fuel.....</i>	<i>167</i>
<i>18. Experience of introduction of Smart-MES system at power plant.</i>	<i>183</i>
<i>19. Theory of accidents and Theory of global catastrophes.....</i>	<i>201</i>
<i>20. Logic of the prevention of accidents on Smart-MES .....</i>	<i>215</i>

<i>21. Accident is losing game of the Person with the Nature.....</i>	<i>223</i>
<i>22. Smart-MES as virtual Model of any power plant.....</i>	<i>235</i>
<i>23. A paradigm of the Self-organizing innovative Smart-MES .....</i>	<i>247</i>
<i>24. Concept of dynamic adaptation of Smart-MES.....</i>	<i>255</i>
<i>25. Smart-MES as Super-SAPR of the Self-organizing Systems .....</i>	<i>261</i>
<i>26. Structure and innovative opportunities of Smart-MES.....</i>	<i>269</i>
<i>27. Intellectuality of the Self-organizing Smart-MES.....</i>	<i>277</i>
<i>28. The self-organizing Smart-MES - Informdynamic's wreath.....</i>	<i>287</i>
<i>29. The Multiagent of the Self-organizing Smart-MES system .....</i>	<i>295</i>
<i>30. The newest understanding of Smart-MES for power plant.....</i>	<i>303</i>
<i>31. Imperception of the Self-organizing Smart-MES System .....</i>	<i>309</i>
<i>32. Principles of Smart-MES as Innovative Project.....</i>	<i>317</i>
<i>33. It is easy for Smart-MES to use, but it is difficult to create.....</i>	<i>323</i>
<i>34. Conclusion.....</i>	<i>331</i>
<i>Bibliography.....</i>	<i>337</i>

## 1. Introduction

---

Always it was meant that all advanced information technology goes from Moscow. But here two Specifications (2009) for calculation of TEP (in one case got to me: PGU (Steam-gas installation) in Mosenergo, in other: State district power station in OGK-2), developed for tenders by the Moscow IT organizations, it is obvious under itself.

I give some excerpts: "characteristics of the equipment have to be in the form of quantitative dependences" (i.e. polynoms), "at creation of a complex the following program modules", "development of a program code" are developed. But these IT organizations at the same power plants and for the same purpose carried out development and deployment of a program code already earlier.

Such was and 20 years ago and proceeds now. And what actually new and innovative? Anything. The new equipment at power plant will be added and TEP (Technical and Economic Indicators) are again necessary the Specification with the tender for calculation realization and with development of a new program code.

But to develop presently a program code of direct action for calculation of TEP of work of the equipment of power plant and for other repartitions it is profanation. The same and use of polynoms for characteristics of the equipment.

On the Open Systems portal in Leonid Chernyak's article "Adaptability and adaptability" [7] the following is told:

"Sooner or later the software nevertheless has to come to the following round of evolutionary development and find two new qualities peculiar to difficult technical systems and live organisms, - an adaptability and adaptability. Complexity of the organization and behavior is called the main property of systems of the future. At the same time they have to be under construction of simple and not really reliable components, to be simple for the user, the administrator and the designer. And for this purpose they have to be executed on the Self-\* technology, i.e. to be self-configured, self-regulated, self-adapted".

That's it according to these recommendations our self-organizing Smart-MES system is also created. It is clear that we, without knowing all these sophisticated scientific forecasts, long went the way, but left where follows and much earlier other IT developers in Russia and abroad. Also it is not terrible at all and not offensively that our system on advantage is not understood and not accepted. The main thing that this bar of IT is so highly raised by us that will already not reckon with it not possibly. And it means that we made revolution in technology of development of big information systems.

Firm InformSystem (Russia, Yekaterinburg) developed the innovative self-organizing Smart-MES system (MES System) of "MES-T2 2020" (The certificate of Rospatent No. 2014618991 on the state registration of the computer program, 2014) for realization of technology of economy of fuel and for increase in energy efficiency of thermal and nuclear power plants at automation of calculations of the actual and standard TEP in real time. It is intended also for realization of technology of accident-free operation of nuclear power units and which can provide the prevention of all emergencies on the NPP, combined heat and power plant and state district power station. This system can be involved in multiagency technology for cognitive management of the Generating and Network companies.

The methodology of creation of Smart-MES system is focused on easy realization of any algorithms without traditional programming, i.e. without use of programmers. It contains full set of modern opportunities. These are text projects of tasks, self-adjustment and self-organization of all system, the analyst, the schedule and optimization.

And now we will show that our system corresponds to the Self-\* technology. For this purpose we will compare it to a live organism, i.e. to the person.

The person, being born, is able to do nothing and knows nothing though in his organism all foundations and components for future skill and future erudition are laid. However, in it initially there are restrictions of talent, i.e. vocational guidance. Thus, if he is fated to be an actor, he will never be the scientific or good engineer. The person studies gradually all



life, even when starts working. Gains knowledge of people by means of textbooks, i.e. by means of certain instructions and algorithms.

Our Smart-MES is also initially empty, i.e. on what is not capable, but in it all prerequisites for future concrete realization are put in the form of the EXE module (the executive file). MES (Manufacturing Execution System - a control system of productions) is that orientation which depending on training can be used in various production directions. Training of Smart-MES is carried out gradually and can always be carried out, even after when it starts bringing real benefit. Text projects of tasks in this case act as textbooks. The EXE module absorbs these projects in itself and by that skill and erudition is gained. And all this is absolute without programming.

And now, as they say, find some differences. It appears, they simply are not present. Therefore it is easily possible to draw a conclusion that our Smart-MES system is identified with a live organism, i.e. it - is adaptable and adaptive.

So it turned out that when great IT and scientists make plans an ocean, we simple IT engineers independently already realized these plans in "metal", i.e. at us not only the unique concept of self-organization of IT systems is developed, and the Smart-MES system is ready to introduction at any power plants in Russia and abroad and on other process productions.

The question of reality of advance of a tendency of the self-organizing IT systems well described S. A. Martynov in the book "Innovative Economy (Road Map 2040)" [5]: "Anybody and nothing is capable to resist to idea which time came!" But here a question only in the one who will use this ready idea: Russia or West, Government or Oligarchs? And time for the self-organizing IT certainly came since stagnation in IT was excessively tightened.

The technology of the organization of economy of fuel on thermal power plants and technology of creation of the self-organizing information Smart-MES system is in detail presented in this monograph, and also questions of the prevention of emergencies by means of this Smart-MES system are taken up, the paradigm of the self-organizing IT System, structure, intellectuality and a multiagentnost of Smart-MES system is described.

In the first half of the monograph the questions connected with increase in profitability of combined heat and power plant, state district power station and the NPP are taken up, and the second half is devoted to ideology of the self-organizing information Smart-MES system without which it is almost impossible to realize economy of fuel.

Therefore, only complex theoretical consideration and the practical solution of these aspects can also yield positive result for achievement of true profitability of thermal power plants which more than is demanded now by the Russian society and in general around the world.

The book is addressed to students, scientists, specialists of power branches, the management of the Ministry of Energy, everything who is interested in problems of economy of fuel and decrease in harmful emissions in the atmosphere.

## **2. Dynamics of an excessive consumption of fuel at power plant**

---

Unique feature of thermal power plants is that, developing the electric power and heat power, they have no opportunity to accumulate them. Thus, the electric power and heat have to be used right there for commercial purposes, i.e. in the market of the electric power and heat the Generation company has to receive money for them. In other words, the volume of power generation and heat completely is defined by their demand in the market.

Once again I will repeat that the electric power and heat it is necessary to develop exactly so much, for money, and differently it simply losses of in vain spent fuel how many will be paid. Thus, a certain quantity of the electric power and heat is strictly regulated by a certain amount of fuel according to concrete technology of the most this power plant.

But the paradox of all modern thermal power plants is just that it that the most strict regulations on them and do not exist. The operational personnel, operating power plant for implementation of the schedule of delivery of the electric power and heat, does not know in real time at all, how many it is necessary to spend fuels in each concrete time span (minute, half an hour). It works blindly, being guided only by the ability and experience.

Tragically would be to rely on the driver who operates the express without the controlling devices, relying only on rails. All perfectly understand it, and it does not even raise questions and doubts.

But why do not understand the Generation companies what to operate difficult dynamic production what the thermal power plant is, without operating control behind an excessive consumption of fuel it is also tragically dangerous both in financial sense, and in ecological.

By electricity generation and heat fuel is spent, but nobody knows, how many it is used in each interval of time - much or a little. If the lower bound naturally is established by necessary number of delivery of the electric power and heat, the upper bound is controlled by nothing, and has

to be controlled by standards. Thus, this technology provokes to an uncontrolled excessive consumption of fuel, and, therefore, and to thriftless and unnecessary financial losses which are commensurate by the sizes with the profit of the generation company.

Dynamics of an excessive consumption of fuel increases at the transitional moments - day and night. It is necessary to trace accurately and quickly an operational excessive consumption of fuel at increase and decrease of deliveries of the electric power and heat. In the present time it occurs "in the dark" power plants. And if to tell more roughly, the gloom and denseness regarding realization of automation of calculations of TEP and an excessive consumption of fuel in modern market conditions on thermal power plants is similar to actions of the arrogant easy rider, undertaken to facet diamonds.

There is an exact science - mathematics which elementary shows that the area of difficult dynamic process in time regarding an excessive consumption of fuel has to be defined only by integral calculus and in any way differently if of course financial losses matter. And the interval of time spans of calculation is less, the accuracy is higher. In the present time for calculation of an excessive consumption of fuel the area of a rectangle with a time interval in one month is stupidly used simply, i.e. dynamics of process is not considered at all, and it is the most gross and ignorant blunder.

Very strange picture turns out that all the time of the Ministry of Energy of the Russian Federation and branch science were mistaken and persistently continue to be mistaken regarding the correct calculation of an excessive consumption of fuel thermal power plants. And their most important delusion is that a thermal power plant, having huge percent of wear of the equipment, is capable to have in separate time intervals economy of fuel, i.e. by some miracle, working without operational current information, to spend fuels less, than it is regulated by standards. But same simply nonsense.

And times of it in principle cannot be, even more horrific and gloomy image turns out. Every minute at power plant there is an excessive consumption of fuel, but nobody sees it, and, therefore, something cannot simply be undertaken for its decrease. The total excessive consumption of

fuel in a month, naturally, consists of minute overexpenditures. Also it turns out as a result such what turn out, i.e. completely depends on will of "god".

And this dull loss of a half of profit by the Generation company in the form of an uncontrolled huge excessive consumption of fuel became possible only thanks to incorrect initial messages of the Ministry of Energy of the Russian Federation and branch science. But whether it is time to think again. The after all absurdly excessively burned fuel in Russia would be enough in addition for 30 new thermal power plants or it is easily possible to reduce the volume of harmful emissions in the atmosphere by 10%. And management of the Generation companies "flies does not catch something", does not fight actively for economy of the rising in price fuel more true.

Passed part of the generation companies into foreign property. It would seem, they that have to value kopek, in sense irrevocable annual loss of 100 million dollars in pipes of power plants.

### ***The profit of the Generation companies without Smart-MES System catastrophically falls***

At such catastrophic reduction of profit of the Generation companies existing now the reasons of this falling since all can have them subjectively different are not important at all. But objectively that they the general are a total absence of an operating control over an excessive consumption of fuel. And we warned about it two years ago that at such uncontrolled and careless excessive consumption of fuel which makes more than 10% of the general expense, eventually, there will come hard times. And they, naturally, came ...

The zealous hostess when there is no money for the current life, starts planning and controlling the operating costs carefully. When the driver does not have gasoline to reach to the necessary point, he chooses more economy mode of a driving. And here power plants uncontrolledly burn down fuels so much, how many it turns out for implementation of the plan of delivery of the electric power and heat.

But after all if we have to reach from point "A" in point "B", we for some reason always choose a short and direct way. Why power plants,

setting for itself a similar task, go actually, without reflecting on trajectory length, and always overcome a way for 10% the bigger.

After all if by electricity generation it is also warm according to standards in concrete night half an hour it is necessary to spend fuel "K", and actually it turns out 30% more, i.e. "1.3K", there are questions. But after all for this purpose it is necessary to control this process. Then there will be also questions, there will be also answers, there will be also improving actions.

And if the power plant actually does not understand at all that becomes with fuel, i.e., naturally, it makes the electric power and heat and satisfies Customers, but does not understand, what price. And all appeals to increase in energy efficiency and to resource-saving pass by the Generation companies.

But question that elementary. It is necessary that in everyone half an hour the actual fuel consumption was strictly equal to a standard cost. That's all. That's all knowledge.

There is a double problem. On the one hand, the Generation companies by means of No-cost Technology of economy of fuel do not want to have additional average profit in 300 million rubles from each power plant and therefore do not save fuel, i.e. use the most not power effective working hours of power plants. On the other hand, because of incorrect techniques of monthly calculation of an excessive consumption of fuel the doubtful energy audit of the Generation companies which does not reveal true reserves of increase in energy efficiency of power plants at all is made, so and is completely useless.

Here also general Russian "indifference" to a problem of an excessive consumption of fuel is observed and from the Ministry of Energy of the Russian Federation, and from the Generation companies.

But after all there is a domestic Smart-MES System which at expenses in 50 million rubles for introduction for 10 thermal power plants will easily provide annual additional profit of the Generation company in 3 billion rubles. Here where enormous real economic effect! Thus costs of fuel will be reduced is more white than for 10% at the expense of a complete elimination, not considered now, an excessive consumption of

fuel. In this case the operational personnel will have a compulsory motivation on economy of fuel through continuous granting on BCP (block control panel) of operational analytics on an excessive consumption of fuel and advice mechanisms on optimum loading of the equipment, and also information on necessary volumes of the bought fuel.

But Management of the Generation companies does not wish to pay the attention to domestic innovations in the form of the Smart-MES "MES-T2 2020" System, equal who is not present even abroad! Really to you did not bother to wander among various economic-mathematical models and confused monitoring, useless for increase in profit providing TEP miscalculations, misleading these you! Open the same eyes, and give to the operational personnel magnificent additional opportunities on management of power plant, and that they as blind little mice knock about on labyrinths of uncountable options of decision-making and always choose the worst. And at you thus the profit thaws!

### ***The conflicts of interests in the generation companies***

After reorganization of power industry thermal power plants stopped being independent legal entities, and passed into the category of the branches completely dependent on management of the Generation companies (further it is simple - the Generation company). Cast became conditional to look as follows: power plants spend fuel, developing the electric power and heat for sale, and management and shareholders of the generation companies get profit on this sale.

And as if cheeks now did not inflate the director of power plants, range of independently made decisions is sharply narrowed by them even in such elementary question as a choice of the program for automation of calculation of TEP (technical-economic indicator).

Four years ago we did adaptation of the program complex on Kashira GRES and if is more concrete, only programming of calculation of standard TEP, according to the specification to Competition. Upon termination of works we go to the director of state district power station and we explain that additional realization of calculations of the actual TEP, calculation of losses and expenses for own needs of the electric power and heat is necessary for normal functioning of all calculations of TEP, also the stage of trial operation, etc. is necessary. For this purpose there has to be an

additional contract for introduction of our Complex since previous everything did not provide it neither in the ideological plan, nor in the financial. He vigorously assured that all issues will quickly resolve. Passed some months. Then the state district power station was shown with information on the announcement of Competition on introduction of our program Complex. In Competition we won, but the statement hanged in OGK-1. And through some time to us the claim from OGK-1 arrives that your program does not function. And from what it has to function if there was no its introduction? Here such marasmus ...

Approximately similar moments were and at Petrozavodsk CHPP TGC-1, and on Troitskaya GRES of "OGK-2", and on the Tyumen CHPP-1 "FORTUM". In a word, the obvious conflict of interests between power plant and the Generation company regarding outlook on automation of calculations of TEP is observed. It would seem that is more visible than the Generation company from height that is necessary for power plant for automation of calculation of TEP. But all so ill-matched power plants and not only on technology, but also on extent of automation of data collection.

However, aspiration of the Generation companies: for all power plants to use identical approach to automation of calculations of TEP - absolutely right decision. But actually it looks, as obviously clumsy transformation of former experience of Experts to such thin and sensual sphere what the thermal power plant is.

In practice correctly chosen platform, how many an economic component of this automation is important not so much. And about it that, just all is also forgotten, including Experts of the generation companies. Time the Generation company works for profit, any modernization has to increase this profit, or promote it.

Well, tell on favor, what incorrect monthly calculation of TEP even on a powerful platform will increase profit? But now at all power plants these miscalculations of TEP since they are executed by outdated techniques without modern market realities function.

These incorrect monthly calculations promote one more conflict of interests between the generation company and power plant because of the fact of economy of fuel. Fuel is a factor production cost which naturally should be reduced. The economy of fuel gives increase in profit which



lion's share is distributed besides power plants. Then why to the operational personnel to climb from skin for economy of fuel if it for it adequately is not paid? Besides the existing huge excessive consumption of fuel on all thermal power plants than is not controlled and correctly does not come to light.

Very strange situation turns out. Power plants are interested in continuation and further the same existence of these miscalculations of TEP, since due to the lack of Smart-MES System from them smaller demand regarding an excessive consumption of fuel. However and the Generation companies not really that hurry ideologically to switch to Smart-MES which is capable to double to them profit a complete elimination of an excessive consumption of fuel at all power plants.

Actually on thermal power plants the method of "carrot and stick" surely has to be used. After introduction of Smart-MES System with the correct calculations of TEP and with monitoring of the current excessive consumption of fuel on BCP (block control panel) this method it will be elementary to promote doubling of profit. And time is full half-hour information on fuel use, and application of "carrot and stick" will be dot and fair. The operational personnel, having before itself the current constant and half-hour information on an excessive consumption of fuel, it will be simply compelled to look for technological options with more economical use of fuel.

Thus, with introduction of Smart-MES System the operational personnel of power plants has a compelled motivation on increase in profit for the Generation company.

### ***The Smart-MES system will quickly double profit of OGK and TGC***

In the beginning we will submit statements of our opponents from JSC TGC-9 and JSC Engineering Center of Power Industry of the Urals given by the Ministry of Energy and housing and communal services of Sverdlovsk region in the Letter No. 22-04-8565 of 26.11.2010 signed by the Deputy minister N. B. Smirnov, and we will try to understand them.

1) "Now calculation of the actual and standard technical and economic indicators at power plants is carried out with use of the program

complexes "Calculation of Technical and Economic Indicators of Work of Power Plant" (PTO automated workplace). The system offered by you is based on the same principles (calculation on an operational interval: 1 min., 30 min. and accumulation of information, i.e. "integral calculus") the accuracy of calculations can also really raise".

Here only to have to be surprised to absolute illiteracy of staff of the Ministry of Energy of Sverdlovsk region in questions of informatization of power plants. How in general Smart-MES can compare to MS Excel (at Sverdlovsk combined heat and power plant)? MS Excel and daily full calculations of standard TEP will not pull that, not to mention integral calculus of half-hour excessive consumption of fuel, and constant calculations with monitoring on BCP is already a fantasy.

At all power plants of Russia PTO (technological department) automated workplace is presented in three variations now: 1) MS Excel, 2) the separate existing programs, 3) the introduced programs on the basis of products of Oracle or Microsoft. All these automated workplaces of PTO have the uniform principle: daily calculation of the actual TEP and monthly calculation of standard TEP. A question of exact and expeditious calculation of an excessive consumption of fuel as in these ARM (the automated workplace) in general do not cost the main reserve of energy efficiency of power plants. So, what to speak about unity of the based principles, at least, it is inappropriate and it is silly.

Calculation accuracy in Smart-MES is not end in itself. The most important is an efficiency and timeliness of detection on an interval 1 minutes of the fact of an excessive consumption of fuel and its fastest elimination.

2) "The excessive consumption of fuel on separate components of thermal profitability and in general exists not because at power plants incorrectly make calculations of an excessive consumption of fuel in time, and owing to deviations of parameters and indicators of technological process from the standard because of deterioration of technical condition of the equipment in use (wear, aging and other). It is possible to lower an excessive consumption of fuel only due to elimination of shortcomings of operation, improvement of quality of repairs and maintenance, reconstruction and modernization of the equipment".

The excessive consumption of fuel at all power plants of Russia exists because management regarding an excessive consumption of fuel is made blindly. The correct calculations only reveal the huge excessive consumption of fuel existing at all power plants. Wear of the equipment influences in general fuel consumption, but not its overexpenditure. The excessive consumption of fuel is equal the FACT minus the STANDARD. And the standard cost of fuel already corresponds to this wear of the equipment. Therefore a source of an uncontrolled excessive consumption of fuel completely is only the human factor which can be excluded by Smart-MES System.

Finally, the constructive reasons of an excessive consumption of fuel are not important at all. But if there is a huge difference in sizes of an excessive consumption of fuel day and night, that, and here wear of the equipment. In this case it is much more important to provide stable operation of power plant regarding an excessive consumption of fuel. And it can be reached only a quick reaction at change of regime loads of increase in an excessive consumption of fuel.

3) "The choice of concrete program complexes is carried out by specialists of power plant - heads and the staff of technological departments depending on a look and structure of the burned fuels, stability of their characteristics, from structure of the capital power equipment, from equipment of power plant modern measuring equipment, the automated system of data processing, etc."

Here so nonsense! In Russia 300 power plants are also not present even two similar among themselves on structure of the capital equipment and technology. It, what turns out, what it is necessary to have 300 concrete program complexes? But, probably, it is also the modern poor level of outlook of management of the Generation companies and state structures. And here to innovative Smart-MES "MES-T2 2020" System neither the structure of power plant, nor structure of fuel is not important at all. All tasks are made out in the form of unpretentious text Projects, and all System is automatically adjusted from these Projects.

In this case at automation of calculations of TEP two basic principles in which the Generation companies have to be terribly interested surely have to be observed:

- Technological ideology of the automated System from a position of energy efficiency of power plant;
- Technical characteristics of the automated System for ensuring this ideology.

The technological ideology first of all has to cause economic effect. If is available, thanks to Smart-MES System, operational information every minute, and the excessive consumption of fuel ( $B_{fakt}-B_{norm}$ ), as well as Logistic criterion of fuel usage ( $B_{norm}/B_{fakt}$ ), are recorded in a database out of which on monitoring of BCP the operational analytics is brought, the operational personnel has no place to disappear how to look for the best operating current decision. Here also economic effect due to emergence of the compelled motivation in operation personnel on a constant control behind an excessive consumption of fuel is created.

4) "Calculation of an excessive consumption of fuel on a minute or 30-minute interval, having the necessary volume of information, not a complex challenge. A problem in system of data collection and processing. At our power plants the automatic system of the commercial accounting of power generation (ASKUE) and give of thermal energy (ASKUT) are introduced today, all other information gathers and processed practically manually at least on a daily interval (and some only in a section of month). Therefore to execute calculations of TEP, high-quality with high precision, on intervals of 1 min., 30 min. are not possible. For this purpose it is necessary to change all system of collection of information for power plants, to change park of measuring devices, i.e. in principle to enter new PCS. At the majority of power plants, it is unprofitable. Calculations of TEP which are made at power plants within the established PTO automated workplace, have sufficient accuracy, all algorithms are verified and correspond to the operating techniques and RD. Replacement existing ARMs at these stations on MES-T2 2010 system is inexpedient".

The first phrase "not a complex challenge" is similar to the statement that everyone will be able to fly on the moon. It is also silly and dull.

Concerning lack of the automated collecting many indicators at power plants. For our Smart-MES System expeditious input of all indicators is not necessary. For this purpose there are algorithms of their

transformation from daily values with autocorrection of rather available operational data.

Concerning replacement existing ARMs. It is not obligatory to throw out at all existing ARM. To be pleasant to you "to kiss" MS Excel, and kiss on health. After all there are some systems of the automated data collection: ASKUE, ASKUT, ASKUG at one power plant, so why cannot be some systems of calculation of TEP. Let's tell, the existing or introduced PTO automated workplace for good reports and Smart-MES System for management of power plant by criterion of minimization of an excessive consumption of fuel.

And now we will pass to doubling of profit on Smart-MES System. Why OGK and TGC do not hurry in the simple way to increase the profit? Yes everything is very simple. At all Generation companies there is an uninterested lobby, expert regarding informatization, in it. After all it is enough to them to tell that all this nonsense and a question in their advantage it is solved. Experts do not need third-party development since they have pocket firms, and the result is already put the second. The main thing to occupy a niche now. And so far, uncontrollable surplus of fuel at a rate of profit it is useless continues to disappear in pipes of power plants.

The innovative Self-organizing Smart-MES System is not simply urged to replace one calculations with others. And useless, existing now, calculations of TEP to replace or add with highly profitable technology of economy of fuel. The no-cost Technology of increase in energy efficiency of power plant on Smart-MES System provides fast realization of economy of fuel for 10%.

And a question even not that the economy of fuel makes 10% or other size, and that the actual excessive consumption of fuel exists and this size is comparable with the general profit of the Generation company. After all the most important is not so much correct to consider TEP, how many quickly to see the current picture on an excessive consumption of fuel for possibility of timely correction of management of technology.

In OGK and TGC clever people work and over time they will understand everything and by all means will come to the correct only conclusion that at power plants the Smart-MES System has to function. It not necessarily has to be our Smart-MES, but there has to be a MES

System with possibility of an operating control over an excessive consumption of fuel in real time.

In this case, introduction of Smart-MES System does not contradict the developed traditions of calculation of TEP or the current introduction of other program complexes at all. Our System is capable to add quickly integrally them and to liquidate a hole in technology, having stopped uncontrolled leak of excess fuel.

The question of doubling of profit of OGK and TGC (Wholesale Generating Company and a Generating Company Territorial) very easily and quickly is solved introduction of No-cost Technology on Smart-MES System. For this purpose it is necessary very little: To address to the reason!

### **3. Perversity of optimization of resources of a thermal power plant**

---

If the best option easily is without use of the optimizing programs, including HOP-optimization [18] (HOP - the characteristic of a relative gain), hardly pertinently to speak about optimization in general.

When the power plant is loaded on the maximum power, the question of optimization in general disappears since for optimization of resources there has to be a sufficient maneuver on loading of the equipment.

Decrease in an excessive consumption of fuel always actually and does not depend on extent of optimization and loading of power plant. Even by the introduced optimization the operating control behind the current excessive consumption of fuel since optimization it is simple desire is necessary, and the excessive consumption of fuel is a result.

Optimization of resources is planned for power plants for decrease in fuel consumption and, unfortunately, in this context the excessive consumption of fuel is not considered. It is connected with that for optimization very narrow circle of technological indicators is, as a rule, used, and here the full model of power plant with calculations of the actual and standard TEP is necessary for calculation of an excessive consumption of fuel.

But by optimization the option when the actual fuel consumption instead of decrease increases because of its big overexpenditure is quite possible.

And the excessive consumption of fuel ( $B_{\text{fakt}} - B_{\text{norm}}$ ) is connected generally with a human factor.

Recently it became very fashionable to propagandize HOP-optimization, as panacea for fuel consumption minimization. This method says that for an increment of power it is necessary to use that turbine for

which the smaller increment of steam, and, therefore, and fuels will be required.

It would be correct if at power plant characteristics of turbines constantly changed, without program not to manage. But they are stable, at least, some years. And optimum to load turbines, using elementary rules, it is possible.

Without being the technologist, I will show it to you.

For an example we will take power plant with 10 turbines T-100-130 with the following parameters:

the mode - one-stage;  $R_{nto} = 0,5 \text{ kgfs/cm}^2$ ;  $Q_t = 0 \text{ Gcal/h}$ ;  $N_{min} = 50 \text{ MW}$ ;  $N_{max} = 116 \text{ MW}$ .

The power plant has the plan for electricity supply  $830 \text{ Mvt*ch}$ . It is necessary to find loading of turbines with the minimum consumption of steam (so, and fuels).

We will accept an initial state for all turbines identical that in the sum there were  $830 \text{ MW}$ . According to the power characteristic we will find the general consumption of steam. It makes  $3074 \text{ t/h}$ .

We use the following algorithm further. Let's consistently load turbines (one, two, three, etc.) on the maximum power, and the rest equally to divide into the others (nine, eight, seven, etc.), but it is not less  $N_{min}$  on everyone.

We will receive the following values of expenses of steam:

1-3088, 2-3099, 3-3114, 4-3130, 5-3179.

We see that the consumption of steam grows, therefore, it not optimum options.

The following option of loading is connected with a stop of two turbines. At us the following combination turned out: 6 turbines on a



maximum - 116 MW, and two equally on 67 MW. In this case the consumption of steam is equal 3067 t/h. Here to you and optimum option.

Thus, the general rule of optimization for turbines can be formulated as follows:

**It is necessary to load so turbines that their maximum number did not work.**

And now we will find possible percent of economy of fuel using the most extreme options:

$$(3179 - 3067) / 3179 * 100 = 3,5\%.$$

But the power plant really works in intermediate options, therefore, this value by program optimization will be much less.

For comparison, introduction of no-cost technology on Smart-MES System gives economy of fuel in 10% because of elimination of an excessive consumption of fuel by means of an operating control over it in real time. Thus, ignoring of a question on the current control over an excessive consumption of fuel will bring to naught all good intentions on optimization of resources at power plant.

The true zero excessive consumption of fuel controlled on minute intervals in real time is also the best optimization of work of all power plant, and not just loading of turbines.

And here involuntarily the TGC and OGK have a doubt that so supposedly all power plants successfully function in market conditions without operational accounting of an excessive consumption of fuel.

But so it developed in the old manner since there was no the Self-organizing Smart-MES System. But after all power plants can work even more successfully.

And as if not to hide the head in sand, the problem of an uncontrolled excessive consumption of fuel was always and remains now. And paradox that nobody knows the true size of this overexpenditure.

The same monthly values with which power plants report to TGC and OGK, widely of the mark because of incorrect techniques. It concerns and the distorted standard schedules polynoms, and lack of integral calculus of half-hour values of an excessive consumption of fuel.

## **4. A failure of the Russian power industry without Smart-MES**

---

Passed more than two years after reorganization of power industry for the purpose of increase in investments into this branch. And what this power industry as a result has? Instead of inflow of investments - its hasty outflow. Investors as if rats desert a sinking ship.

It is very in detail told about it in article: "For investors the sector of power industry looks dreadful" [19].

"We lost faith in this sector in spite of the fact that it is stronger than the others decreased in the price. The environment in sector of power industry deteriorated, we stop being confident in appeal of investments into this sector, and it is difficult to offer it to clients", - explains the decision on closing of fund Dmitry Mikhaylov, the portfolio managing director "The Renaissance management of assets".

The investors invested in power industry lost 50% of investments for the last two-three years. "In such situation there was surprise no that many leave sector", - Nikita Yemelyanov, the analyst of UK "Alpha Capital" speaks.

"Market stock quotations of the companies are on three-year minima, and the branch index returned on levels of August, 2009. As a result the ratio of level of stock quotations (a market assessment) and the income of the companies of sector is on historical minima", - the portfolio manager of "Troika Dialog" Alexey Zhmakin counted.

And instead of speaking about problems in the existing power industry on the Russia-24 channel in the heading Power with aplomb is narrated about perspective solar Chinese batteries in Yakutia with a seven-year payback period. And when showed how the personnel of such perspective solar power station mops clears these solar panels of dirt and snow, involuntarily the conclusion arises by itself that everything at us in Russia becomes through a back place.

In the Generation companies management attracts the pocket IT firms, without thinking of increase in energy efficiency of power plants.

Two years there is a No-cost Technology of economy of fuel of power plants on Smart-MES System which completely would satisfy needs of investors on increase in Profit.

But short-sighted ambitions prevailed, and useless program complexes for automation of calculations of TEP take root. Because of it the Generation companies annually lose 3-10 billion rubles since the introduced complexes are initially not focused on the correct accounting of an excessive consumption of fuel. For this reason more than 10% of fuel are useless takes off for pipes of power plants, depriving of investors of the expected Profit.

After all it is very important to investors to see positive dynamics of development of branch. But when they see that on their money highly effective PGU are under construction, and to sense from them all the same is not present since the elementary current accounting of an excessive consumption of fuel on Smart-MES with monitoring of this analytics on BCP (block control panel) is not adjusted anywhere, they in general have a doubt in correctness of the investments.

After all among 20 Generation companies only the 2nd stay afloat. Here also the following questions arise. Why this chubaysovsky reorganization of power industry was started that then to come to such deplorable result when investors a herd run from power industry? Why SRO (the self-regulating organizations) if I pound from them any are necessary? Why the energy audit if in power passports there is no indicator of power efficiency which is required according to the Law No. 261-FZ is necessary? Why the Ministry of Energy of the Russian Federation was completely eliminated from the solution of questions of increase in energy efficiency of power plants and snubs innovative technologies of economy of fuel?

Answers are not present and cannot be until the disorder prevails not only at power plants at total absence of the accounting of an excessive consumption of fuel on Smart-MES System, but also in the heads of management of the Generation companies which so was fond of market frauds that completely forgot about healthy climate at power plants.

If before reorganization it was impossible to get a job on power plant, now there is nobody to work. If the chief engineer of the largest

combined heat and power plant of the regional center to allocate the competent expert for a request, answers sadly that, unfortunately, at us such is already not present. If the chief of group of the accounting of PTO declares that if will not raise to me a salary, I will not master the new program. And the head of the technical engineering department makes a helpless gesture and what to do, others are not present. It everything is also a disorder!

How it is possible to invest in this disorder? On what the Ministry of Energy of the Russian Federation hopes? But after all there are in Russia breakthrough innovative technologies which easily can replace all existing thermal power plants with the outdate antediluvian technology long ago, including PGU are fuel-free power plants which use the energy of environment (EE). So is not present supposedly as declared to Skolkovo that it destroys our knowledge of thermodynamics. Here also our domestic power industry dies away! And could be Leaders!

### ***At all power plants - incorrect standards***

The firm of Information Systems proved about incorrectness at all power plants of standard schedules and power characteristics of the equipment which are used in monthly calculations of TEP since they do not conform to requirements of expeditious information processing for the theory of integral calculus.

Nobody will object that the power plant is a difficult dynamic object with process production where on any small interval of time a certain amount of fuel is burned and a certain quantity of the electric power and heat is developed. And, on each interval of time always there is the actual expense of fuel and its standard requirement, and consequently also an excessive consumption of fuel, i.e. their difference. The monthly excessive consumption of fuel actually consists of the sum of overexpenditures on all these pieces.

From the theory of integral calculus it is known that, the there are less intervals of time, the calculation of nonlinear dynamic process is more exact. In power industry experts suggested to take for an optimum time span - half an hour. Thus, in a month from 30 days of such pieces - 1440. And now present, monthly calculation from half-hour calculations of an overexpenditure and specific fuel consumption will be how more exact.

And for especially mistrustful there is an axiom for the curvilinear schedule:  $f((x_1+x_2)/2)$  does not equal  $(f(x_1)+f(x_2))/2$ , at  $x_1$  not to equal  $x_2$ , i.e. function from the arithmetic-mean is not equal arithmetic-mean functions. In other words, when using a set of curvilinear standard schedules for calculation of specific fuel consumption on a monthly interval the excessive consumption of fuel, in comparison with its calculation by summation from half-hour calculations is obviously incorrect.

And now we will pass directly to curvilinear standard schedules. After all, if we showed that calculations of specific fuel consumption on a monthly interval are not right, this mistake even more considerably increases at increase in curvilinearity of schedules i.e. if the real schedules after test of coppers and turbines but which are not linearized (transformed to polynoms) are taken.

How it is possible, the real power characteristic of the equipment to straighten a polynom? It is very simple because MS Excel which was spread everywhere by the Ministry of Energy of the Russian Federation, works only with polynoms, and on another is not able. Yes, and the excessive consumption of fuel in monthly calculation is less, time the excessive variability of schedules is cleaned. Thus, technologists of power plants are deceived, involuntarily bringing incorrect curves in power characteristics of the equipment. From here also the mirage on economy of fuel is possible.

But it was so traditional when fuel was not saved. In the present time of TGC and OGK have to in general forbid to distort true characteristics of the equipment to please to "lame" programs of calculation of TEP.

The Smart-MES system, on the contrary, easily works with real standard schedules in real time, providing a true picture on an excessive consumption of fuel.

### ***Power plants with calculations of TEP live in the last century***

Today's situation with calculations of TEP (technical-economic indicator) on thermal power plants is similar to a situation as though you came to shop, and there the seller on bones counts to you delivery. MS

Excel which dominates practically at all power plants - is similar such account with bones.

In the letter No. 22-04-05-2611 of 03.06.2010 the Deputy Minister of Energy and housing and communal services of Sverdlovsk region I.N. Chikrizov according to JSC TGC-9 and JSC Engineering Center of Power Industry of the Urals tells the following:

"Now calculation of the actual and standard TEP at power plants of Sverdlovsk region is carried out with use of the PTO automated workplaces program complexes. The system offered by you is based on the same principles (calculation on an operational interval: 1 min., 30 min. and accumulation of information, i.e. "integral calculus") the accuracy of calculations can also really raise. However, the excessive consumption of fuel exists not because at power plants incorrectly make calculations of an excessive consumption of fuel in time, and owing to deviations of parameters and indicators of technological process from the standard because of deterioration of technical condition of the equipment in use. It is possible to lower an excessive consumption of fuel only due to elimination of shortcomings of operation, improvement of quality of repairs and maintenance, reconstruction and modernization of the equipment".

Here it is really possible to pervert any good undertakings! But after all similar dense nonsense stated us also the Ministry of Energy of the Russian Federation (the letter: No. 10-508 of 18.05.2010, No. 02-229 of 16.02.2011). But give quietly we will understand it in principle.

1) Statement: "Calculation of TEP is performed with use of the PTO automated workplaces program complexes". But at Sverdlovsk combined heat and power plant still use MS Excel. It is not a program complex, and simply a spreadsheet. And at one Perm combined heat and power plant few years ago so calculations in general were carried out to DOS (perhaps and still).

2) Statement: "The system offered by you really can increase the accuracy of calculations". But after all the speech that goes not about increase of accuracy, and that the existing monthly calculations in principle are incorrect since theories of integral calculus for dynamic processes completely contradict.

3) Statement: "The excessive consumption of fuel exists not because at power plants incorrectly make calculations of an excessive consumption of fuel". I of course not the technologist, but such could not think up. Actually the excessive consumption of fuel exists because exact current calculations are not made absolutely and the operational personnel does not possess operational information for prevention of this overexpenditure.

4) Statement: "The excessive consumption of fuel exists because of deterioration of technical condition of the equipment". The excessive consumption of fuel is equal to the actual expense minus a standard cost. But standards are revised each four years and completely correspond to current state of the equipment. So, fuel consumption really depends on wear of the equipment, and here an excessive consumption of fuel - no.

5) Statement: "It is possible to lower an excessive consumption of fuel only due to elimination of shortcomings of operation, improvement of quality of repairs and maintenance, reconstruction and modernization of the equipment". The only opportunity really to lower an excessive consumption of fuel consists in compulsory motivation of the operational personnel by means of expeditious monitoring on BCP of the current values of this overexpenditure.

That is why on all thermal power plants there are automated systems of the commercial accounting of the electric power and heat? Yes because it is money. And where the automated system of the commercial accounting of an excessive consumption of fuel? After all it not smaller money. If we live under capitalism, probably, have to consider and consider all. And that turns out as in a pan full of holes - how many do not pour, and the part all the same pours out. And the spent too much fuel is imperceptible, but constantly flows away from the budget of the Generation companies which is equivalent to 300 million rubles of annual losses on each power plant.

But after all in order that at power plant all was organic and would work for profit, it is necessary very little, i.e. to involve half-hour (better constant) calculations of the actual and standard TEP, including also an excessive consumption of fuel. On BCP (block control panel) monitoring in real time will provide to the operational personnel full current analytics of production. Then will fight simply elementary and against an excessive



consumption of fuel and against other losses and costs of own needs of the electric power and heat.

Modern power plants, even with the shabby equipment, without speaking already about PGU, are simply obliged to have innovative Smart-MES System, but not to be limited to worthless and incorrect monthly calculations of TEP.

### ***Mad world of power industry***

The System Integrator from Moscow addresses to us and says the following: "We have a Specification on automation of calculations of TEP of power plant, but ourselves were never engaged in it. Would like to learn, and your Program corresponds to this TZ (specification) on realization of economic-mathematical model at the level of foreign analogs?".

This is also real "madhouse". It to what the market power industry came that already uses services of nonspecialists in specialized IT. Here only as to such organizations these TZ get? What it is corruption schemes or absolute indifference to results of introduction of IT?

It is equivalent as though the large mechanical plant which before anything similar did not do undertook to make the rocket. But it large, and the rocket is made of metal. Nonsense! And here with software so it is possible to arrive. It at us is so accepted that all - singers, all - musicians, all - doctors and everything, familiar with the computer, - developers and implementers of software for power plants. In this case the vocational school and experience do not matter. Well, on similarity with MS Excel supposedly take and sew up calculations of TEP (technical-economic indicator). Here and all automation! That difficult?

First, in Russia from 300 power plants is not present even 2nd similar on technology and structure of the equipment therefore the universal economic-mathematical model in principle cannot be. Secondly, it in general incorrect now formulation of the purpose of automation of calculations of TEP.

Tell, this automation in market conditions why is necessary? And anybody distinctly will not answer. For example that supposedly it is necessary to watch key parameters of TEP. Well, and that you can make by

results of calculations for last month, even for last days and it is simple anything. And here, when the elementary purpose on providing a zero excessive consumption of fuel in real time which is a specific and clear objective moves forward, for some reason all avoid it.

And now to a question of model. Model of a copper or model of the turbine it is naturally possible to describe and program mathematically all processes which happen inside. But what for? it is not necessary For economy. For this purpose it is necessary to use the principles of "a black box", i.e. there are input and output parameters and that there is not an essence important inside. We after all as a result need mathematical model of all power plant.

Now to a question of foreign analogs, they for achievement of a zero excessive consumption of fuel simply are not present. And that is, it only on similarity of MS Excel with SQL a database. So that we do not respect ourselves and we "slobber" on the western software.

Abroad absolutely other attitude towards technologies of power plants and, therefore, to software for them. And we have absolutely other country. Here if in Russia 300 identical power plants, then another matter would be constructed. And so, each power plant, new experiment with a binding to the district.

Our Innovative Self-organizing Smart-MES System with huge opportunities on the speed of calculations, on adaptability and on functionality far advances foreign analogs for power plants. After all even if at power plant concrete algorithms of calculation of the actual and standard TEP are also unknown, our Smart-MES itself will perfectly generate basic option of calculations, according to techniques of ORGRES Firm.

Our Smart-MES carries out the general calculation of 20000 indicators for 1 second that allows for half an hour in real time on the dynamic optimizer to count over 1000 technological options of management of power plant and on minimax strategy to find optimum option of loading of the equipment. Also on full model of power plant it is possible to form any number HOP (characteristic of relative prirost) and to analyze various production situations.

Our Smart-MES allows to submit various technological schemes and production reports in the combined combination.

Our Smart-MES allows to debug elementary technological calculations directly for digital values, easily jumping from one task to another forward and back. It is important not only during primary formation of calculations, but also at the time of further modification by the user. And calculations in text Projects have a usual engineering appearance with writing of indicators in the habitual for technologists structured look.

Our Smart-MES provides instant formation of any analytics: daily in a section of half an hour, monthly in a section of days, monthly in a section of watches and annual in a section of months. All this easily becomes absolutely without preliminary preparation. For this purpose it is enough on a screen form of a task to note a line with the interested parameters and to press the button. At your service to be submitted the full magazine and the schedule.

Our Smart-MES, thus, solves all problems on automation of calculations of TEP and on optimum control of power plant.

### ***To power plants Smart-MES is time to arm***

Vladimir Putin signed the government resolution regulating the relations between consumers of the electric power and power supply companies, providing cancellation of collection of penalties for an electric power shortage which led to unjustified excess profit. And actually the nonsense turned out: I, for example, being guided by the principles of energy saving, I try to save the electric power, but I for it am assessed with penalties. Nonsense and only which was corrected at last.

But let's look, than it threatens the Generation companies. Existence of penalties for an electric power shortage earlier involuntarily smoothed the general electric loading in a network which positively affected and the Generation companies since the less its unplanned change, the is less and an excessive consumption of fuel thermal power plants.

Therefore, now with elimination of these penalties unevenness of electricity consumption will strongly increase that will inevitably cause still bigger increase in an uncontrollable excessive consumption of fuel i.e. if

the overexpenditure everywhere was at the level earlier of 10%, now the sizes of increase in future this excessive consumption of fuel difficultly to predict even. But that the profit of the Generation companies will surely decrease is an indisputable fact.

And the exit that of this situation is very simple and it lies on a surface. It is necessary to involve elementary urgently at all power plants the accounting of an excessive consumption of fuel in real time with half-hour intervals, i.e. to arm with Smart-MES Systems. Then at the operational personnel to appear the compulsory motivation on economy of fuel and Putin's resolution will be painless for the Generation companies.

But also it is not enough. The generation companies at the expense of a complete elimination of an excessive consumption of fuel will be got in addition on 300 million rubles of annual profit from each thermal power plant.

Today's humorous situation of both thermal, and nuclear power plants is easily compared to a near last condition of passenger vehicles when many because of patriotism preferred domestic Volga instead of import to the Car which besides and is much dearer. But gradually the majority clear that for big money it is better to have worthy "frills" and not to hang with repairs. Thus, Volga on roads almost disappeared.

And the Generation companies will understand soon and will understand that it would be time to get rid of antediluvian MS Excel and other programs of monthly calculation of TEP and to pass to half-hour calculations in real time of the actual and standard TEP, including also an excessive consumption of fuel. In this case the power plant will be able to carry out delivery of the electric power and heat with the most minimum fuel consumption at its zero overexpenditure.

Mentality of Russian and actually lazy person, apparently, that it is always necessary at random that supposedly everything somehow will resolve. Well, why tell to invest money in some Smart-MES when and so the power plant works? But after all much to astonishment of also the Russian Generation companies with the foreign capital also think. Business here not in the Russian mentality, and in something another means. And I think that it is simply general backwardness on the relation in general to

information industrial technologies, and in other words: time of computer toys is now simple.

I remember, once there was a boom of optimizing tasks in the industry. And now they are necessary to nobody. And the commercial account that of the electric power and heat at power plants is most of all connected with the market since it is available and clear. But here that such the commercial accounting of an excessive consumption of fuel it is clear to nobody and anybody it and does not wish to understand since now at power plants there are no persons interested, to climb from skin for enrichment of management of the Generation companies.

But in the management that of these companies too is a little enthusiasm since money that will be spent for introduction of Smart-MES, and whether here the operational personnel will watch and react actually in real time for the current excessive consumption of fuel. It is actually big question. Here to you and a justification that to do nothing for increase in energy efficiency.

The Ministry of Energy of the Russian Federation also took a third-party position, and it after all the state level to which did not stick to wave away, as from importunate flies since it is urged to observe the all-Russian interests. But after all the all-Russian vector is directed according to instructions of the Russian President on increase in energy efficiency.

It turns out that the Ministry of Energy of the Russian Federation shamelessly evades from instructions of the President. How to regard it? Elementary bureaucracy? But, when one and a half years, despite of positive results, the Ministry of Energy of the Russian Federation wave away from No-cost Technology of decrease in fuel consumption of power plants, involuntarily think: Why?

Yes because it did not put the Ministry of Energy of the Russian Federation to push Smart-MES System. And here to approve without fail for reliability of an energy audit half-hour calculations of the actual and standard TEP, including also an excessive consumption of fuel, it is a direct obligation of the Ministry of Energy of the Russian Federation. We insist on it, and we will insist.

Or the Ministry of Energy of the Russian Federation has to be reasoned, with involvement of branch institutes, refute the theory of integral calculus of the area of dynamic process in time for calculation of an excessive consumption of fuel of power plants.

### ***Half-hour calculation of TEP of power plants***

Half-hour calculation of the actual and standard TEP (technical-economic indicator) deserves special attention since it is intermediate between minute and daily calculations. It, naturally, yet not Smart-MES which operates with minute intervals, but in real time these calculations allow to watch an excessive consumption of fuel.

Half-hour calculations are less categorical to the automated collecting basic data and can be quite realized at their partial automation, i.e. in the presence of ASKUE, ASKUT and ASKUG. Missing basic data are supplemented in the program way with their transformation from the previous daily values or by means of regression dependences. Half-hour calculations of TEP can be easily realized at any power plant.

If to speak about daily calculation of an excessive consumption of fuel for formulas, it in principle is incorrect and the more so monthly calculation is quite misleading. It is connected with use of curvilinear standard and power schedules and existence of threshold conditions in algorithms of calculation. Therefore the excessive consumption of fuel on daily and monthly intervals has to turn out only summation of half-hour values, and specific fuel consumption have to turn out only so-so weighing.

Now we will open in more detail why monthly calculation of an excessive consumption of fuel for formulas is incorrect. It pays off on the following dependence:

$$dB = B_{fakt} - B_{norm} = B_{fakt} - (E_{fakt} * b_{e\backslash norm} + Q_{fakt} * b_{q\backslash norm}) / 1000$$

Here specific standard costs of fuel for the electric power and heat ( $b_{e\backslash norm}$ ,  $b_{q\backslash norm}$ ) pay off with use of one hundred standard schedules. But for simplification it is representable that they turn out from one curvilinear function  $b = f(x)$  averaging.

Thus, for monthly calculation:  $b_m = f(\sum(x_i)/n)$ , and at half-hour calculations:  $b_p = \sum(f(x_i))/n$ , i.e. for monthly calculation basic data are

averaged, and then calculation is made, at half-hour calculations at first calculation on each half an hour is made, and then averaging is carried out.

But  $bm \nless b p$ , i.e. they are not equal. Also there is a fair question and which the option is more reliable:  $bm$  or  $bp$ ? Logically it, naturally,  $bp$ . And same you will be told by any competent engineer and the scientist. Then the excessive consumption of fuel has to pay off, as the sum of half-hour overexpenditures. It is also taught also by the theory of integral calculus of the area of dynamic process in time. And the intervals of calculation it is less, the result is more exact.

But why the Ministry of Energy of the Russian Federation does not take this fact seriously? After all as a result of it two very important problems mask. The first it that this calculation is simply incorrect and hides a 10% excessive consumption of fuel because of universal adjustment that on average on each power plant is equivalent to annual loss in 300 million rubles. The second it that completely there is no opportunity in due time to interfere with production for the purpose of elimination of this excessive consumption of fuel.

And now we will consider that can essential introduce half-hour calculation of TEP to all categories from the operational personnel of power plant before management of the Generation company.

1) **PTO of power plant.** PTO (technological department) is exempted from routine work on adjustment of the end results under a zero excessive consumption of fuel since the huge initial overexpenditure, thanks to efforts of the operational personnel will be liquidated in gradually natural way. At Employees of PTO will be more time to deal with logistics issues on optimization of losses and costs of own needs of the electric power and heat.

2) **Operational personnel.** Thanks to compulsory motivation by means of operational analytics on an excessive consumption of fuel which represents monitoring on BCP (block control panel), the operational personnel with open eyes operates technology and due to achievement of the progress on fight against an excessive consumption of fuel has the raised award. In this case really interested competition between watches for achievement of the best results is developed.

**3) Management of the Generation company.** In this case, naturally, management wins most of all since has additional annual average profit from each power plant in 300 million rubles due to reduction of expenses of fuel for 10%. But also harmful emissions in the atmosphere also are reduced by 10%. All this will positively affect and investment climate, and image of the Generation company.

Thus, benefit everything from realization of half-hour calculation of TEP (technical-economic indicator), except competitors. But, if competitors realize constant calculations of the actual and standard TEP, so and an excessive consumption of fuel, they, naturally, will be in the lead because they will start full-scale Smart-MES System which will make for them still big profit due to exact forecasting of purchases of fuel.



## **5. The electrical power Etude in crimson tones**

---

In electricity generation and heat the most important is the Person. And the Person who is interested in high-quality performance of the duties at worthy payment of the work. Before reorganization of power industry quite so also was. But now it absolutely not so. Now, when investors do not have enough profit, to speak about a worthy salary of employees of power plants in general simply excessively. Therefore at such very low compensation and in the absence of social security the elementary formalism in work and absolute lack of initiative prospers.

Power plants are, as a rule, located in regions where with specific specialty it is simple to highly qualified personnel not to find work in other place. Here also they are compelled to vegetate at power plant, without having neither a sincere, nor creative rush. Therefore they are not interested at all in introduction of innovations since from it comes the way nothing of them. Therefore they are not interested in economy of fuel especially as at one power plant there is no operational accounting of an overexpenditure (FACT - STANDARD) this fuel at all. Therefore the situation when the head of group of the accounting of PTO says to the chief is possible that the new program will not master without increase in the salary, and the head of the technical engineering department can make nothing since it has no other people and difficultly to find.

But all paradox of the market relations that always there are contradictions of those who wishes to be enriched with release of the production, and those who does not wish to pay high price for this production. And power engineering specialists constantly seek to increase tariffs for the electric power and heat because of the growing fuel price. But the people categorically protest to this impetuous growth of tariffs. Therefore in the people there is a constant protest mood developing into the mass conflict with which the Government of the Russian Federation is compelled to interfere.

Well and as it is possible to believe justifications of increase of tariffs by the Generation companies when they at one power plant have no elementary current operational accounting of an excessive consumption of

fuel. When mismanagement of power plants is impudently shifted to shoulders of consumers of the electric power and heat. When branch institutes absolutely incorrectly claim that if the excessive consumption of fuel and is, it is result of big wear of the equipment. When the Ministry of Energy of the Russian Federation categorically snubs Innovative No-cost Technology of economy of fuel of power plants on the Self-organizing Smart-MES System.

Certainly, the Generation companies, something try to do for economy of fuel by introduction of automation of calculations of TEP. But they use outdated techniques, and it do absolutely without economic justification. What optimization of resources, when can give an elementary excessive consumption of fuel - result of a human factor? The operational personnel operates power plant regarding an excessive consumption of fuel simply blindly.

But after all there is an exit for increase in profit to investors and for increase in a salary to employees of power plants is an introduction of Smart-MES System which allows to increase profit of power plant by 300 million rubles by elimination of a 10% excessive consumption of fuel. For this purpose the half-hour accounting of this excessive consumption of fuel with its expeditious monitoring on BCP is only necessary.

For example, if at you in a pocket the hole was got, and you poured out a trifle there, surely through this hole the part of a trifle will irrevocably filter. And at all power plants there are huge black holes where it is useless a lot of fuel since the accounting of its overexpenditure is absent fails. And all helplessly turn away from this mismanagement instead of it is simple to take and patch this hole. But all are let in type reasonings that it cannot be because it can be never. And the elementary mathematics shows the absolutely return that black holes exist and it is necessary to reckon with it somehow, well and to fight.

And to investors instead of selling assets, it is necessary to roll up sleeves better and to bring an order at the power plants. On them it is necessary to create compulsory motivation on economy of fuel by means of Smart-MES System with an indispensable condition of the subsequent remuneration. Then all will be happy both employees of power plants, and

investors. Then the creative aura will revive, and for work at power plants turns of persons interested will be built again.

As the classic said: "Standing situation is not present. If you do not go forward, you move back" [20] back. In the present time all power industry with all thermal power plants moves back back, thus covered all with the crimson spots caused by indifference and a devil-may-care attitude from management of the Generation companies and the Ministry of Energy of the Russian Federation to a problem of a huge excessive consumption of fuel.

Of course, it is possible to ignore further these problems and even more strongly to flush thus since conscience that all the same is, all the same there is a fatherlike aspiration to remove the Russian power industry in front lines. At one forum it was declared: "We examined your System, but Japanese it is better". Here so ... Came ... Naturally, authors of this slogan in our Smart-MES System could not realize all depth of innovations, but the blind worship for any import is available.

### ***The consciousness of power industry has to wake up***

On the Internet article is published: "Modernization of power industry was estimated at 11 trillion" [21]. I give only two endurance:

- Modernization of the Russian power industry demands investments in the volume of 11,1 trillion rubles till 2020. The press service of the Ministry of Energy of the Russian Federation reports about it. Department reported that on August 22 at a meeting of the government the concept "Programs of modernization of power industry for the period till 2020" was submitted.

- The reform of domestic power which came to the end in 2008 with the section of RAO UES of Russia was carried out successfully, however for the last five years there was a double increase in prices for energy, thus reliability and quality of service of consumers did not improve. Besides, private investors, having been disappointed in the investments (the state limits tariffs, making investments into power less attractive, than the private capital would like), began sale of the power assets that turned out to be consequence, in particular, of inefficient regulation.

From this follows that the State itself intensively plans modernization of power plants, probably without having waited for it from the Generation companies, and owners of the Generation companies sell assets because of small profit. But notice, nobody wishes to double quickly in the elementary no-cost way this profit by a simple method of the accounting of an excessive consumption of fuel. And in the Program of modernization control in real time of this current excessive consumption of fuel is also not put. Here to you and modernization! It turns out: we will build new power units, and we will not consider an excessive consumption of fuel!

In presentation "Development of power industry of Russia for the period till 2020" [22] academicians of the Russian Academy of Sciences of E.P. Volkov the effect from capital investments is given to generation of 73 billion rubles. But introduction of No-cost Technology of economy of fuel across all Russia will allow to have effect of 100 billion rubles quickly. And this Technology is ignored persistently. Probably this consciousness still cannot wake up in any way, and continues to sleep, as well as fell down in days of socialism.

But the basic principle of capitalism is a strict universal accounting of everything. And at us at all 300 power plants one of the most important criteria of energy efficiency - an excessive consumption of fuel still is not considered (FACT - STANDARD):  $Bf - (b_e \cdot n_r \cdot E_f + b_q \cdot n_r \cdot Q_f) / 1000$ . Yes, it is present at monthly reports, but generally pro forma. Monthly calculation of an excessive consumption of fuel for a formula in principle is incorrect according to the theory of integral calculus of the area of dynamic process in addition it everywhere is exposed to various adjustment because of fear to lose an award. The monthly excessive consumption of fuel has to be only summation of minute or half-hour excessive consumption of fuel.

Why it is necessary to write tens Addresses to all highest authorities that the power industry at last woke up and started saving fuel? Why the elementary moments by the correct calculation of an excessive consumption of fuel simply categorically already on a threshold are rejected in the Ministry of Energy of the Russian Federation? Why branch institutes and big army of scientists-power engineering specialists does not even wish in general to this simplest question: - to pay to fast increase in

energy efficiency of power plants attention? Why the Russian power industry in the matter represents one huge "bog"?

Only once the Ministry of Energy of the Russian Federation positively reacted to our addresses. In the letter from Department of the state power policy and energy efficiency of the Ministry of Energy of the Russian Federation of 27.10.2010 signed by the Deputy director O. P. Tokarev it to be told to No. 02-1400: "The Ministry of Energy of the Russian Federation reports about readiness to return to consideration of a question of prospects of the technology offered by you after representation to the Ministry of Energy of the Russian Federation of the detailed feasibility study".

In a week we sent in the Ministry of Energy of the Russian Federation the Feasibility study on Technology of increase in energy efficiency of power plants (economy of fuel) on MES-T2 2020 MES System. And what? More than a year passed also any reaction. It of course is not serious for the Ministry of Energy of the Russian Federation. This also characterizes bogginess of power industry.

It is clear that at us in Russia any innovative idea should be punched. But that is why introduction of No-cost Technology of economy of fuel does not get a response among the Generation companies which undergo not the best times because of low profit? But after all it is enough to bend down and lift annual profit from each power plant in 300 million rubles which are provided easily by our Technology.

Is it already time for consciousness of power industry to wake up and turn facing energy saving innovations. Problems of economy of fuel by electricity generation and heat have to be on the first place in power industry. And the complete elimination of an excessive consumption of fuel - on the very first place especially as this overexpenditure which on all thermal power plants there correspond more than 10%, does not depend on wear of the equipment, and completely is a consequence of an uncontrolled human factor.

### ***Effect of the become torn BOMB in power industry***

When the bomb, surrounding people blows up, as if it cynically did not sound, having simply gone mad, run and do not understand that

occurred. And back already you will return nothing that. And it is unimportant, or it was act of terrorism, or simply disorder. But it is possible to try to suppress this unpleasant fact if the management is mixed from the public.

It seems that such tactics was also chosen by the Ministry of Energy of the Russian Federation when in every possible way interferes with recognition of emergence of No-cost Technology of economy of fuel of power plants on Smart-MES System which as if the become torn BOMB of all took unawares and shipped in a stupor. Here all bureaucratic tricks are used. Here to you and MES System at all not of MES, here to you and the law interfering it to recommend to the Generation companies, you and lack of sensors here.

After all ridiculously it turns out that for implementation of the commercial accounting of the electric power and heat sensors quickly were, and here for the commercial accounting of an excessive consumption of fuel of sensors it is impossible to find. And even write that supposedly it is not profitable. It turns out, excess fuel uncontrolledly to burn it is profitable, and to save it in real time - is not profitable.

Probably, in the Ministry of Energy of the Russian Federation all froze with horror when understood (or did not understand yet) that so many years calculation of TEP was incorrectly made. Same, how many it is useless excess fuel burned down for many years and who will be responsible for it? Therefore the most rested tactics in the Ministry of Energy of the Russian Federation which sounds very simply was shown: NOT TO LET.

But let's consider an essence of this BOMB on the example of calculation of an excessive consumption of fuel thermal power plants in two options: as now and as has to be, proceeding from the theory of integral calculus for dynamic process what electricity generation is and it is warm.

1) The MISCALCULATION monthly absolutely which is made now at all 300 power plants of Russia:

$$dB = B_f - B_{nr} = B_f - (E_f \cdot b_e \cdot n_r + Q_f \cdot b_q \cdot n_r) / 1000$$

where: dB - an excessive consumption of fuel in a month (here - t. conditional fuel); Bf - the actual fuel consumption in a month (here); Bnr - a standard cost of fuel in a month (here); Ef - give of the electric power in a month (Mvt\*ch); be\nr - specific expenses of fuel on the electric power in a month (kg / Mvt\*ch); Qf - give of heat for a month (Gcal); bq\nr - specific expenses of fuel on heat for a month (kg/Gcal).

Thus, as a rule, at all power plants of dB < 0, i.e. the imaginary economy of fuel is fixed.

2) Monthly absolutely CORRECT calculation which originally has to be made on each minute or half-hour interval (i):

$$dB = \text{SUM} [dBi] = \text{SUM} [Bif - Binr]$$

$$dB = \text{SUM} [Bif - (Eif*bie\nr + Qif*bq\nr)/1000]$$

Thus the condition surely has to be satisfied: dBi > 0 i.e. it means that it is better to work, than is offered standards it is impossible. And the fact of emergence of that dBi < 0, speaks only about incorrect algorithms of calculation. Therefore, dB = SUM [dBi] >> 0, i.e. is much more zero, so, there is very big excessive consumption of fuel.

SUMMARY: The statement that on half-hour intervals calculation will be really more exact, than on monthly, quite misleading. How it can be, if by the second option dB >> 0, and on the first dB < 0? In this case pertinently to tell that it is absolutely different results, and, therefore, and different calculations which correspond to different technologies.

Here that also consists in it the BOMB which already blew up and it is necessary to reckon with it. The catalepsy and horror will go to the Ministry of Energy of the Russian Federation soon, and it is already necessary to adjust in a new way life in power industry. It is necessary to consider by all means stubborn realities of today, it is necessary to solve something with a universal excessive consumption of fuel which annually across Russia correspond to 100 billion rubles.

But in today's market conditions the second option of calculation of an excessive consumption of fuel is valuable the efficiency and timeliness of detection of this fact which can easily be eliminated, achieving thereby

minimization of fuel consumption through compulsory motivation of the operational personnel by means of monitoring of TEP on BCP.

If the Ministry of Energy of the Russian Federation directly also cannot influence the Generation companies in a choice of technology of calculations of TEP, but demand them correctness in elementary mathematical sense it simply its duty. And differently simply you wonder, what level at branch institutes experts when missed such elementary thing work, and to be answerable to have for all existing fictitious calculations for fuel usage of power plants with elements of adjustment of the Ministry of Energy of the Russian Federation.

Whether the Ministry of Energy of the Russian Federation is time to look at the offered No-cost Technology of economy of fuel sensibly, but not to wave away, as from importunate flies. In it all power industry of Russia will only win.

### ***Archaic calculations of TEP PTO of power plants***

Traditionally standard TEP (technical-economic indicator) pay off in PTO (technological department) of power plants generally on a monthly interval which are necessary for definition of standard specific fuel consumption on the released electric power and heat. All comedy of these calculations which operate with a set of power characteristics of the equipment, that they in principle are necessary to nobody since they are absolutely simply useless.

And after all with a serious look the whole group of the account in PTO of each power plant which employees besides are not happy with a low wage is engaged in this calculation, interfering because of it with introduction of new perspective software products. But after all in PTO this group of the account is not necessary at all and calculations in such view with adjustment elements under a zero excessive consumption of fuel especially are not necessary.

The excessive consumption of fuel ( $\Delta B$ ) corresponds to a difference of the actual fuel consumption ( $B_f$ ) and standard ( $B_n$ ). And, the standard cost equals to the sum of the standard costs of fuel on power generation ( $E_f$ ) and heat ( $Q_f$ ) calculated by means of standard specific fuel consumption on the electric power ( $b_{ne}$ ) and on heat ( $b_{nq}$ ).



$$dB = B_f - B_n = B_f - (E_f \cdot b_{ne} + Q_f \cdot b_{nq}) / 1000$$

Thus, calculation of an excessive consumption of fuel with use of 20000 initial and intermediate indicators, and also 300 standard schedules, is reduced to calculation of standard specific fuel consumption of  $b_{ne}$  and  $b_{nq}$ . But if as a result of simple frauds the excessive consumption of fuel becomes equal to zero value, i.e.  $B_f = B_n$ , this calculation is not necessary at all. And, therefore, power characteristics of coppers and turbines which turn out in the course of their tests are also not necessary.

And as for calculation of specific fuel consumption, they elementary turn out in one arithmetic action. And here what science it is not necessary, and it is not necessary difficult calculations for PGU and for GTU, and it is not necessary to consider wear of the equipment, and it is not necessary to consider losses and costs of own needs of the electric power and heat, and it is not necessary to consider various overflows of superheated steam. But the most important it that PTO in general is not necessary. This formula:

$$b_{ne} = 1000 \cdot B_f / (E_f + Q_f \cdot k), \text{ where } k = b_{nq} / b_{ne} = \text{const}$$

Agree that more simply and more honestly incidentally to calculate value  $k$  which is rather stable for concrete power plant, than constantly uselessly to stir a heap of calculations and to be engaged in shamanism for zeroing on paper of a huge excessive consumption of fuel, deceiving thereby the Management of the Generation companies.

Here that situation which exists practically at all power plants in Russia is described. And it means that with such archaic approach for achievement of the western power efficiency to us, as to the moon. All appeals from a high tribune for economy of energy resources simply safely sink in the Russian indifference. After all as it is possible to save fuel resources if plainly anybody and never reflected on a true excessive consumption of fuel at power plants since at one combined heat and power plant and state district power station there is no elementary operational accounting of this overexpenditure.

Besides, this concept "excessive consumption of fuel" of power industry simply does not exist. There is a thought-up "economy of fuel", is "burned through fuels". But burned through fuels there is no overexpenditure since burned through there is for the technological

reasons, and an overexpenditure - because of a human factor since the operational personnel regarding the current excessive consumption of fuel operates power plant simply blindly.

On social networks on my publications power engineering specialists claim that the excessive consumption of fuel in general interests nobody and after reorganization of power industry now at many power plants power characteristics of the equipment and standards are not true. Therefore, authentically it is simply impossible to calculate an excessive consumption of fuel.

There is a wish to object to it to the following. Not the fact of an excessive consumption of fuel, and possibility of minimization of expenses of fuel is interesting to the management of the Generation companies. But constant calculations of the actual and standard TEP on Smart-MES System which can easily be realized and with outdated standard schedules are for this purpose necessary.

It looks very simply. It is known that at the maximum loading of power plant in the afternoon the excessive consumption of fuel is close to zero. Therefore we for a day interval the received maximum settlement excessive consumption of fuel in a minute will present amendments (P) in the form.

$$P = \max (B_{fi} - (E_{fi} * b_{nei} + Q_{fi} * b_{nqi}) / 1000)$$

Then for night hours at the lowered loading of power plant when the greatest excessive consumption of fuel is observed, it pays for a minute as follows taking into account the amendment on outdated standards:

$$dB_i = B_{fi} - (E_{fi} * b_{nei} + Q_{fi} * b_{nqi}) / 1000 - P$$

And the excessive consumption of fuel pays for days integral calculus as it and is necessary for dynamic process of power plant:

$$dB = \text{SUM} (B_{fi} - (E_{fi} * b_{nei} + Q_{fi} * b_{nqi}) / 1000 - P)$$

In this case in the presence of constant calculations of an excessive consumption of fuel it is possible to submit the daily schedule in a section of half-hour fuel consumption that will allow to see visually reserves of economy of this fuel, and, therefore, and reserves of increase of energy

efficiency of power plant. After all when monitoring with these current schedules is presented on BCP, the operational personnel will have forcedly compulsory motivation on economy of fuel. Also absolutely easily it will also be objectively possible to reveal quality of work of the competing watches.

But the most important that correctly calculated excessive consumption of fuel is the main and quite sufficient integrated criterion of energy efficiency of combined heat and power plant and state district power station since it considers all technological moments of work of power plant, including losses and costs of own needs of the electric power and heat. Even the current efficiency of coppers and data on harmful emissions in the atmosphere are also considered in a total excessive consumption of fuel.

But why it is not wished to be understood persistently neither in the Ministry of Energy of the Russian Federation, nor at branch institutes, in the Generation companies? It is clear that at all levels there is an elementary pulling of "rope". But after all there is at all a uniform aspiration to lift domestic power industry on new qualitative level. And it is not possible with the available archaic calculations of TEP PTO since expeditious constant calculations of TEP with use of easy and adaptive and high-speed Smart-MES System are for this purpose necessary at all. Only then it will be possible to see with open eyes real technological process from a position of expenses of fuel.

***Without Smart-MES System the Russian power plants will be always less effective the foreign***

Here, at last, Medvedev again strenuously agitates all for "the Soviet Power", i.e. for energy efficiency. He claims that all economy of Russia loses due to the lack of introductions of power effective technologies much. Probably, the economy on bulbs did not yeild tangible result. And to Skolkovo marking time. And in ASI (Agency of Strategic Initiatives) of anything traveling does not become. In all these "offices", including and the Ministry of Energy of the Russian Federation, short-sighted officials who officially bounce all power effective Innovations vegetate, snubbing on a root all good aspirations.

Strange the picture seems. At the highest levels created various "circles" on interests concerning energy efficiency which, probably, successfully mill among themselves the allocated huge financial resources on introduction of imaginary power effective technologies, and from third-party do not admit anybody there and it is close. There are various structures and the sites on the Internet on energy efficiency at the Ministry of Energy of the Russian Federation, but there not to break. So from where to undertake this energy efficiency? Probably, only from "dampness". And this owns "a crude mold" all positions and in the Ministry of Energy of the Russian Federation, and in the Generation companies, and at power plants.

Why abroad energy efficiency of power plants is much higher, than on the Russian. It is possible to nod of course on big wear of the equipment and to calm down it. But how then to explain that on new power units an excessive consumption of fuel more than 10%. The reason is covered only in a human factor of an indifference which took root in power industry by means of the Ministry of Energy of the Russian Federation and branch institutes of ten years.

And very simple proof to it is absence of the major Criterion of energy efficiency, namely an excessive consumption of fuel, in the monthly reporting of power plant on thermal profitability of the equipment - the Model 15506-1. There appears 121 indicators. There is also an excessive consumption of fuel oil, and the excessive consumption of the main fuel is not present. That it, if not conscious and criminal concealment of reserves of increase of energy efficiency.

Everything is very simple. In monthly calculations this indicator on an excessive consumption of fuel (Fact - Standard) is used only to reduce balance between the actual fuel consumption and standard, i.e. to adjust their difference to zero for calculation of convenient specific fuel consumption. But actually the actual fuel consumption always much more the standard. And time so, this uncontrollable excessive consumption of fuel it is possible to see in real time every minute and, therefore, to liquidate it, having provided thereby economy of fuel across Russia for the sum of 100 billion rubles.

After all if it is told about increase in energy efficiency of all industry of Russia, first of all it is necessary to make surely power effective

thermal power plants and to use all Innovative technologies for this purpose. After all from power plants there is an initial price of electricity and heat.

But actually very unattractive picture with advance of the most perspective Technology of economy of fuel of power plants on Smart-MES System which abroad in other appearance and successfully works long ago turns out, allowing to consider all losses in real time. Therefore also energy efficiency of power plants in the West is much higher because there got used to consider everything. But our domestic Smart-MES "MES-T2 2020" System considerably in all respects surpasses foreign analogs therefore also efficiency from its introduction will be higher that will create real prerequisites in a new way to organize electricity generation at power plants and is warm.

But bureaucratic obstacles of the Ministry of Energy of the Russian Federation and backwardness of views of IT technologies of the Generation companies dully and harmfully interfere with rise in energy efficiency of domestic power industry. It is possible to call as much as necessary all from a high tribune for economy of energy resources but if in the same place above for this purpose anything traveling does not become, it looks everything, at least, ridiculously.

And that for this purpose is not enough. Accurately to state in the law No. 261-FZ for power plants that the main criterion of energy efficiency is the fuel indicator (Fact/standard) which has to be calculated in real time every minute. Thus every minute this criterion cannot be less than 1 (the economy does not happen), otherwise or standards not true, or the algorithm of calculation is not right. Thus, by power effective power plant that at which the monthly fuel criterion is equal 1 can be recognized, but thus the standard cost of fuel surely has to turn out summation of all constant standard costs. Here then we will also be able to compete with the West!

### ***Mysterious Riddle of Power industry***

After reorganization of power industry new structures of OGK and TGC continue to treat a problem of a big excessive consumption of fuel more than cool. Why?

The excessive consumption of fuel is a difference of the actual and standard expenses. The standard cost of fuel is ideal, i.e. indisputable, naturally, on condition of fidelity of algorithms of calculation. But if algorithms of calculation are made, as a rule, by ORGRES Firm, that to doubt their correctness, the bases are not present.

The person cannot operate power plant better than the optimum or standard modes. Therefore, the economy of fuel in principle cannot be, i.e. the fact is always more than standard.

And now two questions:

**The first:** Why in the Model 15506-1, characterizing energy efficiency of power plant and consisting of 121 indicators, the Excessive Consumption of Fuel parameter in general is absent, how absolutely not significant?

**The second:** Why on all thermal power plants the small economy of fuel appears in monthly reports?

The answer is very simple. Value of a big excessive consumption of fuel suits nobody because as to fight against it, nobody knows. There were no Smart-MES Systems earlier, and calculations were conducted in MS Excel therefore half-hour calculations of an excessive consumption of fuel for operational analytics and optimum control were not achievable.

Now similar situation by inertia remains. OGK and TGC did not deal with priorities yet. They start grandiose development of Mathematical Models. But there is an impression that it is caused only by desire to feed up pocket firms.

And what will be with an excessive consumption of fuel? Here in it that is also the most mysterious riddle. But the Ministry of Energy of the Russian Federation withdrew from regulation of these problems.

But the question that does not cost the eaten-away egg since this problem is so easily solved. It is enough to introduce the developed innovative Smart-MES System and all issues with an excessive consumption of fuel will be instantly positively resolved since the reason is covered only in a human factor.

## **6. The Smart-MES system liquidates fuel theft**

Now management of thermal power plants is made only on give of the electric power and on give of heat, i.e. there are operational feedback on the electric power (to  $d_{ei} = E_{fakti} - E_{plani}$ ) and on heat (to  $d_{Qi} = Q_{fakti} - Q_{plani}$ ).

And here operational feedback on the current expenses of fuel ( $d_{Bi} = B_{fakti} - B_{normi}$ ) is absent at all power plants that conducts to an uncontrollable excessive consumption of fuel more than for 10%, and it corresponds to annual average losses on each power plant in 300 million rubles or across all Russia in 100 billion rubles.

But we will consider other hypothetical situation. That if all this fuel of 100 billion rubles across all Russia is not lost anywhere, i.e. no excessive consumption of fuel at power plants is present, and it is "stolen" simply elementary.

All power plants traditionally report monthly calculations of TEP where there is no excessive consumption of fuel in general, i.e.  $B_{fakt} - B_{norm} = 0$ . Here standard costs of fuel ( $B_{norm}$ ) in a month pay off on formulas with use of the data which are saved up in a month that in a root methodologically is not true because of curvilinearity of standard schedules. Besides, that the excessive consumption of fuel really was zero, monthly calculation is very simply adjusted.

Actually the excessive consumption of fuel in a month looks as follows:

$$B_{fakt} - \text{SUM}(B_{normi}) = 0.1 * B_{fakt},$$

where  $B_{normi}$  - a standard cost of fuel on a half-hour interval of time.

The fact of an excessive consumption of fuel in a size ( $0.1 * B_{fakt}$ ) is elicited from practical introduction of Smart-MES System at combined heat and power plant with the power unit PGU.

Let's assume that competent unique technologists work at power plant, and they really do not allow an excessive consumption of fuel, and

expenses of fuel half an hour is constant for everyone correspond to strictly settlement standards (if it not so, a situation in power plants really very deplorable).

Then it is possible to write down:

$$B_{\text{fakt}} - B_{\text{zatr}} = 0.1 * B_{\text{fakt}},$$

where:  $B_{\text{fakt}}$  - the actual expenses of fuel according to reporting documents or Botch, and  $B_{\text{zatr}}$  - the actual valid expenses of fuel.

But that then is:  $0.1 * B_{\text{fakt}}$ ? And it just corresponds to unaccounted or simply stolen fuel ( $V_{\text{vor}}$ ), i.e.  $B_{\text{otch}} - B_{\text{zatr}} = B_{\text{vor}}$ .

In other words, the power plant reports for fuel according to monthly calculation of TEP which is 10% more spent (it only a hypothetical fabrication). But time excess fuel does not appear in reports anywhere, they can be let on the left and to have for a top on some million rubles monthly increases to a salary.

But it is fine, this theft in the generation company. And how to be with unjustified overestimate of tariffs for the released electric power and heat? After all it is absolutely dishonest in front of all Russia because of what its economy becomes more expensive. Why all people have to pay for theft of fuel at power plants.

And what turns out in the dry rest? Then that because of incorrect monthly calculations of TEP on thermal power plants by means of theft of fuel the top is illegally enriched, and all economy of Russia is the hostage of these miscalculations. And most interesting that the Ministry of Energy of the Russian Federation, knowing about the developed No-cost Technology of economy of fuel on Smart-MES System long ago, this fact completely ignores, and in practice elementary indulges large-scale theft of fuel at all power plants.

It is possible to calm down of course that it only a comic hypothetical fabrication. Or perhaps not? At least, by means of Smart-MES System of this economy of fuel it is easily possible to achieve, and, please, steal fuel silently. And on the other hand, the existing excessive consumption of fuel this same theft, but only the dullest and confused.



But after all it is possible an increase in the all-Russian scale of 100 billion rubles to have without theft, and it is quite civilized, i.e. not to buy simply excess fuel. All this is easily realized by means of Smart-MES System.

Besides there is an important fact in one more feature of Smart-MES System. She can warn emergencies which were, is and will always be.

The emergency easily develops into accident with the human victims. In it is possible not to trust and wait until it reaches you. But will be already late and there will come the fact of other huge theft of money directly from your pocket.

***Breakthrough Smart-MES System or to whom the excessive consumption of fuel of power plants is favorable***

On a social network on my statements concerning increase of energy efficiency of power plants there were numerous responses. I give only their small more civil part to present that the power engineering specialists and experts connected with power think:

1) "Those who operates, controls and executes power functions, all are in a share, according to the section of the income from deception of the population and the enterprises. The size of this income directly depends on the level of losses of energy resources. The more the level of losses, the is more level of the income. The business constructed on squandering of energy resources, excuse, in a different way cannot work" [23].

2) "And you about lofty matters. And how many accidents at stations? And that ORGRES was disorganized and to develop programs for extension of service life of thermal power plant and to carry out diagnostics of the equipment there is nobody".

3) "The Ministry of Energy of the Russian Federation was discharged and, apparently, so will be further because to ask there is nobody and there is nobody. There is a purposeful destruction of energy efficiency" [24].

4) "And in a lobby whispered that the similar situation with low energy efficiency is extremely favorable to the management as they from it have the big income in own pockets around to shareholders".

5) "The law No. 261-FZ initially was non-working, due to the lack of control measures and a huge number of the departments participating in coordination of its separate sections".

6) "And now to reduce electricity consumption on the started-up object I need to receive so many coordination that I will sit free of charge on the started-up object not less than half a year".

To whom is the huge excessive consumption of fuel so favorable? There is such impression that irrespective of our continuous talk on this subject really simply nobody wants to believe in its existence. I think that the excessive consumption of fuel is necessary to nobody.

But in each Generation company there is the lobby of the introduced IT technologies which cannot simply allow dissent from outside. Really political will of the Management of the Generation companies has to be shown to understand that calculations of the actual and standard TEP in real time with an interval no more than half an hour it not simply possibility of full elimination more than a 10% excessive consumption of fuel, but also the prevention of emergencies.

I give three possible views of an excessive consumption of fuel:

1) Management categorically does not trust and does not want to believe that there is an excessive consumption of fuel at power plants in principle.

2) Management thinks that if there is any excessive consumption of fuel, it because of big wear of the equipment.

3) Management strongly doubts that even if the excessive consumption of fuel will be revealed, it categorically cannot be reduced owing to technological features.

It is possible to argue on this subject indefinitely, but we will try to sort these moments quietly. It is clear that if the management of the Generation company - rested and simply does not want to hear neither about an excessive consumption of fuel, nor about Smart-MES System, all reasonings on this subject to it "to a lamp".

But in the Generation companies there are also sensible people who understand that if it is possible to increase with small losses significantly energy efficiency of power plants why and not to carry out it.

It is natural where it would be simpler to make the decision if in the next Generation company it was already realized. But then not only the prices, but also talk of this subject would be absolutely others.

1) Management categorically does not trust and does not want to believe that there is an excessive consumption of fuel at power plants in principle.

The excessive consumption of fuel corresponds to a difference of the actual expense and a standard cost of fuel ( $dB = B_{fakt} - B_{norm}$ ). But if there is no excessive consumption of fuel, so there is its economy? But the economy of fuel is possible only in small periods when supply of fuel stops, and the copper owing to the thermal lag effect continues to develop steam and, therefore, a turbine unit - the electric power. And after cooling of a copper its heating will require the same amount of the saved fuel.

As a result of economy of fuel is not present even at optimum loading of the equipment. Actually the economy can be only in comparison with the last periods. Loading optimization more influences a standard cost of fuel, and only indirectly - the actual expense since the person participates in this chain.

The power plant is a dynamic object when every minute there is the actual fuel consumption, but there is also its settlement standard cost. During the stable work every minute the actual expense cannot be less standard since it in general is impossible to common sense. In transitional regimes of economy of fuel cannot be especially.

Thus, the power plant cannot work better, than it is offered to it standards. Otherwise - simply standards are not right. Therefore only the excessive consumption of fuel which constantly collects from constant overexpenditures is possible.

But the most important that real half-hour calculations at average combined heat and power plant with the additional power unit PGU demonstrate existence of this huge excessive consumption of fuel. But here

in what a riddle. It appears, in monthly calculations on MS Excel for the same combined heat and power plant it is proud the economy of fuel flaunts.

And the solution of these miracles is covered in elementary frauds in PTO (technological department). Simply in calculations of the actual TEP (technical-economic indicator) there is a real consumption of network water, and in calculations of standard TEP this expense much smaller the actual. Here so the management of PTO of power plant elementary makes a fool the management of the Generation company. And it is very difficult to check it. And here half-hour calculations will already not miss this shamanism.

In market conditions when not developed electric power and heat are paid but only demanded, and to have to pay for fuel wholly, here to you and still a source of an excessive consumption of fuel.

2) Management thinks that if there is any excessive consumption of fuel, it because of big wear of the equipment.

In this case the excessive consumption of fuel is involuntarily substituted for its actual expense here. Business all that anybody (except us) never saw a real settlement half-hour excessive consumption of fuel since the Smart-MES System is for this purpose necessary, and except us anybody does not have it.

Monthly calculations of TEP for the saved-up data in a root are not right because of curvilinearity of standard schedules and existence of threshold functions in calculations. These calculations it is necessary to carry out no more than half an hour on intervals, and in a month to receive value of an excessive consumption of fuel only summation of half-hour overexpenditures.

And now, how it is possible to explain with wear of the equipment the following real fact? At the maximum loading of power plant in the afternoon the excessive consumption of fuel is close to zero, and at incomplete loading at night the overexpenditure reads off scale for 30%. It that in the afternoon wear of the equipment does not influence an excessive consumption of fuel, and influences at night?

Here the essence of incorrect statements of a grief of experts also consists in this nonsense. However, to them the Ministry of Energy of the Russian Federation and regional the Ministry of Energy very attentively listen and with aplomb duplicate them in the answers.

And how to be with an excessive consumption of fuel which occurred because of impossibility to realize excessively developed electric power. Precisely wear of the equipment is not guilty of this fact.

3) Management strongly doubts that even if the excessive consumption of fuel will be revealed, it categorically cannot be reduced owing to technological features.

The huge excessive consumption of fuel existing now on all thermal power plants, maybe production, and commercial. If with a commercial overexpenditure more or less everything is clear that the developed electric power and heat cannot collect, i.e. they have to be at once favourably realized, and here with a production overexpenditure everything is not so unambiguous.

The production excessive consumption of fuel can be for the technological reason and because of a human factor. But in order that to understand it and to reveal, the Smart-MES System is necessary.

And here that precisely with confidence it is possible to tell, so it that by means of System it is easily possible to get rid and of a commercial excessive consumption of fuel, and from production, bringing to those Generation companies annual additional profit not less than 300 million rubles from each power plant.

For example: At night the need for the electric power falls. Therefore, it is necessary to reduce supply of fuel in power coppers that actually and occurs. But there is a lawful question. Why thus the current excessive consumption of fuel increases? Yes everything is very simple. Blindly, using only regime cards, it is not possible to control it simply.

But, having the schedule of delivery of the electric power and heat, by means of Smart-MES System it is possible to reduce fuel supply slightly earlier, than it is required according to the schedule of delivery, considering a big thermal lag effect of multiton coppers. And by means of Smart-MES

System it is easy to control in general constantly the minimum current excessive consumption of fuel at exact observance of the schedule of delivery of the electric power and heat.

Summary: We never said that only our Smart-MES System is capable to help to cut fuel consumption in the Generation companies. The economy of fuel is a technology. And it can be realized on any software, but for some reason now it and close is not observed.

And we are firmly sure that our Smart-MES System - the most easily adaptable and the most high-speed. And another to realize this technology on elimination of an excessive consumption of fuel, without having the software with similar characteristics, it is practically not possible.

### ***Two philosophies of economy of fuel of power plants on Smart-MES System***

The technology of economy of fuel based on half-hour or on constant calculations of an excessive consumption of fuel and on representation of the current analytics of TEP on BCP (block control panel) of power plant provides two philosophies for the Generation companies: Consumer and Patriotic which on outlook are opposite as Chinese the YIN and YAN.

The consumer philosophy looks as follows. The technology saves fuel of more than 10% of the general expenses. Therefore, time in cost on the released electric power and warmly fuel component over 50%, additional profit will be very notable. It is clear that at such huge profit it is possible and to increase an award to the operational personnel for magnificent production achievements in the sphere of increase in energy efficiency of power plants. And this personnel will work even more more successfully, making for shareholders still big profit.

The patriotic philosophy directly does not influence increase in profit. But it qualitatively affects all economy of Russia since the economy of fuel conducts to decrease in selling prices of the electric power and heat. In this case market mechanisms of the competition which conduct to increase in volumes, well, therefore, join and arrived.

However, now in Russia the operating market of the electric power is not present, and, therefore, there is no competition also. So that to reduce

the prices - it turns out to itself more expensive. But for some reason the Generation companies terribly are afraid to introduce this perspective Technology of economy of fuel, being afraid of that the Ministry of Energy of the Russian Federation will see other picture with the valid expenses of fuel and will stop practice of unreasonable increase in tariffs.

On it there is a wish to tell the following, referring to numerous letters from the Ministry of Energy of the Russian Federation in our address that this department was discharged of cares of economy of fuel for a long time, having transferred all these efforts to SRO. Therefore, the Patriotic philosophy of economy of fuel can be forgotten forever since it is not necessary to anybody. Well and well, that the people are scary dissatisfied with constant increases in tariffs for the electric power and heat. Well and well, that power-intensive production of large production consumers of the electric power not competitive because of high prices. But, the Generation companies, using Consumer philosophy of economy of fuel, will be able sharply to increase the profit.

But all comedy that of this situation that the Generation companies behave as "dog in the manger", i.e. neither themselves - nor to people, neither consumption - nor patriotism. This perspective and actually No-cost Technology becomes dusty two years on shelves, and the Generation companies do not wish to save fuel. They will better introduce useless for increase there arrived economic-mathematical models of power plants and monitorings of TEP with foreign software. Probably, it and is favorable to someone, but only not to shareholders and investors of the Generation companies. Here also it turns out that instead of the Chinese outlooks of the YIN and YAN management of the Generation companies prefers primordially Russian outlook – HREN (the CRAP).

In social networks recommend to us that agree about free introduction of the Technology of economy of fuel on Smart-MES System, but with payment of a half of profit for the first year. So same for one power plant of the whole 150 million rubles instead of some scanty 10 million! We, naturally, agree!

The generation companies, we offer you free introduction of hi-tech innovative Technology which will quickly make all your Generation company attractive to investors. That on average on 300 million rubles of

annual additional profit from each power plant are not necessary to you? Same at 10 combined heat and power plants and state district power station at least additional 3 billion rubles arrived for the company. Any other technology is not capable to give such huge economic effect with payback in only one month.

I will remind shortly an essence of this splendid Technology. Everyone half an hour or in real time is carried out every minute the automated input of basic data from the systems of the commercial accounting of heat, the electric power and gas existing at power plants. Missing initial parameters are supplemented in the program way with use of various methods. After that the general half-hour or minute calculation of the actual and standard TEP (technical-economic indicator), including an excessive consumption of fuel during this time is carried out. The current analytics of the main half-hour and minute TEP, including an excessive consumption of fuel is brought to BCP of power plant in monitoring. If necessary optimizing and intelligent mechanisms are started.

The operational personnel constantly beholds the current dynamics on an excessive consumption of fuel. The system can give out the advancing councils for decrease or for increase in supply of fuel at power coppers. But the most important the personnel in real time has exhaustive information and it has a compulsory motivation on economy of fuel.

***The TGC and OGK are not ready to lower an excessive consumption of fuel by means of Smart-MES System***

The firm of Information Systems observes full unavailability of TGC and OGK (generation companies) to lower an excessive consumption of fuel by means of introduction of Innovative Smart-MES System for realization of calculations of TEP at power plants.

All power plants of TGC and OGK show in the monthly reports on fuel usage, as a rule, small economy of fuel. Especially as in monthly calculations on MS Excel it is easy to make it, i.e. to adjust. Anybody as monthly calculations for an excessive consumption of fuel are not right does not know about the actual reserves of economy of fuel at each power plant. Half-hour calculations, well are for this purpose necessary, as a last resort, daily, and monthly indicators have to turn out by an accumulation



method, i.e. integral calculus. And it at all power plants is absent traditionally as in MS Excel it cannot simply be realized.

The paradoxical picture turns out that in Russia there is unique own software with payback in one month even if the economy of fuel of everything in 1% will be reached, and the TGC and OGK are blind. At power plants work is organized by the principle of ensuring deliveries of the electric power and heat without thinking about the size of an excessive consumption of fuel. And the excessive consumption of fuel allowed even for half an hour of work, is not compensated any more. And why to make huge efforts at some moments by means of optimization of resources? But whether it is more logical to allow simply its constant overexpenditure.

It is possible to minimize an excessive consumption of fuel by very simple method of half-hour tracking behind fuel usage. For finding of the best option of management right there is a dynamic mechanism of viewing for half an hour to 1000 options of technological realization. And with experience with "open eyes" at continuous calculation of the current values of an excessive consumption of fuel it is possible to choose easily the best option at the transitional moments: change of air temperature, day and night, etc.

Why the TGC and OGK are so deaf to these innovations? To it we have no explanation. Perhaps, only one explanation: they simply are still morally not ready to pay close attention towards PTO of power plants and to allocate a worthy place for reliable calculations of TEP.

### ***Why build PGU, and forget about economy of fuel?***

The firm of Information Systems made attempt to understand the reason of absence of the operational accounting of an excessive consumption of fuel in the progressive PGU (steam-gas equipment) technology and on a thermal power plant in general.

Recently PGU finds broad application for modernization of the existing combined heat and power plants and state district power station because of higher efficiency in comparison with steam-power installations. It means that development of the same quantity of the electric power and heat requires theoretically less fuel. But nobody knows how it on a half-hour interval will be coordinated with the actual fuel consumption. The

monthly excessive consumption of fuel consists of half-hour overexpenditures. To count an excessive consumption of fuel on formulas on a monthly interval in a root it is not right because of nonlinearity of standard schedules.

What turns out? The TGC and OGK invest billions on construction of PGU for receiving additional profit and stint to invest couple of millions on Smart-MES System for an operating control behind an excessive consumption of fuel.

But both PGU, and power plant the person operates. And anybody did not cancel a human factor in management of difficult production yet. It is obvious that blindly the person will never be able to achieve in management of optimum results, even in the presence of HOP-optimization.

Besides PGU is built in the existing power plant, and it means existence of various overflows on fuel, water, the electric power and steam. Quickly it is not possible to regulate balances to the person without the return information on an excessive consumption of fuel simply. Therefore in practice there is a big excessive consumption of fuel.

Traditionally by techniques of the Ministry of Energy all calculations for fuel usage are made only on a monthly interval, and such major indicator as an excessive consumption of fuel, is not present even in the model 15506-1. It speaks about the initial indifferent relation to this indicator.

Therefore in the calculations of power plant the excessive consumption of fuel is arranged close to zero. And it means that specific fuel consumption which are used for planning, pay off from a condition of the actual fuel consumption, i.e. already in advance put an excessive consumption of fuel in 10% that in market conditions simply thriftlessly.

## **7. Commercial innovative accounting of an excessive consumption of fuel**

---

Practically on all thermal power plants there are automated systems of the commercial accounting of the electric power (ASKUE), is warm (ASKUT) and fuels, for example: gas (ASKUG). And where automated system of the commercial accounting of an excessive consumption of fuel (ASKUPT)? Here ideologists of power industry for market conditions did not finish something. After all if the size of a 10% annual excessive consumption of fuel is in terms of money equal to profit of the Generation company, it not jokes that for average power plant makes 300 million rubles, and, therefore, for the medium-sized Generation company - 4 billion rubles. And it everything dull losses!

Naturally, it is necessary to prove still this fact of a 10% excessive consumption of fuel, but it a bit later, and now we will consider ASKUPT essence, i.e. the commercial accounting of an excessive consumption of fuel. If systems of ASKUE, ASKUT, ASKUG are independent and independent systems, ASKUPT is completely dependent on these systems since it is based on them.

ASKUPT in the form of Smart-MES System uses data of ASKUE, ASKUT, ASKUG and performs constant calculations of the actual and standard TEP of which the current excessive consumption of fuel is result. All analytics is given monitoring for BCP (block control panel) for possibility of expeditious detection of the fact of this excessive consumption of fuel and for timely intervention in production. Thus, ASKUPT provides positive operative technological feedback for increase in energy efficiency of power plants.

Well, and now about the fact of a 10% excessive consumption of fuel. The uncontrollable excessive consumption of fuel is present every minute so that the monthly calculations existing now show even its ephemeral economy, this overexpenditure does not disappear anywhere, and it simply is noticeably reflected in profit of the Generation company. But why then this excessive consumption of fuel is adjusted to zero in monthly calculations, and obviously it is not shown in reports? And it is simple because in such look it is necessary to nobody. After all this excessive consumption of fuel belongs to the last period and with it already

to make nothing. And adjust because it is necessary to receive specific fuel consumption on the electric power and heat according to the actual consumption of this fuel for planning of its purchases the next month. Thus, in plans put this excessive consumption of fuel in advance.

Let's not speak, it is ethic or unethical to shift mismanagement of power plants regarding existence of a huge excessive consumption of fuel which impudently enters tariffs, on consumers of the electric power and heat since everything is regulated by the market. But, seemingly, that the market that in general is not present the present at which surely there has to be a deficiency of consumers that for it there was a tariff fight. And time is taken for any price, to speak about the real market of the electric power and heat so far rather early.

Not to reveal a huge actual and uncontrollable excessive consumption of fuel the existing incorrect monthly calculations of TEP in the methodical plan. The Smart-MES System is for this purpose necessary. With its help we on an average thermal power plant revealed the following explainable regularities.

1) The excessive consumption of fuel is present on each half-hour interval, therefore, it is and on each minute interval. This results from the fact that the operational personnel operates power plant blindly regarding an excessive consumption of fuel. And it is real, without having the current information on an excessive consumption of fuel, it is not possible to operate according to standards.

2) An excessive consumption of fuel at night much more, than in the day. So, at night the overexpenditure reaches 30%. It is clear that at night loading of power plant falls. And at the power plant excess fuel, even is uncontrolledly in vain burned at its general reduction at this time.

Now on all thermal power plants there was a paradoxical picture. If power generation and heat is strictly regulated by schedules of their delivery, here fuel costs of their development are absolutely regulated by nothing, and have to be regulated by standards in real time. And you still want to tell, what if there is no restriction on fuel expenses, there is no its overexpenditure? Here that also consists in it the main nonsense of market understanding of work of power plant.

Only the automated system of the commercial accounting of an excessive consumption of fuel (ASKUPT) is capable to bring an order with

uncontrolled and with irresponsible squandering of constantly rising in price fuel.

But the generation companies will have to understand eventually that if they now have profit in a size "P", and could actually without expenses have very easily and "2\*P".

### ***Profitability of power plants can be doubled***

Quantitatively profitability is estimated as private from division arrived to expenses. At introduction of No-cost Technology of economy of fuel of power plants on Smart-MES System the general expenses practically do not change, but the profit increases twice at the expense of a complete elimination of a 10% excessive consumption of fuel. Thus, and profitability of power plants, naturally, increases twice.

This obvious fact can trust or be not to trusted, but one is indisputable that anybody and never definitely counted the actual excessive consumption of fuel since it is possible only by means of Smart-MES System, using integrated methods of calculation of the area of dynamic process. In the present time those figures about an overexpenditure or about imaginary economy of fuel which are present at monthly reports of thermal power plants, so widely of the mark that simply you are surprised where watches management of the Generation companies, allowing such negligence in market conditions, thus cutting itself profit by half.

Here for doubling of profit by means of Smart-MES System surely it is necessary to consider three moments: the correct identification of the fact of an excessive consumption of fuel in real time, expeditious elimination of this overexpenditure and exact forecasting of purchases of fuel. If the first and third moments completely are a Smart-MES System prerogative, the second more already depends on the operational personnel to which tools of System will be by all means provided for the correct decision-making. But the human factor all the same remains. If monitoring on BCP provides all operational information about the current excessive consumption of fuel and there are advising options on loading of the equipment, and also strong bonus incentive, the success is inevitable.

But absolutely clearly one that without half-hour calculations of the actual and standard TEP, and, therefore, and without the current accounting of an excessive consumption of fuel, absolutely will turn out nothing for

increase in energy efficiency of power plants, without speaking already and about any increase in its profitability.

Today's condition of electricity generation and heat at power plants without Smart-MES System is similar to automobile works without the main conveyor. To operate now power plant according to regime cards of the equipment the same profanation as calculation of an enthalpy of water and steam according to Vukolovich's tables [25]. It would seem, everything is: both the PCS, and ASUP, but is not present the main thing - production management of production for what the Smart-MES System is intended.

Any high-quality management surely means existence of operational feedback. So for power plant at power generation and heat according to the schedule of delivery such feedback is the current information on an excessive consumption of fuel. But it traditionally is not present on one thermal power plant. Then about what high-quality management in general it is possible to speak? And that it: miscalculations of branch institutes or their total ignorance in questions of management?

One expert from power plant directly declared: how to us quickly "to pull" the 10th ton warmed large object (copper)? And actually, how it can be operated blindly? Here both it is burned uncontrolledly and excess fuel is useless that across Russia is equivalent to 100 billion rubles. But after all it is potential profit of the Generation companies.

And now present that on BCP according to the schedule of delivery of the electric power and heat taking into account their current requirements of the monitor the full picture on optimum loading of the equipment and with the current analytics on an excessive consumption of fuel is displayed. The operational personnel makes decisions and constantly sees an operational picture not only on the electric power and heat, but also on an excessive consumption of fuel. It is also high-quality feedback control which besides is regulated also worthy bonus.

The modern philosophy of functioning of power plants is based on full irresponsibility for a huge excessive consumption of fuel for only that reason that actually anybody and never even felt this overexpenditure and does not wish to feel. The same not revealed overexpenditure elementary by means of subraces is also impudently suppressed at all levels. Why? Probably cloudlessness of similar existence outweighs possible profit of the Generation companies so far.

But after all is also interests of society in decrease in growth of tariffs for the electric power and heat. And this very strong restriction which needs to be considered at indispensable continuous growth of cost of fuel. Besides the existing energy audit is so formal and confused, time is content with incorrect data from power plants on an excessive consumption of fuel. But the main objective of an energy audit to plan it ways on increase in energy efficiency of thermal power plants. But when the 10% excessive consumption of fuel at all power plants is elementary ignored, the role of this energy audit probably simply is reduced to a feeding trough for godfathers.

The Smart-MES System role for automation of production management of production can be ignored naturally. But how many it to last? After all as a result all the same not to leave her anywhere. As by all means it is necessary to leave and antediluvian MS Excel on which calculations of TEP in PTO of power plants are now performed.

***Without Smart-MES billions flow away from the Generation companies***

From where now the Generation companies have decent Profit? The answer is simple: It from increase in tariffs for the released electric power and heat, and from attraction of investments due to additional issue of shares. But it is Profit of today. And after all only yesterday they did not have this Profit, and tomorrow it will not be. All this means that the Generation companies live only for today, without thinking about tomorrow's, deceiving thereby investors.

But after all know well that for receiving stable maximum Profit it is necessary to lower as much as possible expenses, especially, unproductive losses. These losses should be revealed in real time and quickly to react for their elimination. Here I do not peddle any old stuff. But it appears that it does not reach "young-looking" management of the Generation companies absorbed only by problems of the market at all i.e. cheaper to buy fuel and more expensively to sell the electric power. But, unfortunately, the tendency appears such that fuel cost will only grow, and society will not allow to increase tariffs for the electric power. Already now many power-consuming industries focus the expansion abroad, where cheaper the electric power.

Many unproductive losses, including and an excessive consumption of fuel, TEP (Technical and Economic Indicators) in real time come to light

only by means of expeditious calculations actual and standard. But it appears that in all Generation companies of it simply do not know, time on all thermal power plants of Russia monthly or daily calculations of TEP prosper. Well, and what benefit they can bring, stating results of last period?

And after all on such difficult dynamic object as power plant, loading strongly changes within a day. In the afternoon it raised, and at night the lowered. Therefore, it is necessary to watch losses constantly. And it is not present anywhere. But if nobody watches losses, anybody and does not liquidate them. And time so, they uncontrolledly dominate at all power plants, and anybody knows nothing about them.

Here it is so healthy! And where competent energy audit? And where aspiration on increase in energy efficiency, according to the Law No. 261-FZ? And where the leading role of the Ministry of Energy of the Russian Federation on increase in the international image of the Russian power industry? It is not present anything even in plans. The strange picture turns out: The generation companies put billions on building of steam-gas or gas-turbine power installations and annually dully lose billions from not revealed and not eliminated losses and from an excessive consumption of fuel, and all this shamelessly compensate unreasonable increase in tariffs. In the same occasion all Bulgaria hoots now. But if all Russia takes in head to rise by racks, any Generation company to will be bad. So why to test the people for durability? He perfectly remembers promises and market Chubais's assurances.

But after all there is still the major problem is always possible Accidents which instantly eat billions. The human factor of an indifference, spontaneous operation of automatic equipment, wear of pipelines and the equipment - were always harbingers of Accidents. But after all the Smart-MES System can easily reveal any Emergency and prevent Accident, and, therefore, not allow milliard losses.

There is such impression that "yellow-beaked baby birds" who only and are capable to open "beaks" widely settled in the Generation companies deaf and blind. They do not hear groans of consumers of the electric power and heat, they do not see the mess at power plants caused by total absence of economic approach to identification and elimination of unproductive losses and a huge excessive consumption of fuel.



In power industry the vicious picture is observed. The generation companies because of the increasing expenses easily punch increase in tariffs for the released electric power and heat which are increased greatly by intermediaries. The Ministry of Energy of the Russian Federation, probably, supports them, referring to lime justifications of Generators. But the Ministry of Energy of the Russian Federation which is responsible for increase in energy efficiency in branch, issues illiterate instructions for power accountants on power passports which only fix mismanagement of power plants and do not reveal energy efficiency increase reserves. You see the Ministry of Energy of the Russian Federation cannot and does not want to interfere with activity of Generators, referring to their independence. And how the Law No. 261-FZ which for all is obligatory?

In recent times the Committee on power of the State Duma of the Russian Federation prepare global changes to the Law No. 261-FZ. Also it would be desirable to hope that these changes will affect power plants too and will be directed on saving of billions not only the Generation companies, but also all industry of Russia. And the Innovative Smart-MES System easily will help with it!

### ***Excess profit of OGK and TGC from introduction of Smart-MES***

Excess profit - profit, in the size much exceeding normal. But if introduction of Smart-MES System allows to have profit from one power plant in 300 million rubles at expenses of all in 10 million rubles, it not simply excess profit, and super excess profit.

How such huge profit and why any other System cannot provide it is got? It is all about the organic unity of Smart-MES System and Technology. The innovative Smart-MES System has such powerful characteristics which allow to formulate the Technology directed on receiving profit through economy of fuel in 10%. Nevertheless other introduced Systems for automation of calculations of TEP initially are not focused on receiving profit at all and therefore to wait for it further is simply useless.

The main source of profit is the complete elimination of a banal excessive consumption of fuel about which at all power plants prefer simply nothing the nobility, using thus outdated techniques of monthly calculation of the actual and standard TEP. In it that a bomb is also planted. Not only that monthly calculations in principle are not right since there

have to be half-hour or even minute calculations, but monthly calculations of specific fuel consumption are elementary and shamelessly adjusted to a zero excessive consumption of fuel.

It also is clear. What I found if as a result of monthly calculation the huge excessive consumption of fuel turns out? All the same nobody knows that farther with it to do that since it reflects last period. But if the size of the period is minute, it already absolutely other picture. Actually it turns out in real time it is possible to have operational information on an excessive consumption of fuel and in due time to use it for decrease in this overexpenditure.

We have in Russia in station society such strong confidence that no computer program will be able to change the course of electricity generation and heat which developed for years at which absolutely there is no current control over an excessive consumption of fuel. In the present time at all power plants there are only two controlled vectors: it is the electric power and heat. But in modern market conditions introduction of the third controlled vector is necessary: it is an excessive consumption of fuel, considering that in tariffs for the electric power and warmly fuel component reaches 60% and that fuel cost constantly grows, and the increase in tariffs for the electric power and heat is regulated by the state.

There has to be at OGK and TGC a double interest in the fastest introduction of Smart-MES System for identification and a complete elimination of an excessive consumption of fuel, as biggest unproductive losses. On the one hand there are 10% margin of safety from market fluctuation in prices of fuel, and on the other hand, the profit that will positively affect and on inflow of new investments into power industry elementary doubles.

All torture us: You at first prove that there is really an excessive consumption of fuel on thermal power plants that it can be lowered and that the profit will correspond to 300 million rubles. On what we answer: There are stubborn laws of mathematics and, including, the theory of integral calculus of the area of dynamic process. Such curvilinear areas in time represent both power generation, and give of heat, and an excessive consumption of fuel. But if on the electric power and heat their operational account is carried out, on an excessive consumption of fuel the same account simply is not present, and never was.

But if at one power plant in principle there is no correct accounting of an excessive consumption of fuel as it is possible to prove its existence without implementation of this account. On paper in the feasibility report, please, there are all calculations with justifications. In the same place it is described that on real measurements at one combined heat and power plant the following regularity was revealed: in the afternoon the excessive consumption of fuel is close to zero, and reaches 30% at night. Scientists object us that the excessive consumption of fuel is caused by big wear of the equipment. But then, why in the afternoon that the overexpenditure is almost close to zero? Or, what in the afternoon at full load of power plant of an excessive consumption of fuel wear of the equipment does not influence, and at night at the lowered loading suddenly began to influence? The complete nonsense!

But if wear of the equipment has no relation to a huge excessive consumption of fuel, then it turns out that it is result of the purest human factor which, naturally, can be found, studied and liquidated.

Or still such attack from employee of station: Specify, what "lever" to turn to lower an excessive consumption of fuel. So that's that. The cleverest technologists from power plants ask developers of System as to them to lower this overexpenditure. Came. We that, have no branch institutes any more? But, unfortunately, to them the task be set cannot while the accounting of this excessive consumption of fuel really is not adjusted.

But comedy of all this situation with an excessive consumption of fuel that we speak more than a year about this problem, and we are called from the Generation company and ask: You can realize calculations of the actual and standard TEP? They even thoughts do not assume that thus will be able also to have excess profit!

### ***Gloss and Poverty of OGK and TGC***

After reorganization of power industry powerful management with highly skilled IT divisions came to the top level of OGK and TGC. The main objective of IT was, as soon as possible to plunge into market economy. And they with success plunged, but forgot hurriedly about the production level of power plants. As a result it turned out Mercedes with a cursor from Volga.

But the profit that is formed at combined heat and power plant and state district power station, and they both worked, and continue to count in the old manner TEP (technical-economic indicator) in MS-Excel. But this poverty will not be coordinated with market economy in any way.

In new conditions technologists of PTO (technological department) of power plants have to own logistics. And the logistics is the outlook concerning optimization of expenses, and, first of all, naturally, fuel consumption.

Business reaches to the point of absurdity. Power plants work month and do not know the actual size of an excessive consumption of fuel. And at the end of the month they elementary adjust calculation to its small economy. OGK and TGC (generation companies) arranges such situation, time they do not wish to introduce Smart-MES System, for production management and control in real time of an excessive consumption of fuel.

Why concerning introduction of information technologies at the macro level of OGK and TGC were very quick, and concerning micro level they are so inert? It seems that they or cannot find worthy MES System, or in general on it do not reflect. But simply you are surprised when they thoughtlessly stake on Oracle products for calculation of TEP or on other block programs with a "lame" adaptability because their choice is absolutely near from MS Excel. Well, and where innovative break? Where solution of a question of efficiency of fuel usage?

But the Firm of Information Systems let out the Self-organizing Smart-MES System for PTO of Power plants for the purpose of realization of half-hour calculations of technical and economic indicators in real time long ago with the subsequent integral calculus of an excessive consumption of fuel that will allow to save 10% of fuel on thermal power plants of TGC and OGK.

## **8. Compulsory motivation of economy of fuel**

---

Motivation - process of creation of system of the conditions influencing behavior of the person, sending it to the party, necessary for the organization, regulating its intensity, borders inducing to show integrity, persistence, diligence in achievement of the objectives. The compulsory motivation is based on application of the power and threat of deterioration of satisfaction of needs of the worker in case of non-performance of relevant requirements by it [26].

Here the statement on the Internet concerning economy of fuel: "In Soviet period for economy of fuel awards relied the personnel of power supply systems. Now such incentive is not present and incentive to save fuel with such growth of tariffs - too is not present. By the way, the salary of ordinary employees of stations does not depend on growth of tariffs and practically does not grow, stopped at the level of 2008".

Thus, nobody saves fuel on power plants, and does not even think to save. Fuel is spent so much, how many it is spent for implementation of the schedule of delivery of the electric power and heat. The motivation of economy of fuel at the operational personnel completely is absent. But the most interesting in that, as the Generation companies that have nothing to reproach employees of power plant since according to monthly reporting data at all power plants of an overexpenditure fuels are not present, and there is even its economy, i.e. power plants on paper work completely according to standards, though with use of methods of adjustment.

Here to such unfavourable conclusions the Generation companies tired out themselves, persistently ignoring need of realization of an operating control over an excessive consumption of fuel in real time.

But if is absolutely not present at the operational personnel of motivation and opportunity to save fuel why to create for it this motivation forcibly? That is from the worker it is possible to ask only when the feasible task is accurately set.

And in the present time in all Generation companies the task for power plants looks the next comic way: It is necessary to provide implementation of the schedule of delivery of the electric power and heat and whenever possible to try to spend less for it very expensive fuel. Here such nonsense is present at all power plants!

But same it is very easy, quickly and it is actually bezzatratno possible to correct. And in this case the compulsory motivation of economy of fuel will sound as follows: Here for you on monitoring the current excessive consumption of fuel is removed every minute, and it is necessary that it was always zero. That's all!

Well, and time the task is accurately set, it undoubtedly will be surely executed. And then 10% of an excessive consumption of fuel will disappear, and on each power plant there will be an additional annual profit in 300 million rubles which small part can be directed on awarding of especially zealous employees.

Compulsoriness of this motivation still is and that the excessive consumption of fuel already becomes address, but not as now absolutely faceless. At any time it is possible to analyse who and when allowed a huge excessive consumption of fuel, and to find out the reason: either it is negligence, or it is the technological miscalculation which immediately should be eliminated.

Thus, the compulsory motivation of economy of fuel of thermal power plants can give by a simple and no-cost method sharp jump of increase in energy efficiency of power plants and return on production Wednesday emulative spirit for bigger percent of economy of fuel for the benefit of the Generation companies.

Opportunity in real time to control settlement indicators which can be emergency harbingers at power plant becomes another the positive accompanying moment of this compulsory motivation. It is simple to control thousands of indications of temperatures and pressure of people is not able. For this purpose the description of their ties among themselves in total with discrete parameters and with continuous control in real time, and also with issue of preliminary preventions to the operational personnel is necessary.

In this case management of the Generation companies can sleep peacefully since the true excessive consumption of fuel completely is absent, people with enthusiasm work, achieving Stakhanov results, possible malfunctions are constantly controlled, without bringing power plant to accident.

In this case the compulsory motivation of economy of fuel solves at once two major problems: social and innovative. The social problem is based on equitable distribution of an award according to result of economy of fuel. Innovative modernization provides in real time interrelation of the

lower level of the automated data collection (PCS) with the top level of acceptance strategic business of decisions (ASUP).

### ***Compulsory motivation of increase in profit of the Generation companies on MES System***

You can tell that it is the complete absurdity! How it is possible to refuse increase in Profit? And why still some motivation, especially - compulsory is for this purpose necessary? But realities of today in the Generation companies which voluntary annually lose on average on 300 million rubles of additional Profit from each power plant and which management quietly lies on the furnace are that, unfortunately, being lazy even to give a hand to pick up ownerless huge packs of notes.

After all if at you directly at all on a view from a pocket impudently pull out money, you by all means loudly are indignant. And the Generation companies obediently are silent in a rag, and at this time as if in pockets full of holes daily somewhere fail ten of millions of rubles. You naturally object that supposedly it is a nonsense.

But then ask any Generation company very simple control question: Whether there is at them though at any power plant current information on an excessive consumption of fuel for half an hour or in a minute, and whether they want it to have and to use in the peace purposes, i.e. for receiving additional Profit?

Naturally, all will look at you, as at the idiot. What excessive consumption of fuel? About what you speak? Such concept does not exist at all. And all mathematical calculations with application of integral calculus of the area of dynamic process proving absolute incorrectness everywhere of monthly calculation of specific fuel consumption now in use for the saved-up data are left in the basket as if it is about the perpetual motion machine.

The businessman from Germany calls me and says that here encountered your invention and I am surprised that you cannot already introduce two years scary favorable technology, let's try realize it at us since in Germany very much show consideration for any opportunities of economy of fuel. He told me that at them at all power plants the TEBIS System is introduced, and asked to summarize in the ratio with our Smart-MES System.

I got acquainted with it and drew to it the conclusion that is the developed information system for collecting and data storage with the

corresponding service, but it does not do calculations for the current excessive consumption of fuel. And it for average combined heat and power plant corresponds about 20000 initial and intermediate parameters and 300 standard schedules. So our MES System carries out these calculations in only 1 second. Quicker simply it is not possible!

Well and, again, about compulsory motivation. You present that at the CEO of the Generation company in an office on the plasma monitor in all wall the current information on the lost Profit in every minute, for everyone a floor of hour, for every day in the form of analytics and the accruing annual result is constantly output. This lost Profit pays off in value terms from an excessive consumption of fuel at all power plants.

And this dear Director constantly observes how from his company literally from under a nose billions completely flow away. It what nerves are necessary, what quietly to behold it. Here then precisely this Director will be indignant and will stop this lawlessness. It or will force to save fuel on all the power plants, or will simply remove this opposite plasma panel.

And now that this Director does not even guess this huge excessive consumption of fuel, after all its subordinated to it on it do not report since do not trust in it, and do not want to trust. They are absolutely convinced that if there is some small excessive consumption of fuel, these are necessary production losses. And differently supposedly also cannot be.

But all paradox of current situation with an excessive consumption of fuel on all thermal power plants that anybody is reasoned did not disprove it, i.e. existence of a steady excessive consumption of fuel is absolute on all thermal power plants of more than 10% of its general expense. Branch institutes keep silent. ORGRES firm which introduced some decades miscalculations of the actual and standard TEP, dropped out "in a deposit". The Ministry of Energy of the Russian Federation authoritatively declares that it at all not their business, and now it already SRO prerogative. And power accountants who in general are far from technology of calculation of an excessive consumption of fuel live in SRO. Thus, all this overexpenditure "on a drum"!

Here also it turns out that only the compulsory motivation on increase in Profit, i.e. installation of the monitor with the current analytics on the flowing-away Profit before a nose of the CEO of the Generation company, perhaps and is an exit from this defective situation. But in this case this Director has to be, at least, not the coward and ready to face the truth. But something such is not observed on the horizon yet!



## **9. True energy efficiency of power plant**

---

Why Energy efficiency is necessary? Naturally, for economy of energy resources. And not because at us they are not enough. And it is simple, the Russian President decided that somehow it is necessary to accustom all at any level to thrift since abroad specific consumption of energy resources several times is less.

Finally, business and from above will reach thermal power plants. Time the Generation companies do not realize yet that, the earlier they will undertake the authentic accounting of an excessive consumption of fuel, the they more will be the winner. At least even because elimination of the excessive consumption of fuel existing now in 10% on all thermal power plants, will make for them additional profit in 300 million rubles from each power plant.

All will agree that it is impossible to call power plant power effective if it allows an excessive consumption of fuel in 10%. But most surprising another that about this huge excessive consumption of fuel anybody does not even suspect since monthly reports of power plants fix economy of fuel.

Whether but perhaps it is real without use of the operational accounting of an excessive consumption of fuel? Now we will theoretically expose this constant lie of power plants, or, if on more softly, desire to please management of OGK and TGC.

The interval of calculation of the actual and standard TEP, and, therefore, and an excessive consumption of fuel, has to be minute or, at least, half-hour. And on larger intervals the excessive consumption of fuel has to turn out only summation, i.e. with use of the principle of integral calculus of the area of dynamic process.

For the proof we will review a simple example, having presented dynamic process in the form of spheres. It is necessary to find the volume of 3 spheres with diameters: 10, 20, 30 - by two options. The first - correct:

separate calculation for each sphere and summation. The second - wrong: calculation of average diameter and calculation of total amount.

Sphere volume:  $V = 4/3 * 3,14 * R^3$ .

By the first option:  $523 + 4186 + 14130 = 18839$ .

By the second option:  $4186 * 3 = 12558$ .

Thus, the mistake makes  $(18839 - 12558) / 18839 * 100 = 33\%$ .

Here any will tell, why was to count and it is so clear that by the second option it is simple to consider nonsense. But quite so affairs with monthly calculations of TEP at all power plants also are now. All indicators collect within a month, and then calculation of an excessive consumption of fuel is carried out.

Now present that in the winter: at the beginning of a month of 0 degrees, and at the end of the month -40. And figure-20 participates in calculation. And so all thousands to indicators both pressure, and temperature are averaged. Instead of spheres in real calculation it is used hundreds of nonlinear schedules which, besides, are distorted by polynoms. So about what exact monthly calculation of an excessive consumption of fuel in general it is possible to speak. But if calculation is all the same not right, it, naturally, it is possible easily and to correct in the convenient party.

And now a thermal power plant it is comparable with the engine which was supplied according to standards with coal and sent from Moscow to Vladivostok with all stops and with a strict requirement on the minimum fuel consumption without its additional subloading. Well and how the driver in blind can fulfill this requirement? Everyone will tell that without indicators of the correct fuel consumption throughout all way to the movement moments with various speed and at the moments of stops to make it simply not perhaps.

But the operation personnel on a thermal power plant operates quite so, i.e. in the blind. It has no concept, what current size of an excessive consumption of fuel at it and as it depends on various technological situations. But according to monthly reporting data it turns out that it worked better than standard data. And it in principle cannot be. The strange

nonsense turns out. In a question we agree with the engine that without operating control the economy of fuel is not possible. And at power plant it turns out that the economy of fuel is carried out by itself. But miracles do not happen. Therefore, it is obligatory to eat an excessive consumption of fuel, but its size is simply not known.

Thus, on a thermal power plant if the operating control behind an excessive consumption of fuel is not exercised and in time corrections are not brought in production on cancellation of this overexpenditure, every minute this excessive consumption of fuel is present. And in a month this overexpenditure grows to the impressive sizes.

For elimination of an excessive consumption of fuel, and in passing and other losses, it is rather simple to introduce No-cost Technology on Smart-MES System. But this System will not simply easily provide economy of fuel, but also at the most up-to-date innovative level will provide in general automation of production management in real time.

Energy efficiency is, first of all, wisdom and insight - here the most actual motto not only household and industrial consumers of the electric power and heat, but also producers in the conditions of an increase in prices for fuel.

### ***Energy efficiency of thermal power plants beyond a fantasy or large-scale deception***

What is the energy efficiency of thermal power plants and as the criterion of this energy efficiency that it was possible, somehow to compare power plant by this criterion among themselves is defined, branch institutes and the Ministry of Energy of the Russian Federation do not know. There is the general phrase that energy efficiency is an economy of energy resources. For thermal power plants is a fuel. But we will try to understand this question partly.

Let's assume that energy efficiency of power plant is objective and there is a subjective. Objective - depends on technological feature of power plant and it cannot be improved without constructive changes. Subjective - depends on the person and, therefore, it can be changed by means of the

correct organization of production. Subjective energy efficiency is always more or is equal objective on - to definition. Let's take for criterion of energy efficiency the relation objective to subjective which is equal or less than 1. Thus, power plants with criterion of energy efficiency equal to unit or 100% are absolutely power effective.

As an objective assessment of energy efficiency we will take a standard cost of fuel, and as subjective - the actual expense. But the difference between the actual fuel consumption and standard corresponds to an excessive consumption of fuel. Thus, the power plant will be power effective if the excessive consumption of fuel is equal to zero.

But zero excessive consumption of fuel, well or very close to it appears in all monthly reports of thermal power plants. It means that all 300 power plants in Russia are absolutely power effective, even without having the current control of this excessive consumption of fuel. That is, without making any efforts on economy of fuel and working regarding its overexpenditure absolutely blindly, all power plants achieve grandiose results. It is valid beyond a fantasy. Here that also consists in it large-scale deception not only the Generation companies, and and the Ministry of Energy of the Russian Federation.

But this deception should be proved still. And so ... The monthly excessive consumption of fuel is equal to a monthly actual expense minus a monthly standard cost of fuel:

$$dB = B_{\text{fakt}} - B_{\text{norm}}$$

If  $dB = 0$ , namely it also appears in monthly reports,

$$B_{\text{fakt}} = B_{\text{norm}}$$

The monthly standard cost of fuel is equal to the sum of expenses on power generation and is warm:

$$B_{\text{norm}} = B_e + B_q \text{ or } B_{\text{norm}} = (b_e * E + b_q * Q) / 1000,$$

where:  $b_e$ ,  $b_q$  - specific costs of fuel of monthly power generation (E) and heat (Q).

But if  $dB = 0$  then  $B_{fakt} = (b_e * E + b_q * Q) / 1000$ , namely it is also necessary to disprove it.

Here indicators  $B_{fakt}$  (tut),  $E$  (Mvt\*ch),  $Q$  (Gcal) are the actual monthly values received by means of the account. And indicators  $b_e$  (kg/Mvt\*ch),  $b_q$  (kg/Gcal) - the settlement standard indicators received on formulas from monthly data among which there is a set of average values of pressure and temperatures, and also values according to standard nonlinear schedules.

Electricity generation and heat at power plant is difficult dynamic process with continuous change of loadings: day and night. If we present the actual fuel consumption in a month in the schedule form with half-hour divisions, it will be not the direct horizontal line, and there will be a fringe. At anybody does not raise doubts that the area of this schedule or the general monthly fuel consumption should be counted by method of addition of half-hour values.

But from ours that formulas:

$$B_{fakt} = (b_e * E + b_q * Q) / 1000$$

it turns out that we count the actual fuel consumption summation of two rectangles:  $(b_e * E)$  and  $(b_q * Q)$ . Here that also consists in it the most important error of modern calculations of TEP at power plants. Thus, will be correct:

$$B_{fakt} > (b_e * E + b_q * Q) / 1000.$$

Therefore as the actual monthly fuel consumption will pay off summation of half-hour values, and standard monthly fuel consumption has to pay off in the same way, i.e. summation of half-hour values.

Therefore, specific fuel consumption have to pay off on half-hour intervals, and it is better on minute. So, a half-hour (minute) excessive consumption of fuel is present always since the actual expense is more than current control, standard because of total absence, of this overexpenditure.

But what magic way in monthly reports of power plants the zero excessive consumption of fuel turns out? First, naturally, because of

incorrectness of a method of calculation of monthly TEP, and, secondly, elementary various methods of adjustment are used everywhere. MS Excel is also convenient to these that it provides a wide field for creative approach to monthly subtraces TEP. But whether the Generation companies need this poppycock?

Actually, all thermal power plants have criterion of subjective energy efficiency less than 90%, and it is very low indicator which reason only the human factor is. If to shift it to profit of the Generation companies, the criterion of efficiency of their activity is estimated no more than 50%. It means that, having brought only actually organizational methods criterion of energy efficiency of power plants to 100%, the profit of the Generation companies will double.

### ***Energy efficiency of power plants does not depend on wear of the equipment***

One of the most important strategic problems of the country who was put by the Russian President - to reduce by 2020 power consumption of domestic economy by 40% [27]. Its realization requires creation of a perfect control system of energy efficiency and energy saving.

For all enterprises the obligation for the accounting of energy resources is entered. The organizations, cumulative annual charges which on consumption of energy resources 10 million rubles exceed, obliged at least once in five years to pass power inspections by results of which the power passport of the enterprise fixing advance on a scale of energy efficiency [28] will be made.

In comparison with modern western power plants It should be noted the following distinctions in energy efficiency of the Russian power plants: the average electric efficiency approximately on 10 percentage points is less, than at modern western stations. Consumption of fuel at old stations of the Soviet construction is about 30% higher, than at the western stations, at development of identical volume of the electric power [29].

There are some reasons of low level of efficiency of the Russian power plants (by data the Internet). Some of them are a consequence of

design characteristics of the capital equipment, some - its wear. The skill level and motivations of the personnel have a great influence on real efficiency of power plants [29]. Design parameters of power plant cannot be easily changed without large investments. The effective and profitable way is to approach technological parameters as it is possible closer to design sizes.

So give we will understand everything on an order and we will find out: whether wear of the equipment influences Energy efficiency. On the Internet the following definitions of Energy efficiency are given. Energy efficiency (usefulness of energy consumption) - a useful (effective) expenditure of energy [30]. The power effect is degree of perfection of receiving from fuel of the energy capable to make work [31].

But why the Ministry of Energy of the Russian Federation so still also did not develop universal Criterion of Energy efficiency for power plants? Or the power passport of power plants and will be formed on the basis of incorrect techniques of monthly calculation of specific fuel consumption on power generation and is warm? And if there is no Criterion of Energy efficiency of power plants, how then among themselves to compare them: Combined heat and power plant, state district power station, PGU?

We are ready to help with this Ministry of Energy of the Russian Federation. We suggest to use Logistic Criterion of Energy efficiency for all thermal power plants:

$$K_{ef} = B_{nr}/B_f * 100 = (B_f - B_{per}) / B_f * 100 = (1 - B_{per}/B_f) * 100,$$

where:  $B_{nr}$  - the standard (settlement) fuel consumption received by the correct calculation;

$B_f$  - the actual fuel consumption;

$B_{per}$  - an excessive consumption of fuel.

The logistics defines optimization of expenses [32]. But time in tariffs for the electric power and heat the share of cost of fuel makes 50-60% therefore it is possible and to be limited only to a fuel component.

More any indicators are also not necessary since all of them are considered at calculation Bnr.

The correct calculation of TEP will be: minute or half-hour calculations of the actual and standard indicators with the subsequent their accumulation on a monthly interval.

That at which the criterion is equal 100% will be power effective power plant. The criterion of Energy efficiency cannot be more than 100%, as well as there cannot be an economy of fuel. In this case it is necessary to speak in general about incorrect algorithms of calculation. If the Criterion of Energy efficiency is less than 100%, then the power plant for each percent has to pay to the state a penalty of 10 million rubles for irrational use of fuel.

And now we will pass to wear of the equipment. If we agree that the Criterion of Energy efficiency of power plants is result of division of a standard cost of fuel into its actual expense (and other definition simply is not present), we will consider on what the standard cost of fuel depends.

$$Bnr = (be\text{\textbackslash}nr * Ef + bq\text{\textbackslash}nr * Qf) / 1000,$$

where:  $be\text{\textbackslash}nr$ ,  $bq\text{\textbackslash}nr$  - specific standard costs of fuel on power generation ( $Ef$ ) and heat ( $Qf$ ).

But specific expenses of fuel pay off according to standards which surely consider wear of the equipment. Therefore, the more wear of the equipment, the is more than value of specific expenses of fuel. That is, wear of the equipment does not conduct to decrease in a standard cost of fuel, and, on the contrary, to its increase. Thus, Energy efficiency depends not on wear of the equipment, but only on a human factor.

For the additional proof we will take two identical power plants with identical wear of the equipment and with the identical plan of power generation and heat. But different people work for them, therefore, and management of power plant will be various. As a result, at an identical standard cost of fuel the actual fuel consumption will be a miscellaneous, and, so and a miscellaneous criterion of Energy efficiency. Therefore, at



these power plants there will be also various Energy efficiency. Then and here wear of the equipment?

Now for absurdity power plant it is comparable with a supermarket which successful functioning in the same way is defined by Criterion of Efficiency:

$$K_{ef} = S_r/S_f * 100 = (S_f - S_u)/S_f * 100 = (1 - S_u/S_f) * 100,$$

where:  $S_r$  - the settlement cost of goods received after its realization;

$S_f$  - the actual cost of the delivered goods;

$S_u$  - the cost of the stolen goods.

In a supermarket to exclude a human factor in the form of theft for increase in efficiency of trade, establish video cameras for control in real time, and at the exit there are "Cerberuses". Now present that there are no both video cameras, and "Cerberuses" then clearly that it is possible already and to forget about effective trade. All perfectly understand this, and management, without reflecting, invests in equipment for an operating control so much, how many it is necessary.

The generation companies consider that at power plants the operating control behind an excessive consumption of fuel is not necessary. The incorrect monthly report with convenient figures suffices. But the excessive consumption of fuel is the same theft. Only the state, i.e. at all users has this timid theft of the electric power and heat since the excessive consumption of fuel is included in tariffs. The stolen annually uncontrollable fuel all thermal power plants in Russia would be enough for functioning of 30 more new additional thermal power plants.

But this problem is solved very simply. It is necessary to exclude a human factor by method of an operating control in real time behind an excessive consumption of fuel by means of Smart-MES System. But this System will specify weak places in production not only regarding an excessive consumption of fuel, but also regarding costs of the electric power and heat of own needs, and regarding losses.

And Smart-MES, finally, in general will make civilized electricity generation and is warm, having provided to operation personnel "eyes and

ears", and to management of the generation company operational levers for management of financial processes.

### ***The excessive consumption of fuel is the best Criterion of Energy efficiency of power plants***

The firm of Information Systems believes that the excessive consumption of fuel ( $B_{fakt}-B_{norm}$ ) on half-hour (daily, monthly) an interval in the form of logistic criterion of fuel usage ( $B_{norm}/B_{fakt}$ ) that will allow to cut fuel consumption for 10% has to become the main criterion of Energy efficiency of power plants.

Power plants monthly send Models 15506-1 "Report of power plant on thermal profitability of the equipment" to OGK and TGC [36] where 121 indicators contain, and here the excessive consumption of fuel is absent. But, if the true half-hour excessive consumption of fuel is close to zero or the criterion of fuel usage is close to unit, it means that the power plant works economically since participate in calculation of an excessive consumption of fuel all 121 indicators. And in this case value of an excessive consumption of fuel has to be predominating.

Now concepts: the big actual size of an excessive consumption of fuel on a monthly interval - in general is absent since it at power plant simply is not allowed elementary fine tuning of results in MS Excel under small economy of fuel. And, as a rule, it is explained with inaccuracy of initial parameters.

Until the end of a month at power plant nobody knows about the sizes of an excessive consumption of fuel, i.e. management of power plant regarding optimum fuel consumption happens blindly. But after all fuel cost in tariffs occupies 60% and, apparently, the actual true excessive consumption of fuel in commercial conditions has to be the main indicator, but not properties.

Why this situation remains unaddressed from OGK and TGC? There is an elementary misunderstanding of a current state of power plants. This contradiction of power plant, as the lowest production and nothing decisive link, and the highest management.

At the top level, on an example, academically make technical requirements for competition on mathematical model of power plant with a set of need of optimization on HOPZ (characteristic of a relative gain of expenses). Everything is healthy, plans an ocean. And even certification of the service personnel, i.e. girls from PTO is considered, and sensible technologists left because of a scanty salary long ago.

A few years ago we tried to introduce our program Complex at combined heat and power plant. We come to the chief engineer and we say that for work with System sensible experts are necessary. He only made a helpless gesture supposedly at us such is not present. As a result we made the part, but the PTO Complex did not earn. Now, of course, we considered a lot of things and a lot of things changed in technology of introduction. But for this purpose we needed to fill cones to the detriment of image.

Our experience shows that without import of reliable signals and without mobile realization of reliable calculations of the actual and standard TEP, in general is useless to speak about optimization.

Exit very simple!!! First of all it is necessary to introduce Smart-MES System with half-hour calculations of an excessive consumption of fuel. The developed analytics will give opportunity to operation personnel with open eyes to operate power plant. Well, and further, please: HOPZ, dynamic optimizer, simplex method.

***The human factor harms to energy efficiency of power plants, and SmartGrid is a utopia without Smart-MES***

At a forum of power engineering specialists concerning an excessive consumption of fuel and a mess in power industry the following was declared: "The same situation in all other countries. And when everywhere same, it any more not a mess, but new world order. And this new order keeps and develops on the basis of new laws. Everywhere it is more favorable to people to construct the generation, the sources of heat and cold, than to wait when the ministries are engaged in something, except a self-survival. Decentralization in power is called as SmartGrid. And it - not only the engineering design, but also organizational. People not only build

generation and networks, but also define standards of compatibility and safety, laws of regulation and pricing" [37].

The following wants to answer it. Before creating SmartGrid (A clever Network or Clever Power), it would be more correct to create everywhere at first SmartPowerStation (Clever Power plant). And that it is similar to the Clever House which is heated by means of "Potbelly stoves". Comically SmartGrid in the All-Russian scale when because of a huge uncontrollable excessive consumption of fuel annually in Russia 100 billion rubles dully take off for pipes of thermal power plants looks now, poisoning the atmosphere. And all this because of an elementary human factor.

Let's consider two categories of a human factor, i.e. at the lower level and at the top level of the Generation company. At the lower level, i.e. at the level of power plant - the operational accounting of an excessive consumption of fuel is it all the same or it is not present since the additional profit on economy of fuel all the same passes by them. At the top level, i.e. at the level of the management of the Generation company - it seems the economy of fuel but so that huge this excessive consumption of fuel did not appear in reporting papers, and differently how to defend increase of cost on the electric power and heat is also necessary.

Therefore if half-hour calculations of TEP, only for internal use are realized. Monthly calculations on the basis of which reports are formed, are carried out completely as before, i.e. with possibility of adjustment of specific fuel consumption under a zero excessive consumption of fuel. In this case power accountants have nothing to grasp the Generation companies and to point by it to low energy efficiency since there are no exact data in principle.

If we speak about SmartGrid i.e. how about the self-regulating environment, why in power industry in general power passports and power accountants are necessary? But for SmartGrid the sound market at which the Generation companies would be interested in searches of any internal reserves of decrease in expenses and increases of energy efficiency is necessary. In Russia it will only be possible to speak about existence of such market of the electric power when the prices of it stand or even will

spread in a bottom. But sufficient surpluses of the electric power are for this purpose necessary, and it is not present now. Therefore, and the market is not present. Therefore prices of electricity constantly aspire up.

It is now clear somehow to control the Generation companies on energy efficiency and by that to contain an increase in prices for the electric power, and power passports are necessary. But here an ill luck - according to the contents this energy pass for power plant is equated to the usual house. And the power plant after all burns a huge amount of fuel which cost contents in price of electricity and heat reaches 60%.

Therefore surely in the power passport emphasis has to be put on the correct identification of a reserve of increase of energy efficiency through decrease in fuel consumption, and for this economic expense there are standards.

Therefore, it is necessary only to the Ministry of Energy of the Russian Federation to show political will and for the correct calculation of an overexpenditure (FACT - STANDARD) fuels has to be in the power passport necessary intervals of calculation of TEP are surely specified. These intervals should not exceed half an hour. And the monthly calculation of TEP existing at all power plants is quite misleading because of curvilinearity of power characteristics of the equipment and standard schedules.

Here also very unattractive picture on implementation of requirements of the Russian President of general increase in energy efficiency which main brake is the usual human factor of an indifference turns out.

The Ministry of Energy of the Russian Federation does not hurry to change power passports of power plants for the purpose of a reliable energy audit of the Generation companies. Management of the Generation companies ignores a Smart-MES System role for increase in energy efficiency of power plants, hiding thus from the public a huge excessive consumption of fuel. The operational personnel of power plants regarding an excessive consumption of fuel operates power plant blindly since on all

300 combined heat and power plants and the state district power station completely is absent the operational accounting of this overexpenditure.

But we raise at SmartGrid on the Western sample, without having for this sufficient basis. Certainly, the power industry has the right to create fashionable SmartGrid, but it has to be on a decent basis, i.e. not at the expense of consumers of the electric power and heat who should not pay a huge excessive consumption of fuel because of mismanagement of power plants.

### ***Integrated Indicator of energy efficiency of combined heat and power plant and state district power station***

Let's ask two very simple questions. What indicator defines criterion of energy efficiency of thermal power plants? How to compare among themselves power plants on an energy efficiency factor? And anybody distinct will not tell anything about it: neither in the Ministry of Energy of the Russian Federation, nor at branch institutes, in the organizations which are carrying out an energy audit neither in the Generation companies, nor at power plants.

Here it is so healthy! All in sweat are engaged in increase in energy efficiency, and that this such do not know. Naturally, know in general, and for this purpose even heaps to nobody the necessary formal power passports are formed.

In what here business? And everything is very simple. Before reorganization of power industry energy efficiency of power plants interested nobody. But when the Russian President designated a vector on general increase in this energy efficiency, the power industry led by the Ministry of Energy of the Russian Federation was elementary not ready. Moreover after reorganization there were independent Generation companies which define strategy of the development and which are formally elementary bounced by "stupid" power passports. And nobody knows that is farther with this unnecessary heap to do.

And our two-year hints to the Ministry of Energy of the Russian Federation about existence of an excellent Integrated Indicator on thermal

power plants in the form of an excessive consumption of fuel, do not yield tangible results yet. It is natural as it is possible to break in itself this moral barrier and to listen to tiny not technological IT Firm when the largest branch institutes are silent.

But it everything is easily explainable. After all the real excessive consumption of fuel anybody never saw since there was no Smart-MES System. And those overexpenditures which turn out in monthly calculations, technologists are explained by either an error of devices, or inaccuracy of calculations. Therefore everywhere these calculations are adjusted to a zero excessive consumption of fuel or even to its small economy. Here so fine it turns out! This is also energy efficiency in operation!

How we managed to reveal this problem? Somehow we at combined heat and power plant put experiment on Smart-MES System with half-hour calculations of the actual and standard TEP and noticed that daily the excessive consumption of fuel is close to zero in the afternoon, and at night it reads off scale for 30%. It turns out that devices and calculations there is nothing at all. Simply the excessive consumption of fuel actually always was and is, and, probably, it is result of a human factor since the operational personnel regarding an excessive consumption of fuel operates power plant blindly.

But we revealed still very important thing. It appears, to calculate an excessive consumption of fuel on a monthly interval in general categorically not truly, it needs to be received only summation from half-hour calculations.

Why the excessive consumption of fuel is the Integrated Indicator? Because it turns out, as a difference between the actual fuel consumption ( $B_{fakt}$ ) and standard ( $B_{norm}$ ). The standard cost is defined by summation of costs of fuel of give of the electric power ( $E_{fakt}$ ) and give of heat ( $Q_{fakt}$ ). Thus specific standard costs of fuel for the electric power ( $b_{norm\ e}$ ) and for heat ( $b_{norm\ q}$ ) are used.

$$dB = B_{fakt} - B_{norm} = B_{fakt} - (E_{fakt} * b_{norm\ e} + Q_{fakt} * b_{norm\ q}) / 1000$$

Here for calculation of specific standard costs of fuel ( $b_{norm\ e}$ ,  $b_{norm\ q}$ ) use all indicators on all equipment of power plant. In other words, all calculations of the actual and standard TEP become for the sake of these two indicators.

Then also the Logistic Criterion of energy efficiency by which it is very easy to compare any power plants (combined heat and power plant and state district power station) to any kind of fuel is elementary formulated, and it looks as follows.

$$K = dB/B_{fakt} * 100\%$$

After all look how everything is simple. To watch energy efficiency of power plants, the nobility only this Criterion which with the correct calculation in general is unknown now on one power plant is enough. But actually everywhere its value exceeds 10%.

In this case it is necessary to understand strictly that negative dB value or ephemeral economy of fuel cannot be at all. Thus, all of economy which were shown earlier and which everywhere are shown in monthly reports of power plants now, is unintentional input in delusion not only the managements of the Generation companies and the Ministry of Energy of the Russian Federation, but also in general all people of Russia.

Tell on favor, what if power plants are not able and do not want to count correctly an excessive consumption of fuel, and, therefore, and to seek to liquidate completely it why consumers of the electric power and heat have to pay this mismanagement? Why this huge excessive consumption of fuel shamelessly joins the Generation companies in tariffs, how productive expenses which it is not at all? And when the Ministry of Energy of the Russian Federation will bring an order with these miscalculations of TEP for a reliable energy audit of thermal power plants?



## **10. Cloudy Technology of economy of fuel of power plant**

The cloudy Technology means an arrangement of computing resources on the remote server [38] far outside power plant. Thus, the power plant has no Program of calculation TEI (Technical and Economic Indicators) at all and, therefore, it does not serve. In this case the power plant uses only calculation service, providing basic data on the WEB INTERFACE and receiving results of this calculation.

It as the small enterprise does not incorporate the accountant, and he is "coming". The enterprise, without paying a salary to the accountant, pays only quarterly for service of drawing up reporting tax documents that is several times more economic. However, there is no accountant for performance of non-standard financial operations near by.

Generally, the Cloudy Technology allows the Generation companies easily and without serious consequences to break a psychological barrier of mistrust to use of the new Smart-MES software product and in general to do without obligatory competition since in this case after all it is got nothing. It and is economically very favorable. But if only service is used, for it it is always possible to change also the supplier.

The economy of fuel is an indispensable and main condition of increase of energy efficiency of power plants. The easiest way of economy of fuel is expeditious tracking its overexpenditure (the actual expense - a standard cost). This excessive consumption of fuel on all thermal power plants makes more than 10% of the general expense, and at night at the lowered loading of power plant the excessive consumption of fuel reads off scale for 30%. But anybody actually does not see it since anywhere there is no current half-hour accounting of this overexpenditure.

The cloudy Technology focused on economy of fuel looks as follows. Everyone half an hour from power plant on the WEB INTERFACE is automatically sent a database with half-hour initial information. The system counts the actual and standard TEP for this half an hour, and the resulting information is sent back on power plant where it can be presented in the form of reports and in monitoring on BCP. The operational personnel, thus, constantly sees the current half-hour information on an excessive consumption of fuel, and it has a compulsory motivation on search of decisions for economy of fuel. It is not present at one power plant now.

The order of introduction of this Cloudy Technology can have three stages.

**First stage:** Free testing. At this stage for one power plant algorithms of calculation of the actual and standard TEP are transferred to us. After completion of adaptation the database with daily initial information is sent us. We at ourselves carry out half-hour calculations of TEP for days and we submit to power plant the resulting data and analytics in half-hour cuts. At a positive response the following stage is possible.

**Second stage:** Adaptation for all power plants. Here all calculations for all power plants of the Generation company are realized. Then half-hour calculations of TEP in real time on Cloudy Technology are adjusted.

**Third stage:** Transfer in the Generation company. In case the Generation company wishes to operate itself Smart-MES System that is naturally correct and quite logical, the fulfilled Cloudy Technology is transferred to the Generation company with acquisition of licenses for the software by it.

Plus of Cloudy Technology is its comparative low cost. Though against estimated huge profit it not such and an important factor. The following plus is total absence in requirement of qualified personnel at power plant for service and operation of Smart-MES System. But the most important plus is absolute absence of risk since in the beginning without the conclusion of contractual obligations acquaintance to work of System on real data is carried out.

Minus is lack of opportunity, at least, at the initial stages, to use a set of optimizing, analytical and intelligent tools of Smart-MES System.

Thus, Cloudy Technology, being already on itself an economic product, allows also in addition to promote considerable economy of fuel of power plants, so to make notable annual additional profit for the Generation companies that averages on 300 million rubles from each power plant.

### ***The bewitching possibilities of MES for economy of fuel of power plants***

At the beginning it should be noted especially that it is the only domestic Smart-MES System for power plants which is originally oriented on receiving profit by the Generation companies on a complete elimination of an uncontrollable excessive consumption of fuel. The average annual

size of profit corresponds to the 300th millions of rubles on each power plant.

Why still anybody seriously does not bring up this, apparently, obvious question on elimination of an excessive consumption of fuel? Probably, it so developed historically. Before emergence of the market of the electric power the accounting of an excessive consumption of fuel was simply not necessary. And such backward outlook and continues to prevail.

Now in many Generation companies are introduced and various Systems for automation of calculations of TEP which are not capable to solve at all a problem of a complete elimination of an excessive consumption of fuel since ideologically they not so far left from MS Excel take root.

In Smart-MES System, on the contrary, absolutely new principles of information processing are used, and the latest philosophy which is focused on economic effect is put. In this case here it is impossible to mark out any one feature since it is organic set of properties: adaptability, speed, functionality.

Without this Smart-MES System the solution of a question on the current control over an excessive consumption of fuel in general is impossible. But only the economy of fuel is capable to make for the Generation companies considerable additional profit. In this case all optimizing tasks without control of an excessive consumption of fuel do not solve this problem at all and are simply fiction.

It occurs because now on all thermal power plants the operational personnel concerning an excessive consumption of fuel operates power plant simply blindly. And time it so, the operational analytics on the current excessive consumption of fuel will not be provided to them yet, at them it will be elementary to be absent compulsory motivation on economy of fuel.

But it becomes more difficult for Generation companies to play tariffs, and maybe in general in the future it is not necessary. Therefore only the big internal reserve on economy of fuel is capable to solve their economic problems.

And the most important that it is elementary to make it by means of No-cost Technology of economy of fuel on Smart-MES System. After all for some reason it is clear to all that to conduct the market relations without operational accounting of the electric power and heat it is simply impossible. But for some reason thus miss that the accounting of an

excessive consumption of fuel is the same economic problem without which decision electricity generation and it is warm simply defectively.

It occurs because now at all power plants of fuel is spent without restriction so much, how many is actually spent for electricity generation and heat without thinking about standards. But same completely contradicts the economic principles, the power plants focused on increase in energy efficiency.

After all by and large on that also there are calculations of a standard cost of fuel that in real time it was possible to compare the current actual expense to them. But it actually is not present at one power plant. It turns out that the existing monthly calculations of a standard cost of fuel exists only pro forma especially as methodically they in principle are not right. And, considering that they simply everywhere are adjusted, it in general unnecessary calculations.

Is it better to force these calculations of a standard cost of fuel to serve the Generation companies for receiving additional maximum profit absolutely without capital investments.

It is possible to believe or not to believe in success of this No-cost Technology, but that expeditious half-hour calculations of the actual and standard TEP in real time will introduce at power plant in general new quality, i.e. sight to the operational personnel regarding an excessive consumption of fuel, is the indisputable fact.

Therefore, the bewitching possibilities of Smart-MES System it not simply its any characteristics, and huge potential profit with an economic return in only one month.

### ***Role of MES System in economy of fuel of power plants***

Any computer program provides first of all that information which without it cannot be received. And differently, it would be and is not necessary. Another matter, the person has the right to use this information or not. The more often the person uses results of this program, the this program becomes more powerful. But if the computer program promotes fast increase in profit, this program in general does not have the price!

Traditionally in PTO of power plants the program for calculation of TEP was always used and continues to be used now only for ascertaining of results of work of power plants for the monthly period. And in this case, the essence of a platform of the program is not important at all, whether it be it is simply antediluvian MS Excel, or the most up-to-date technology on

Oracle products, from it it becomes more useful not. Even, if attempts of realization of optimization of resources become, but on the former poor principles, it simply is the ridiculous attempts directed what somehow to acquit itself.

Why Management of the generation companies so easily follows the tastes these tricks camouflaged with various academic jabber in the form of Technical requirements to Automation of calculations of TEP PTO. Yes because he simply does not understand a question essence, and to have completely to rely it on the IT Expert who besides has also "devils" in the head (From, to snatch money, to the self-affirmation I). This most high quality Expert in the field of information technologies at the same time is any Expert in the technological sphere of power generation and heat.

The irreplaceable role of introduction of MES System in dynamic production is known for a long time, but that's it is absolutely new to power industry. And here follow not simply to consider a role of the Smart-MES System, namely all set of Technology of decrease in an excessive consumption of fuel on this System.

Traditionally power plants cope on devices on BCP and the automated means of the commercial accounting of give of the electric power and heat. And here the commercial accounting of an excessive consumption of fuel on them completely is absent. And it when the Generation companies fight for the wholesale markets of the electric power when the Generation companies seek to get the maximum profit, perfectly understanding that the fuel component in tariffs for the electric power and heat occupies 50-60%, i.e. very huge.

It would seem, obvious that for fast increase in profit the Generation companies it is necessary to adjust first of all the mode of the most strict economy of fuel on all thermal power plants. But here that also there was a huge gap in knowledge and at the Ministry of Energy of the Russian Federation, and at branch science, and, naturally, at the Generation companies since it historically it was never required and therefore it was not studied.

But when we try to inform common truths regarding the correct calculations of TEP, and we offer No-cost Technology of increase in energy efficiency of power plants and fast elimination of an excessive consumption of fuel, it is perceived extremely hardly and is slowed down.

And it is clear why. In many Generation companies various introductions of program complexes on automation of calculations of TEP

are started. And, naturally, their stop is impossible, since. Both gingerbreads, and champagne were already promised the management of the Experts.

But miracles do not happen. Will pass a little time, and all will be convinced that it was dense delusion. Champagne will not be. And what further? In this case in vain lost money is not so important, and the downtime is important.

But all ingenious is really very simple. There is enough, in parallel to start introduction of Smart-MES System. And it not the conflict of interests, and reasonable combination of Strategy and Tactics. The existing and already introduced program complexes will provide the generation companies with Strategy regarding automation TEP, and the Smart-MES System will supply power plants with Tactics on the fastest decrease in an excessive consumption of fuel in real time.

When the operational personnel on BCP sees on monitoring the current constant information and dynamics on logistic criterion of fuel usage ( $k = B_{norm}/B_{fakt} \rightarrow 1$ ), the incentive motivation will force it to look for the best technological decisions for elimination of an excessive consumption of fuel ( $\Delta B = B_{fakt} - B_{norm} \rightarrow 0$ ) on all operational time spans. And it will lead, eventually, to considerable economy of fuel means of elementary control of technological process.

Refusal of the present possibility, i.e. of introduction of Smart-MES System for no-cost considerable decrease in fuel consumption, and, therefore, and for doubling of the profit, will put this Generation company obviously in the lagging behind positions, both in economic sense, and in sense of the modern market organization of electricity generation and heat.

The uncontrolled and irresponsible constant excessive consumption of fuel will promote more and more degradation of power plants, especially considering their considerable wear of the equipment.

## **11. A subjective excessive consumption of fuel at power plant**

All statements that the huge excessive consumption of fuel is caused by big wear of the equipment, are not well-founded at all. But the most regrettable that it is declared by experts from branch institutes. Perhaps of course, they confuse this overexpenditure to the actual fuel consumption? After all on one thermal power plant never this excessive consumption of fuel was counted correctly and not counted now. As for fuel consumption, it is naturally fair that it depends on wear of the equipment. But the considerable excessive consumption of fuel is result of purely subjective human factor.

We conducted researches of half-hour calculations of TEP on Smart-MES System at combined heat and power plant and it became clear that the average excessive consumption of fuel in days makes more than 10%. And at night it reads off scale for 30%. Dynamics of this overexpenditure looks as follows. In the afternoon it sticks to about zero, and is closer to night hours the overexpenditure starts increasing gradually and then at night some hours keep on a maximum. In the morning the excessive consumption of fuel again gradually reduces to zero.

Experts explain this fact to that at night loading of power plant falls. So it so, but then, and here wear of the equipment? After all standards according to which the excessive consumption of fuel pays off, already correspond to this wear. And here dynamic change of loading naturally directly influences an excessive consumption of fuel. But after all the operational personnel operates power plant simply blindly concerning this excessive consumption of fuel since its operational account everywhere is absent. Here therefore that always existed and exists a huge uncontrollable excessive consumption of fuel.

And now we will remind that the excessive consumption of fuel corresponds to a difference of the actual expense and standard ( $\Delta B = B_{\text{fakt}} - B_{\text{norm}}$ ). Thus, for achievement of a zero excessive consumption of fuel for each half an hour its actual expense has to correspond to the standard. But if the half-hour standard cost is not known, as well as is now at all 300

power plants, to carry out it simply not perhaps. Therefore it turns out that the actual expense on exceeds at night the standard many.

This results from the fact that at decrease in loading of power plant at night the number of degrees of freedom and diversity on management of power plant sharply increases. But at the maximum loading of these degrees freedom simply is not present therefore the right only option of management with a zero excessive consumption of fuel works.

Therefore it is easily possible to draw a conclusion that this existing excessive consumption of fuel on all thermal power plants is result of blind subjective management of the operational personnel. But after all then this excessive consumption of fuel which across all Russia is equivalent to 100 billion rubles, it is easily possible to liquidate, having entered into electricity generation and heat the half-hour current accounting of this excessive consumption of fuel on Smart-MES System. Then the operational personnel, seeing on BCP in monitoring half-hour analytics of an excessive consumption of fuel, it will be compelled to take measures for its elimination. Thus, the operational personnel has a compulsory motivation on elimination of an excessive consumption of fuel and on economy of fuel in general, making for the Generation companies annual additional profit in 300 million rubles from each combined heat and power plant and state district power station.

Innovative Smart-MES System, possessing powerful adaptation and high-speed properties, easily allows to provide not simply the current accounting of an excessive consumption of fuel in real time, but also to create in general other automated environment for management of power plant. And which against the poor and antediluvian environment existing now at the all-station level is represented as progressive absolute energy saving No-cost Technology with a set of optimizing and analytical tools.

It is only possible to be surprised a lag effect and backwardness of thinking of management of the Generation companies which does not notice at itself scandalous ruin on automation of calculations of TEP at a modern level of development of Russia on global modernization of power industry near by at all. That costed only by manual processing of chart tapes which else it was necessary to refuse 10 years ago, or calculations of



TEP in DOS which became covered by a thick layer of a mold for a long time.

Even incredible attempts of some Generation companies do not decide to organize automation of calculations on economic-mathematical model from 3-unit SQL by structure the most important, i.e. a complete elimination of a huge excessive consumption of fuel at all. But instead of quickly realizing universal elimination of an uncontrollable excessive consumption of fuel, power plant elementary it hide, adjusting for this purpose calculations of TEP. And it for some reason the Generation companies quite arranges, even losing thus annual additional profit in 300 million rubles from each thermal power plant.

Only the Smart-MES System with the enormous opportunities is capable to bring power industry out of stagnant situation with this huge universal excessive consumption of fuel completely.

### ***Fast increase in energy efficiency of combined heat and power plant and state district power station by means of Smart-MES System***

As we already spoke, now on all 300 thermal power plants in Russia traditionally completely there is no elementary current account and the analysis of an excessive consumption of fuel, and it leads to that this 10% unproductive overexpenditure unreasonably Generation companies joins in tariffs for the electric power and heat. Suffer from it, as simple inhabitants because of high tariffs for housing and communal services, and all industry in Russia in general.

At all power plants the operational personnel regarding an operating control over an excessive consumption of fuel operates power plant simply blindly as of old, controlling only give of the electric power and heat, and without reflecting on amount of fuel necessary for this purpose at all.

There is a paradoxical picture that when the Russian President proclaimed a vector on general increase in energy efficiency of the industrial enterprises, thermal power plants uncontrolledly in the old manner continue to burn fuels so much, how many it will turn out for implementation of the plan of delivery for the electric power and heat.

I consider that long ago it is time to bring an order and to stop empty squandering of natural resources. For this purpose it is enough to enter at all power plants half-hour calculations of TEP on Smart-MES System with providing monitoring on the current excessive consumption of fuel on BCP. Then the operational personnel will have a compulsory motivation on economy of fuel. And many tons of the kept fuel which are equivalent in a year to 100 billion rubles, it is possible to use rationally for other needs.

Unwillingness the Generation companies to save fuel it is similar to sabotage. And actually, why to save if the consumer is compelled to accept those tariffs which establish the Generation companies? After all in Russia the real market on the electric power is not present therefore there is no rivalry in aspiration to reduce fuel expenses and by that to increase energy efficiency of power plants.

But the Government of the Russian Federation intends to control further rigidly degree of increase in tariffs and therefore the profit of the Generation companies on it will only fall. And only the Smart-MES System which will quickly orient the operational personnel on thriftily careful attitude to fuel can rescue this inevitable falling of profit. Thus, Smart-MES is peculiar "lifesaver" for the Generation companies.

The innovative Smart-MES System will at once introduce a modern form of information technologies at power plant. It consists in exact calculation of the actual and standard TEP, including also an excessive consumption of fuel, and also in convenient and comprehensive access to analytical information, including various means on optimization of resources. In the present time at one power plant it is not present anything. It is very regrettable. It means that the Generation companies excessively were fond of trading, having forgotten about production.

And here the moment when it is just necessary to adjust information technologies below at power plants to the information technologies which are available in the Generation companies above came. And differently time will be missed, and the profit of the Generation companies will catastrophically decrease, and owners will sell the actions.

The no-cost Technology of economy of fuel will very quickly transform electricity generation and is warm to the best, entering into this process elements of the current control and the analysis of all expenses and

especially an excessive consumption of fuel. And emergence of a huge excessive consumption of fuel is rich material for discussion of the reasons of this regrettable fact which can reflect or imperfection of technology, or to reveal the vicious human factor incapable in time to react to change of need for the electric power at night.

The Smart-MES System will easily reveal all this and will record, having provided thereby ease of detection of the reasons and specific violators of techniques on prevention of an excessive consumption of fuel. But Smart-MES will also easily prompt also optimum distribution of resources in real time. And for trading it will easily predict necessary amount of fuel for any period according to the plan of delivery of the electric power and heat.

Only the Smart-MES System is capable to provide substantial increase of energy efficiency of combined heat and power plant and state district power station. It not simply other program, it in general other outlook and other philosophy of fast adaptation of difficult settlement systems, extremely high speed of calculations, magnificent number of analytics and optimizing mechanisms. And all this is made for convenience and the technologist of PTO, and for the operational personnel of power plant.

### ***To save or not to save fuel of power plants***

Question: To save or not to save fuel of power plants - in itself already is provocative since any will tell that, naturally, it is necessary to save. But it only in words, thus he for this purpose will not make anything. And it is observed from the most top level to the ordinary employee of power plant. In what here business? Yes, everything is very simple - matter in an elementary material interest.

At us passed long ago those times when feats were made for idea, now they are carried out only for worthy payment. Let's consider a behavioural condition of two extreme groups in the Generation company: the operational personnel of power plant, and also the personnel of other shops, including PTO, and management of the Generation company. On the one hand, a salary in 50 thousand rubles with total absence of the rights in decision-making on attraction of innovations at the level of power plant and, on the other hand, a salary in 1 million rubles with all opportunities of

creation of economic policy at power plants. Thus the No-cost Technology of economy of fuel in 10% on Smart-MES System with receiving annual profit in 300 million rubles on each thermal power plant is offered to them.

It would seem, everything is healthy! Enormous increase of energy efficiency of power plants is available! Well, and what reaction of these groups to these innovations? The group of the lower link is it seems interested since doubling by it of a salary for the account of production progress, bonus at achievement, on economy of fuel in real time is possible, but at it hands since she has no right to vote are unfortunately short. The group of the top link is not interested to change the habitual course of production since having the huge salary of anything from it in addition will not have at all because everything will leave to investors, and the headache is provided owing to absolute transparency in this case of the fact of a considerable excessive consumption of fuel, and, therefore, and an indicator of the unsatisfactory management.

How to be? How to save fuel on power plants in the All-Russian scale which is equivalent to empty annual losses for the sum of 100 billion rubles? Here only the political will of the Ministry of Energy of the Russian Federation will help. And for this purpose that is necessary very little, namely: To legalize half-hour calculations of the actual and standard TEP, including also an excessive consumption of fuel. In this case and the energy audit will be not formal and confused, and directed on true increase in energy efficiency of power plants.

Actually with introduction of half-hour calculations there will be a new commercial function in addition to the accounting of the electric power and heat - the accounting of an excessive consumption of fuel that never was. In this case the operational personnel surely will have a compulsory motivation on economy of fuel since it in monitoring on BCP will constantly observe the current analytics on an excessive consumption of fuel according to which either bonus charges, or punishments are coming.

But nobody wants to save fuel. In this case inertial traditions of irresponsibility are very strong. After all if not to show a huge excessive consumption of fuel anywhere, "rubbing" everything that it is not present and cannot be, and life in general is simpler, and this overexpenditure with

great success is paid by consumers of the electric power and heat. Thus, 100 billion rubles annually across Russia are useless take off for pipes of power plants, polluting the atmosphere 10% more.

Here involuntarily there is a comparison of power plant with the oligarch which easily got the capitals. It builds the life without the principle of economy. And the power plant provides delivery of the electric power and heat, without reflecting on an excessive consumption of fuel. How many it is burned, so production since all the same everything will be eventually paid demands so much.

But after all always there are objective reasons of an excessive consumption of fuel, and there are subjective. Now they are not divided since in general this overexpenditure is not considered therefore anybody and does not know the specific weight of these subjective reasons. But the excessive consumption of fuel for the subjective reasons is a powerful reserve of easily achievable increase in energy efficiency, and, therefore, fast increase in annual profit in 300 million rubles on each thermal power plant, i.e. it is necessary to bend down and lift simply.

The powerful Smart-MES System elementary and quickly solves all these problems on providing the Generation companies with the additional profit got at the expense of a complete elimination of an excessive consumption of fuel and installation at power plants of true competitive spirit between watches for the maximum economy of fuel. All design features of the Innovative Self-organizing Smart-MES System on advance time therefore even to professional system analysts it is often unclear many how it from the simple text description of a technological task is developed huge System with all attributes: Databases, Screen Forms, Reports, Settlement DLL Programs.

Same "trouble" with economy of energy resources is present, for example, relatively and power effective bulbs. They a heap lie in shops on shelves, and nobody hurries to snatch away them for economy of the electric power. And here behind usual bulbs of an incandescence people ransack in their search. And bulbs in 100 W who are forbidden to production by the law, are successfully marked by plant in 99 W.

### ***Vector of energy efficiency of power plants***

In the letter No. 09-2131 of 30.09.2011 from the Ministry of Energy of the Russian Federation the Deputy director of Development department of power industry V. V. Bannikova writes: "The Ministry of Energy of the Russian Federation pays special attention to questions of economy of fuel. Now with participation of the leading branch institutes the question of the comprehensive innovative program of construction and reconstruction of objects on the basis of heating power units PGU with the high technical and economic rates (TEP) is studied. In the conditions of the market relations in power industry, high technical requirements to information and analytical systems, systems of the PCS of stations and similar systems, besides calculation of TEP additional requirements are imposed ..." And further 15 points concerning optimization, calculation of prirost, forecasting, planning, modeling and calculation of TEP follow.

Not only that in Smart-MES System all these issues are resolved for a long time, but also many other issues directed on economy of energy resources are resolved. And here in this letter words it is not told about an excessive consumption of fuel, about the correct intervals of calculation of TEP, as though with it at power plants everything is all right and as though it does not concern energy efficiency of combined heat and power plant and state district power station. But after all it is the Ministry of Energy of the Russian Federation which has to formulate strategy of development of power industry for many years ahead. But except PGU (steam-gas station) it is looked through nothing.

By the way, PGU are too not deprived of an illness in the form of an excessive consumption of fuel. And we already showed that all power effective constructive advantages of PGU can be cancelled by the uncontrollable excessive consumption of fuel which is result of a human factor. After all power plant not theoretical energy efficiency, but practical has to excite. Very often PGU with the combined copper utilizer is operated as steam-power installation in the worst option, i.e. without gas turbine. Here to you and raised by efficiency, here to you and energy efficiency!

Well, tell where the energy efficiency vector first of all has to be directed? On optimization of resources or on the accounting of an excessive consumption of fuel? Besides that optimization of resources gives increase in energy efficiency by only 3%, and the accounting of an excessive

consumption of fuel for 10%. And how it is possible to do optimization without the correct account?

Any appeal to increase of energy efficiency means economy of energy resources, than for power plants fuel more is. The standard cost of fuel shows, what its expense is minimum possible for the actual give of the electric power and heat. The actual fuel consumption is those expenses which the power plant incurred at management and at direct influence of a human factor. The excessive consumption of fuel shows, how actual process departed from regulations, i.e. from standard ( $\Delta B = B_{\text{fakt}} - B_{\text{norm}}$ ).

If this process regarding an excessive consumption of fuel is constantly controlled in real time with granting operational analytics for BCP (block control panel), the operational personnel continuously sees information on the current excessive consumption of fuel and by that the compulsory motivation on economy of resources, such is the nature of the responsible person is created. And it is easy to do conclusions. Now it simply is not present. And conclusions which become (or do not become) now for last monthly period, can help nothing for increase in profitability of power plant.

Here also it turns out that the Ministry of Energy of the Russian Federation directs an energy efficiency increase vector only for implementation of constructive highly expensive projects, and completely ignores No-cost Technology of decrease in fuel consumption. Very deplorable picture when the existing thermal power plants with antediluvian technology of calculation of TEP (technical-economic indicator) extend construction of "perspective" power units PGU turns out. It is equivalent as in a poor slum to put the plasma TV which at similar operation will also become poor soon.

But, when the Ministry of Energy of the Russian Federation directs the main vector of energy efficiency, in general, on already outdate PGU technology since in a nape more perspective technology with decentralization of power industry on hydrogen fuel breathes, especially is unclear, why to a question of an excessive consumption of fuel such cool attention. Probably, the Ministry of Energy of the Russian Federation considers that if not far off use instead of gas and coal of the hydrogen

received from water and it is not necessary to consider an excessive consumption of fuel now. But then the same sensitive issue will rise and with an excessive consumption of water.

Correctly chosen vector of energy efficiency defines strategy for many years ahead. But so far the Ministry of Energy of the Russian Federation focuses on economy of the electric power and heat buildings the attention on which, naturally, should be given. But elimination of an excessive consumption of fuel on all thermal power plants No-cost Technology gives 10 times bigger prize in energy efficiency, than all expensive actions for replacement of usual electric bulbs by the light-emitting diode.

Technologists complain how it is possible to operate quickly multiton inertial coppers for economy of fuel at night when for a deviation from the dispatching schedule of delivery of the electric power and heat penalties follow? Here therefore and it is difficult to operate since there is no Smart-MES!

### ***Mad excessive consumption of fuel of power plants***

The excessive consumption of fuel is equal: The FACT an expense minus the STANDARD an expense which is determined by the following formula:

$$dB = B_{\text{fakt}} - (E_{\text{fakt}} \cdot b_{e \text{ \norm}} + Q_{\text{fakt}} \cdot b_{q \text{ \norm}}) / 1000$$

Here specific fuel consumption ( $b_{e \text{ \norm}}$ ,  $b_{q \text{ \norm}}$ ) on the electric power and heat decide on use of one hundred curvilinear standard schedules on the monthly period that in principle it is incorrect according to the theory of integral calculus and an axiom for the curvilinear schedule. But all comedy of this monthly calculation with adjustment elements that as a result practically always the excessive consumption of fuel is close to zero.

The conclusion arises that all this calculation of the actual and standard TEP is made only for definition of specific fuel consumption, and the question of an excessive consumption of fuel in general in this case does not interest. Therefore there is such rough neglect elementary fundamentals of mathematics. Therefore calculations in the form of iterations with intervention of manual correction (for example: a



consumption of network water for standard calculation) are carried out to a condition of approximate equality of an excessive consumption of fuel to zero.

But then allow, why it is asked all this fuss to make with one hundred standard schedules? When there is an elementary formula for definition of specific fuel consumption in general without standards which has a simple appearance:

$$b_e = 1000 \cdot B_{\text{fakt}} / (E_{\text{fakt}} + Q_{\text{fakt}} \cdot k_{\text{sr}}), \text{ where: } k_{\text{sr}} = b_q \cdot c_p / b_e \cdot s_r$$

You right there object that it is the sheer marasmus. But it is, unfortunately, not bigger marasmus in comparison with those calculations which are present at all power plants now. After all some people in PTO are occupied with these calculations, and in this case in general PTO is not necessary!

And now about an excessive consumption of fuel. According to our data the overexpenditure makes 10% of the general fuel consumption, and according to other data it reaches 20%. Exact value at power plants and in the Generation companies is not known by anybody. Besides and nobody wishes to know. Here so requirements of the Russian President for increase in energy efficiency, i.e. any positive reaction even in practice take root from the Ministry of Energy of the Russian Federation.

The question of the correct half-hour calculations of an excessive consumption of fuel is interesting and important not that exact monthly values of this overexpenditure will be found. And that there is an opportunity on the basis of these calculations in real time to lower this overexpenditure and in general to improve other expensive TEP of power plant, such as losses and costs of own needs of the electric power and heat.

Technologists object us and say literally the following that if the schedule of delivery of the electric power and heat is strictly observed, no excessive consumption of fuel can be. It is good. Whereas to explain half-hour analytics on an excessive consumption of fuel which we recorded at combined heat and power plant with the power unit PGU. From the schedule we see that in the afternoon the excessive consumption of fuel is minimum, and at night is maximum and reaches 20%. Say to us that everything is correct. In the afternoon the power plant is almost completely

loaded, and is not present at night. But why after all there is an overexpenditure? The intelligible answer is not present. Because at all power plants the similar half-hour analytics on an excessive consumption of fuel simply is absent.

What physical sense of this excessive consumption of fuel? Let's consider a simple chain of a copper and the turbine. Gas comes to a copper, from a copper sharp steam arrives on the turbine, from a turbine unit the electric power is released. At the exit of a turbine unit the output electric power for which deviation from the dispatching schedule financial punishment strictly follows is strictly controlled. Therefore, control of electric power is exercised by means of regulation of intake of gas in a copper. But the copper - is inertial.

To you it is necessary to reduce upon transition to the night mode power reduction of a consumption of gas. But warmth in a fire chamber some time remains former. Therefore an exit one - to pit a little excess steam in the atmosphere. Naturally operate a copper according to regime cards. But there is one danger - so to reduce gas supply that electric power will pass for the lower bound admissible which consequence the most strict punishment will be. And after all the copper will not be warmed at once. Where the smaller risk and actually absolutely uncontrolledly power to operate method of drain of excess steam. But thus the excessive consumption of fuel is present.

Naturally, all this told it is possible to carry on nonsense of the layman, but from it problems will not become less. From it the excessive consumption of fuel will not decrease. From it the half-hour analytics of the main settlement TEP and an excessive consumption of fuel on BCP will not appear. From it the operational personnel regarding the current excessive consumption of fuel will not begin to see clearly. From it nobody will return to the Generation companies the missed annual profits to 300 million rubles from each power plant.

## **12. Stubborn Analytics of an excessive consumption of fuel of power plants**

---

At one power plant in Russia anybody and never saw and does not represent dynamics of technological process expressed through half-hour settlement actual and standard indicators, and, therefore, and an excessive consumption of fuel. It became possible only with the advent of Smart-MES System. Besides, the System allows to see this dynamic process in real time that does possible in due time to interfere with it for the purpose of decrease in this excessive consumption of fuel which has to become the main criterion of energy efficiency of power plants.

Management of the Generation companies is for some reason firmly convinced that at their power plants of an overexpenditure fuels are not present and cannot be. They are convinced that it is quite possible to receive even economy of fuel, i.e. excess of a standard cost of fuel over actual, on the equipment which was outdate that. Though the excessive consumption of fuel also does not depend on wear of the equipment since degree of wear is already considered in standards, but the economy of fuel is in general a utopia.

However, the worn-out equipment demands to itself special attention since its characteristics are less stable. Therefore it is much more difficult to achieve the minimum excessive consumption of fuel on it. And in this case the Smart-MES System role increases even more.

In modern power industry there are some incontestable Axioms regarding an excessive consumption of fuel which for some reason did not consider earlier and now persistently continue to ignore: both Ministry of Energy of the Russian Federation, and branch institutes. And after all the science has to advance considerably production and specify to it the right and advantageous direction.

In practice the return picture turns out: the science continues to pull electricity generation and is warm regarding an excessive consumption of fuel in an ignorance bog. The science as "saddled" MS Excel for monthly calculation of the actual and standard TEP (technical-economic rate) in due time, and continues it to operate impudently. Even, if other software, and even if SQL a database is used is used, the ideology persistently remains former.

The concept of any automated system of calculations of TEP has to consider these Axioms surely. The neglect them conducts simply to uselessness of calculations of TEP regarding increase in energy efficiency of power plants. I give some such Axioms:

1) The economy of fuel on any time span cannot be. The economy of fuel is an excess of settlement need for fuel according to standards over the actual expense of fuel. Standards reflect the existing condition of the equipment. Thus, the economy of fuel displays or that fact that the equipment became newer that simply a nonsense, or the fact of incorrect algorithms of calculation of standard TEP.

2) The interval of calculation of the actual and standard TEP has to be minimum (minute or half an hour), and on all other intervals (days, month) these TEP have to turn out only accumulation.

3) It is necessary to watch an excessive consumption of fuel constantly in real time by means of its monitoring for BShchU. Here very simple and obvious principle is used that the earlier the process deviation from nominal is noticed, the it is simpler to correct it.

4) Introduction of the software for calculation of TEP has to have economic efficiency. The most important and big error of modern approach in the Generation companies it that they initially focus the software for PTO only on settlement and optimizing functions without concrete economic component.

5) The software for calculation of TEP has to be easy and adaptive and high-speed. For providing the given Axioms there has to be a mobile and multipurpose MES System.

Now, as well as all last years, instead of half-hour calculations monthly calculations of TEP (technical-economic rate) and excessive consumption of fuel are everywhere used, i.e. daily accumulation of the actual TEP and monthly calculation of the actual and standard TEP is carried out. This ignorant approach was offered by ORGRES Firm as main ideologist of all calculations, and it is approved in the Ministry of Energy of the Russian Federation.

In what the inaccuracy of this approach is covered? Yes everything is elementary, the mistake consists in simple neglect the basic mathematical

principles when using curvilinear schedules. And hundreds of these curvilinear schedules are involved in calculations of standard TEP.

This principle is expressed by the following inequality:

$$F(\text{SUM}(xi) / n) \text{ not equally } \text{SUM}(F(xi)) / n$$

Also it sounds as follows: Function from Averaging (as now - it is absolutely incorrect) is not equal to Averaging of Functions (as has to be - truly). And still easier to say that there are elementary rules of integral calculus for dynamic production.

Naturally, the objection follows at once that though the error and is, but it such small that no practical value has. It is only possible to answer it to one, and who and when in general considered this error, say, in a year. The Smart-MES System is for this purpose necessary, but its that just and is not present at one power plant.

The neglect elementary mathematical laws for difficult dynamic process what the power plant is, not simply conducts to degradation of technology of power generation and heat regarding economy of fuel, and in general does incompatible the modern market relations of the Generation companies with the backward principles of management of use of fuel at power plants.

The generation companies, operating development by the electric power also it is warm for the wholesale market, do not operate economy of fuel at all and do not control its thriftless overexpenditure.

Thus, the state for the Generation companies created very convenient and favorable environment for business which is that all uncontrollable excessive consumption of fuel of which nobody knows, successfully and impudently joins in tariffs for the electric power and heat.

And nevertheless, whether it is favorable to generation companies to know about the fact of a huge excessive consumption of fuel at all power plants? But there is a golden rule, the more know, the best maneuver. And it in market conditions - positive and indispensable quality.

Now in Russia two inconsistent tendencies are observed: constant increase in cost of natural fuel and increase of protest mood of citizens because of the increasing tariffs for the electric power and heat.

The Generation companies easily can create a steady situation for the business, having ensured a sufficient reserve of energy efficiency by means of true elimination of an excessive consumption of fuel.

But there will be also such power plants which will assure that they have absolutely right algorithms of calculation of TEP which consider all costs of own needs and all losses, and there is no adjustment of basic data, and the economy of fuel all the same turns out. But also in this case it is possible to speak only about incorrectness of algorithms of calculation which include the incorrect standard schedules which are unfairly straightened by polynoms.

### ***Nonsense predetermines innovations in power industry***

30 years ago the nuclear power industry considerably surpassed thermal regarding computer automation. Now they were actually made even. But it not because the thermal power industry was tightened to nuclear. But because the nuclear fell to thermal power industry, especially regarding calculations of TEP.

Both on thermal power plants, and on nuclear power plants full calculations of TEP are carried out on the monthly period on antediluvian technology which initially was incorrect. And only right technology are minute or half-hour calculations of the actual and standard TEP with the subsequent their accumulation on a monthly interval.

But pass competitions on development of programs for calculation of TEP and still in a basis incorrect messages are put. And even it is unimportant that innovations are offered. And if, say, the license on work with confidential materials is not present (for the NPP), these innovations actually - anything. Thus, on one bowl of scales of Themis the most powerful innovations urged to increase energy efficiency of power plants, and on another - the most stupid piece of paper which is elementary bought are placed. And this piece of paper in a verdict outweighs innovations.

Such here level of modern competitive collective consciousness.

Criteria of an assessment and comparison of offers are given in one competitive documentation: 1) The cost of performance of work - 55%; 2) Completeness and quality of the description of the performed work - 20%; 3) Experience and qualification of the Performer - 25%.

Well, we will tell for bolts and nuts it, maybe, and approaches. But as it will be coordinated with introduction of the hi-tech software product, as Smart-MES System which introduction due to economy of fuel makes annual profit in 300 million rubles. You are perplexed when there is a bargaining for introduction cost instead of 10 million rubles only 3 million rubles supposedly are offered is not allocated any more. It at payback that in one month.

But when competition is won by the organization which never adjoined to power industry and which simply understands nothing about the correct calculations of the actual and standard TEP, elementary wonder. Where you slide power industry?

It is strange when in modern conditions competitions on development of programs for calculation of TEP at the price of 3 million rubles for term in one year together with introduction are announced.

For comparison, the Smart-MES "MES-T2 2020" System was developed by us 10 years at prime cost not less than 200 million rubles. But we take money only for its delivery (only 2% of prime cost), adaptation and introduction.

And what expects to receive power plant, announcing due to a misunderstanding competition on development of the program of calculation of TEP with half-hour analytics? Perhaps, by the nonsense and naivety she expects to receive a program masterpiece? But miracles that do not happen. And she will surely receive next temporary program "plug" with the academic bias.

Well, and where declaration of economic effect of introduction of the program? Or the profit is not necessary to the generation company any more? And where aspiration to implementation of directives of the Russian President on increase in energy efficiency of power plants and economy of fuel? Even any hint ...

It is necessary to understand perfectly that when in the specification to competition it to be told about development of the program for calculation of TEP, all stages of development are naturally necessary for this power plant about which the creator of competition probably is not aware. But in this case it will be the program only for this power plant, and it will consider only this algorithm of calculation. But same long ago the

outdate approaches. That also consists in it modern paradox and modern nonsense.

On the one hand, the power industry passed into new market conditions, but on the other hand, the organization of informatization remained antediluvian. On the one hand, PGU for increase in energy efficiency of power plants, but on the other hand take root, there is no progressiveness for introduction of MES System for the purpose of decrease in an excessive consumption of fuel. On the one hand, try to develop new programs, but on the other hand, are absolutely blind to already available innovative easy and adaptive and high-speed Smart-MES.

It is quite natural that nobody cancelled a trial and error method. But this period of search was strongly tightened by management of the generation companies. But the brilliant decision that lies on a surface. It is Smart-MES System! She both will save fuel, and will double profit, and will prevent accident at power plant.

### ***The Stone Age for IT in PTO of power plants without Smart-MES***

In 2009 released JSC Firm of Information Systems the new version of the Tool program Complex - MES-T2 2007 System of v.6.248 in structure:

- The PTO v.6.x professional Complex for adaptation and functioning the file - a server configuration,
- The v.7.x Kliyent-Server application for functioning with any SQL Server,
- The graphic v.5.x editor for Monitoring of TEP,
- Web application v.7.x for realization of calculations of TEP on the Internet.

The slangy term "Stone Age" is used for designation of the people leading a breeding and primitive life, and meaning their big technological backwardness.

And what is now used in PTO (technological department) of power plants for calculation of TEP (technical-economic rate) of work of the equipment? The primitive technology based on MS Excel. Unless it not the Stone Age? And we know power plants where DOS dominates. It when PGU widely take root, and calculations of TEP are carried out by means of



a stone axe. Whether it is a shame it is to the most advanced power industry in the world. Whether the Ministry of Energy of the Russian Federation ignoring of emergence of the most advanced Innovative System for automation of production management of power plants - Smart-MES "MES-T2 2020" is a shame,

- which easily adapts for any power plant,
- which has the highest speed of calculation on automatically created DLL programs,
- which has the most powerful mechanisms of analytics for optimization of resources and global forecasting,
- which easily creates dynamic models of power plants with minimax strategy,
- which allows to post online the most difficult calculations of TEP with possibility of analytics from any corner of the globe.

Really it everything will be demanded only years through ten when OGK and TKG pomudret?

There is still an assumption that heels of the abrupt Moscow IT companies distributed among themselves a sphere of influence on OGK and TGC, and these are 300 power plants across Russia. Otherwise how to explain the following facts:

- our victory in competition on Kashira GRES hangs in OGK-1,
- our victory in competition at Petrozavodsk combined heat and power plant hangs in TGC-1,
- our victory in competition on Troitskaya GRES hangs in OGK-2.

Simply some IT Mafia works. After all to them not to cope with lots of power plants. According to the most optimistical forecasts not less than 10 years for automation of calculations of TEP at all power plants will be required. And also the level of future automation is doubtful.

Whether it is better for this purpose to use the self-organizing Smart-MES machine gun which is already existing unique innovative.

### ***Technology instead of the program of calculation of TEP***

The computer program always adapts to production, and Technology, having an organizational component, opposite makes some changes to the existing course of this production. Thus, introduction of the program does not influence production and does not conduct to increase in

profit. The technology is initially called for increase in this profit. The technology considerably surpasses the program in the contents and simply it absorbs. Thus, the Technology can do everything that the program, but with orientation to receiving profit does. In this case, the program always acts as the supernumerary, and Technology as the creator. And if from Technology it is possible to allocate the program, from the program to receive Technology it is simply impossible.

Now on all thermal power plants for calculation of TEP only programs are used. But whether they bring any benefit to the Generation companies? As supernumeraries, probably, bring, but no more than that. And would like to have the Generation companies something bigger from these programs? Certainly, would like, but, unfortunately, they do not know that it is simply impossible. For this purpose there has to be a Technology, but not the program.

In due time JSC Mosenergo suggested us to participate in competitive procedure on introduction on a number of stations of the Automated system of display of key technical and economic indicators (ASO KTEP). In other words, introduction of the program of calculation of TEP.

But we did not begin to participate in this competitive procedure, naturally, since since 2011 decided to introduce only Technology on Smart-MES System TEP of power plants directed on generation of profit at calculations with their expeditious monitoring in real time. In other words, we are not engaged not in effective hand-made articles any more. And we cooperate only with those who wishes to have significant additional profit at introduction of our No-cost Technology of economy of fuel.

The essence of this Technology consists in the following. In real time with a minute interval calculations of the actual and standard TEP, and, naturally, with obtaining the current values of an excessive consumption of fuel and logistic criterion of fuel usage are carried out. All current key TEP and, the most important, an excessive consumption of fuel are presented in the form of analytics in monitoring on BCP (block control panel). If necessary everyone half an hour are started optimizing mechanisms with delivery of councils to the operational personnel for the best loading of the equipment.

The operation personnel in this case has compulsory motivation on economy of fuel since it constantly observes this current excessive

consumption of fuel on monitoring on BCP. According to quality of management and lack of an excessive consumption of fuel the operational personnel gets a considerable award since as a result of its conscientious work and impressive opportunities of Smart-MES the Generation company has additional annual profit from each power plant in 300 million rubles.

In PTO (technological department) of power plants need every month to make reports and models with adjustment of results for management of the Generation company since all main TEP (technical-economic rate), including also an excessive consumption of fuel disappears, everyone half an hour are transferred to the central panel of this Generation company where automatically and necessary summary reports for any period are formed. PTO personnel in this case is loaded not by foolish reports, but intellectual activity for the purpose of the analysis and reduction of losses and costs of own needs of the electric power and heat, and also for the purpose of modernization of calculations of TEP on Smart-MES System.

The technology is supplemented with also intelligent mechanism with the knowledge base. Let's tell, at the same technological parameters, why constantly to start dynamic half-hour optimization on full model of power plant when it is possible to record simply all these installations in memory and then in need of them instantly from there to take. Thus, in the knowledge base various half-hour technological cuts are fixed, and if necessary on algorithm of recognition of a dynamic image the necessary information is taken from memory and it is provided to the operational personnel for management. Also this mechanism is used and for forecasting of the exact sizes of the bought fuel.

Thus, the Technology operates power plant, and the program blindly fixes results of last reporting period. It is possible to communicate with Technology in real time for the purpose of improvement of energy efficiency of production, and the program as the stupid idol, it is useless the whole month is silent, and only at the end gives out already to anybody unnecessary "pearls". The technology constantly attracts forward, focusing all on modernization, and the program inevitably pulls back, as the weight fastened to the athlete's feet. The program it that appeared long ago and already became obsolete, and the Technology is a perspective baby who was born miracle, thanks to brilliant heredity.

### ***Wrong planning of purchases of fuel in OGK and TGC***

The firm of Information Systems claims that those OGK and TGC on which there is no exact (half-hour) accounting of an excessive consumption of fuel, exceed when purchasing necessary amount of fuel for 10%.

Such results were yielded by analytics of half-hour excessive consumption of fuel in days where clearly it is visible that the main excessive consumption of fuel is carried out at night. Now the operation personnel works blindly since there is no feedback in the form of the calculated excessive consumption of fuel for last half an hour, and these are every day of 10%.

The purchasing planned size of fuel ( $B_p$ ) pays off on a formula:

$B_p = (b_e * E_p + b_q * Q_p) / 1000$ , where

$b_e$  - specific fuel consumption on power generation (kg / Mvt\*ch),

$E_p$  - planned power generation (Mvt\*ch),

$b_q$  - specific fuel consumption on development of heat (kg/Gcal),

$Q_p$  - planned development of heat (Gcal).

Specific fuel consumption pay off on the monthly period. And, as a rule, as a result they turn out such that the small economy of fuel was shown. But differently also cannot be since change of specific expenses in the third sign conducts to very great values of an excessive consumption of fuel. Also it is explained by an error of basic data. Therefore specific expenses are elementary arranged under the satisfying values.

Theoretically calculation of specific fuel consumption on a monthly interval in general is incorrect because of nonlinearity of standard schedules.

Therefore, only half-hour calculations will provide, first, exact sizes of an excessive consumption of fuel and, secondly, will exclude possibility of fine tuning of monthly values of specific fuel consumption since monthly TEP have to turn out accumulation, but not calculation. And if the operation personnel has exact half-hour information on an excessive consumption of fuel, it will be able to minimize this overexpenditure. Therefore, and planning of purchases of fuel to be reduced by 10%.

### **13. The parallel mythical worlds in power industry**

Now in power industry exist and quietly two main behavioural parallel worlds get on among themselves. In one world all strenuously and actively is called for innovations, for energy efficiency, for new information technologies. In other world the same personnel also strenuously and absolutely indifferently slows down introduction of innovative power effective information technology.

The explanation of this phenomenon only bureaucracy and corruption would be strong simplification of a situation. This rather simply elementary indifference of officials lacking initiative which was created many years. We have anybody for anything does not answer with the chair. If is, say, so that who did not support a power effective innovation in time, his dismissal without blamestorming session would follow at once. Perhaps then and Russia did not tail after world economy.

Here the next exemption letter from Department of the state power policy and energy efficiency of the MINISTRY OF ENERGY of the Russian Federation No. 02-496 of 12.04.2011 signed by the deputy director S. P. Makukhi. In which it is said that the position of Department concerning allocation of power plant of federal submission for pilot introduction of Smart-MES System on it remains invariable, i.e. negative. And further it is reported that further correspondence on the matter is represented inexpedient. I.e. in other words, but you would not go far away with the innovative and energy saving ideas, and to us "to a lamp" before this modernization.

But, foreknowing reaction of the Ministry of Energy of the Russian Federation, I did not send any letter to its address. So refusal of further correspondence, most likely, belongs not to me, and to the Civic chamber of the Russian Federation, to the State Duma of the Russian Federation, to the Federation Council of the Russian Federation, to the Russian Prime

Minister and to the Russian President with whom I also directed addresses on No-cost Technology of economy of fuel of power plant on Smart-MES.

Here one more letter of last period in our address from the same Department of the state power policy and energy efficiency of the Ministry of Energy of the Russian Federation No. 02-1400 of 27.10.2010 signed by the deputy director O. P. Tokarev. In which it is said that the Ministry of Energy of the Russian Federation reports about readiness to return to consideration of a question of prospects of the Technology offered by us after representation to the Ministry of Energy of the Russian Federation of the detailed Feasibility study.

Here such metamorphosis, here such parallel worlds. That Ministry of Energy of the Russian Federation shows interest in innovative Technology of economy of fuel, ignores it, conveniently referring to the Federal law.

And can after when we prepared the detailed feasibility report of Technology of economy of fuel, the Ministry of Energy of the Russian Federation simply became a shame with the omissions regarding an uncontrolled excessive consumption of fuel thermal power plants for many years.

The similar question is connected with the parallel worlds and about Skolkovo to which we submitted the application for the Project of Innovative No-cost Technology of economy of fuel of power plants. On the one hand our demand approaches on many positions: it and energy efficiency, it both power nuclear and thermal, it and information technologies. But here ill luck. Participation to Skolkovo requires independent involvement of the foreign partner.

This absurd of organizers Skolkovo is caused by desire of the fastest commercial promotion of Projects abroad. But in ours that a case, it is necessary to bring at first to the native fatherland an order with mismanagement of power plants regarding an uncontrolled and careless

excessive consumption of fuel. And on it not one ten years will leave, considering slow mentality of management of the Generation companies.

Here so in Russia innovations take root and move ahead. Instead of support, state structures put a spoke in the wheel of modern modernization. Instead of the help, from state structures there is a continuous negative. In this case progress is carried out not thanks to state structures, and contrary to them.

We were invited to the Business summit "STRONG RUSSIA - 2011" to the Moscow State memorial estate "TSARITSYNO", as on an authoritative expert platform for joint adoption of constructive decisions in the field of social and economic development of the country and their effective realization, with support at the highest level from the State Duma of the Russian Federation to the Russian President Administration.

I on this invitation very skeptically responded to the executive director of National Agency of strategic projects. About what strong Russia in general it is possible to speak when the country bureaucrats operate, including also the Ministry of Energy of the Russian Federation for which it is necessary nothing. And they need one that they were disturbed less with different innovative ideas.

### ***Riddle of the Sphinx in power industry***

It is accepted to call the most difficult riddles riddles of the Sphinx. In power industry also there is most difficult, and still unsolved following riddle: Why the Generation companies do not want Transparency in calculations of TEP and excessive consumption of fuel?

Here Transparency is understood as both reliability of TEP (technical-economic rate), and correctness of calculations of TEP, and efficiency of monitoring of TEP, and controllability of TEP. Transparency in this case is associated with absolutely pure glass through which without distortions the valid condition of electricity generation and heat on thermal power plants in an overexpenditure section by them fuels is highlighted.

At power plants every minute it is developed and, naturally, a certain quantity of the electric power and heat is released to the consumer. Every minute to be spent for it a certain amount of fuel, but there is also quite certain standard of constant expenses of this fuel. The difference between the fact and the standard makes a minute excessive consumption of fuel which in principle cannot be negative, i.e. the economy of fuel in a minute cannot be since it contradicts standard schedules.

But when we will look at monthly reports of thermal power plants, practically at all the economy of fuel flaunts. Here to you and paradox! Here to you and essence of a riddle of the Sphinx! But the most interesting that it does not confuse neither the Generation companies, nor the Ministry of Energy of the Russian Federation at all.

Thus, the huge excessive consumption of fuel on each thermal power plant is actually equal not less than 10%, and on papers it is not present in general, on the contrary, there is even an economy. Why the Generation companies close eyes to it? Or perhaps they and the truth consider, what save fuel? But "fools" in management of the companies are not present. Then that?

That also consists in it a riddle of the Sphinx, but it is not solved yet. Let's try to argue partly at least in this direction. After reorganization of power industry management of the Generation companies had a main objective on development of the market of the electric power and heat, and also realization of game on the prices of fuel and tariffs. But this somehow settled. Then there was the following task of construction of new power units PGU.

Meanwhile, in the Generation companies nevertheless various works on automation of calculations of TEP, but, naturally, on a "antiquated" basis are conducted. Well, and how the missed profit because of absolutely incorrect approach to this automation?

I was called from South Korea since read one of press releases about No-cost Technology of economy of fuel of power plants on Smart-MES



System. To my astonishment they were not struck at all that we these innovations cannot at ourselves in Russia realize.

Abroad instantly and correctly understood rational grain of our Technology. They understand at once that it is possible to get decent profit and actually without expenses. On any thermal power plant the current excessive consumption of fuel historically quickly does not pay off, and the operational personnel regarding this excessive consumption of fuel operates power plant blindly. This Technology provides to the personnel compulsory motivation for economy of fuel and for optimum loading of the equipment.

To consider that management of the Generation companies of it does not understand, it would be extremely precipitate. But, absolutely precisely, so it that each company has the interested lobby in pushing through of development of the pocket firm. And, by the way, this their right cause.

However, there is a Ministry of Energy of the Russian Federation, the Department of the state power policy and energy efficiency having in structure which has to watch, probably, behind realization of power effective Technologies on thermal power plants and, at least, to propagandize them, but not to interfere to widespread introduction of these energy saving innovations the indifferent inaction.

### ***Adjustment of calculations of TEP of power plants turns out is authorized by the Ministry of Energy?***

For calculation of TEP of power plants the following Documents approved by the Ministry of Energy of the Russian Federation are used.

1) Methodical instructions on drawing up the report of power plant and joint-stock company of power and electrification on thermal profitability of the equipment, RD 34.08.552-95, ORGRES, Moscow, 1995 [36].

2) Methodical instructions on forecasting of specific fuel consumption, RD 153-34.0-09.115-98, ORGRES, Moscow, 1998 [39].

Both of these documents are issued before reorganization of power industry, but are used and now for calculation of the actual and standard TEP of power plants in the monthly reporting periods. By the way, in the second Document to item 1.1.3 it is written: It is not allowed to consider at tariff forecasting an excessive consumption of fuel because of omissions in operational and corrective maintenance of the equipment. Only it is not told at all as it is correct to reveal these excessive consumption of fuel at monthly calculations.

In these Documents it is accurately said that calculations of TEP are carried out on a monthly interval. But according to the theory of integral calculus for dynamic process it is known that the accuracy of calculation depends on a time interval. And than the time interval of calculation is less, that the accuracy of calculation of the area of dynamic process is more exact.

So, the excessive consumption of fuel (dB1) at all power plants pays off now as follows on the monthly period:

$$dB1 = Bf - Bnr1 = Bf - (be\backslash nr * Ef + bq\backslash nr * Qf) / 1000$$

And has to be so:

$$dB2 = Bf - Bnr2 = Bf - [\text{SUM} (be\backslash nri * Efi + bq\backslash nri * Qfi)] / 1000$$

Here: Bf, Bnr - the actual and standard costs of fuel. Ef, Qf - the actual development (give) of the electric power and heat. be\backslash nr, bq\backslash nr - standard specific fuel consumption on the electric power and heat. i - values on minute intervals.

It is obvious that at curvilinearity of standard schedules which are used at calculation of be\backslash nr and bq\backslash nr, the overexpenditure of dB1 is not equal to dB2 overexpenditure. Therefore, in the above-stated techniques the error of calculation of TEP of power plants was initially put and this mistake is approved by the Ministry of Energy of the Russian Federation.

But power plants that with this mistake should live somehow and correctly to predict fuel purchase. And what to do if by calculations the big excessive consumption of fuel turns out, and, therefore, and it is impossible

to use specific fuel consumption for forecasting? In techniques of anything about it it is not told. Here also power plants should adjust elementary calculations that there was a zero excessive consumption of fuel that on the basis of the adjusted specific fuel consumption it would be possible to predict the bought fuel somehow.

And huge that the excessive consumption of fuel actually is present and is negatively reflected in profit of the Generation companies. And in advance put perversity of the above-stated techniques which is authorized by the Ministry of Energy of the Russian Federation consists in it.

There are two negative moments which absolutely are not meeting the requirements of market economy which demands fuel consumption optimization. The first such moment is that the huge excessive consumption of fuel found at the end of the month is the already come true fact with which to do nothing, except how to sustain financial losses. The second such moment is that, having incorrect data on specific fuel consumption, to have to predict the overestimated purchases of this fuel.

But these two major problems are successfully solved in No-cost Technology of economy of fuel on Smart-MES System for a long time. And only you wonder that it is management of the Generation companies "flies does not catch", carefree allowing annual losses in a look it is useless the burned fuel on 300 million rubles from each thermal power plant. And where watches the Ministry of Energy of the Russian Federation when across all Russia the excessive consumption of fuel is equivalent 100 billion rubles which besides poisons our atmosphere.

Therefore, existing on all thermal power plants of a different look TEP camouflaged adjustment of calculations under a zero excessive consumption of fuel, the Ministry of Energy of the Russian Federation since actually they to them it is implicit also does not disturb and were initially authorized. Referring to that now the Generation companies are independent economic entities, the Ministry of Energy of the Russian Federation in general does not wish to recognize these questions concerning increase in energy efficiency of power plants due to elimination

of an excessive consumption of fuel on Smart-MES that is in a full conflict with the Russian President's course. Thus, it turns out that the Ministry of Energy of the Russian Federation maintains mismanagement of the Generation companies regarding an overexpenditure them fuels.

### ***Fuel revolutionary situation in power industry***

The revolutionary situation is when tops cannot ..., and bottoms do not want ... In power industry the Generation companies cannot infinitely increase tariffs for the electric power and heat for preservation of the profits with a growth of cost of fuel, and power plants do not want to squander uncontrolledly fuel national property in the form of its overexpenditure because of carelessness of management any more, without having thus the bonus.

The paradoxical picture when management of the Generation companies demands from power plants minimization of fuel consumption at implementation of the schedule of delivery of the electric power and heat turns out, does not give to the operational personnel at all opportunity quickly to reveal an excessive consumption of fuel in real time. As a result this excessive consumption of fuel turns out huge, i.e. not less than 10%, and in monthly reports of PTO of power plants flaunt the adjusted economy of fuel.

But all perfectly know that this excessive consumption of fuel very big and it successfully enters tariffs, but operational that from it is not easier for the personnel since the award is not paid for imaginary economy of fuel. And if this personnel would have the current picture on an excessive consumption of fuel, would show efforts for its decrease and on legal grounds would apply for extra fee.

Thus, excess fuel is useless and is uncontrolledly burned, poisoning the atmosphere, management of the Generation companies steadily has the profit, increasing tariffs, and the operational personnel has no motivations on economy of fuel, so and has no opportunity to improve the welfare. That also consists in it social discontent of bottoms.

Why the Generation companies do not hurry to provide to the operational personnel the simplest mechanisms of motivation of economy of fuel, increasing thereby for itself annual profit by 300 million rubles from each power plant? The answer is very simple. Management was born and brought up not under capitalism, and he should make decisions already in new economic realities. It is unfortunately very difficult for it to present and believe that the Smart-MES System is capable to double them profit.

Experts at management of the top management are specialists technologists who were engaged in due time in adjustment of calculations of TEP at power plants since the question of accuracy of calculation of an excessive consumption of fuel never so was particularly acute earlier. But time that already another! It would be time to begin and reflect on it, it would be time to consider all production and non-productive expenses and losses in real time, it would be time to manipulate not simply in the market the cost of fuel and tariffs, and to adjust at power plants competitive spirit with economic incentives.

When everything is clear to the operational personnel and about the current give of the electric power and heat, and about the current excessive consumption of fuel, it has a powerful operational feedback, leaning on which he by all means will achieve the best energy efficiency. In the present time a production situation the extremely unstable.

The production plane for stability should have three support, and now its of everything two: give of the electric power and give of heat. The third support in the form of an excessive consumption of fuel completely is absent therefore the production plane cannot be held in stable situation constantly. And therefore this production plane elementary is unsteady, but can fall. And it already accident, is already incommensurable financial losses.

And that is required very little. It is necessary to have on BCP of power plant continuous monitoring with the current excessive consumption of fuel which pays off in real time every minute. Then the operational personnel will see result of the management and under a prism of an

excessive consumption of fuel. It will be simply compelled, especially at the transitional moments of change of loadings (day and night), quickly to react for elimination of the arisen excessive consumption of fuel.

But if for the operational personnel already there is an opportunity to regulate production not only regarding power generation and heat, but also regarding fuel consumption minimization, from it it can already and be asked, is reasoned having indicated it punctures. If the similar motivation makes additional profit why and not to encourage employees.

Thus, the revolutionary fuel situation will quickly be transformed to quiet competitive labor process with the worthy bonus. And the foundation to this prosperity will be laid by introduction of Smart-MES System with No-cost Technology of economy of fuel on thermal power plants.

## **14. 17 moments Smart-MES and Energy efficiency of thermal power plant**

---

The current state of affairs in power industry very precisely is represented excerpt from Yulian Semyonov's novel and the art television movie "17 moments of spring" of the same name [40]: "The serious proofs indicating Stierlitz as on the Soviet resident (on power plant of the Soviet sample with a huge excessive consumption of fuel) fall into hands of the chief of Gestapo Müller (The management of the Generation company). Stierlitz conducts intense psychological duel with Müller, seeking to avoid a failure. Explanations which it can present to the justification, are rather shaky, but Müller is satisfied with them".

Now the obvious dissonance between the Generation companies (OGK, TGC) which are created for the market relations, and power plants at which the Soviet ferment in the relation to power generation continues to prosper is observed and is warm. Why to strain and introduce energy saving technologies when it is much simpler to include an excessive consumption of fuel in tariffs, and not to show this huge overexpenditure in monthly reports, officially using adjustment methods. It quite suits the generation companies, time for calculations of TEP (technical-economic indicator) of power plants they buy the programs using the same incorrect techniques of the Ministry of Energy of the Russian Federation that were and in MS Excel.

For an example I provide the statement of the head of state district power station of the central region of Russia concerning introduction of Smart-MES with half-hour calculations of TEP for elimination of an excessive consumption of fuel:

"You offer a full garbage. I work in electricity generation more than 20 years. On state district power station. And in my hands keys which as will save fuel, will not be. And half-hour calculation is also not necessary. Because it is not indicative. The sentry, still, where did not go, and here for change, in days it is serious already. The matter is that the competent operator and without any programs knows where he can save and where cannot. Do not forget as quality of the personnel falls and as the equipment

is unreliable. At present time is not present a material interest to save fuel. Earlier it was, now not. Concerning an excessive consumption of fuel at night: Everything is simple, in the afternoon of state district power station drags full capacity (the most economical mode), and at night at least (most gluttonous). And not to do anything with it".

In 30 years the power industry regarding automation of calculations of TEP passed some spiral rounds of computer development (SM-2 with the assembler, personal computers with DOS and Fox Pro, Windows and Excel, Oracle and MS SQL Server), but ideologically she marks time. Still exist only the daily account actual and monthly calculation of standard TEP. And how it, interestingly, matches market economy and energy efficiency of power plants?

Tell, in general, why the Generation company needs calculations of TEP? It is quite enough to have the accounting of the electric power, heat and fuel. After all for planning of purchases of fuel the specific expenses received from the actual fuel consumption are all the same used. And for this purpose standard schedules are not necessary at all. How, interestingly, the generation company for the prosperity uses efficiency of coppers, a steam consumption on the turbine and one thousand more indicators for last month? And in any way. Therefore she also makes light of incorrect monthly calculations.

Now the special boom (generally in OGK) introductions of calculations of TEP on Oracle products is observed, and it is used not only as the SQL Server of databases, but also for client part and for the Application server. In total OGK are located in Moscow, and, the state district power stations entering it, are scattered across all Russia. Therefore think of OGK it is possible to understand: The foreign Oracle System which uses ERP SAP R/3, well fits into the Internet for centralization of TEP of power plants. Introduction of ERP SAP R/3 for the top level costs 500 million rubles. Therefore, realization of calculations of TEP for the full scheme at all power plants will cost not less.

The biggest argument in plus is, naturally, known and popular brands - SAP and Oracle. But, before reorganization of power industry I talked to programmers of Sverdlovenenergo who then introduced R/3, concerning convenience of the mechanism of a nastraivayemost in this R/3. Any of



them was not who positively would speak of it: continuous dregs and language foolish. And it is also Oracle. And technologists of PTO (technological department) for modification and for further development of calculations will have to be on friendly terms with it. But it is a choice of OGK.

Now further, if in ERP the selection method for many and note calculations is used, in calculation of TEP (technical-economic indicator) it simply is not present since each of several thousand indicators pays off on the unique algorithm. Even for coppers and turbines with identical brands various standard schedules because of various degree of wear of this equipment are used. Therefore realization of calculations of TEP on products of Oracle it is incommensurable more difficult, than in R/3.

But a question here in what. If the ocean is piled up such plans, there has to be from it though any advantage and, naturally, an economic effect. But from where it can undertake if optimization of resources gives economy of fuel no more than 3%? From incorrect monthly calculations of TEP too I pound a little. Let's say that monthly or even daily calculations of TEP, and, therefore, and calculation of an excessive consumption of fuel are absolutely right, but these are calculations of the left time.

Only the Smart-MES System with minute or with half-hour calculations can really increase energy efficiency of power plants due to timely detection of deviations and an operational impact by production. In this case from Oracle System only the SQL Server of databases is used. The application server on DLL, client places, a place of autotune of all System is a unique domestic innovative development.

And now about 17 innovative moments from Smart-MES life:

- 1) Text Projects of tasks;
- 2) Car digitization of standard schedules;
- 3) Self-adjustment of all MES System from pressing of one button;
- 4) Car generation of DLL calculations;
- 5) Application server car formation;
- 6) Car downloading of tables and settings for the SQL Server;
- 7) Car representation of any analytics;
- 8) The dynamic optimizer on minimax strategy;
- 9) Car plotter HOP (characteristic of relative increment);

- 10) Intelligent mechanism of optimization and forecasting;
- 11) Linear optimization by a simplex method;
- 12) Test of the equipment and regime card;
- 13) Expeditious Monitoring without graphic editor;
- 14) Agent of emergency safety of power plant;
- 15) Vector graphic editor of treelike structure;
- 16) Avto-ZIP-Arkhivator;
- 17) A car creation of WEB CALCULATIONS on the Internet.

These innovative moments are not present more in one other System. Of course, it is possible to claim that something from them is not obligatory. Undoubtedly, the power plant does not require the prevention of an emergency at all, the graphic editor for archive of thermal and electric circuits is not necessary, calculations after repair of the equipment for creation of regime cards are not necessary. But achievement of increase of energy efficiency somehow needs to be provided.

When there is a monitoring of minute or half-hour excessive consumption of fuel in total with other TEP, then it will be easier to set the task of rational use of fuel for operation personnel. When miscalculations in management are quickly visible, then it will be easier to reveal guilty of this mismanagement. When accurate control of an excessive consumption of fuel is adjusted, then overestimate of its purchase for 10% will not be required. And here only then true Energy efficiency will be reached!

Nobody will tell that it is possible to operate power plant without devices on BCP (block control panel). But it everything was so moved initially. And initially nobody reflected on an excessive consumption of fuel since it was so minor indicator that it even is not present in the model 15506-1. And here the market relations came, the economy of fuel began to play not the last role, various options are looked for.

But clever brains, probably, forgot that all ingenious - is simple! It is necessary to adjust elementary the exact operational accounting of an excessive consumption of fuel. It is necessary to exclude completely a human factor in a question of economy of fuel: I want - I save, I want - no. It is necessary to enter concepts of "carrot and stick" not to monthly work of watches, and to a concrete half-hour episode.

And that it for the statements of the head of power plant (provided above) that at night at the minimum loading of anything it is not possibly to make with a big excessive consumption of fuel. It when the operation personnel works in blind regarding the current excessive consumption of fuel, it is right - there's nothing to be done. It is so necessary to give urgently to operation personnel all settlement current information, having armed it thereby not only eyes, but also intellectual opportunities of Smart-MES System.

And, at last, about economic effect of introduction of Smart-MES. It is simplest to consider economic effect from the point of view of economy of fuel since its component in tariffs for the electric power and heat makes 50-60%.

The fact of a complete elimination of an excessive consumption of fuel which makes 10% of fuel consumption, introduction of Smart-MES difficultly to disprove as exact calculation of an excessive consumption of fuel is absent at all power plants. Exact calculation is meant as half-hour calculation of an excessive consumption of fuel with use of real standard schedules and integral calculus of these half-hour calculations of TEP on the monthly period.

The monthly consumption of natural gas of average combined heat and power plant makes 95540 thousand m<sup>3</sup>. The estimated cost of 1 thousand m<sup>3</sup> of natural gas makes 100 dollars or 5 thousand rubles. Thus, annual charges on fuel make:  $95540 \cdot 5 / 1000 \cdot 12 = 5732$  million rubles. Economic effect of elimination of 10% of an excessive consumption of fuel makes:  $5732 \cdot 10 / 100 = 573$  million rubles.

Even if at calculations there are some inaccuracies, the impressive figure all the same turns out. And it is the missed benefit of power plants. Besides at the current expeditious calculations will undergo economy and other components: it and losses of the electric power and heat, it and expenses of the electric power and heat for own needs.

### ***Investigation of the Model 15506-1 for Power plants***

Firm InformSystem made own investigation concerning absence in the Model of 15506-1 most important indicators - the Excessive consumption of Fuel on thermal power plants, and drew a conclusion on

weak opportunities of the programs for calculation of TEP introduced at power plants in modern market conditions.

The model 15506-1 is a Report of power plant on thermal profitability of the equipment which is provided in Methodical indications of the Ministry of Energy of the Russian Federation: RD 34.08.552-95 [36] (The executive - ORGRES Firm).

In the letter to Information Systems No. 10-508 of 18.05.2010 the Ministry of Energy writes: "Now the specifications and technical documentation on fuel usage is developed by the generation companies independently, without confirmation by the authorized expert organization and without statement in external supervisory authorities. The similar situation creates conditions in which the generation companies can convincingly prove easily achievable level of standard specific fuel consumption on the released electric and thermal energy. Thus there is no motivation in performance of actions for increase of thermal profitability of the equipment" (The deputy director of Department of an operating control and management in power industry and mobilization trainings in energy industry).

However, all OGK and TGC (generation companies) use the Model 15506-1. And in market conditions the huge excessive consumption of fuel at power plants is not necessary to them. Why the Ministry of Energy withdrew from the solution of a question of economy of fuel? The answer arises only one: do not know as. It is possible therefore in the Model 15506-1 initially there was no major indicator on an excessive consumption of fuel.

Why at the Model of 15506-1 of 121 indicators there is an excessive consumption of fuel oil (reserve fuel), and the excessive consumption of the main fuel is absent? In the model such set of minor indicators in a section of coppers and turbines, and the logistic criterion of fuel usage ( $B_{norm}/B_{fakt}$ ) is absent.

If at the Model 15506-1 there was an indicator - a monthly Excessive consumption of Fuel, power plants would be compelled to show its valid huge size, well or to arrange under small economy. But it would be obvious more difficult since all technologists perfectly know that it is significant. As everyone half an hour occurs an excessive consumption of fuel, in a

month this size becomes impressive. But nobody knows the current operational half-hour value of an excessive consumption of fuel since at power plants there is no Smart-MES System therefore it simply is not present and in the Model 15506-1. There is no indicator - there is no problem.

And OGK and TGC lose huge profits since buy fuels 10% more, than has to be on optimum use.

Only Smart-MES can on full real dynamic model of power plant for half an hour count 1000 technological options on minimization of an excessive consumption of fuel and give out councils to the personnel on duty on BCP. And the introduced various Monitorings TEP and Mathematical Models with HOPZ-optimization in it are powerless since they are only the improved MS Excel option.

### ***About Mysterious Soul of the Russian Power***

In power industry existence of two streams concerning energy efficiency of power plants is observed: a turbulent flow of the words and a laminar stream of the affairs directed to the opposite sides and existing in the parallel planes.

Soul - set of the mental phenomena which are closely connected with the Organism, in particular, feelings and aspirations [41]. We can be taken with ease faultfinding of any constructive position, carp at everything that to us is alien owing to our laziness, idleness and lack of initiative. And also that we cultivate the concept "freebie" as attribute of "mysterious Russian soul". On the one hand, anything it is not necessary to do the fruitful. And, on the other hand, everything it is possible to dump on this "mysterious Russian soul". Yes the reality why is necessary, the real action leading to positive result why is necessary.

From high tribunes we constantly hear appeals to energy efficiency and to innovations. And what in practice? We directed addresses with offers on decrease in an excessive consumption of fuel by power plants by means of introduction of innovative Smart-MES System: To the Russian President, Government of the Russian Federation, Ministry of Energy of the Russian Federation, all political parties, all generation companies and even oligarchs. And silence...

And at this time on all thermal power plants the continuous regress connected with fuel usage is observed. Before reorganization of power industry in PTO (technological department) of power plants the qualified technologists worked, and after reorganization in PTO the wage level was lowered, and sensible technologists left. Girls since results of work of PTO of power plants for the generation companies are little significant came to their place. From this follows that progress is not present. And as V. G. Belinsky spoke: "Who does not go forward, that goes back: standing situation is not present" [20]. Thus, full regress is observed. It is a little more and PTO at power plants liquidate as superfluous since all of them equally adjust monthly reports on fuel usage.

But why not to introduce Smart-MES capable of power plants to reveal weak places in technology and to help with economy of fuel, which maintenance of cost with tariffs to 60%. And PTO has to go in for logistics, i.e. optimization of expenses. Thus, instead of adjustment of reporting data, PTO can become the think-tank of energy efficiency of power plants, so, and in general the Generation companies.

### ***Reasonable balance between a bulb and power plant***

Now the State program on replacement acts on all territory of Russia of usual electric bulbs of an incandescence on light-emitting diode nano - bulbs, as the most power effective [42]. During too time, no-cost technology of economy of energy resources on thermal power plants is in the sheer shelter. It would seem, what communication between them and, and here balance between a bulb and power plant?

Any economy of energy resources is carried out first of all in interests of the State. If the nano - the bulb also has the work resource increased several times which is interesting generally only to users because of compensation of its high cost, the lowered power at one and too to possibility of lighting it to the State, perhaps, the main advantage since smaller loading of power plants for this purpose is required. But if it is from above declared that the State is interested in any kinds of economy of energy resources, then in this regard pertinently to consider and economy of energy resources the most thermal power plant and to compare to economy of energy resources nano - a bulb in the all-Russian scale.

For comparison we use the effectiveness ratio ( $To$ ) expressed through work of a total prize on the electric power in days in one thousand  $Mvt \cdot ch$  ( $E$ ) on profitability of realization ( $R$ ). Thus, for the nano - a bulb of  $Kl = El \cdot Rl$ , for power plant  $Ke = Ee \cdot Re$ .

1) Let's assume conditionally that replacement of a usual bulb on nano - a bulb, in general will lead to electricity consumption release. Let's say that 6 hours are per day used one bulb in 60 watts on one person. Thus, the saved electric power will be equal:  $El = 60 \text{ watts} \cdot 140 \text{ million people} \cdot 6 \text{ h} / 1000 = 50 \text{ thousand } Mvt \cdot ch$ . Profitability of realization of replacement of lamps is defined, proceeding from the big capital investments which are paid back approximately in 5 years. Therefore, profitability of  $Rl = 1/5 = 0,2$ . From here, effectiveness ratio of  $Kl = El \cdot Rl = 50 \cdot 0,2 = 10$ .

2) The average power of the power plant is equal 500 MW, and in Russia - 300 power plants. The general power of all power plants is equal:  $500 \text{ MW} \cdot 300 = 150000 \text{ MW}$ . Introduction of Smart-MES will allow to liquidate an excessive consumption of fuel on thermal power plants that makes 10% of the general used fuel. Thus, the saved fuel will allow to provide in addition proportional power generation in a size:  $Ee = 150000 \text{ MW} \cdot 0,1 \cdot 24 \text{ h} / 1000 = 360 \text{ thousand } Mvt \cdot ch$ . Profitability of realization of economy of fuel is determined from profit in 300 million rubles and expenses in 10 million rubles by each power plant. Therefore, profitability of  $Re = 300/10 = 30$ . From here, effectiveness ratio of  $Ke = Ee \cdot Re = 360 \cdot 30 = 10800$ .

As a result we see that realization of no-cost technology of economy of fuel is more effective than realization of full replacement of glow lamps by LED lamps in one thousand times ( $Ke/Kl = 10800/10 = 1080$ ). Here so fine it turns out! It appears, the State strenuously supports much less effective technology and does not pay any attention to innovative highly effective technology on economy of fuel thermal power plants at all.

Why such disgrace is possible? Whether not therefore that the nano - bulbs was lobbied by Chubais, and for no-cost technology there is nobody to tell the kind word since all hide the friend for the friend and only send pieces of paper to the Ministry of Energy of the Russian Federation which

was simply discharged of problems of economy of fuel on thermal power plants.

In the Ministry of Energy of the Russian Federation to us with enviable stubbornness repeat that you at first introduce the offered Technology and receive the reference that the effect will be reached, then we will look. And in the Generation company quite lawfully ask and where you introduced this Technology, what to us to look? The circle became isolated. And on this circle we already walk two years, sending addresses of times a month to all highest authorities. To sense is not present so far!

And meanwhile daily on each thermal power plant it is uncontrolled and useless it is burned fuels for 1 million rubles that in a year across Russia 100 billion rubles which dully take off for station pipes run somewhere.

Thus, we from a high tribune are urged to save on matches and to put water metering devices, and the State cannot show political will and introduce at power plants the operational account on an excessive consumption of fuel. Naturally, in one year at all power plants not to adjust this account, as well as not to replace in one year all bulbs of an incandescence with the light-emitting diode. But it is necessary to do both it, and that, i.e. it is necessary to observe reasonable balance between a bulb and power plant.

For the accounting of an excessive consumption of fuel at power plants it is necessary to involve innovative Smart-MES System which will provide the current analytics of this overexpenditure on monitoring of BCP that will create favorable conditions for compulsory motivation of the operational personnel on economy of fuel in real time.



## **15. Without criteria the Energy audit of power plants - fiction**

In Article 15 of item 2 of the Law No. 261-FZ [43] it is said that Main objectives of power inspection are:

- 1) Obtaining objective data on volume of the used energy resources;
- 2) Definition of indicators of power efficiency;
- 3) Determination of potential of energy saving and increase of power efficiency.

In Article 2 of item 4 of the Law No. 261-FZ [43] it is said that power efficiency - the characteristics reflecting the relation of useful effect from use of energy resources to the expenses of energy resources made for receiving such effect.

In relation to a thermal power plant useful effect are the actual give of the electric power ( $E_f$ ) and the actual give of heat power ( $Q_f$ ). Expenses of energy resources is the actual fuel consumption ( $B_f$ ). To express  $E_f$  and  $Q_f$  through fuel, standard specific fuel consumption on the electric power ( $b_{e\backslash nr}$ ) and on heat ( $b_{q\backslash nr}$ ) are used. Thus, the Criterion of power efficiency for any period which is necessary according to the Law No. 261-FZ, looks as follows with use of half-hour measurements ( $E_{fi}$ ,  $Q_{fi}$ ,  $B_{fi}$ ) and calculations ( $b_{e\backslash nri}$ ,  $b_{q\backslash nri}$ ):

$$EE = \text{SUM} ((E_{fi} * b_{e\backslash nri} + Q_{fi} * b_{q\backslash nri}) / 1000) / \text{SUM} (B_{fi})$$

But take the power passport on any thermal power plant (to combined heat and power plant, state district power station) and will see implementation only of the first point of Article 15 of item 2 of the Law No. 261-FZ which concerns objective data. And how to be with the second and third main points which concern Criterion of power efficiency? Their performance, appears, is elementary sabotaged also by the Generation companies, and Power accountants. Therefore, the Law No. 261-FZ in general, and power inspection in particular, at all is not carried out. And about it the Ministry of Energy of the Russian Federation which is obliged to control implementation of this major Law for some reason is silent.

But if in the power passport it really nothing valuable simply to insert from the point of view of increase in potential of energy saving of

power plant, therefore, all existing calculations of the actual and standard TEP at power plant fiction. In other words, they are in monthly or daily options, but methodologically are not true because of curvilinearity of standard schedules at all. These calculations have to be carried out at most on half-hour intervals.

The Expert from "RusHydro" writes me and, providing the power passport on one of hydroelectric power station, asks: "In what you see potential? How we could lower costs of SN and HN (own and chemical needs) with use of Smart-MES?"

I answer that I am not the technologist and therefore to speak to me about it not absolutely correctly. I will better stop that Smart-MES can:

1) To carry out any calculations of TEP with use of schedules in real time with automatic input of information from your automated means of data collection, the ASKUE type. The interval of calculation can be minute or half an hour.

- 2) Expeditious representation of various analytics.
- 3) Realization of optimizing tasks.

To reduce expenses it is necessary to see constantly them in real time. Then, having analysed them on a daily interval, it is easier to understand where there is a reserve. Loading of power plant changes day and night, the air temperature and waters, etc. changes. But the operational personnel seeks to implement the plan of delivery of the electric power, being guided only by the experience. The system will be able to play a role *sovetyvayushchy*, especially, in the transitional modes.

On what the following was told: "Well, we will think! ASKUE at us is only planned on the majority of hydroelectric power station".

And again about an energy audit. It would seem, this simplest question on realization of a reliable energy audit shows that from the Ministry of Energy of the Russian Federation to producers of the electric power the all-Russian fact of need of increase in energy efficiency of power plants for some reason is very not convenient to all. Therefore one sabotage, filling in power passports trivial and to nobody with the necessary information, and others cover this sabotage.

And from a high tribune continue to expire intensively slogans about need of general increase in energy efficiency ...

### ***Amendments to the Law No. 261-FZ for a right energy audit***

Why in the Law No. 261-FZ [43] on energy efficiency questions on various buildings are taken very in detail up and even incandescence bulbs are mentioned, and here about power plants is not told words? It is only possible to guess that the power plant is simply equated to a construction. But this only construction which develops the electric power. And the electric power is basis in general for all industry and for life of people. Initial cost on the consumed electric power is created at power plants and in the Generation companies, and all economy of Russia depends on this cost.

In Article 4 of the Law No. 261-FZ [43] it is told: Legal regulation in the field of energy saving and increase of power efficiency is based on the following principles:

- 1) effective and rational use of energy resources;
- 2) support and stimulation of energy saving and increase of power efficiency;
- 3) systemacity and complexity of carrying out actions for energy saving and increase of power efficiency;
- 4) planning of energy saving and increase of power efficiency;
- 5) use of energy resources taking into account resource, production and technological, ecological and social conditions.

But if on all 300 thermal power plants of Russia the excessive consumption of fuel makes more than 10% and who (neither in the Generation companies, nor in the Ministry of Energy of the Russian Federation) about it does not know and does not want to know, about what legal regulation it is possible to speak in general. If all are higher the listed points for combined heat and power plant and state district power station elementary are not carried out. And all this occurs because of traditional absence of the operational accounting of an excessive consumption of fuel. But also as a result of it, on all thermal power plants absolutely doubtful energy audit is carried out.

In Article 2 of item 4 of the Law No. 261-FZ [43] it is told: power efficiency - the characteristic reflecting the relation of useful effect from use of energy resources to expenses of energy resources ...

For a thermal power plant it looks as follows:

$$EE = (Efakt * be\_norm + Qfakt * bq\_norm) / 1000/Bfakt$$

Where: EE - Power Efficiency;

The useful effect of power plant is give of the electric power (Efakt) and heat power (Qfakt), the fuels expressed through expenses by means of specific standard costs on the electric power (be\_norm) and on heat (bq\_norm);

Expenses of energy resources minus the actual expenses of fuel (Bfakt).

On the other hand, the excessive consumption of fuel is defined as:

$$Bper = Bfakt - (Efakt * be\_norm + Qfakt * bq\_norm) / 1000$$

$$\text{Then: } EE = (Bfakt - Bper) / Bfakt$$

As we see that power efficiency of thermal power plants completely depends on the size of an excessive consumption of fuel. But now on all thermal power plants incorrectly define this excessive consumption of fuel, and even by means of monthly subraces simply bring it to naught. Therefore it turns out that all thermal power plants very energoeffektivna that is very far from truth. And all this because in the Law is absent an accurate regulation for thermal power plants of intervals of measurement and calculation of the actual and standard TEP, including also an excessive consumption of fuel.

In the letter No. 3.25-24/127 of 17.04.2012 from Committee on power of the State Duma of the Russian Federation it is told: "On the issue of release of the directive by obligatory half-hour definition of an excessive consumption of fuel on thermal power plants you should address to the Ministry of Energy of the Russian Federation into which power release of similar documents is included".

In the letter No. 02-524 of 16.04.2012 from Department of energy efficiency of the Ministry of Energy of the Russian Federation it is told: "Carrying out an energy audit is regulated by the Law No. 261-FZ.

Provisions of the Federal law do not contain powers of the Government of the Russian Federation or Federal executive authorities according to rules of power inspection".

In Article 6 of the Law No. 261-FZ [43] it is told: "In the field of energy saving and increase of power efficiency treat powers of public authorities of the Russian Federation:

1) formation and implementation of a state policy in the field of energy saving and increase of power efficiency; ..."

Here something is not understood? The Government of the Russian Federation unless is not public authority of the Russian Federation or the economy of fuel all thermal power plants of Russia unless does not fall within the scope of a state policy in the field of energy saving?

In the letter No. 02-1694 of 12.10.2011 from Department of energy efficiency of the Ministry of Energy of the Russian Federation it is told: "Requirements to the power passport are approved by the order of the MINISTRY OF ENERGY of the Russian Federation of 19.04.2010 No. 182 registered in Ministry of Justice of the Russian Federation 6/7/2010 No. 17498".

In the letter No. 02-524 of 16.04.2012 from Department of energy efficiency of the Ministry of Energy of the Russian Federation it is told: "In our opinion of the offer on an energy audit of the enterprises of power industry it is expedient to you to send to the relevant self-regulating organizations in the field of power inspection". Also the reference to the SRO list, where their more than 100 is given.

It is called simply - sent far away!!! And how Law No. 261-FZ and its Article 6? And this Article in the Ministry of Energy of the Russian Federation can is applied selectively. Here if in this Law it is told about incandescence bulbs, it is a prerogative of the Ministry of Energy and if about power plants it is not told words, please, receive the bureaucratic formal reply.

In the letter No. 3.25-24/127 of 17.04.2012 from Committee of power of the State Duma of the Russian Federation it is told: "If you have information on the concrete facts of use of a doubtful energy audit of the

generation companies or offers on change of provisions of the Federal law No. 261-FZ ask to direct this information and offers to Committee".  
Signature: Chairman of I.D Committee. Grachyov.

Concerning information I answer: All power accountants make a doubtful energy audit of all Generation companies. It not because they wish it, and simply there are no corresponding regulations in the Ministry of Energy of the Russian Federation by obligatory half-hour calculations for an excessive consumption of fuel. Therefore on all thermal power plants old traditional monthly calculation of TEP which in a root is not right because of curvilinearity of standard schedules is used, and these incorrect data are fixed in power passports. But it not simply doubtful energy audit, and it besides, does not bring what advantage for identification of reserves of increase in energy efficiency of the Generation companies.

And, at last, about offers on change of provisions of the Law No. 261-FZ.

To add [43] following to item 2 of Article 11 (Ensuring power efficiency of buildings, structures, constructions): 4) For constructions with dynamic productions, for example, a thermal power plant (combined heat and power plant, state district power station), as a part of requirements time intervals of calculation of power efficiency, but no more than half an hour have to be defined. On the reporting periods this power efficiency and specific expenses of energy resources have to turn out only by an accumulation method from values on all time intervals for this period. For thermal power plants power efficiency on each time interval has to be defined as the relation of a difference of the actual fuel consumption and its overexpenditure to the actual fuel consumption, thus the excessive consumption of fuel on each interval cannot be negative.

To add [43] following to item 7 of Article 15 (Power inspection): 7) For constructions with dynamic productions, for example, a thermal power plant (combined heat and power plant, state district power station), the power passport has to contain information on time intervals of calculation of power efficiency.

Introduction of these amendments to the Law No. 261-FZ will allow to make an energy audit of the Generation companies really reliable and to provide the correct determination of potential of energy saving and increase

of power efficiency of thermal power plants. A complete elimination of a thriftless excessive consumption of fuel at combined heat and power plant and state district power station across all Russia by 1000 times of more power efficiency, than replacement of all glow lamps by the energy saving. Besides harmful emissions in the atmosphere from thermal power plants will be reduced by 10%. At mass reduction of an excessive consumption of fuel favorable conditions for reduction for 8% of prices of electricity and warmly will be created that will also positively affect in general on all economy of Russia. In value terms all uncontrollable excessive consumption of fuel at all 300 power plants of Russia now, i.e. inefficient annual losses, is estimated at 100 billion rubles.

### ***Energy efficiency is dictated by the power passport***

The power passport of power plants is intended for reflection of the existing energy efficiency and for development by power accountants of further ways of its increase. Actually the power passport existing now does not promote increase in this energy efficiency, and only notes that the power plant really works.

According to the vector proclaimed the Russian President on general increase in energy efficiency, the main instrument of influence of the Ministry of Energy of the Russian Federation on the Generation companies is only the power passport.

In the letter from the Ministry of Energy of the Russian Federation No. 10-508 is told of 18.05.2010 the following:

"Now the specifications and technical documentation on fuel supply is developed by the generation companies independently, without confirmation by the authorized expert organization and without statement in external supervisory authorities. The similar situation creates conditions in which the generation companies can convincingly prove easily achievable level of standard specific fuel consumption on the released electric and thermal energy. Thus there is no motivation in performance of actions for increase of thermal profitability of the equipment".

But after all the Ministry of Energy of the Russian Federation itself promotes such state of affairs. Here we will look at the Appendix No. 13 of Requirements to the power passport "Data on indicators of power

efficiency" [44]. Except general phrases anything is not present, i.e. completely there are no regulations of determination of true energy efficiency of power plants.

Here therefore that in the power passport have to be surely in addition specified: Interval of measurement and calculation of TEP, Absolute value of an excessive consumption of fuel (dB) and its Relative value ( $\% \text{ dB/Bfakt} \cdot 100$ ).

But also it is not enough. It is necessary to register accurately that on these intervals the actual and standard TEP pay off, including also an excessive consumption of fuel. And, on all intervals the excessive consumption of fuel on groups of the equipment and in general on power plant cannot be negative, i.e. such fictitious economy is impossible. It means that the power plant cannot work better, than it is offered standards. Otherwise either standards, or algorithms of calculation are incorrect. Monthly indicators and an excessive consumption of fuel have to pay off not on formulas, but only accumulation (summation, averaging, weighing) from half-hour TEP. The mention that in calculations of standard TEP power characteristics of the equipment without their polinomization, and in the form of the actual results of natural measurements at test of the equipment have to be used will be in this case not superfluous.

Now on all 300 thermal power plants the accounting of an excessive consumption of fuel traditionally is absent. The accounting of an overexpenditure (the actual expense - a standard cost) are half-hour or constant expeditious calculations. Before reorganization of power industry it interested nobody and the overexpenditure was the most minimum since power plants actually worked at a full load day and night. All electric power went to a uniform general network. Therefore all techniques on fuel usage which were developed in ORGRES, and were approved in the Ministry of Energy of the Russian Federation, were focused on monthly calculations of TEP. Actually the concept of an excessive consumption of fuel did not exist at all.

Our researches at combined heat and power plant revealed a 10% excessive consumption of fuel that in scales of Russia is equivalent to 100 billion rubles. There are contradictions between the Generation companies and the State in general. Probably, not favourably obviously to show to the



generation companies a huge excessive consumption of fuel, being formally limited to those requirements which are imposed to power passports. And the State in the person of all consumers of the electric power and heat is compelled to pay this huge excessive consumption of fuel which is result of mismanagement.

If the State forbade release of 100 watt bulbs of an incandescence that actually forcibly to reorient all on the energy saving. That concerning thermal power plants especially it has to make the same, i.e. forcibly create conditions for economy of energy resources. And it can be made only through power passports. We carried out comparative calculation and it became clear that elimination of an uncontrollable excessive consumption of fuel on all thermal power plants by means of Smart-MES System by 1000 times energoeffektivny, than full replacement of usual bulbs on energy saving.

If the Generation companies make the electric power and heat power, initial cost on this production is formed in these companies. But if by means of introduction of Technology on economy of fuel it is possible to reduce cost on the electric power and heat by 8% at the expense of a complete elimination on all thermal power plants of an excessive consumption of fuel which everywhere exceeds 10%, it is possible to tell that all industry of Russia will be more economic and more competitive. The cost of power-intensive production will be reduced, the cost of utility tariffs will also be reduced that will positively affect social climate in society. The released fuel can be used in other directions. Fuel consumption reduction by power plants will lead and to reduction of harmful emissions in the atmosphere.

But the most important that for this economy of fuel capital expenditure is not necessary. It is only necessary to make changes to regulations of filling of the power passport for power plants and to demand them accurate performance.

Certainly, there will be a great number of sceptics. But only practice is criterion of truth. Besides never at one power plant did not count correctly an excessive consumption of fuel, therefore, and did not see it. Therefore anything also did not become on its reduction.

If the Russian President proclaimed a vector on general increase in energy efficiency [45], it is necessary to begin with the Generation companies and with power plants.

Lately in the Generation companies power units PGU (steam-gas installations), as more economic strenuously are under construction. But the accounting of an excessive consumption of fuel there is still absent. It turns out that the elementary human factor of disorder can easily eat all this profitability.

It is known that on all thermal power plants the park of the equipment is strongly worn-out, and it conducts to increase in expenses of fuel, but it influences and increase in an excessive consumption of fuel, especially at night at smaller loading of the equipment even more. As at the outdated equipment blindly it is not simply difficult and wasteful to operate power plant regarding an excessive consumption of fuel, but also it is unsafe since easily can the emergency will be created. And it already losses not only Generation company, but also State in general.

In letters of the Ministry of Energy of the Russian Federation of 30.01.2012 and No. 02-296 of 06.03.2012 the Department of energy efficiency asked to direct to No. 02-118 the detailed calculations proving a time interval of measurement of indicators for calculation of TEP on my multiple Addresses. But about same the theory of integral calculus of the area of dynamic process [46] accurately speaks, i.e. the interval is less, the calculation is more exact. And the correct definition of intervals of measurement and calculation of indicators and for evident identification of the actual reserve of economy of fuel requires practical research of this problem.

### ***Doubtful energy audit of the Generation companies***

With possibility of identification of true reserves of increase in energy efficiency of thermal power plants it is necessary for a reliable energy audit of the Generation companies that the Ministry of Energy of the Russian Federation in a directive way defined intervals of measurement and calculation of TEP, including also an excessive consumption of fuel which have to be no more than half an hour.

The energy audit of power plants is intended for identification of the valid reserves of increase of energy efficiency that now actually is absent in all Generation companies. It is connected with that traditionally on all thermal power plants the excessive consumption of fuel which is the main reserve of increase in energy efficiency incorrectly pays off. Besides monthly calculations of TEP are everywhere adjusted to a zero excessive consumption of fuel.

Thus, the Generation companies on the power plants provide to power accountants absolutely incorrect information on an excessive consumption of fuel, and actually it elementary criminal hiding. Well, and time is absent at power plant an excessive consumption of fuel, according to reports it turns out that with energy efficiency everything is normal.

Actually on all thermal power plants this excessive consumption of fuel (the actual expense - a standard cost) exceeds 10% of the actual expense which unfairly joins in tariffs for the electric power and heat since this overexpenditure is simply result of mismanagement of power plants. It is connected with that the operational personnel regarding an excessive consumption of fuel operates power plant blindly. Here also it turns out that in the afternoon at the maximum loading the excessive consumption of fuel is close to zero, and at night when loading decreases, this overexpenditure reads off scale for 30%. Across Russia all this excessive consumption of fuel is equivalent to 100 billion rubles which it is useless annually take off for pipes of power plants, polluting the atmosphere.

The correct calculation of an excessive consumption of fuel which has to be calculated only on half-hour intervals, and on other intervals (days, month, year) it has to turn out accumulation, will allow power accountants to see a true picture at power plant and by that to influence increase in energy efficiency, developing methodical instructions.

It is equivalent as measurements of heat conductivity of walls of buildings are made, for definition of weak places and elaboration of the warming actions. Without such devices it is simply impossible to resolve the matters. The solution of questions and on economy of fuel at power plants without the correct expeditious calculations for an excessive consumption of fuel is also impossible.

Finally, the unproductive excessive consumption of fuel power plants is not only a problem of the Generation companies which can easily have annual additional profit in 300 million rubles from each power plant, and is rather a problem of all Russia since high tariffs for the electric power and heat constrain development of its economy. After all it is easily and it is actually bezzatratno possible to eliminate a 10% excessive consumption of fuel on all 300 thermal power plants, it means that also easily and quickly without prejudice to the Generation companies possibly to reduce tariffs for the electric power and heat by 8%.

Such reduction of tariffs by the Generation companies will lead to reduction of tariffs of housing and communal services that will give positive social effect, and to depreciation of production of power-consuming industries that will also positively affect all economy of Russia and it is possible to dispose of the released fuel more effectively. And after all the energy audit of the Generation companies for this purpose is also intended to find reserves of increase in their energy efficiency, so to plan ways on economy of fuel. But without the correct current calculations of an excessive consumption of fuel in real time it cannot simply be carried out.

Why unpromising correspondence which is followed by bureaucratic formal replies of officials from Department of energy efficiency, modernization and development of energy industry is conducted with the Ministry of Energy of the Russian Federation on the matter two years? After all it is their direct duty to promote energy saving technologies. It would seem that if you do not understand questions of integral calculus of the area of dynamic process which the excessive consumption of fuel is, attract branch institutes. Why to suppress the indifference innovative ideas and technology?

In the letter No. 3.25-24/43 of February 17, 2012 from Committee on power of the State Duma of the Federal Assembly of the Russian Federation of the sixth convocation it is said that the Address on the matter is sent to NP "Scientific and Technical Council of UES of Russia" for studying. But business did not move off dead center.

And that for this purpose a little. It is necessary that the Ministry of Energy of the Russian Federation issued the directive by obligatory half-

hour calculation of all TEP, including an excessive consumption of fuel, on all thermal power plants.

Energy audit, this power inspection of power plants and assessment of all aspects of its activity connected with costs of fuel and energy of different types [47]. The energy audit purpose - to estimate efficiency of use of fuel and energy resources and to develop effective measures for decrease in expenses of power plants [48].

Power examination is conducted according to requirements of the Federal law No. 261 of November 23, 2009 "About energy saving and about increase of power efficiency ... Russian Federation" [43]. Power inspection of power plant - data collection and processing about use of energy resources for receiving reliable information about the volume of the used these resources, about indicators of power efficiency, for identification of opportunities of energy saving and increase of power efficiency with reflection of the received results in the power passport.

But as the energy audit of thermal power plants if there is no correct Technique even by calculation of an excessive consumption of fuel (FACT - STANDARD) can be carried out. The existing monthly calculations of an excessive consumption of fuel in a root are not right since theories of integral calculus of the area of dynamic process of power generation and heat completely contradict.

Thus, not revealed huge excessive consumption of fuel simply joins in tariffs for the electric power and heat. It turns out that consumers of the electric power and heat have to pay this mismanagement of power plants.

Repeatedly this question was raised for the Ministry of Energy of the Russian Federation, but positive reaction is not present. The nonsense turns out: The law is, and the Technique of the correct performance of this Law is not present. But after all the Ministry of Energy of the Russian Federation after all has to see to it about correct calculation of an excessive consumption of fuel on all thermal power plants since it and is an energy efficiency indicator. Ignoring of the idea of an energy audit since the provided data power plant far are not true turns out.

For the correct implementation of the Law on energy saving the simple order of the Ministry of Energy of the Russian Federation about

need of carrying out calculations for thermal profitability of the equipment on intervals no more than half an hour suffices.

The Ministry of Energy of the Russian Federation has to understand that the Generation companies will not pass to half-hour calculations of the actual and standard TEP (technical-economic indicator). They do not need to save fuel, after all and so all overexpenditure easily joins in tariffs. They are easily covered with the outdated Techniques approved by the Ministry of Energy of the Russian Federation which regulate monthly and only monthly calculations of standard TEP, and, therefore, and an excessive consumption of fuel.

It would seem, the simplest question of universal transition to half-hour calculations of an excessive consumption of fuel which so far for nothing soars in air. But the Ministry of Energy of the Russian Federation sees in it only small increase in accuracy of calculations which cannot essentially affect the end results. And it means, as so everything is remarkable and good.

But as everything when plainly nobody knows the true size of an excessive consumption of fuel since its current values are not known at all can be good. Monthly calculation of an excessive consumption of fuel is similar to shamanism, only the subject management of PTO. It can easily provide any values of this overexpenditure, maneuvering several indicators.

True values of this excessive consumption of fuel can be both 5%, and 20% and generally simply any since all of them equally incorrectly pay off and therefore about them it is elementary anything and it is not known.

But unless it is solid for Russia when at the high level it is constantly told about lofty matters of energy efficiency, and to bring the simplest order with calculations of TEP not in power? Besides, there is a developed Smart-MES System which easily resolves all these issues.

## **16. Intellectual regulation by energy efficiency**

Intellectual management and regulation of energy efficiency of power plants in real time surely means existence of Reason which basic element is the knowledge base or memory [49]. Reason, taking necessary technological information from the knowledge base, quickly provides adoption of optimum decisions on loading of the working equipment, providing implementation of the schedule of delivery of the electric power and heat.

Management of energy efficiency is focused on minimization of expenses of fuel at its zero overexpenditure. In this case the objective on minimization of expenses of fuel is surely solved in two aspects: current optimization of resources and current control of an excessive consumption of fuel. For optimization of resources the half-hour interval is accepted, and for control over an excessive consumption of fuel there has to be a minute interval.

Thus, management of energy efficiency includes three processes:

- 1) The operational accounting of an excessive consumption of fuel with monitoring of analytics on BCP (block control panel) of power plant;
- 2) Optimization of loading of the equipment with criterion of minimization of fuel consumption and training of the intelligent mechanism, i.e. filling of the knowledge base;
- 3) Use of the intelligent mechanism for management of power plant and for fuel purchase forecasting.

At the beginning we will decide on two concepts: 1) Optimization of loading of the equipment for the purpose of fuel consumption minimization; 2) The correct current calculation of an excessive consumption of fuel for the purpose of its complete elimination.

The first defines our desire which is based on standards. The second fixes that really turns out, i.e. defines a fact deviation from the standard. In percentage expression of economy of fuel: the first gives 3%, and the second 10%. Naturally, at joint realization of optimization of resources and

an operating control behind an excessive consumption of fuel its economy for 13% is possible.

And now is more detailed about these three interconnected management processes.

1) The operational accounting of an excessive consumption of fuel is basic process of intellectual management of energy efficiency of power plants since without reliable current information in general the correct management in real time is impossible. This process with minute intervals provides in monitoring on BCP all necessary analytics on an excessive consumption of fuel and on other settlement TEP.

The operational personnel, having constant current information on an excessive consumption of fuel before eyes, operates technology so that to provide implementation of the schedule of delivery of the electric power and heat at a zero excessive consumption of fuel.

2) Optimization of loading of the equipment and training of the intelligent mechanism defines current manual control by power plant by the operational personnel on the basis of its experience and regulations. In this case optimization gives only a starting point at change of the technological modes: day and night. The subsequent correcting control is exercised according to the current information on an excessive consumption of fuel.

Training of the intelligent mechanism, namely, filling of the knowledge base with technological information is carried out at achievement of a zero excessive consumption of fuel. In this case in the knowledge base all technological cut is fixed.

3) Use of the intelligent mechanism for management and forecasting defines the highest innovative automation of production management of the electric power and heat at power plant. In this case highly skilled experience and exact regulations for loading of the equipment is not required any more. All necessary information, both for the current management, and for forecasting the trained intelligent mechanism will prompt.

All above the described processes are so simple and obvious that wonder why there is their huge misunderstanding from the Generation



companies and the Ministry of Energy of the Russian Federation. Why the Generation companies go on increase in tariffs instead of by means of No-cost Technology on Smart-MES System to reduce the production expenses and first of all an uncontrollable excessive consumption of fuel which constantly rises in price and will rise in price?

Probably, the most vicious mentality of Russia which strongly differs, for example, from Japan also consists in this dull and indifferent relation to innovations. To management of the Generation companies laziness even to penetrate into a question essence, and bureaucrats of the Ministry of Energy of the Russian Federation in general wave away, as from importunate flies.

But water sharpens a stone. Therefore we will persistently prove to both the Generation companies, and the MINISTRY OF ENERGY of the Russian Federation all innovative advantages of our No-cost Technology of increase in energy efficiency of power plants on the basis of intellectual management on Smart-MES System.

### ***Half-hour optimization of TEP of power plants***

At power plants of costs of fuel according to the specific contents in prime cost of the electric power and heat are the main. They make as a rule to 50-60% of all expenses. Costs of fuel depend on amount of the spent fuel and its price. If the price of fuel is a consequence of the market relations, the amount of expense fuel for development of the set amount of thermal and electric energy entirely depends on quality of functioning of power plant.

One of ways of increase in efficiency of power plants is optimization of loading of the equipment for implementation of the plan for power generation and is warm with fuel consumption minimization. Here it must be kept in mind that the power plant surely has to have power reserves on development of thermal and electric energy. I.e., if the power plant works at the maximum power, senselessly to speak about optimization in general. But the power plant has to have reserves, otherwise, in case of failure of the equipment, it will break implementation of the plan, and it will cause huge financial losses. Besides it is necessary to consider also planned repairs of the equipment.

At all power plants the polytypic equipment is, as a rule, installed, especially it concerns turbine units. One turbines are intended only for power generation, others for electric and thermal energy, but with different ratios by efficiency. Power plants with cross communications, i.e. combined heat and power plant more are suitable for optimization of fuel resources.

Optimization at power plants is necessary when forecasting and for decision-making. But if the forecast, it only the forecast, at transition processes it is necessary to make optimum decisions quickly. Transition processes, i.e. transition of production from one steady state in another at power plants arise constantly: that will fail any equipment, the external situation in the market of heat and the electric power will exchange.

The schematic model of linear half-hour optimization for 3 coppers and 2 turbines realized by the Simplex method which is built in Smart-MES System is given below.

$$\begin{aligned}
 K_{11}X_1 + 0 + 0 &< Q_1 \\
 0 + K_{22}X_2 + 0 &< Q_2 \\
 0 + 0 + K_{33}X_3 &< Q_3 \\
 K_{41}X_1 + K_{42}X_2 + K_{43}X_3 &< E_1 \\
 K_{51}X_1 + K_{52}X_2 + K_{53}X_3 &< E_2 \\
 K_{61}X_1 + K_{62}X_2 + K_{63}X_3 &< T_1 \\
 K_{71}X_1 + K_{72}X_2 + K_{73}X_3 &< T_2 \\
 K_{81}X_1 + K_{82}X_2 + K_{83}X_3 &> E \\
 K_{91}X_1 + K_{92}X_2 + K_{93}X_3 &> T \\
 X_1 + X_2 + X_3 &\rightarrow \text{MIN}
 \end{aligned}$$

where:  $X_1, X_2, X_3$  - fuel expenses coppers

$Q_1, Q_2, Q_3$  - production of steam coppers

$E_1, E_2$  - power generation by turbines

$T_1, T_2$  - selection of heat power from turbines

$\ominus$  - the released electric power

$T$  - the released heat power

$K_{ij}$  - coefficients

Half-hour optimization of TEP provides the best production management of power plant with minimization of expenses of fuel, and consequently with maximizing profit.

## *Ideal System for power plants*

At the beginning of the narration looked on the Internet that write about ideal Systems, and wanted, was to extol our development, but decided not to do it for one reason. The question where your wonderful program works, brings down on the spot. To brag there is nothing. And the excuse that it new, does not convince.

Then decided to come on the other hand. Namely, what is necessary for the Generation companies from automation of calculations of TEP (technical-economic indicator)? In all TZ (specification) to competitions one sounds is an efficiency of information on work of the equipment, well and optimization of resources.

I will dare to express the seditious opinion. All Generation companies from introduction of any automation need only profit. In this case on development and deployment of System by calculation of TEP not the specialist in the software, but the technologist has to make TZ. After all, finally, to the management of the Generation company and furthermore to shareholders, it is not important at all, by what way the positive effect is reached. All of them equally perceive any System, as "a black box". So why in TZ to expose the mass of the academic requirements clear only to programmers who do not define the main essence, i.e. necessary profit. After all the declaration of optimization does not mean that this optimization will really make this profit.

If calculations of TEP on MS Excel brought though any profit, the Generation company would have at all no desire to automate work of group of the accounting of PTO (technological department).

When to TZ it is academically written that has to be and so whereas to be with innovative approach. After all on that they and innovations that in a root change habitual outlook. And it is correct to apprehend it with summer not perhaps, for this purpose there have to be simply other brains. Is it better to perceive automation simply through a profit prism. And system experts have to analyze ready System on the demonstration version. And existence it has to be the main requirement in TZ. But if the performer has even no demonstration version, though at a set of introductions, then here not only does not smell as innovations, but does not smell also as profit.

And now about technology of the top level of the Generation company. Power plants transfer to the top level a set of data, even in their one model 15506-1 121 [36]. Power plants transfer also calculations to MS Excel. In one TZ and it was specified that in the Generation company there have to be similar Systems of calculations of TEP with data input synchronization. What it, mistrust to power plants? And maybe, the Generation company will be able to improve production at power plant backdating?

Actually everything has to be very simple. The current half-hour values of several indicators have to be transferred to the top level in real time from each power plant: Development (give) of the electric power, heat power in the form of steam and hot water, fuel expense. These indicators in real time have to be compared to the schedule of deliveries of the electric power and heat power, and, the most important, to the schedule of consumption of fuel. The schedule of half-hour expenses of fuel is formed intellectual opportunities of System from a condition of lack of an excessive consumption of fuel and optimum loadings of the equipment.

In the Generation company on each power plant the monitor with these current indicators is installed. The deviation fact from the schedule of any indicator - motivation in real time to find out the reason. Implementation of the schedule of delivery of the electric power and heat power at strict observance of the schedule of consumption of fuel also is guarantee of energy efficiency of all power plants of the generation company.

And now we will look at our development of Smart-MES: money for introduction - the miserable amount, economic effect - is enormous, around - continuous innovations. This is also ideal System!

### ***The power industry got stuck between MS Excel and MES***

Position of power plants in hierarchy of extents of automation of calculations of TEP surely has to be considered from two positions: directly the level of automation and the size of profit received from this automation. But if the level of automation of power plants is somewhere between MS Excel (spreadsheet) and MES System (Manufacturing Execution System, production executive system), the profit size at all power plants is simply at the level of MS Excel, i.e. absolutely zero. In this case MS Excel

corresponds to the lowest antediluvian level of automation, and MES has the highest and priority level to which any power plant in Russia did not grow for the present.

Thus, the power industry as if costs on bow-legs, i.e. one foot, regarding automation level, it leaves from MS Excel a little, but other foot, in a part of profit, continues to be trampled down at the level of MS Excel. And the further one foot moves away from another, the it is more than instability in this foolish pose. Ridiculously and sadly to observe it from outside. It would seem than that it is simpler to move at once both feet on the MES level, and, please, stability is reached.

Here to you and the highest level of automation with all delights of MES: easy adaptation, high speed of calculations, optimization of resources, operational analytics, intellectual opportunities. But here also worthy annual profit in 300 million rubles on average on each thermal power plant at the expense of a complete elimination of 10% of an excessive consumption of fuel about which now even anybody also does not suspect.

In what reason of such backwardness and short-sightedness? Yes everything is very simple. The management of the Generation companies which is responsible for IT very well acquired the principles of system engineering, but understood nothing in economy questions since before reorganization of power industry it was simply not necessary to it. But now it would be time and to think again and cease to push that into the power plants of system which are not making profit.

It is absolutely clear that simply introduction of MES System will not make any profit. For this purpose there has to be an introduction exactly and only Technologies on the basis of Smart-MES. The technology means that the power plant surely wishes to have profit and from the very beginning itself actively participates in introduction of System, having thus, naturally, double loading since it is necessary to operate at the same time old methods of calculation of TEP and to master and advance the new.

There was at us a deplorable experience at one combined heat and power plant when after the second stage on adaptation of separate tasks, us it was offered to group of the accounting of PTO (technological department) to test these tasks until they are tied in System. On what the

management of PTO declared to us that will check all System only in general. In it the absolute unwillingness of power plant in advance "to feel" the Program was shown.

When all System was ready, and testing and training was provided, it appeared that independently girls from PTO did not need to work with System of time as terms under the contract approached end. On our offer on extension of the contract with the purpose of working off of all situations, from the management of PTO refusal followed. In it the complete indifference and illiteracy of the management of PTO was shown, considering that incorrect standard schedules were provided to us, and that values of entrance signals were far from face value.

At this approach of power plant to introduction of automation of calculations of TEP not that, naturally, there will be no profit, but also the powerful System turns out elementary not working. Then it is asked, why all this to start? But the power plant of guilty does not consider.

The correct introduction has to be not formal, but joint creative process. If the power plant wishes to have profit in 300 million rubles on introduction of Smart-MES, all favorable conditions have to be provided for fruitful this introduction by power plant: the worthy sum of the contract, convenient conditions of accommodation, the qualified employees, an advertizing campaign. If the Performer is ready to enclose all the experience and creative potential for the benefit of power plant, the Customer has to be ready it to accept everything and to appreciate.

There was at us still such case when introduction of the Program of calculation of TEP was carried out at the same time on three combined heat and power plants in one region. It would seem that it is simpler to allocate the car for this purpose, after all POWER it has to be interested in fast and successful introduction. But is not present. And the lion's share of time dully left on long-distance transport. As a result contractual obligations were formally fulfilled, but from it it is not easier for power plants.

Many years ago, when I worked in nuclear power industry, and we introduced Systems for power units, the NPP actually provided us to all. Naturally, now other time. But it is important to understand one that at introduction of the most difficult Performer and Customer Technologies have to interact, as a uniform organism. Only then there will be successful

an introduction not only Programs for calculation of TEP, but also will be to threaten in power on Smart-MES and to have profit in 3-10 billion rubles.

### ***Degradation of IT in power industry***

There is one very strange question: Why in railway branch introduce only domestic IT development, an in power industry are preferred by the import? Can because the Generation companies - independent subjects, and it as all are assured, more effectively. Perhaps, but only not in relation to Information Technologies which now undergo the sheer degradation in power industry.

Here before me import Presentation "Programs for management of power - Optimization of the combined production of heat and the electric power on electric power plants" the foreign company "Metso" [50]. The expert from Chelyabinsk praised highly this System greedily, as a standard of perfect System for power plants in Russia.

I say to it that our presentation is not worse, and creation of model of power plant for calculations of the actual and standard TEP in real time and for optimization of resources is much simpler and better. And the most important that our Smart-MES is completely attached to the Russian reality and corresponds to domestic techniques and views of ORGRES firm of technological calculations of thermal profitability of the equipment.

But it is impossible to overpersuade. And why in us such blind worship for the West is put? But, probably, after all for persuasiveness it is necessary to consider highlights more in detail. Let's analyse only some in comparison of "Metso" and Smart-MES: Technological schemes, Adaptability, Speed of calculation, Analyst, Optimization and Advantages.

TECHNOLOGICAL SCHEMES. "**Metso**": Schemes are formed of icons which will connect lines (streams). Schemes at the same time are a basis for creation of model of power plant. Schemes have an enclosure. The current values of settlement TEP are not brought to schemes. **Smart-MES**: Schemes are designed from primitives which snatch to earlier drawn lines. Schemes have no relation to mathematical model of power plant. Vector schemes allow any enclosure. On schemes the conclusion of all current settlement TEP with viewing of their history for any date is possible.

ADAPTABILITY. "**Metso**": Adaptability is limited to possibility of model from icons. The exact visual description of work of power plant is realized. **Smart-MES**: For adaptability restrictions are not present. When modeling power plant the principles of black boxes are used. All System is automatically adjusted at compilation of text Projects of technological tasks. There is a Founder function for automatic generation of basic Projects in which only types and station numbers of coppers and turbines are specified. Any change is made to algorithms of calculation in 5 seconds.

CALCULATION SPEED. "**Metso**": It is not specified. **Smart-MES**: Full calculation of the actual and standard TEP of average combined heat and power plant, i.e. 20000 main and intermediate indicators pay off less than 1 second. Such huge speed of calculation it is necessary for dynamic optimization of resources on full mathematical model of power plant.

ANALYTICS. "**Metso**": There are in advance predetermined analytical schedules. **Smart-MES**: A big variety of analytical tools contains: The review of indicators, the Operational magazine with analytics, Expeditious monitoring, the Express analysis, Half-hour and minute analytics, Statistics of indicators, Graphics of TEP, Creation of regime cards. For example, you on a screen form were interested by any indicator in a section of coppers or turbines, you simply press the button and, please, before you all analytics though in a month on days, though for any days on half an hour.

OPTIMIZATION. "**Metso**": There is a possibility of linear optimization of separate sites of power plant. **Smart-MES**: Realization of any quantity of problems of linear programming is put by the Simplex method. Realization of any number of problems of dynamic optimization on full model of power plant is possible. For half an hour 1000 technological options and a choice of the best on minimax strategy miscalculate. Any number HOP (characteristic of relative increment) of optimization on full model of power plant is realized. There is a Base of intellectual knowledge with possibility of fixation of optimum technological cuts for the purpose of their use in the current management of power plants and for forecasting of purchases of fuel.



ADVANTAGES. "**Metso**": Optimum production of heat and the electric power, optimum use of fuel, the improved efficiency of energy, reliable and exact data of background, the improved opportunities to plan servicing and schedules of works. **Smart-MES**: The same, but with a bias on elimination of an excessive consumption of fuel that will allow to have additional profit from each power plant in 300 million rubles. There is also a possibility of the prevention of emergencies.

SUMMARY. In Russia there is the worthy Smart-MES System for power plants which surpasses foreign analogs in many parameters. Persistent and blind ignoring of domestic development also defines today's degradation of IT since only the domestic development can be developed under themselves, achieving still their bigger superiority over the foreign.

Here the Generation companies as a result of Competition attract major companies which were never engaged earlier in it to realization of automation of calculations of TEP. Unless it not degradation of IT? Naturally, they have skilled experts, naturally, they have an extensive experience of introduction in other areas, naturally, they have huge resources and communications. But same power industry where 300 power plants are also not present even two similar on technology and on structure of the equipment. And in addition to it, especially now, at power plants constantly there are various technological changes.

Undoubtedly these major companies surely will make something or, or with attraction of foreign development. But where flight of innovative thought, where perfection of technology on economy of fuel, where motivational mechanisms for achievement of a zero current excessive consumption of fuel and for enhancement of profit?

It seems that IT departments in the Generation companies, having carried out the initial task of creation of market mechanisms, do not understand further what to do. They do not understand how to provide power plants with modern IT technologies. Therefore they also chose tactics of cover by large IT firms. Risk like small, since it known firms.

But there is one big BUT. For example, if the child has to be born in nine months, that, having been born earlier, he already to become premature and he needs to be treated. And in IT for creation of modern System some years of tests and mistakes for judgment and search of an

innovative solution are necessary. And otherwise is there will be a premature System for which continuous treatment will be required.

In a case with import development of business are even worse. It is constant dependence on the overseas uncle and licenses. Abroad very much became skilled to flog the products. So, for example, the equipment costs not much, but spare details and expendables then will cost more than the most this equipment.

It is clear if there was no domestic development, but they are. It is clear if domestic development would be worse import, but they even it is better. It is clear if in Russia there would be no cool IT specialists, but the same experts from Russia abroad work. In what a difference, so it in approach to IT abroad. There this development is financed according to the full program, and we have who as will be able.

Generally, still nobody cancelled patriotism. Also we urge both the Ministry of Energy of the Russian Federation, and the Generation companies to look round around here at us in Russia and not to ignore domestic IT development, and to let them wide pass for overcoming of the existing degradation of IT in power industry and for significant increase in energy efficiency of power plants.

## **17. Integrated evaluation of an excessive consumption of fuel**

The integrated evaluation (business assessment) or Integral calculus gives rich mathematical apparatus for modeling and research of the processes happening in power industry. The interval between calculations is less, the integral calculus of indicators of dynamic production is more exact [46]. For power plants, according to experts, this interval has to make half an hour.

The excessive consumption of fuel corresponds to a difference between actual and standard fuel consumption on the released electric power and heat power [36].

$$\Delta B = \int_{t1}^{t2} B(t)dt - \left[ \int_{t1}^{t2} \mathcal{E}(t)b_{\mathcal{e}}(t)dt + \int_{t1}^{t2} Q(t)b_m(t)dt \right]$$

$$\Delta B = \int_{t1}^{t2} \{B(t) - [\mathcal{E}(t)b_{\mathcal{e}}(t) + Q(t)b_m(t)]\}dt$$

$$\text{Перерасход} = \text{Факт} - \text{Норматив}$$

$\Delta B$  - an excessive consumption of fuel (here - ton of conditional fuel),

$B$  - actual fuel consumption (here),

$\mathcal{E}$  - the actual released electric power (Mvt\*ch),

$b_e$  - standard specific fuel consumption on the electric power (here / Mvt\*ch),

$Q$  - the actual released heat (Gcal),

$b_t$  - standard specific fuel consumption on heat (here/Gcal).

Calculation of an excessive consumption of fuel on a half-hour interval is much more exact, than monthly calculation. Calculation of specific costs of fuel of electricity generation and heat in monthly calculations is similar to use of average temperature on hospital for establishment of the diagnosis to the patient.

The power plant functions for receiving profit. Therefore, at implementation of the plan for delivery of the electric power and heat, in reports not "beautiful" data on fuel usage as now occurs, and true have to be provided. It will allow to see and fix problems at power plant, and, therefore, considerably to increase profit.

Calculation of indicators for an excessive consumption of fuel has to be made only on each half-hour interval. All replaceable, daily, decade, monthly, quarter and annual TEP (Technical and Economic Indicators) have to turn out from half-hour values by an accumulation method (summation, averaging or weighing), but not calculation for formulas. Monthly calculations are not right since for calculation of standard TEP nonlinear power characteristics of the equipment are used.

Let's consider two options of calculation of the actual and standard TEP of power plants: the 1st option - calculations of TEP are carried out on the entire periods; the 2nd option - calculations of TEP are carried out only on the half-hour periods, and on all others (change, days, month, quarter, year) TEP turn out accumulation.

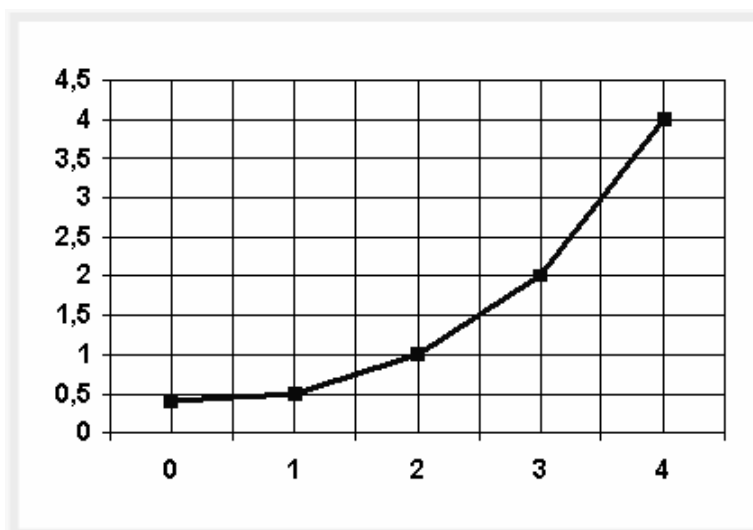
The first option which exists at all power plants, the most inexact now. And, the bigger period (month, quarter, year), the big inaccuracy of calculation of TEP. It is connected also with nonlinear characteristics of standard schedules.

The second option corresponds to the most exact calculation as dynamic process at power plants on consumption of fuel and on electricity generation and heat goes continuously. And therefore, in each interval of time a certain amount of fuel is spent for production of certain quantities of the electric power and heat, as well as there are quite certain standards of fuel consumption according to external conditions which constantly change: day and night, winter and summer, air temperature, etc.

The main economic indicator at power plants is the excessive consumption of fuel as it defines a reserve of increase in profitability. But inaccuracy of definition of this indicator which practically is always exposed to adjustment for the purpose of providing the acceptable reporting

data for the management of the Generation companies, actually deprives of them this reserve, and, therefore, and prospects on increase in profit.

Let's review an unpretentious example of calculation of arithmetic-mean value by both options, using the following nonlinear schedule from sequences (x, y): (0, 0.4), (1, 0.5), (2, 1), (3, 2), (4, 4).



By the first option:  $Y = f((1+4)/2) = f(2.5) = 1.5$  (incorrect)

By the second option:  $Y = (f(1)+f(4))/2 = (0.5+4)/2 = 2.25$  (true)

Total the divergence makes:  $(2.25-1.5)/2.25*100 = 33\%$ , it speaks about a huge error of calculation of an excessive consumption of fuel by the first option, existing now at all power plants.

And now present that in calculations of an excessive consumption of fuel hundreds of nonlinear standard schedules are used. And besides, at a number of power plants not only for calculation of standard TEP (technical-economic indicator) standard schedules are used, but also for calculation of the actual TEP they are used. TEP miscalculations everywhere exist when it is told about need of increase in profitability of power plants. And it is necessary to begin, first of all, with reliable calculations of TEP. But at power plants instead of looking for and eliminating etiologies, use anesthetizing (adjustment of results of calculation).

We proved by method "by contradiction" a constant big excessive consumption of fuel at all power plants contrary to their satisfactory monthly reporting data.

The method "by contradiction" [51] consists in the following. The complete list of various situations with the consecutive proof of their insolvency is considered. That option for which this proof does not exist, and is true.

We give the following possible situations of an excessive consumption of fuel for all month with half-hour calculations of indicators, and these calculations within a month about one and a half thousand.

All sizes (them 1440) on an excessive consumption of fuel have values:

- 1) all close to zero;
- 2) all positive;
- 3) all negative;
- 4) part positive and part the negative. Negative - mean economy of fuel.

The technological situation in power plant constantly changes: day and night, air temperature, etc., and an excessive consumption of fuel pays off and consequently, depends on one hundred indicators. The monthly excessive consumption of fuel actually consists of half-hour overexpenditures. Zero value of an excessive consumption of fuel means that its actual expense corresponds to the standard.

Power plants always show small value of economy or an excessive consumption of fuel in monthly reports on fuel usage. For adjustment of this result there is a certain number of inexact parameters by means of which it is easily possible to provide any final figures.

Time we have monthly values about zero, then first of all it is necessary to consider options 1 and 4. Option 1 in general is improbable because blindly it is impossible to trace and establish hundreds of parameters equal to standard values within a month. Option 4 approximately of the same order - cannot be compensated absolutely

accurately all overexpenditures the extent of economy in their total equal values.

Option 3 it in general a fantasy when during a time to speak about quality of standards in general. There is option 2. Thus, the excessive consumption of fuel in a month turns out summation of overexpenditures for each half an hour, and it is very big reserve of energy efficiency which power plants involuntarily hide.

For increase in profitability of power plant it is impossible to work without half-hour reliable calculations of an excessive consumption of fuel and without quick search of the best technological decisions.

From the Generation companies the active objection follows: we supposedly have no excessive consumption of fuel and cannot be, and opposite, at all power plants constantly there is its economy. On state district power station and combined heat and power plant strictly watch it.

But let's not hurry and quietly we will understand everything. As speak in the courtroom: let's operate only with the facts.

**Fact 1.** The excessive consumption of fuel pays off as a difference between the actual fuel consumption and a standard (settlement) cost:  $\Delta B = B_{\text{fakt}} - B_{\text{norm}}$ . Standard TEP, including and a standard cost of fuel, at all power plants pay off only at the end of the month on the saved-up daily indicators. These standard indicators are traditionally necessary for filling of the monthly model 15506-1. Therefore: the excessive consumption of fuel per every day, not to mention a half-hour overexpenditure, simply is not known.

**Fact 2.** Standard monthly TEP pay off on the saved-up daily indicators. The standard cost of fuel is defined as the sum of fuel consumption on power generation and is warm:

$$B_{\text{norm}} = (E \cdot b_e + Q \cdot b_q) / 1000, \text{ where:}$$

E, Q - the actual development (give) of the electric power and heat (Mvt\*ch, Gcal);  $b_e$ ,  $b_q$  - specific fuel consumption on development (give) of the electric power and heat (kg / Mvt\*ch, kg/Gcal). For calculation of

specific fuel consumption hundreds of curvilinear standard schedules are used.

Proceeding from an axiom for the curvilinear schedule:

$$F\left(\sum_{i=1}^n (x_i)/n\right) \neq \sum_{i=1}^n (F(x_i))/n$$

it is possible to draw a conclusion that procedure (accumulation, and then calculation) is not equal to procedure (calculations, and then accumulation).

Naturally, calculation when calculations of indicators on small intervals of time, and then their accumulation are performed will be correct. Thus, calculation which exists now: daily accumulation and monthly calculation - in a root it is not right. Therefore: receiving standard TEP on the daily (monthly) period by method of integration (accumulation) from half-hour (minute) calculations will be absolutely correct.

**Fact 3.** From the theory of integral calculus it is known that the less time intervals, the are more exact result of dynamic process. It means that calculations of data for days and their accumulation in a month will not yield the correct result. Therefore: calculations of TEP and excessive consumption of fuel have to be made only on half-hour (minute) intervals.

**Fact 4.** The standard schedules used in monthly calculations of TEP (technical-economic indicator) traditionally turned out by a polinomialization method from natural measurements. But polynoms bring distortion of real technological process. From here perhaps also there is an imaginary economy of fuel. Therefore: half-hour calculations of TEP have to use natural standard schedules without polynoms.

**Fact 5.** Operation personnel, implementing the plan of delivery of the electric power and heat, can know the current fuel consumption. And here the flowing size of an excessive consumption of fuel to it is not known. Thus, regarding an excessive consumption of fuel it operates power plant blindly, i.e. it is obviously inefficient. Therefore: on BCP of power



plant there has to be a monitoring of the current excessive consumption of fuel.

**Fact 6.** The excessive consumption of fuel allowed for half an hour further only will collect. No imaginary economy (according to experts) compensates further this overexpenditure. Therefore: if there is at calculations (without adjustment) an economy of fuel, it means that there are flaws at algorithms of calculation of TEP, including also polynoms of standard schedules.

**Fact 7.** Operation personnel, operating blindly power plant, cannot provide a zero excessive consumption of fuel. For example, here before us the daily schedule of an excessive consumption of fuel. If in the afternoon half-hour overexpenditures are close to zero, at night they read off scale for 30%. Therefore: only the human factor is guilty of a big excessive consumption of fuel at power plant.



**Fact 8.** For determination of the size of an excessive consumption of fuel also we will use daily data with half-hour calculations. So, for example, the excessive consumption of fuel in days is equal 200 t.u.t. at the actual fuel consumption 2474 t.u.t. Therefore: the excessive consumption of fuel corresponds 8%. If for calculation to use natural standard schedules, this overexpenditure will be even more. And it makes a reserve of increase of energy efficiency of power plant.

**Fact 9.** The solution of a question of optimization of resources without realization is higher than the listed moments is simply the myth. All methods of optimization, including and HOP-optimization, are based on standard schedules. But their correctness as it was stated above, questionable. Simple approximate researches of use of optimization gave economy of fuel of only 2-3%. Therefore: only sharing of the current

control of an excessive consumption of fuel in real time with optimization of resources will give really advantageous effect.

**Conclusion:** In modern calculations of TEP at all power plants the most negative sides above the listed facts are collected. Under these conditions to speak about increase of energy efficiency of thermal power plants in general it is problematic. The exit consists only in introduction of no-cost technology of economy of fuel on Smart-MES system.

The fact of dismissal of the whole change because of the allowed big excessive consumption of fuel on a thermal power plant is known. It is equivalent when fined blind because of transition by it are expensive in not put place. So supply with sight operation personnel on BCP (block control panel), then it is not necessary to draw deplorable conclusions on the monthly fact of an excessive consumption of fuel. Much more simply and the cheapest way, operating power plant every minute and everyone half an hour, to control its current overexpenditure.

At the end of the month at each power plant fill the model of 15506-1 of 121 indicators and send it to the management of the Generation company. But why in the Generation company to know efficiency of each copper and other hundreds of indicators in a section of coppers and turbines. And here really important indicator: the excessive consumption of the main fuel - in the model 15506-1 is not present [36]. So a mistake it or intention because of ignorance how precisely to consider it? Really, when the technique on the model 15506-1 was formed, the Smart-MES system was not. But now is!

And at all power plants continue, as well as 10 years ago, not to operate, and blindly to fix an uncontrollable excessive consumption of fuel.

Unique feature of thermal power plants is that, developing the electric power and heat power, they have no opportunity to accumulate them. Thus, the electric power and heat have to be used right there for commercial purposes, i.e. in the market of the electric power and heat the Generation company has to receive money for them. In other words, the volume of power generation and heat completely is defined by their demand in the market.

Once again I will repeat that the electric power and heat it is necessary to develop exactly so much, for money, and differently it simply losses of in vain spent fuel how many will be paid. Thus, a certain quantity of the electric power and heat is strictly regulated by a certain amount of fuel according to concrete technology of the most this power plant.

But the paradox of all modern thermal power plants is just that it that the most strict regulations on them and do not exist. The operational personnel, operating power plant for implementation of the schedule of delivery of the electric power and heat, does not know in real time at all, how many it is necessary to spend fuels in each concrete time span (minute, half an hour). It works blindly, being guided only by the ability and experience.

Tragically would be to rely on the driver who operates the express without the controlling devices, relying only on rails. All perfectly understand it, and it does not even raise questions and doubts.

But why do not understand the Generation companies what to operate difficult dynamic production what the thermal power plant is, without operating control behind an excessive consumption of fuel it is also tragically dangerous both in financial sense, and in ecological.

By electricity generation and heat fuel is spent, but nobody knows, how many it is used in each interval of time - much or a little. If the lower bound naturally is established by necessary number of delivery of the electric power and heat, the upper bound is controlled by nothing, and has to be controlled by standards. Thus, this technology provokes to an uncontrolled excessive consumption of fuel, and, therefore, and to thriftless and unnecessary financial losses which are commensurated by the sizes with the profit of the Generation company.

Dynamics of an excessive consumption of fuel increases at the transitional moments - day and night. It is necessary to trace accurately and quickly an operational excessive consumption of fuel at increase and decrease of deliveries of the electric power and heat. In the present time it occurs "in the dark" power plants. And if to tell more roughly, the gloom and denseness regarding realization of automation of calculations of TEP

and an excessive consumption of fuel in modern market conditions on thermal power plants is similar to actions of the arrogant easy rider, undertaken to facet diamonds.

There is an exact science - mathematics which elementary shows that the area of difficult dynamic process in time regarding an excessive consumption of fuel has to be defined only by integral calculus and in any way differently if of course losses matter. And the interval of time spans of calculation is less, the accuracy is higher. In the present time for calculation of an excessive consumption of fuel the area of a rectangle with a time interval in one month is stupidly used simply, i.e. dynamics of process is not considered at all, and it is the most gross and ignorant blunder [46].

Very strange picture turns out that all the time the branch science was mistaken and persistently continues to be mistaken regarding the correct calculation of an excessive consumption of fuel thermal power plants. And their most important delusion is that a thermal power plant, having huge percent of wear of the equipment, is capable to have in separate time intervals economy of fuel, i.e. by some miracle, working without operational current information, to spend fuels less, than it is regulated by standards. But same simply nonsense.

And times of it in principle cannot be, even more horrific and gloomy image turns out. Every minute at power plant there is an excessive consumption of fuel, but nobody sees it, and, therefore, something cannot simply be undertaken for its decrease. The total excessive consumption of fuel in a month, naturally, consists of minute overexpenditures. Also it turns out as a result such what turn out, i.e. completely depends on will of god.

And this dull loss of a half of profit by the Generation company in the form of an uncontrolled huge excessive consumption of fuel became possible only thanks to incorrect initial messages of branch science. But whether it is time to think again. The after all excessively burned fuel in Russia would be enough in addition for 30 new thermal power plants or it is easily possible to reduce the volume of harmful emissions in the atmosphere which there correspond 30% at night by 10%.

Practically on all thermal power plants there are automated systems of the commercial accounting of the electric power (ASKUE), is warm (ASKUT) and fuels, for example: gas (ASKUG). And where automated system of the commercial accounting of an excessive consumption of fuel (ASKUPT)? Here ideologists of power industry for market conditions did not finish something. After all if the size of a 10% annual excessive consumption of fuel is in terms of money equal to profit of the Generation company, it not jokes that for average power plant makes 300 million rubles, and, therefore, for the medium-sized Generation company - 4 billion rubles. And it everything dull losses!!!

Naturally, it is necessary to prove still this fact of a 10% excessive consumption of fuel, but it a bit later, and now we will consider ASKUPT essence, i.e. the commercial accounting of an excessive consumption of fuel. If systems of ASKUE, ASKUT, ASKUG are independent and independent systems, ASKUPT is completely dependent on these systems since it is based on them.

ASKUPT in the form of Smart-MES system uses data of ASKUE, ASKUT, ASKUG and performs constant calculations of the actual and standard TEP of which the current excessive consumption of fuel is result. All analytics is given monitoring for BCP for possibility of expeditious detection of the fact of this excessive consumption of fuel and for timely intervention in production. Thus, ASKUPT provides operative technological feedback for increase in energy efficiency of power plants.

Well, and now about the fact of a 10% excessive consumption of fuel. The uncontrollable excessive consumption of fuel as it was already told above, is present every minute so that the monthly calculations existing now show even its ephemeral economy, this overexpenditure does not disappear anywhere, and it simply is noticeably reflected in profit of the Generation company.

But why then this excessive consumption of fuel is adjusted to zero in monthly calculations, and obviously it is not shown in reports? And it is simple because in such look it is necessary to nobody. After all this excessive consumption of fuel belongs to the last period and with it already to make nothing. And adjust because it is necessary to receive specific fuel

consumption on the electric power and heat according to the actual consumption of this fuel for planning of its purchases the next month. Thus, in plans put this excessive consumption of fuel in advance.

Let's not speak, it is ethic or unethical to shift mismanagement of power plants regarding existence of a huge excessive consumption of fuel which impudently enters tariffs, on consumers of the electric power and heat since everything is regulated by the market. But, seemingly, that the market that in general is not present the present at which surely there has to be a deficiency of consumers that for it there was a tariff fight. And time is taken for any price, to speak about the real market of the electric power and heat so far rather early.

Not to reveal a huge actual and uncontrollable excessive consumption of fuel the existing incorrect monthly calculations of TEP in the methodical plan. The Smart-MES system is for this purpose necessary. With its help we on an average thermal power plant revealed the following explainable regularities.

1) The excessive consumption of fuel is present on each half-hour interval, therefore, it is and on each minute interval. This results from the fact that the operational personnel operates power plant blindly regarding an excessive consumption of fuel. And really it is not possible to operate according to standards, without having the current information on an excessive consumption of fuel.

2) An excessive consumption of fuel at night much more, than in the day. So, at night the overexpenditure reaches 30%. It is clear that at night loading of power plant falls. And at the power plant excess fuel, even is uncontrolledly in vain burned at its general reduction at this time.

Now on all thermal power plants there was a paradoxical picture. If power generation and heat is strictly regulated by schedules of their delivery, here fuel costs of their development are absolutely regulated by nothing, and have to be regulated by standards in real time. And you still want to tell, what if there is no restriction on fuel expenses, there is no its overexpenditure? Here that also consists in it the main nonsense of market understanding of work of power plant.

Only the automated system of the commercial accounting of an excessive consumption of fuel (ASKUPT) is capable to bring an order with uncontrolled and with irresponsible squandering of constantly rising in price fuel.

But the generation companies will have to understand eventually that if they now have profit at a rate of  $P$ , and could actually without expenses have very easily and  $2*P$ . But for this purpose the personnel of power plant has to have a motivation.

Motivation - process of creation of system of the conditions influencing behavior of the person, sending it to the party, necessary for the organization, regulating its intensity, borders inducing to show integrity, persistence, diligence in achievement of the objectives. The compulsory motivation is based on application of the power and threat of deterioration of satisfaction of needs of the worker in case of non-performance of relevant requirements by it.

Here the statement on the Internet concerning economy of fuel: "In Soviet period for economy of fuel awards relied the personnel of power supply systems. Now such incentive is not present and incentive to save fuel with such growth of tariffs - too is not present. By the way, the salary of ordinary employees of stations does not depend on growth of tariffs and practically does not grow, stopped at the level of 2008."

Thus, nobody saves fuel on power plants, and does not even think to save. Fuel is spent so much, how many it is spent for implementation of the schedule of delivery of the electric power and heat. The motivation of economy of fuel at the operational personnel completely is absent. But the most interesting in that, as the Generation companies that have nothing to reproach employees of power plant since according to monthly reporting data at all power plants of an overexpenditure fuels are not present, and there is even its economy, i.e. power plants on paper work completely according to standards, though with use of methods of adjustment.

Here to such unfavourable conclusions the Generation companies tired out themselves, persistently ignoring need of realization of an operating control behind an excessive consumption of fuel in real time.

But if it is absolutely not present at the operational personnel of motivation and opportunity to save fuel why to create for it this motivation forcibly? That is from the worker it is possible to ask only when the feasible task is accurately set. And in the present time in all Generation companies the task for power plants looks the next comic way: It is necessary to provide implementation of the schedule of delivery of the electric power and heat and whenever possible to try to spend less for it very expensive fuel. Here such nonsense is present at all power plants!

But same it is very easy, quickly and it is actually without expenses possible to correct. And in this case the compulsory motivation of economy of fuel will sound as follows: Here for you on monitoring the current excessive consumption of fuel is removed every minute, and it is necessary that it was always zero. That's all!!! Well, and time the task is accurately set, it undoubtedly will be surely executed. And then 10% of an excessive consumption of fuel will disappear, and on each power plant there will be an additional annual profit in 300 million rubles which small part can be directed on awarding of especially zealous employees.

Compulsoriness of this motivation still is and that the excessive consumption of fuel already becomes address, but not as now absolutely faceless. At any time it is possible to analyse who and when allowed a huge excessive consumption of fuel, and to find out the reason: either it is negligence, or it is the technological miscalculation which immediately should be eliminated.

Thus, the compulsory motivation of economy of fuel of thermal power plants can give by a simple and no-cost method sharp jump of increase in energy efficiency of power plants and return on production Wednesday emulative spirit for bigger percent of economy of fuel for the benefit of the Generation companies.

Opportunity in real time to control settlement indicators which can be emergency harbingers at power plant becomes another the positive accompanying moment of this compulsory motivation. It is simple to control thousands of indications of temperatures and pressure of people is not able. For this purpose the description of their ties among themselves in total with discrete parameters and with continuous control in real time, and



also with issue of preliminary preventions to the operational personnel is necessary.

In this case management of the Generation companies can sleep peacefully since the true excessive consumption of fuel completely is absent, people with enthusiasm work, achieving Stakhanov results, possible malfunctions are constantly controlled, without bringing power plant to accident.

In this case the compulsory motivation of economy of fuel solves at once two major problems: social and innovative. The social problem is based on equitable distribution of an award according to result of economy of fuel. Innovative modernization provides in real time interrelation of the lower level of the automated data collection with the top level of acceptance strategic business of decisions.

The innovative Model of functioning of a thermal power plant simply looks as follows:

Fuel Fact → Steam → Electric power → Fuel Norm

In this case, innovation is that in real time no more than half an hour pays off with an interval standard fuel which is compared to the actual. It never was, and now is not present on one thermal power plant in Russia. The actual fuel consumption on each time interval is always more or is equal to a standard cost. The problem of functioning of this Innovative Model consists in that on each time interval the actual fuel consumption was close to the standard. In this case the most optimum option of receiving the maximum profit by the Generation companies due to big economy of fuel will be reached.

Here the solution of a question of optimization of loading of the equipment expands possibilities of this Model only a few, but in any way it does not substitute. Now on thermal power plants the steady following situation is observed. In the afternoon at the maximum loading of the equipment the actual fuel consumption is close to standard, and at night at the lowered loading the actual expense exceeds standard more than for 30%. Thus, at night power efficiency of power plants sharply falls.

Say to us that it occurs because of 10 ton coppers. But there is a simple concept - management with an advancing, i.e. considering a big lag effect of power coppers, it is necessary to reduce their loading slightly earlier, than the need for the electric power will fall.

The mathematical Model of power plant represents full calculations of the actual and standard technical and economic indicators (TEP) which expeditious half-hour calculations of a standard cost of fuel are result. In this case management of power plant looks as follows. At the end of each half an hour the actual fuel consumption and standard is known. Further management at excess of the actual expense over the standard is directed on elimination of this divergence at implementation of the schedule of delivery of the electric power and heat. But in the same way this analysis can be made and with an interval one minute. Then the delay of the operating influence will be minimum.

All this is realized quickly by easily adaptive and high-speed Smart-MES system which contains a big set of analytical, optimizing and intelligent convenient tools.

## **18. Experience of introduction of Smart-MES system at power plant**

---

The Smart-MES system appeared as MES System for automation of production management of power plant in 2007. Before, this System represented the Tool adjusted program Complex under the name "Technological Office". In 2008 understanding of ideology of creation of big Systems on the basis of the newest innovative development of "MES-T2 2007", now "MES-T2 2020" came. This ideology represents very simple structure from various set of technological tasks in the form of blocks: INPUT block, block CALCULATION, block REPORT. Thus, naturally, each task entering any block has the data input in a screen form, calculation of indicators and the printing of reports which are created automatically.

The Smart-MES system has no fixed set of technological tasks at all. All necessary tasks individually for each power plant are written in the form of text Projects, and all system is automatically adjusted at compilation of these Projects. For acceleration of initial creation of Projects, in the Complex there is a tool means "the Founder of System" allowing to generate for concrete power plant a basic configuration from calculations actual and standard TEP (Technical and Economic Indicators) by power industry techniques. At compilation of Projects DLL programs for high-speed calculation are also automatically created.

The main objective providing successful introduction of the Complex consists in optimum distribution of all technological tasks of three blocks: INPUT, CALCULATION, REPORT. Thus by all means there will be some redundancy of number of indicators. But such splitting daily allowance and monthly tasks allows to automate information processing as much as possible. In this case the INPUT block is responsible for import of data from other Systems of the lower level and for manual data input. The block CALCULATION represents one general DLL program which is automatically generated from all Projects intended for calculations. The block the REPORT carries out analytical functions and submits general reports in various cuts.

In what there was our delusion at the previous stages at adaptation of the PTO (Technological Department) Complex at power plants? We simply by inexperience followed the tastes of technologists of power plants who provided us the existing calculations in MS Excel and would wish to see result in a similar look. But, if technologists communicated with MS Excel ten years and to it stuck, realization of the same calculations on other system was perceived by them simply in bayonets. I.e. figuratively speaking instead of the system had one entrance and one exit, at us it turned out that the system has a set of entrances and a set of exits in which the User simply got confused. It would seem, everything is so automated and everything is so simple, at operation the system turned out unsuccessfully configured.

Therefore the order of realization was changed according to above the described blocks.

We developed the set of provisions which have to be recorded in the Contract for introduction of the PTO program Complex for calculation of the actual and standard TEP of power plant on Smart-MES system.

Still, because of our inexperience and indispensable desire and in everything to please all, introduction of the PTO Complex was carried out at default in the Contract below the given positions that led to vague results and continuous approaches "on a rake" at our benevolent initiatives. Huge opportunities of Smart-MES for realization of problems of management of power plant in which it is possible to drown simply with an indispensable growth of appetite of PTO of power plant without financial security, remain indifferently from the Generation companies.

#### **Obligatory clauses of the contract:**

1. The customer has to promote the Developer of system in every possible way.

We heard the following statements of employees of PTO: We will not do it, there is no time, are occupied, it are not obliged for a low wage.

2. The customer provides all necessary and reliable information with real calculations for a control example at delivery of the PTO Complex.

We met a situation of check of results of calculation on the current data, but not when materials are given out 8 months ago. During this time

the customer so changed initial calculations in MS Excel what it is not necessary to speak about correctness of calculations by new system.

3. Training of the personnel of PTO (technological department) is made from the first stage: Delivery and inspection.

We were puzzled with unwillingness to be trained in work on the Complex before its final delivery. Well, and at the end on it already there is no time.

4. Standard schedules of power characteristics of the equipment have to be reliable.

We saw a huge divergence (to 30%) the approved standard schedules with the current results on MS Excel macros.

5. Entrance signals of the automated means of data collection have to be reliable.

We got acquainted with the automated means of data collection at which the current values differ from nominal to 4 times.

6. The performer does not bear responsibility for the incomplete and provided by power plant doubtful information.

We realized the helplessness at the requirement power plant of truthful calculations at incorrect entrance information. We offered and realized use of correction coefficients, perfectly realizing absurd of a situation.

7. At the first stage the concrete list of tasks and reports without possibility of further additions at the subsequent stages is formed.

We felt irrepressible appetite when understanding unlimited opportunities of System at scanty financing.

Concrete money and, generally the very insufficient is allocated for introduction of the Program. For concrete money also concrete work, very concrete, but not in general has to be performed, it seems - everything has to be realized. And it "everything" has to be accurately stipulated at the beginning of the conclusion of the Contract for introduction of the PTO Complex.

Justification of total absence of differences of introduction of Smart-MES system for realization of calculations of TEP at any power plants is

given below: Combined heat and power plant, state district power station, hydroelectric power station and NPP.

Power generation and heat at power plants belongs to the sphere of process productions, and the program Smart-MES Complex was initially developed for automation of calculations of TEP of process productions, but with a bias on power industry. And such bias is caused by that the CEO of Firm InformSystem Chernov V. F. more than 10 years directly worked at nuclear power plants in Russia and abroad.

Process production is characterized by that each indicator of each equipment pays off on the unique formula, and such indicators some thousands. This type of tasks cardinally differs from tasks like "Warehouse", "Accounts department", etc. as have no concept about performance of the same operations over a set of records, i.e. in general there is no selection.

And now we will consider structure of various power plants with the uniform principle of work, i.e. impact of motive energy on the turbine. A source of this motive energy is: for combined heat and power plant and state district power station - the power boiler, for the NPP - the nuclear reactor, for hydroelectric power station - the river. That is, from the point of view of the principle of "A black box" - there is an entrance and there is an exit and that occurs in this box for calculation of all-station TEP (technical-economic indicator) not so important. Naturally, calculation of TEP of the nuclear reactor differs from calculation of TEP of a power copper, but also calculations for each type of turbines differ, as well as calculations of coppers depend on fuel type. Besides, the equipment combination at all power plants differs.

From everything is higher told, it is obvious that it is impossible to create uniform mathematical model at least for any circle of power plants. All power plants, and their more than 300, have unique technology both, therefore, the and only the mathematical model of calculation of TEP of the working equipment.

When the Generation companies get under charm of major companies with existence at them allegedly ready calculations for coppers and turbines, it is similar to when the sculptor for the creation chooses in

advance prepared hands and feet. The creative System has to be molded from a piece of pliable clay.

As the talented sculptor and high-quality clay in this case the Smart-MES system without any rigidly sewn up calculations for coppers and turbines, but with convenient and flexible tools on fast designing of any unique systems for any power plant is represented. And here the structure and the sizes do not play value.

Let's shortly remind about above to the described realization. All tasks are formulated in simple META language in the form of text Projects, and all system is automatically adjusted from these Projects.

By us it is defined the new duration and structure of stages of introduction of Smart-MES system for realization of calculations of TEP PTO (PTO Complex) at power plants with the general them lasting 12 months.

To below to the provided simple scheme of introduction of the PTO Complex we went long enough, undergoing, naturally, failures. Having developed plug-and-play tool means, we believed that power plants from first minutes of introduction will actively take in it part. But power plants did not want to appreciate our powerful innovations and remained to them indifferent that us could not but nonplus.

It would seem, all of us do correctly, considering that I in nuclear power worked a long time. Created the convenient and simple tool for the technologist of PTO, but something we constantly miss, probably, simply usual human factor.

So, the Contract provides introduction of the PTO Complex in the 4th stage with below the given duration of separate stages:

- 1) Delivery (purchase) of Smart-MES system and inspection (collection of information on the existing tasks, standard schedules and import of data) - 1 month;

- 2) Adaptation of the PTO program Complex in the form of separate tasks (designing of tasks and an institution with digitization of standard schedules) - 5 months;

3) Coordination of all problems of PTO in system with import of data and delivery of the PTO Complex in trial operation - 3 months;

4) Trial operation of the PTO Complex by the personnel of power plant, preparation of magazines, control of analytics and delivery of system in commercial operation - 3 months.

Adaptation of the PTO Complex to conditions of concrete power plant is understood as writing of the Complex of Projects with calculations of the actual and standard TEP and an institution of power characteristics of the equipment in a graphic view with their subsequent digitization. All system of calculations is automatically adjusted at compilation of these Projects.

Coordination of tasks in system provides functioning of the PTO Complex with one entrance. It means that the automated and manual data input is realized in one ARM (the automated workplace), forming thereby a uniform basis of basic data. Everything other ARM is simply information are joined with these basic data.

Trial long operation will allow PTO (technological department) personnel to master full-scale work on a program Complex, every day solving TEP (technical-economic indicator) problems on real data.

Call me somehow from power plant and ask a strange question: How much is your Program? I ask a counter question: You need the Program which only counts TEP or Smart-MES system which in addition to calculation of TEP, promotes receiving profit in 300 million rubles? My counter question obviously nonplused my interlocutor. He probably did not expect to hear that the program still can make profit. But if Smart-MES easily allows to get such huge profit, the question of the price of introduction of this system is in general the tenth importance.

There was at us one case from nearby Tyumen CHPP-1. To us they suggested to realize calculations of TEP for 1,5 million rubles supposedly do not allocate any more. By that moment we needed to work MES System in addition earlier we did not face PGU. We also agreed for this scanty sum how to be told, because of sports interest, considering that combined heat and power plant nearby. Naturally, we easily realized half-hour calculations of the actual and standard TEP. But here an ill luck, on the termination of



the contract it became clear that the standard schedules provided to us differ from the macros put at them in MS Excel. And entrance signals from means of data collection of ASKUE and ASKUT do not correspond to nominal rates at all. On our offer, in common to lick everything into shape, i.e. to correct flaws of the combined heat and power plant, under the additional agreement, did not find understanding. Here also everything hung in mid-air, without having reached real full-scale introduction.

Thus, since 2010 we do not participate in realization simply empty and to nobody the necessary monthly calculations of TEP any more. We introduce only no-cost technology of economy of fuel of power plants on Smart-MES system, naturally, through expeditious calculations of TEP. We also do not participate in competitions any more on automation of calculations of TEP if power plants all the same, what program is introduced. We cooperate only with those who wishes to introduce our innovative Smart-MES system and by all means wishes to get from it the greatest possible additional profit.

Though there is a proverb that for free and vinegar is sweet, however the Generation companies for free wish to receive not so sour vinegar, namely sweet high-quality "candy" for automation of calculations of TEP of power plants. Why this most free "candy" prospers in power industry? Everything is elementary simple. Financing allocates the Management to which no business is present before this automation of calculations of TEP as in the existing its look now it does not bring any benefit, not to mention profit. And the requirement that it was "candy", employees of PTO and IT who have to finance well no relation and influence put forward.

Here some bright examples from our unfavourable practice.

SVERDLOVSK combined heat and power plant. Somehow we decided to do much good for local combined heat and power plant and to introduce the PTO Complex on MES System absolutely free of charge. In the management of combined heat and power plant of opponents was not. Well, we quickly also realized calculations of standard TEP for their calculations in MS Excel, got standard schedules and began to verify results of calculation. They do not go. Made additional possibility of calculation for their polynoms, instead of real standard schedules.

Calculations went. Specified by it that their polynoms do not correspond to the last standard schedules.

But here us unexpected attack of the conductress of group of the accounting of PTO which declared to us was taken aback that with us stops all contacts because of the low wage. We run to the head of the technical engineering department with this news. On what he only also declared to us that supposedly she will have done with the youthful follies soon, and we should wait. But we needed to do nothing how to retire back home. And, naturally, further this mission we stopped in general. Our rush was not estimated ... Here if the combined heat and power plant paid 10 million rubles, the management surely would show political will for a successful completion of all this work.

TYUMEN CHPP-1. (already spoke, but I will repeat) From PTO of combined heat and power plant we were prevailed upon to be realized automation of calculations of TEP for 1,5 million rubles at the operating minimum price in 5 million rubles. We agreed, but about it further strongly regretted since combined heat and power plant to which we made incredible concessions and with soul got down to business, simply zaterrorizirovat us threats, allegedly we did not finish something there.

But we not easy realized all calculations of the actual and standard TEP according to the contract and the provided materials, and free of charge carried out at the request of combined heat and power plant the most powerful modernization of all software for half-hour calculations of TEP in real time with operational analytics that at us it was not earlier realized. But instead of gratitude were hit "on ears" because of the compelled suspension of works on fault of the combined heat and power plant.

After completion of work by us clear that the standard schedules provided to us do not correspond to macros in Excel, and entrance signals do not correspond to nominal rates. On our offer to continue collaboration for correction of defects of the combined heat and power plant in the additional agreement refusal followed. Well, then we had to take the leave simply ...

KASHIRA GRES. We won tender "Programming of the specifications and technical documentation on fuel usage of JSC Kashira GRES - 4 in 2006" for the sum of 200 thousand rubles as the only

participant, it is seen such gawks for such scanty sum except us was not. We, naturally, realized everything according to the contract on our program complex in time. But after all it is only standard TEP.

We went to the director of state district power station and everything explained that in order that the system worked, are in addition necessary: calculation of the actual TEP and costs of own needs and losses of the electric power and heat that under the contract is not provided at all and the separate contract is for this purpose necessary. He assured us that it will easily solve.

But to our surprise competition on introduction of our program Complex "Technological Office" was again announced. We again won it, but his statement for a long time got stuck in OGK which was not approved.

SUMMARY. Thus, we ceased to push luck and for cheap contracts, naturally more, we do not undertake. We also completely ceased to participate in competitions on automation of calculations of TEP since understood that power plants do not need progress. Understood also that still Generation companies and do not need additional annual profit in 300 million rubles from each power plant.

In the world there are only two financial criterion functions on automation of calculations of TEP. The first - to pay less for this automation. The second - to get more profits on this automation. And these two functions are not compatible. In the present time in all Generation companies the first criterion function which is regulated by the held competitions prospers. Thus, the Generation companies, deciding on modernization of calculations of TEP, even do not think of profit. There is it or because of ignorance of opportunities of software, or because of elementary disbelief that automation of calculations of TEP is capable to bring also huge profit.

Let's review examples of these two options taking into account their cost and profit. The first option which is used now: C1 cost = 3 million rubles, profit of P1 = 0 million rubles. The second option on Smart-MES: C2 cost = 10 million rubles, profit of P2 = 300 million rubles. In the first option the look falls at once on cost, and at zero profit there is a natural

desire that this cost was even less. In the second option the look falls already on profit, and in this case the size of cost is not so important.

Let's give indexes of profitability of these options [52]. First option:  $J1 = P1/C1 - 1 = 0/3 - 1 = -1$ . Second:  $J2 = P2/C2 - 1 = 300/10 - 1 = 29$ . But from theoretical economy it is known that at  $J > 1$  innovative project is considered economically effective. Otherwise ( $< 1$ ) the project is inefficient  $J$ . In the conditions of rigid deficiency of means the preference has to be given to those innovative solutions for which the profitability index is highest.

Here so arrived ... It appears according to science the Generation companies implement the most inefficient projects on automation of calculations of TEP, and they ignore highly profitable project on Smart-MES system so far. But it is interesting why? In this case only two versions of the answer are possible: the first - they very much want to feed the pocket firm, the second - they do not trust in possible profit.

As for profit, so it is easy to check it. It is enough to execute four half-hour calculations of an excessive consumption of fuel: in the winter and in the summer, day and night. Average value will turn out around 10%. But time this excessive consumption of fuel completely depends on lack of the current control of it, therefore, influence of this uncontrollable human factor by means of Smart-MES system and compulsory motivation can be minimized. Here to you and profit. But there are still problems with the prevention of emergencies which are easily realized on this system, and it is already additional huge profit.

Let's say it is possible to object that with a size of profit of 300 million rubles we got excited a little. And what the profit in 30 million rubles it is not enough that the project was quite profitable, after all it only economy of fuel in 1%? And if to take for payback of the project in one year, the cost of profitable introduction of Smart-MES can quite reach the same 30 million rubles.

It is important to understand to the Generation companies that introduction of automation of calculations of TEP of an old sample under a new mask it is already simple over ignorance, especially in market conditions when anybody to a step does not make without benefit for

himself. And meanwhile the Generation companies continue to lean on realization of this profitless technology in vain persistently.

This system we developed a long time since looked for the best innovative solution. And here it is found is Smart-MES "MES-T2 2020". All previous versions which we tested at power plants, were only landmark. It agrees that they spoiled our image since they actually not everywhere work and not through our fault. But without costs probably it is impossible. After all in our understanding any stage was the best realization in due time. So, before reorganization of power industry we the next versions under the names "Technological Office" and "MES-T2 2007" it is skilled introduced according to the reduced adaptation scheme at the following power plants: CHPP Chepetsk Mechanical Plant, Kola NPP, Sosnogorsky combined heat and power plant, Perm CHPP-9, Angarsk CHPP-9, Biysk combined heat and power plant, Vorkuta CHPP-2, Kashira GRES, Seaside state district power station, Sverdlovsk combined heat and power plant, Norilsk CHPP-1, Norilsk CHPP-2, Norilsk CHPP-3, Yelabuga combined heat and power plant, Tyumen CHPP-1.

Very shortly about technology of economy of fuel. We noticed a huge excessive consumption of fuel at introduction of MES System on the Tyumen CHPP-1. And, in the afternoon it is close to zero, and in the night reads off scale for 30%. But nobody knows about it since at one power plant is not present half-hour (especially is not present constant) calculations of an excessive consumption of fuel (the actual expense - a standard cost). But if the operational personnel on BCP (block control panel) in real time constantly sees the current analytics on an excessive consumption of fuel, it has a compulsory motivation to look for ways on reduction of this overexpenditure.

Clever people from above with aplomb declared that our feasibility report (Feasibility study) is advertizing. But there can be it partly and so. After all the feasibility report is formed before development for investment justification, and our feasibility report on energy saving technology is made after development of MES System at the expense of own resources. Therefore this fact it is seen people from above and it is unclear. And we invested in development of the Smart-MES system, best in the world, for process productions more than 100 million rubles. But we offer not system, but technology which without our system not simply to realize. Here we

see completely the fault, time we cannot convince management of the Generation companies of prospects of our Smart-MES.

For these years we took the following steps to parts of introduction and promoting of our development:

1. Honest participation in competitions. We a few years ago participated in 4 competitions and at the level of power plants them won. But results of competition for some reason without explanation were not approved by the management of the Generation companies. Explanation here the very simple: Proceeding from corporate interests, the winner in advance probably was planned, but he in honest competition did not manage to win. We drew a natural conclusion: Innovations are necessary to nobody. Therefore we simply stopped participating in this farce further.

2. Reduction of price of introduction to 0. We made a failure attempt of free introduction of MES System. We quickly agreed with management of Sverdlovsk combined heat and power plant and realized calculations of standard TEP. But need any time of double calculations in their MS Excel and on the new program for check of its working capacity did not suit the conductress of group of the accounting of PTO since she demanded increase in a salary. But, as the head of the technical engineering department declared, money is not present, and thus everything successfully decayed. Therefore we drew a natural conclusion that the size of the price does not influence a choice of our MES System.

3. Providing data on transcendental profitability. All theses of management of the Generation companies about need for introduction of innovations their good profitability are lie. We at introduction of MES System declared profitability of 18750% which by 1000 times exceeds the accepted canons of an index of good profitability. But we do not observe turn of demands for introduction. Therefore conclusion: in the existing market conditions in power industry other economic laws work.

4. Guaranteeing multi-billion profit. We on figures proved that at introduction of our technology of economy of fuel by means of MES System the additional profit for each Generation company will make 5 - 20 billion rubles. But when investors are extremely not happy with the sizes of

the profit, management of the Generation companies works absolutely formally and cynically, without noticing energy saving technologies since the Russian mentality of management the stranger and the accurately distinguishes pockets. Therefore at increase the specific IT manager of anything actually will not get the general profit of the Generation company. But time it is the only expert in this sphere, he manages the IT policy favorable only to himself. Conclusion: the profit is not necessary to IT management.

5. We proclaimed the following option based on the ultrahigh price of introduction of Smart-MES system at which "kickback" makes 95%. Let's assume that the price of development and deployment of Smart-MES system for realization of expeditious calculations of TEP for the purpose of economy of fuel over 10% is discussed of 100 million rubles. Here our participation - 5 million rubles and services of the representative of the Generation company - 95 million rubles. And if to discuss the price of 200 million rubles, services of this representative will pull on 190 million rubles. And in the presence in the Generation company of 10 power plants this representative of the Generation company personally itself will have already about 2 billion rubles which are easy for mastering in one year.

Thus, all possible options in our fatherland were ineffectual.

In what in this case difference from others the similar existing schemes of introduction of new calculations of TEP? The basic and the most important difference is that now any calculation of TEP at one power plant in one Generation company does not make obvious profit. And introduction of technology of economy of fuel on Smart-MES is capable to provide profit of 300 million rubles. Therefore even if to increase introduction cost to 300 million rubles, the enormous index of profitability, equal 100% that is not present at introduction of any serious innovation will turn out.

Our MES System is tested at ten power plants. On our site ([www.Inform-System.ru](http://www.Inform-System.ru)) there is a demonstration version on which it is easily possible to look at work of MES System and algorithms of calculation of the actual and standard TEP for the following power plants: Vorkuta CHPP-2 of "KES", Yelabuga CHPP Tatenergo, Kashira GRES of

"Interrao", Kola NPP "Rosenergoatom", Perm CHPP-9 of "KES", Seaside DGK GRES, Sverdlovsk CHPP KES, Sosnogorsky CHPP KES, Norilsk CHPP-1 of "NTEK", Angarsk CHPP-9 of "Ikrutskenergo", CHPP Biyskenergo, Tyumen CHPP-1 "Fortum".

After a gallop from our site of [33] DEMOS of Constructor2012.exe and after installation by means of start of AutoRun.exe and a choice "PTO Complex" the System will be installed in local option with BDE. Start "the Designer ARM", and the program with algorithms for the Tyumen CHPP-1 is ready to calculations. Cause the Half-hour Analytics point in the Analytics Menu and will see information on an excessive consumption of fuel. In the Control Menu the Manager of Systems point will choose power plant and install System on this power plant.

Thus, at introduction of Smart-MES system of negative results in principle cannot be by us since I have an extensive experience of introduction of Systems on nuclear power plants. I introduced Systems on 7 power units in due time: on the Beloyarsk NPP, the 2nd on the Ignalina NPP and the 4th on Dukovana's NPP in the Czech Republic. Without these Systems in principle it is not possible to start these power units and the more so their operation is not possible.

After introduction of Smart-MES at such innovative scope of economy of fuel and reduction for 30% of harmful emissions in the atmosphere for certain there will be no release from investors at this Generation company.

On the Internet many experts introduce the "seditious" idea that the Russian corporations strongly were disappointed in large program systems, especially foreign since they did not equal hopes for improvement of operational performance at total absence of profitability. But at socialism all knew that any computer program of the top level if makes any profit, only very much indirectly. Why under capitalism it suddenly has to make profit? After all the mentality of management to software did not change at all. It was and remains ignorant, and because of it and scornful.

However when large western IT brands offer the systems and promise transcendental profit on introduction, to them already



unconditionally trust since at them these systems functions worldwide. But after a year of operation are convinced that under our conditions it is simply thrown out money.

Actually everything is very simple. Any program has to have ability quickly to react to change of a production context, especially in our developing economy. But it is not present in one western program since at them this economy is already developed, and, therefore, and it is stable. That's it this adaptability is also put in our Smart-MES system which self-organization will instantly consider all new realities in algorithms of calculation. So, it long will not become outdated, and will long make profit.

The question costs about risk and about mentality. At once I will tell that to overpersuade someone it is unpromising since only the mentality is a brake of introduction of innovations, and all talk on risks of introduction of IT is no more than reflection of this mentality.

Further it is compelled to repeat a little in the context of mentality.

A few years ago we suggested to introduce absolutely free of charge our system at Sverdlovsk CHPP JSC TGC-9 IES-Holding at us in Yekaterinburg, i.e. completely without financial, and, therefore, without the main risk. All of us realized calculations of TEP and pointed to their mistakes in calculations. But instead of gratitude received "slap in the face" from the head of group of the account which refused to contact further to us without increase to it salaries. The head of the technical engineering department on it only helplessly made a helpless gesture. We naturally retired, and the irreplaceable employee returned to favourite MS Excel.

A little earlier at the request of PTO of the Tyumen CHPP-1 of JSC Fortum we undertook realization of calculations of TEP at the price by 10 times smaller today's, i.e. at the minimum financial risk. Everything was realized by us with automatic data input from their systems of ASKUE and the PCS and with half-hour calculations of the actual and standard TEP. But when time came to hand over system, it became clear that the power characteristics of the equipment provided to us incorrect, and entrance signals widely of the mark. By means of program "crutches" we proved that from our party everything is right. But as a result the system was thrown

since the combined heat and power plant refused to continue work through the additional agreement for elimination station a mistake.

And even earlier we performed work for Kashira GRES of JSC INTER RAO-electrogeneration (was in OGK-1 earlier) on programming of the specifications and technical documentation on fuel usage on our system. When everything was handed over successfully, it became clear that the girl whom we trained, on a floor of year from PTO transferred to KTTs for training. Result: system - in a recycle bin.

But the most incredible thing was in JSC NTEK (Norilsk). They at the beginning of development of system bought complexes for 3 combined heat and power plants for the purpose of independent adaptation. In some years again invited us for realization of ten tasks, according to TZ (specification). We were sure that at them all calculations of TEP are already realized, and we should walk only a hand of the master and to help them to adjust additional tasks. But on arrival to our horror it appeared that they have in general all on zero. And time at us is no more than one month of two for 3 combined heat and power plants which are scattered territorially. We had to involve the generator of projects of the actual and standard TEP in system and on their basis to involve additional tasks. For high-quality debugging of all complex we addressed with the offer on the additional agreement. On what bureaucratic refusal and the requirement about need received everything to execute in accuracy according to TZ. Well, unless it is possible so with experts? We needed only to answer: is. We took it literally and threw out 90% of calculations from system, made protocols for each combined heat and power plant with the list of all tasks of TZ where at delivery collected signatures under each task of the protocol. On a selection committee all of us perfectly showed and showed all protocols from all combined heat and power plants, but added that with calculations of 3-that (power) they have no full system.

We faced similar mentality at two tens combined heat and power plants, state district power station and the NPP.

Especially I was struck by contact with my native Beloyarsk NPP where I was on the staff the 4th years at construction and start of BN-600 and where I together with TsNIIKA introduced the URANIUM complex.

The head of the technical engineering department invited us to show them our system that we also made with their SQL server on Oracle. It seems everything was pleasant, and applicants of others are not present. But during competitive selection we were not passed due to the lack of the admission, but the Tomsk polytechnical university passed, seemingly, in general without experience with power plants regarding calculations of TEP. But on the Kola NPP we also conducted work without admission and to us and on the NPP in general presence is not necessary since I on them worked 10 years and all secrets I know. After the Beloyarsk NPP I introduced systems on the Ignalina NPP (2 power units) and on Dukovana's NPP (The Czech Republic, 4 power units) at the request of Minpribor.

And where you here from everything are higher than the told saw risks? They simply are not present, and there is a usual mentality of indifference. And not to allow at introduction of Smart-MES of the similar relation, we accepted the following rules.

We carry out all introductions only without intermediaries. Before signing of the contract we demand to provide us all production materials by calculations of TEP (technical-economic indicator) with control examples, including entrance signals, and with the instruction in the contract of guarantees of their fidelity. We carry out only half-hour (constant) calculations of the actual and standard TEP with monitoring of analytics on an excessive consumption of fuel on BCP (block control panel) for compulsory motivation of the operational personnel on economy of this fuel. All replaceable, daily and monthly TEP for reports are formed only by accumulation of half-hour TEP. After signing of the contract by us up to end operation more any materials us are not accepted. And all additions and changes are made out only through additional agreements.

Here before me the fresh Specification on purchase of services in earlier introduced program complex (PC) for PTO of Verhnetagilskaya GRES of JSC INTER RAO-Elektrogeneration in 2014. In TZ in the general requirements it is told: item 2.1. Ensuring steady functioning of the introduced software, maintenance of relevance of data and reduction of the algorithms of its work to changeable service conditions caused by need of

users, or change and expansion of interfaces of interaction with system. Term of 10 months.

In other words earlier introduced software does not possess the present possibilities, and, therefore, it will not possess them further. These purchases can be infinite since life constantly changes.

And here we see that systems without possibility of expeditious adaptation to new conditions without developer everywhere take root. If the personal computer require 10 months, Smart-MES will require some minutes without additional financing since all this will be easily made by technologists in real time.

## **19. Theory of accidents and Theory of global catastrophes**

Firm InformSystem proves justice, offered by it, theories of accidents of the NPP, using the principle of analogy to the available and recognized theory of accidents [15]. But the Theory of technogenic and natural disasters does not give opportunity of management of development of these accidents, she only explains them and gives the chance of forecasting. And our Theory of accidents opposite gives the chance on timely prevention of development of an emergency on the NPP and on thermal power plant.

The science defines concept analogy as similarity in properties or signs. The conclusion by analogy is a conclusion as a result of which the knowledge used for a formulation of a scientific hypothesis is reached. But the knowledge gained by analogy (even unconditional or strict) always is only probable. Their reliability has to be confirmed by practice.

Accident is the damage of the car, machine, the equipment, the building, a construction which is followed by violation of production and connected with danger to human lives. Accident is a major accident with the big human victims, i.e. an event with very tragic consequences. Distinction between accident and accident consists in weight of consequences and presence of the human victims.

Any accident or accident cannot happen for any one reason. All accidents are a result of action of several reasons and set of adverse factors. The most frequent option, it when the mistakes made at design interact with the mistakes made at installation and are aggravated with misuse.

The terms "accident" and "theory of accidents" were entered by Rene Tom and Christopher Ziman in the early seventies. Accident in this context means sharp high-quality change of object at smooth quantitative change of parameters on which it depends. The important advantage of the Theory of accidents is that it does not demand detailed mathematical models and can describe situations not "quantitatively", and is "qualitative".

The theory of accidents is applied to heart beat researches, in geometrical and physical optics, embryology, linguistics, psychology, economy, hydrodynamics, geology and the theory of elementary particles, to modeling of activity of a brain and mental disorders, revolts of prisoners in prisons, to behavior of exchange players, influence of alcohol on drivers of vehicles.

And here the theory of accidents for practical use is not suitable for the NPP. For this purpose also the newest theory of accidents as reflection of the theory of accidents is offered. The concept "incorrect indignation" which unites any technological changes which break the normal course of production on the NPP is entered into theories of accidents: wear of the equipment, failure of automatic equipment, operator's mistake, i.e. quite discrete changes. In this case, wear of the equipment, including and corrosion of pipelines, have to be considered in total with the current loading.

Thus, the theory of accidents accurately formulates development of any accident as slow building of various quantitative factors and high-quality instant transition to other state. In other words, the gradual increase in potential energy conducts in a certain point to spasmodic transition it in kinetic energy.

Using a method of analogy to the theory of accidents and that accident and accident is related concepts, we will formulate the theory of accidents of the NPP: The emergency by means of gradual strengthening of incorrect indignations at a set of their certain critical weight instantly turns into destructive accident.

Therefore development of any accident on any production and, especially, on the NPP surely has two phases:

- 1) Emergence of an emergency which begins with the first incorrect indignation and gradually acquires new these incorrect indignations before creation of a certain critical weight by them. This period can take some time up to several years. The size of critical weight cannot simply be foreknown.

2) The created critical mass of incorrect indignations instantly leads to destructive accident, and on the NPP in addition with radioactive emissions and to irreparable moral and physical consequences for all society.

But the most terrible and awful here that on the NPP constantly not one always develops, and some emergencies, forming itself certain branches, being in different stages of development. These branches can be crossed, then the number of incorrect indignations gathered in them is summarized, in steps thereby, coming nearer to critical weight or at once it creating.

The set of branches of emergencies exists the proof that on the NPP always, wear of all equipment is. Nobody will deny that wear, as well as corrosion, have over the years an adverse effect on normal functioning of the NPP, so, these factors are, according to the theory of accidents - incorrect indignations. But wear and corrosion is always, and in total with loadings they represent, in fact, rudiments of various branches of emergencies.

On the NPP for prevention of transition of an emergency to destructive accident there is a multiecheloned protection. It works when approaching accumulation of number of incorrect indignations to critical weight, i.e. is close by the time of emergence of destructive accident. On the one hand, it is very good that safety of the NPP is ensured by reliable protection. But on the other hand, the calm hope only for this protection is called as extreme carelessness since according to the theory of probability even the most reliable mechanisms sometimes bring.

Therefore, the theory of accidents gives the chance in general development of an emergency not to bring excessively, i.e. to protection operation. Here idea very simple. If the appeared incorrect indignations quickly to reveal and eliminate, approach of critical mass of these incorrect indignations will not be at all, and, therefore, and protection will never work. Thus, the NPP will become - accident-free.

We developed axioms of the latest theory of accidents on nuclear power plants on the basis of which the accident-free technology of

operation of power units and which from other positions ensures absolute safety of the NPP is formulated.

"Rosenergoatom" approves the following: "The system of the account, classification and the analysis of events of low level (harbingers of emergencies) allowing to reveal beforehand outlined negative tendencies in safety and to take the necessary correcting measures operates on all NPPs".

Here at once there are questions: And where the analysis of wear of the equipment and aging of pipelines in total with loadings, and where the analysis of errors of action of the operator, and where the analysis on false and spontaneous operation of automatic equipment? And all this in the general interrelation with all processes on the power unit. On one NPP it simply is not present. And when, after the next emergency stop of the power unit, write that the emergency prime cause becomes clear, it speaks about ignorance of bases of the theory of accidents. No prime cause of accident in the nature exists, and there is a set of the incorrect indignations which reached emergency critical weight.

For example: the pipeline is broken off. What in this case prime cause: or an elevated pressure in a pipe, or large volume of a rust? It appears neither that and nor another, but only set of these factors. Or at the fire usually say that the reason in conducting short circuit. It categorically is not right, since actually the reason in a complex of factors: easily combustible environment, the raised current, failure of the current machine gun and existence of a source of fire because of conducting isolation breakdown.

Thus, the knowledge of the theory of accidents will allow not to allow not simply and close destructive accident, and to create in general accident-free technology of operation of the NPP. In this case, as it was already told, incorrect indignation we will call any change worsening the production technology: wear of the equipment, operator's mistake, false operation, etc.

#### **Axioms of the latest Theory of accidents:**

- 1) Accident consists of two phases: long emergency and transient



destructive accident. The emergency can last for years, since single incorrect indignation. Gradually it acquires new incorrectnesses. When their quantity gains a certain critical weight, the emergency turns into destructive accident. Protection on the NPP actually work at the latest stage of an emergency.

2) Never one incorrect indignation leads to destructive accident. Emergence of this destructive accident requires two and more incorrect indignations making critical weight. Each accident is characterized by the critical weight.

3) New incorrect indignation on the NPP can be as a rudiment of a new emergency, well addition to already available emergency. Thus, on the NPP always there are some branches of these emergencies which can be crossed or develop independently. Critical weight can be created gradually or in steps when crossing emergencies when their already gained masses develops.

Now on all NPPs completely there is no diagnostics of an initial stage of an emergency. Therefore the seeming quiet situation on the power unit is actually very dangerous. It means that actually all personnel on all nuclear power plants, work in the conditions of an emergency since wear of the concrete equipment is already incorrect indignation.

Now present an initial idealistic picture when on the power unit everything is normal, i.e. absolutely there are no all incorrect indignations. In this case for simplicity we will not consider wear of the equipment. And here production is started. All changes in real time are watched by Smart-MES system, and will constantly check these changes for a correctness. At identification of the first incorrect indignation the system right there reports on BCP for timely elimination of this incorrectness.

Naturally, it is at once done everything possible for giving to production of a normal technological state. And incorrect indignation is removed. On the power unit again a normal quiet production situation before emergence of the following incorrectness.

And now we will analyse it according to the theory of accidents. If all arising incorrect indignations are liquidated at once at their emergence, creation of critical mass of incorrectnesses is simply excluded, and, therefore, and protection which work on a closing stage of an emergency, will never be involved. And it means that the power unit urgently also will never stop.

In this situation it is quite possible to say that functioning of the NPP became absolutely safe, i.e. simply accident-free.

And now present prospects which are promised by this accident-free technology of the NPP. The questions connected with possible radioactive emissions remained far behind. Society prefers to all combined heat and power plants, state district power station and hydroelectric power station only the NPP, as the most environmentally friendly. The nuclear power industry of Russia got a second wind, having outdone nuclear technologies of the western countries, especially the USA.

But in this situation, the arising bureaucratic formal replies, not simply show a strong lag effect of thinking of nuclear scientists, but also the indifference they slow down economic development of Russia. The short sense of these formal replies is that at us supposedly and so everything is good and it is necessary nothing to us. And meanwhile nuclear power units urgently stop, subjecting society of radiation hazard since and deeply echeloned protection ever can refuse.

There are some Theories somehow connected with accident, it: The theory of reliability, the Theory of safety, the Theory of risk, and that's it still for some reason is not present the Theory of accidents. But after all such Theory which would describe development of any accidents, has to be. After all when this mechanism then it is possible and to fight against it is known. And times of the Theory of accidents are not present for this reason power plants catastrophically collapse, doing harm not only to the Generation companies, but also Russia in general.

The following excerpts are taken from scientific articles on the Internet:

"The theory of reliability operates with a random variable of time between consecutive refusals - for unique accidents this size to strive for infinity (besides, act as the reasons of accidents not only refusals of equipment, but also badly formalizable mistakes of the person, and poorly predictable off-design external influences)" [53].

"Optimistical results VAB (probabilistic analysis of safety) on the CNPP played then a mean soothing joke. Past mistakes were eliminated, the VAB tools were improved in the highly specialized branch direction for reduction of influence of uncertainty. Today VAB - the recognized specialized additional tool of an assessment of compliance in nuclear power" [53].

"The time cycle of existence of OPO (hazardous production facility) includes both regular functioning, and emergency events. Accidents of catastrophic character in a limit can finish life cycle of OPO. The most rough analysis of known dangers of accidents on OPO indicates preference of execution of the operating safety rules received in the empirical way from tragic experience of last industrial accidents"

"Set of the knowledge containing in safety rules (including high-quality indicators and quantitative indices), it is impossible to change for results of the analysis of dangers and a quantitative assessment of risk. The first order the past and prevent known failures in the present, and the second look for tears in the future. The acceptable risk of accident cannot serve as the only criterion of safety of object" [54].

Here the brightest excerpts of a current state are given in scientific community of the question connected with accidents. Also notice it is not told about nature of development of the accident anywhere. Everywhere accident is represented the such instantly arising destructive process. But actually it is far absolutely not so.

Accident as a live organism develops gradually, but not at once. In it the fundamental main total mistake of scientists who from the hopelessness to accident attract both the Theory of risk, and a safety rule also consists. After all for the Chernobyl NPP according to the Theory of risk of accident should not have been, and it take and happen. After that scientists with

aplomb declared that now all of them considered that. But it is the complete lie and nonsense, as well as lie that if to work strictly according to instructions, and accidents will never be.

For descriptive reasons descriptions of an essence of accident we will follow the simplest example: Explosion of the house because of gas leak. It is absolutely clear to all that for the fact of the explosion there have to be three components: gas leak, the closed volume and a source of fire. Lack of any will provide an utter impossibility of the explosion. But the corresponding explosive concentration of gas at leak is created not at once, and gradually. And it is very easy to watch leak of gas, but the corresponding sensors in apartments are not present. It is possible to speak of course here and about probability of explosion, and about instructions gas use which all have and which nobody read and if read, long ago forgot. But that it is simpler - to put for accident prevention sensors with automatic overlapping of gas. In this case and the Theory of risks is not necessary and instructions are not necessary. And the most important, billions of rubles from lack of need to build new housing the victim will be saved. And human lives in general are invaluable.

But power plant millions times more difficult more dynamically than the reviewed example. How hundreds of people can, working at different sites, to provide thousands of obvious and implicit various situations? Especially as now the existing environment of the operational personnel at all power plants "is quite ordinary". Therefore to them the Theory of accidents with the corresponding realization in the form of Smart-MES system also has to come to the help.

For some reason scientific minds consider that if on nuclear and thermal power plants there is a protection against accidents, everything is all right with this phenomenon. But they forget about a commercial component of this fact. Any operation of antiemergency protection surely conducts to financial losses. But protection can not work then losses are incommensurable. After all nobody will object that it is better not to allow operations of protection at all. Here for this purpose that the Theory of accidents is also necessary, it is necessary to understand an essence of any accident then it will be easy to fight against it.

It is necessary to realize accurately that never one reason of any incorrectness leads to accident. It accurately shows above the given example. Also it is necessary to understand that accident includes two phases of the development: the first is an emergency, the second - destructive accident. The emergency proceeds slowly and not considerably, since one factor of an incorrectness and gradually acquiring other factors. With achievement of critical mass of these incorrectnesses the emergency turns into already visible accident, protection are engaged in diagnosing and which prevention.

Thus destructive accident is threshold function without possibility of return to initial positions, and the emergency is not such threshold function and at any stage it can be returned to a normal state, i.e. not to bring a situation to operation of protection. The task consists only in that at the beginning of development of this emergency to reveal the first incorrectness and in due time to report about it for the subsequent its elimination without loss of the mode and rate of works at power plant.

Let's follow for persuasiveness still an example with the metal pipeline. It is clear that over time the pipe unevenly rusts under the influence of hostile environment, and, therefore, from it its durability falls. But in order that on this pipeline there was an accident to its gap, two factors, this current state of the rusting metal and existence in the pipeline of pressure exceeding the current durability of a pipe are necessary. But after all the pipe rusts gradually for years, therefore, and working pressure it is necessary to reduce constantly then there will be no these gaps. But behind it at power plants there is no current control, and same one thousand sites.

On nuclear power plants there is (at least, in my stay was) a function of registration of initiative signals which are necessary for clarification of the prime cause of operation of antiemergency protection. But, as a rule, it did not bring any positive results. However, working in Czechoslovakia for Dukovana's NPP, I as much as possible increased the allowing possibility of this function without loss of initiative signals, but, however, any more messages are not right here. Initiative signals do not show the reason of the

beginning of an emergency, and inform only on a closing stage therefore they are absolutely useless for the analysis and blamestorming session.

After all if only one incorrect parameter can be the cause of the beginning of an emergency, the task of the prevention of accidents has to consist in timely diagnostics and identification of this signal. But as to make it nobody knows since still and did not face science of such task because of the distorted concept of the accident which they also did not conjecture.

Many years ago I was at conference on the prevention of accidents at the Moscow institute on nuclear power where many years were engaged in this subject huge number of scientists. And here one of global development consisted in fixation of technological cuts on the NPP at operation of antiemergency protection, i.e. accumulation of the knowledge base about accidents with the subsequent recognition of dynamic images. Now it seems so ridiculous and ridiculous when to us elementary other approaches to realization of this major problem are known.

Let's consider the current technological state of power plant and we will assume that at present everything is correct, i.e. everything regularly works. Here means that all and discrete, and analog parameters function according to the established regulations. But suddenly for any reason incorrectly works one parameter from several tens of thousands. The task consists in expeditious diagnosing of this parameter. But how to define its correctness?

Here it is necessary to understand an essence of the most technological process, namely its start or a stop. For start of any process specific actions are carried out in strict sequence, i.e. we cannot execute the following step is not executed previous yet, considering that still more previous are already executed, and all the subsequent wait for the performance. And if we agree with it, and at all power plants so really and is then for definition of a correctness of operation of any parameter absolutely there is no need to analyze a condition of all parameters, and it is quite enough to check only the adjacent.

In this case the logical condition of a correctness of change of parameter looks as follows:

$k_i = +K(i-1) \& -K(i+1)$ , where:

$i$  - current step,

$k$  - one current parameter,

$K$  - set of parallel parameters,

( $+K, -K$ ) - it is conditionally included, switched off.

Thus, change of parameter correctly if all previous adjacent parameters are included, and all subsequent adjacent parameters are switched off.

There is one feature that for definition of a correctness of change of parameter a logical condition of a correctness identical both at start of technological process, and at its stop. Thus, having described similar logical conditions for each parameter, its correctness of change easily is defined.

On the Internet met the phrase that scientists and engineers cannot understand how there is an accident. But it only proves justice and fidelity of our Theory of accidents on which follows that emergence of accident requires some reasons. Never one reason will lead to accident.

There was an explosion of ammunition in a warehouse near Samara [55]. It also the largest accident. It is possible to introduce, of course, the seditious idea that for urgent utilization of several million ammunition on purpose, for example, to cover up tracks of mass plunder, elementary simulated accident with suicide bombing. Or the fire in the largest house is also accident. And it is ridiculous then from firemen to hear that short circuit of conducting was the reason. But all this from ignorance of the Theory of accidents according to which follows that at least two reasons or two incorrect indignations are necessary for any accident.

The serious perception us the created Theory of accidents by all public services will allow to look absolutely in a new way at these destructive processes and to keep billions of rubles which are necessary for creative activity of society. According to this Theory some incorrect indignations which appear spontaneously during various periods are

necessary for accident. And if we in due time liquidate the first indignation, we will rescue the NPP from accident.

On the basis of the 40 years' operating experience of nuclear power installations by Smutnev V. I. work (Practical culture of safety of operation of the NPP) is written [16] which all officials and the organizations try not to notice.

In this work Smutnev V. I. wrote the following: "-potentially dangerous difficult technological system operating by the natural principles and laws which cannot neither change nor cancels the block of the NPP any person in the world, whatever high position he held. These laws should be known, understood and carried out certainly".

In the work Smutnev V. I. gives the following fundamental axioms of culture of nuclear operation:

1) The car (the block of the NPP) interacts not only (and not so much) with the person operator, but with a certain managing director of community.

2) The car "does not know" also cannot know laws of human society.

3) The car represents always absolutely rigidly determined (cause and effect) system.

4) Instructions and service regulations of the block of the NPP are always relative (moderately relativities of knowledge the person of laws of operation of the machine at the moment).

5) Hierarchical structure of the operating community interacting with car (the block of the NPP) - objectively nondeterministic system.

6) The operator - the person with all physiological, mental and social features of the person in general.

All that is told Smutnev V. I. will be coordinated with our Theory of accidents.

For an example we will consider a human body. In the person constantly there are processes which do not depend on him and therefore directly he is not able to operate them. Let's tell, a digestive tract, blood system, airways. But the organism at any malfunctions (incorrect indignations) gives to the person about it a signal, for example, through



pain. The person can react, taking medicine, or not to react. At timely not reaction the number of these incorrect indignations will collect, in the same way as on the power unit, and the person gets to reanimation, and on the NPP work protection. Further the person can not survive, and on the NPP of protection can not ensure absolute safety from radioactive emissions.

But unlike a human body on the modern NPPs diagnostics about incorrect indignations completely is absent. And, apparently, quite obvious that is better in advance, i.e. in the germ, to prevent development of an emergency, than to be helpless witnesses of already come true fact of sudden operation of protection. But it is no secret that the emergency muffling of the reactor with intensive branch of warmth, i.e. a far emergency situation, conducts to reduction of a resource of the reactor. And it everything huge financial losses.

As the person should not rely on saving reanimation, and "Rosatom" should not be content with protection on the NPP what they would not be. If the person in due time accepts a pill, on the power unit the indignation incorrectness in a look also in due time has to come to light and be eliminated: wear of the equipment in combination with loadings, spontaneous operation of automatic equipment and wrong actions of the operator. Then the person quietly without reanimation lives up to an old age, and the power unit without operation of protection will quietly function before the termination of service life.

Smutnev V. I. in the work reflected the main thought that though the operator and operates processes on the power unit, but he is not able to capture all variety of internal processes, so and cannot assess correctly and in due time the current situation which is imperceptible for the operator undergoes changes. Therefore here it is necessary to apply other approach on monitoring in interrelation of all least changes on their correctness, it is also necessary for ensuring absolute safety of the NPP to direct philosophy of views of its fail-safety.

All this is subject to Smart-MES system which, using the Theory of accidents and having boundless opportunities for the easiest adaptation to any NPP, can reveal in advance and in due time report about incorrect changes on the power unit, creating thereby favorable aura round the NPP.

If all incorrect indignations are eliminated at once, they will not collect, and, therefore, business will never reach operation of protection. Thus, over time for safety of the NPP the role of protection will leave on a background since power units will become in general accident-free, and protection will be only for reinsurance.

After all if the offered technology of the prevention of emergencies from safety results in fail-safety of the NPP, it will already revive absolutely other relation of society to nuclear power in general, and at the international level all countries will prefer to have only the accident-free Russian NPPs.

## **20. Logic of the prevention of accidents on Smart-MES**

"There is a logic of intentions and the logician of circumstances, and the logic of circumstances is stronger than logic of intentions" - I.V. Stalin [56]. But is also logic of the prevention of these circumstances.

The production activity at power plants uses logic of intentions, and accidents at the same power plants happen according to logic of circumstances. But time of the logician of circumstances is stronger than logic of intentions, accident if she in accordance with the circumstances is fated to be not to stop any more. And now all means at power plants are focused only on decrease in consequences of already come true accident. But there is a question: Why in general to allow this accident when there is a logic of the prevention of circumstances, i.e. accidents?

By the way, all predictors and psychics use logic of the prevention of circumstances for a long time. Here both creation of planets, and zodiac signs, and national signs are considered. But if to predict natural accident quite difficult, to predict modern industrial accident - simply elementary. Why at power plants which treat category dangerous, especially nuclear power plants, the logic of the prevention of circumstances, namely accidents is not used? Yes because, nobody knows how to do it. And after all we have ready decisions for a long time.

Let's review an unpretentious example. There are three discrete parameters "A, B, C" which surely in a strict order should be switched on and off, and violation of this order causes an emergency. Tens of thousands of similar discrete parameters are concentrated on power plants, and to catch one, especially - some spontaneous incorrect operations, at first sight, very difficult issue which is not resolved by still large branch institutes. In this case, various shifts in the form of duplication, do not solve a problem on fast identification of this spontaneous, so, incorrect operation. But the fact of the prevention of an emergency, well and, therefore, accidents also depends on timely detection.

In this case very simple algorithm is offered. For detection of spontaneous operation it is not necessary to analyze all technological cut, i.e. a mutual condition of all parameters at all. It is quite enough to analyze

a condition only of adjacent parameters. If this state is correct, everything is normal, and otherwise, it is spontaneous operation, so, is an emergency. In this case it is meant that there are strict and accurate regulations of start and a stop, both separate sites of power plant, and power plant in general. And it actually is.

And now, we will return to our example and we will agree to designate: a, b, c - is switched off (an initial state); A, B, C - is included (a final state). Also we will describe in brackets of a condition of adjacent parameters at consecutive inclusion "a, b, c" for definition of their correctness: A(b); B(A,c); C(B). Everything is very simple! Now at switching off: A, B, C - is included (an initial state); a, b, c - is switched off (a final state). Also we will describe in brackets of a condition of adjacent parameters at consecutive switching off "A, B, C" upside-down for definition of their correctness: c(B); b(A, c); a(b).

Here is observed the interesting fact that conditions of adjacent parameters changes of concrete discrete parameter, absolutely identical at various directions. And now we will simulate spontaneous change of parameter "B" at all included and at all switched-off parameters. Conditions of adjacent parameters in this case in both options will be the following: b(A, C); B(a, c). As we see, in both cases there is no coincidence to a correct condition of adjacent parameters which correspond: b(A, c); B(A, c). Here also the emergency is revealed, so and accident is prevented!

Together with discrete parameters surely there are also analog parameters with the lower and top settings. In case of identification of an incorrect situation to the operator council or the instruction to action is given for BCP, or even the operating influence can be automatically made for preservation of a former situation. All this is easily described in meta language in text projects of problems of Smart-MES system.

Thus, there are two tasks: as it is instant among one hundred thousands potential indignations on the power unit instantly to reveal incorrect indignation and how to train system to carry out all these actions for recognition of an emergency. After all in this case realization which are used in the PCS, do not approach. Here the principle of neurodynamic programming of recognition of a dynamic image has to be used.

The analysis on a correctness of indignations simply looks as follows. There is the previous technological cut and current in which indignations or changes come to light. In the presence of this change it is checked for a correctness, for example, by the following already earlier told method.

If we consider the directed connected sequence of managing directors of parameters: A, B, C - that rule of a correctness of change for the B parameter will be the following:  $B = [A] \& [-C]$ , where: [A] - a set of the adjacent already involved parameters, [-C] - a set of not involved parameters adjacent yet. Here parameters are understood as any possible indignation.

Accident - spontaneous development of technological process at power plant contrary to will of the person which is directed on destructive activity. Accident always arises suddenly. Accident if arose, not to prevent it any more. In this case actions of the person are directed only on decrease in its consequences. Both the natural phenomena, and wear of the equipment, and a human factor can be a source of accident.

Before accident always there is an emergency which if in due time to find, it is possible and to prevent accident, so and to keep huge financial means of the Generation company. The emergency has the long period of the maturing. It develops gradually unlike the accident which already proceeds immediately.

It as a twig which you gradually bend. If you stop it bending, i.e. eliminate the reason of its bending, it will adopt the initial provision and will be same magnificent, as before. But if you do not eliminate the reason in time, the twig elementary, eventually, will break, and then it already as a twig simply is no good, and it is necessary to buy a new twig.

All 300 thermal power plants in Russia with huge wear of the equipment represent constructions from many thousands of bent twigs which are not in a steady state. Thus, to enough one twig to pass the side of a legal bend and all this design will instantly collapse. And it means that there was an accident of power plant to the human victims. In the dry rest from carelessness and short-sightedness of management - the Generation company is ruined, and the management in prison.

I can be objected that at us everything so is provided. On what I as the expert in nuclear and thermal power industry, I will tell that then there would be no accidents and on the Chernobyl NPP, and on Sayano-Shushenskaya hydroelectric power station, and other smaller accidents at power plants. Accident is such piece which can be, and can not be. In this case neither scheduled preventive maintenance of the equipment, nor experience of the operational personnel not a hindrance to accident emergence if she is fated to be owing to confluences of many circumstances.

For example: At power plant in one and too time various experts on various sites for various reasons independently from each other departed from regulations a little. In same it is a high time on several technological sites analog parameters strongly came nearer to inadmissible borders. And in the same time, as ill luck would have it, on several pipelines there were fistulas. Besides, the high-voltage wire for some reason broke. Here to you and emergency. If in time not to settle, everything will blaze. But after all all factors are separately quite admissible also anything terrible. Danger is constituted by set of these situations which cannot be controlled by the person since the Smart-MES system is for this purpose necessary.

Let's take, for example, pressure testing of the pipeline which becomes for determination of its readiness for a heating season. But after all irrespective of it shabby pipelines are broken off at the most inappropriate moment. And small accident can cause larger and already with the human victims. At power plants different branches of pipelines have the degree of wear, and, therefore, can sustain with guarantee only certain values of temperature and pressure. But to the person not in power constantly to control it.

On power plants of one thousand discrete parameters, signaling condition of latches and various switches. Yes, there are various circuit blocking. However, all operational personnel for some reason passes serious training on exercise machines and check on sanity. Therefore, protection against "fool" is not present. And differently, training on other technology why is necessary. After all each power plant from 300 - unique. But than that, apparently, it is simpler: the beginner sat down on BCP (block control panel) and began to move "levers", and Smart-MES politely prompts to it that it is necessary to do and in what sequence. Here that and

any fool will quickly learn to operate the most difficult equipment optimum.

Generally, the power plant is difficult dynamic object of very increased danger where the operational personnel is not protected in any way. Yes it cannot be also protected. For this purpose there has to be a guarantee of impossibility of accident. And only Smart-MES which is capable to reveal any emergency can provide this guarantee and in due time to warn about it for the subsequent its elimination.

Innovative Smart-MES in real time is capable to control both wear of the equipment, and value of settlement sizes TEP, and conditions of discrete parameters. But the most important that all this becomes in total. The main advantage of this system that all this is realized quickly and simply. At any time the personnel of power plant can elementary correct and increase analysis algorithms of an emergency.

For operation of Smart-MES special preparation since initially it was focused for technologists is almost not necessary. All system is developed from pressing of one button. At this moment text drafts of the analysis of emergencies are compiled in all components of system: menu, database, screen forms, reports, dll-programs, etc.

In a final type of Smart-MES, being advising, it is almost capable to carry out many repartitions from optimization of resources and forecasting of purchases of fuel to a complete elimination of an excessive consumption of fuel and the prevention of all emergencies, creating thereby other creative environment of functioning of power plant.

We are convinced that in Russia the safest nuclear reactor [57] under which "pan" for localization of consequences of accident is located [58]. Undoubtedly it is necessary, but as the extreme safety mechanism. Well, and where system of the guaranteed prevention of all emergencies?

All means for safety of the NPP can conditionally be divided on static (passive) and into dynamic (active). And so, on all NPPs in Russia only passive security aids which quietly are waiting in the wings are used to work at the right time. But under the law of meanness can not work. A striking example - accident in the Moscow subway [59].

Figuratively it can be compared to war where at passive protection the group sits in an entrenchment and waits when attack, and at active protection uses scouts that at attack in due time to leave aside and in general to avoid collision. In this case it is clear to all that the knowledge is always better than all situation in advance, than absence of information. And the Smart-MES system can provide it. Then there will be no situations with sudden stops of power units to which all Russian NPPs are subject.

In the letter No. 9/04/3100 of 08.07.2013 from JSC Rosenergoatom Concern it is told: "The concept of deeply echeloned protection based on use of system of physical barriers is applied to safety of the NPP. For timely detection of defects on the NPP the modern diagnostic aids allowing to prevent equipment failures and prevention of their development into accidents are used".

Why then nuclear power units suddenly stop if everything on the NPP is provided? Or after all in Rosatom not everything is all right? And how to make that there was everything as it is necessary, do not know even in YIP RAHN (Institute of problems of management of V. A. Trapeznikov the Russian Academy of Sciences).

Recently in Moscow passed the XII All-Russian meeting on problems of management (VSPU-2014) in YIP RAHN for which we prepared two reports: "Technology of the prevention of emergencies on nuclear power plants with use of MES-T2 2020 MES System and "The new concept of a self-adjustment of MES-T2 2020 MES System for management of any process production and power plants". Thus at a selection stage the first report was rejected, and the second was approved.

I did not know in the beginning how it is possible to disregard such important problem as safety of the NPP, and then understood that himself deals with this problem of YIP RAHN long ago and unsuccessfully, and competitors are not necessary to it. For VSPU-2014 scientists from YIP RAHN on subject of the NPP prepared three reports: "Evolution of the NPP PCS for VVER, problems, unresolved questions, new threats and the possible directions of development" [60], "Automation of nuclear power plants - YIP RAHN'S experience" [61] and "Integration of databases by development of systems of the top (block) level of industrial control system of the NPP" [62].



But in these reports words it is not told about possibility of creation of the accident-free NPPs. A little it is said in the first report about need of development of the NPP PCS of the fourth generation, and that technical means of the PCS modern programmatically do not suit for the NPP. It is also told that unification and reduction of the nomenclature of means and the software, increase of self-diagnostics of the PCS and its security, ensuring participation in the maneuverable modes is necessary for maintenance of frequency in a power supply system, ensuring cybersafety.

Here it is so healthy, it appears, cybersafety is very necessary, and nuclear safety, turns out, not really. Or YIP RAHN simply does not know how to come nearer to her. When "Rosatom" claims that on all NPPs with diagnostics everything is all right, and YIP RAHN declares the return, but without the specific proposals directed on increase in safety of the NPP, the conclusion arises only one that problems are.

In the summary to our report the following is told:

The firm of Information Systems suggests to look at a problem of safety of the NPP a little on the other hand, i.e. not since the end as now, and since beginning, or to consider not a final stage of an emergency when work protection, and an initial stage when this emergency just arises. Usually, when protection works, on initiative signals try to understand the emergency prime cause. But after all this prime cause can be revealed in advance, without bringing process to protection operation. Actually at once some emergency branches can arise, and anybody about it does not even suspect. When in any branch incorrect indignations gain critical weight, it and means that it would already be time for protection to work. But why it is necessary to keep the production, most difficult and dangerous to all people, in the constant internal suspense when it is possible to extinguish in general all arising incorrect indignations at their emergence. And it means that creation of critical mass of incorrectnesses in principle will not be possible, and, therefore, and protection will never work and the compelled stops of the power unit will not be, but there will be also no danger to the people in general.

In above the specified letter the director of production and operation of the NPP of "Rosenergoatom" declared that the accident risk makes 0,00001 in a year on the reactor. But this figure of probability of accidents is good only for constructive comparisons, but not for calm of the people.

Actually according to probability theory it sounds as follows. The probability of emergence of destructive failure of the nuclear power unit very small, but this accident can happen to radiation emissions at any time.

Therefore dynamic safety of the NPP on Smart-MES system which in real time looks through every second all situation on the power unit concerning both wear of the equipment, and false operation of automatic equipment, and the operator's mistakes is necessary. Thus, the system works in an advancing, constantly trying to discover all incorrectnesses, for their timely elimination.

Why Smart-MES system? Because its self-organization allows to modernize instantly in real time algorithms of diagnostics.

It would be time to pass to "Rosatom" to automatic control of nuclear power units on the NPP and to the Generation companies on state district power station and combined heat and power plant. It was historically most strictly forbidden to design computer-controlled power units. The argument was that at an emergency of people, got used to inaction, will not be able to interfere in due time for prevention of development of accident.

It is clear that then there was no our self-organizing Smart-MES, there was no our theory of accidents, there was no our algorithm of cognitive diagnostics of emergencies and it was not simple powerful computers. But now it everything is. All of us made for you and for you, dear nuclear scientists and power engineering specialists, for the modern NPPs and for "Rosatom", for modern state district power stations and combined heat and power plant and for the Ministry of Energy. Take, use our innovations which will make any power plants the best in the world and design the computer-controlled accident-free NPPs of power units.

But today's archaic BCP with systems of SIUR and SIUT look simply ridiculously. After all if suddenly work protection and the power unit for the unclear reasons stops, there is a question and where there was this operation personnel and why allowed a power unit stop? The answer is very simple. This personnel at accident is simply useless.

Actually the human factor only disturbs, and during the work of the NPP it is not necessary at all. All processes on the NPP computers on multiagency technology have to operate. And the dispatcher has to have only two buttons: to start and stop the power unit.

## **21. Accident is losing game of the Person with the Nature**

The theory of Games is a mathematical theory of conflict situations [63]. Conditionally, we will call a production activity of power plant game of the Person with the Nature. In this game each party wishes to win. The person, operating power plant, seeks to make at any cost the maximum profit for the Generation company through power generation and it is warm, without paying attention to Game of the opponent, i.e. Nature. And the Nature also wishes to prevail through wear of the equipment, a rusty of pipelines, various breakages, breakdowns in windings of transformers, spontaneous operations of the operating automatic equipment and a mistake of the Person.

In this game without Smart-MES the Person has no chances. Eventually, the Nature all the same wins and there is an accident. When it occurs, nobody knows. But if the Person does not use Smart-MES for a constant control over this conflict situation, it surely will occur. In this case scheduled preventive maintenance will not help - they, perhaps, is a little bit removed accident, but can it and approach.

Let's present, for example, a pipe. It constantly rusts, it rusts unevenly. But time it rusts constantly, so the size of possible maximum pressure in this pipe falls constantly. And if not to watch it, finally will break off it. And consequences of this accident depend on where it was established.

Let's consider how it can easily be controlled. Let's accept for the new pipeline:  $K=1$ , and for the maximum working pressure ( $P_m$ ):  $K_p = P_i / P_m \leq 1$  where - pressure in "i" put  $P_i$  after initial start of the pipeline. Let's accept also a condition of an accident-free situation:  $K * K_p \leq 1$ . And, "K" increases every day by size:  $1 / (S * 365)$ , where S - duration of service life advanced in years. It follows from this that in "i" day of operation of the pipeline admissible working pressure has to be the following:  $P_i = P_m / (1 + i / (S * 365))$ .

But times of a similar constant control are not present at one power plant, than bigger wear of the equipment, subjects probability of emergence of accidents of different degree only increases. Wear at many power plants

exceeds 50%, and they work at full capacity. Besides, even on nuclear power plants operation of the power units which fulfilled the planned resource lasts.

Yes, the commission draws the positive conclusion on extension. Yes, is not enough for the electric power and the people it is necessary to work somewhere. But the commission cannot know that becomes in pipes. And even their control can not reveal the defects which appeared over time. Even if there will be an accident on the NPP, all State will pay for it, but on thermal power plants accident will lead that in general to huge losses of Generation companies. Besides the new tendency of expansion of power plants perspective power units PGU especially demands a constant control over loadings of the outdated equipment.

The person in Game with the Nature always loses because the Nature has no concept pity, she cannot grease the palm, it does not accept kickbacks. She can only be outwitted a constant control over a situation and timely intervention for replacement of the outdated equipment. After all emergence of fistula on the pipeline is one of forms of manifestation of an initial stage of accident. But happens that carries all turbine with much bigger consequences, than during it to replace.

The nature in the theory of statistical decisions is considered as a certain uninterested instance which behavior is not known, but, in any case, does not contain an element of conscious counteraction to plans of the Person. However, in the conditions of uncertainty from the point of view of trouble-free optimum operation it is difficult for Person to make the reasonable decision for the maximum prize. For the description of an success of the applied strategy the concept of risk is entered into theories of decisions. In our case it is risk of accident. At calculation of the risk corresponding to each strategy in these conditions the general usefulness for the Person of this state of nature is considered. At a choice of optimum strategy in unknown conditions with known probabilities it is possible to use not only an average prize, but also average risk which, certainly, needs to be turned into a minimum.

Proceeding from three below the listed facts, I call into question absolute safety of all NPPs in Russia and abroad on which there is no accident-free technology on Smart-MES system.

I give these facts from the Internet and from the press who do not demand a denial.

First fact: "on June 7, 2013 at 19:45 the power unit No. 4 of the Leningrad NPP is stopped by operation of automatic equipment in the regular mode in compliance design algorithms. After clarification of the reasons of operation of automatic equipment the power of the power unit will be restored" [64]; "on June 9, 2013 at 02:10 the power unit No. 2 of the Balakovo NPP is switched-off from a network by operations of automatic equipment. Shutdown of the power unit happened in full accordance with design algorithm and production schedules of safe operation" [65].

Second fact: The main activities of VNIIAES [66] listed on the site do not provide work on accident-free technology on MES System at all. Except the PCS other Systems are not created.

Third fact: In AIF No. 23 5-11 of June, 2013 in the article "It Is Reliable, as a Wall" it is told: "Our nuclear scientists constructed the safest NPP in China. The Tianwan NPP which is considered one of the most reliable and safe nuclear power plants in the world" became one more object of national pride. But in this article words it is not told about accident-free technology on MES System since it there simply is not present.

Conclusion: Very deplorable picture turns out. We for the whole world say that we ahead of the planet of all on safety of the NPP, and a row right there nobody notices the developed accident-free technology on Smart-MES system and in an emphasis does not see. Here you only ponder in above the provided phrase: "After clarification of the reasons of operation of automatic equipment ..." It means that antiemergency protection suddenly worked, and nobody knows why. But protection according to the theory of probability can ever not work, despite duplication.

Also notice, for some reason in nuclear power in general emphasis is placed only on safety, but not on fail-safety. But same different approaches. Safety does not exclude accidents at all, and fail-safety in principle excludes any accidents. Well, and what it is more reliable and better?

Today's NPPs can be compared to the fancy car with one hundred safety cushions which do not guarantee against possibility of the accident. Yes, the person can be rescued, but the car will be rumped. Yes, and pillows can refuse. And now present a situation that safety cushions are not present in general since accident or collision in principle are not possible because of the advancing prevention, same it is certainly repeatedly safer for all.

Say to me that from a meteorite all the same not to escape. But so after all it is possible to reach marasmus since perish and from an icicle.

In this case all ingenious is simple, and the more simply, the better. Well, where it is even simpler if not to bring a situation to accident in general, and to extinguish all indignations at the time of their emergence. But they should be able to be revealed in due time, and just the Smart-MES system excellently is able to do it.

According to our theory of accidents, protection work at emergence of several indignations which uncontrolledly appear in various periods, and it can be also years, for example, metal corrosion. Once again I will put on it emphasis that one indignation never leads to protection operation, and, therefore, and to accident.

You only ponder upon an essence everywhere of the existing barbarous approach to test of outdated pipelines by method of pressure testing of a network of heat supply, i.e. for clarification of an unusable section of the pipe, it is pumped up an elevated pressure. And that turns out in practice. Test, for example, the kilometer site of the underground route, and there is a lot of rusty places. But breaks through always one weakest site. Break off a pipe, replace its small site, bury and again test. Then breaks through other site, well, etc.

And that it would seem more simply: to keep account of all sites of pipelines and under laws of physics and chemistry every month to reduce the maximum admissible pressure. If working pressure is more current maximum, it is necessary or to reduce working pressure, or to change all section of the pipe. Also notice, in this case two indignations work: corrosion of metal and pressure of the heat carrier.

On the NPP there can suddenly be hundreds of indignations: wear of the equipment, spontaneous operation of automatic equipment, wrong actions of operation personnel, short circuit and other natural indignations. Only the Smart-MES system can trace in due time behind all this variety.

In this case I how many do not call into question all progressive technical solutions of the modern NPPs. I say only about one that it is possible to make even better that it is already time to pass from blind protection of power units of the NPP to the intellectual prevention of emergencies on already ready Smart-MES system.

Here very strange picture turns out that nobody will tell that accidents it is an integral part of technology of nuclear and thermal power plants. None of tops of "Rosatom" will not make bold to declare that accidents on the NPP were and will always be since the wave of indignations right there will rise. But that in practice it also occurs. After all the fact of operation of antiemergency protection against destructive accident with huge emissions of deadly radiation is divided figuratively by a share of millimeters.

And what on Sayano-Shushenskaya hydroelectric power station accident could not be prevented? Yes, it is easy. But all of us for some reason better will heroically restore with use of huge public funds, than we will in advance a little think and will decide to introduce ready innovations.

After all accident in our life it not some exotic, but ordinary category with threshold irretrievable function. Let's tell, the person incidentally cut a finger. It too accident. Earlier everywhere taught safety measures. It is also the correct approach, but within the NPP strict observance by the personnel of regulations is not enough because of the most difficult technology. To the aid the intelligent mechanisms put in Smart-MES system have to be called.

It would seem that more simply, time from accidents not to get to anywhere, time accident is an integral part of any production, especially the NPP, it is necessary to diagnose development of an emergency simply in due time. Then all Russian NPPs will be not simply safe, and accident-free!

We on other formulated the questions connected with accident rate of the NPP and entered new concepts: internal and external accidents which were Russia, actually secret for all society.

In this case external (destructive) accident is followed by radioactive emissions, and internal accident on the NPP is characterized by operation of antiemergency protection and the emergency stop of the power unit. However, "Rosatom" never used the term "internal accident", applying the calming words of type: there was an unplanned stop of the power unit, automatic equipment worked in the regular mode, radiation level in norm.

But any sudden violation of a production cycle also is accident. In this case the size of this accident since for the NPP this any internal accident can develop into external accident with big tragedies is absolutely unimportant. This unsteady transition is blocked reliably by the multiecheloned protection. Then of that to be afraid? Why not to tell to the people the truth? That there was the next accident on the NPP, protection worked, and all can sleep peacefully so far.

After all at normal operation nuclear power plants do not constitute danger to the personnel, the population and environment. However emergencies (incidents) and accidents can influence safety of the NPP.

According to recommendations of IAEA for an importance assessment from the point of view of safety of the events occurring on nuclear installations and objects the International scale of nuclear events of INES [67] is used. She estimates all emergency events on nuclear objects on a 8-ball scale. Events are taken for zero level, insignificant for safety. Further levels 1 (anomaly), 2nd (incident), the 3rd follow (serious incident). Levels, starting with the fourth, are described as accident. the 4th is an accident without great risk outside a platform, the 5th - accident with risk outside a platform, the 6th - serious accident, the 7th - a major accident.

Thus, according to the glossary of "Rosatom": Accident on the NPP - breakdown of service of nuclear power plant at which there was an exit of radioactive materials for the borders provided by the project [68]. The term "Accident" is understood as the event connected with radiation consequences.



But here a word meaning "Accident" on Business to the dictionary: Failure, breakage, damage, failure, violation of a normal rhythm of work [69].

The strange picture turns out. For example, the rupture of the turbine on a thermal power plant is the largest accident, and on nuclear power plant it only incident (violation) and even not incident. Why such discrepancy? After all the same accident on Sayano-Shushenskaya hydroelectric power station claimed many lives. Why there are double standards in power industry for thermal power plant and the NPP? Everything is very simple. Probably, for decrease in intensity in society to have to tell sweet lie about the NPP.

In the Report on safety (2012) "Rosatom" writes: In 2011 on the NPP in Russia 45 violations are registered. All happened violations in work of the NPP are estimated on the International scale of nuclear events of INES, as the NPPs which are not influencing safety and not being incidents.

And if instead of 45 violations would sound - 45 internal accidents. These are 4-5 accidents on each NPP, i.e. every quarter on each of 10 NPPs on accident. Or in Russia every week on the NPP there are internal accidents. What would be food for "Green"! All this is equivalent as managed with the people at the Chernobyl accident which learned about everything in the latest turn, and for many it already was late.

It can be compared to the house apartments in which periodically flare up. And firemen of all calm that supposedly fire extinguishing systems are provided everywhere. But to inhabitants it is for some reason all the same disturbing. And it is simple to make that that apartments in principle did not flare up.

And on the NPP it is necessary to carry out that there were no internal accidents in general, then need for INES scale completely will disappear. After all if there are no internal accidents, therefore, there will be no destructive external accidents also. Then that the people really will be able to sleep peacefully.

And for this purpose there are all technical capabilities: both the Theory of accidents, and accident-free technology of operation of the NPP, and easily adaptable Smart-MES system, but is necessary political will of

the Leadership of Russia. After all it is not necessary for "Rosatom" as it absolutely does not have sense to change known technologies.

But "Rosatom", expanding construction of the NPP abroad, probably not up to the end considers mentality of that local population which considerably differs from us. It we can suffer for years adversities and we will not tell anything openly. And that local the population has no authorities, especially at counter-propaganda of the USA. The Ignalina NPP which was built with great dispatch by Russia and I including in Lithuania, closed, and nobody peeped. And if abroad on the NPPs which were constructed by Russia, the series of internal accidents begin, Russia will instantly lose the powerful market.

On the site of "Rosatom" the following is written: The NPPs of the Russian Federation are operated reliably and safely that is confirmed by results of regular checks, both independent bodies (Rostekhnadzor), and the international organizations (VAO NPP, etc.). Over the last 5 years on the Russian NPPs it is not recorded any serious violation of safety classified above zero (minimum) level by the international scale of INES. By criterion of reliability of work of the NPP Russia came to the second place in the world among the countries with the developed nuclear power, having outstripped such developed states as the USA, Great Britain and Germany.

But here a small ill luck - it is not specified, and who on the first that a place? Also it appears is Japan. Here so paradox! The country where the most reliable NPPs, now forever there will be with a label "Fukushima". It says only about one that all these notorious criteria of reliability of work of the NPP are in practice the complete fiction and self-complacency.

Whether but imaginary criteria of reliability which do not bear any responsibility are necessary to society? It is quite obvious that society needs only accident-free technologies. And in this case there should not be a place to corporate interests and bureaucracy, namely it and is observed in "Rosatom" where already on a threshold the accident-free technologies offered by us on the basis of the newest Theory of accidents created in Information Systems are swept aside.

The video "The Atom Horizons of August 31, 2013" [70] in which with aplomb is narrated about new technology of rejuvenation of the NPP is distributed in the Internet. But if is more concrete, this technology

concerns rejuvenation of the case of the reactor of the NPP by method of its annealing. This rejuvenation allows to prolong a metal resource from 30 to 100 years. In the same place it is told that all NPPs working in Russia - station of the first and second generation. The majority of them will reach the design resource soon. Therefore, in 2016 the Kurchatov institute will start rejuvenation of the NPP.

Everything is seemingly healthy and remarkable! New power units of the NPP it is not necessary to build. It is quite enough to rejuvenate the old. But the NPP - same not only the reactor, and generally - people who involuntarily become hostages of this rejuvenation.

It is equivalent as established to the aged man instead of worn-out heart new from the young donor. It is possible of course for advertizing for knocking-out of huge public financing to proclaim that the aged man was rejuvenated and to it active life for 100 years is prolonged. But it is clear to all that, how many it is taken away by the nature, he is so much and will live. After all except heart there are still vessels hammered with cholesterol, there are smoked lungs, there is a liver poisoned with alcohol and it is a lot of still that is the grown old.

And at power plant there is a huge mass of pipelines and other production equipment which wears out even before the reactor. And the production technology of the electric power and heat becomes outdated. After all for some reason the decrepit and emergency house is preferred to be taken down and build new with use of the latest technologies and materials. And this rejuvenation of reactors at one-sided approach focuses in nuclear branch in general to freeze progress for many years.

But in this case the probability of increase in number of emergencies which can lead, eventually, and to destructive accident with radiation emissions sharply increases. After all besides the reactor there is a radiation first contour of heat exchange. And simple people who from benefits of the NPP have nothing except a headache, have to be for some reason involuntarily involved to the sphere of terrible potential infection? But here the priority of the person as always costs on the last place, and has to be on the first.

After all if State award is awarded by the Russian Federation to founders of materials for nuclear reactors and for methods of extension of

terms of their operation, for some reason our accident-free technology of operation of the NPP which allows to exclude in general any emergencies, is in the sheer shelter. Can because it infringes on many corporate interests since need and for these materials, and for technology of extension of term of operation, and for a catcher of the melted radioactive fuel completely disappears.

All today's safety of the NPP is directed on prevention of hit of radiation materials in environment at emergence of an emergency. For this purpose also especially strong technologies are created. But if to exclude in general possibility of emergence of any emergencies, and, therefore, and different overloads then will worry there is nothing. And society will perceive in a different way the NPP.

But on the other hand extension of service life of the reactor same noble and favorable cause. And here the personnel of the NPP in this case should not be endangered. For this purpose it is necessary to control simply constantly process of emergence of an emergency therefore there should not be an operation of antiemergency protection at all. Therefore the NPP has to be accident-free.

Thus, process of extension of service life of the NPP has to be not only from rejuvenation of the reactor, but also from continuous diagnostics of all incorrectnesses on the NPP according to our Theory of accidents and the developed technology of accident-free operation of the NPP on Smart-MES.

After all that our system regarding the easiest adaptation to any power plant and regarding the highest speed of calculation for instant identification of incorrect indignation is able, is not able any system in the world. And it means that all nuclear power plants have no 100% of protection against emergence of emergencies at any time which can arise and from wear of the equipment, and from false operation of automatic equipment, and from the operator's mistakes.

But it says only about one that at such indifferent relation to a problem of the prevention of emergencies from "Rosatom" and from the Country leaders in general, says only about one that all forgot lessons of Chernobyl at all. Therefore I will remind [71].

In the night of April 26, 1986 on the fourth block of the Chernobyl NPP (Ukraine) there was the largest nuclear accident in the world, to partial destruction of an active zone of the reactor and an exit of splinters of division out of zone limits. 190 tons of radioactive materials were released into the atmosphere. 8 of 140 tons of radioactive fuel of the reactor appeared in air. Other dangerous substances continued to leave the reactor as a result of the fire lasting nearly two weeks. People in Chernobyl underwent radiation by 90 times bigger, than when falling a bomb to Hiroshima. Accident was resulted by radioactive infection in a radius of 30 km. The territory of 160 thousand square kilometers is polluted. The northern part of Ukraine, Belarus and the West of Russia suffered. 19 Russian regions with the territory of nearly 60 thousand square kilometers and with the population 2,6 million people underwent radiation pollution.

According to the most conservative estimates, the cost of elimination of consequences of accident on the CNPP cost to the Soviet Union over 300 billion dollars. According to the estimates of the government of Belarus, by 2016 expenses on elimination of consequences of Chernobyl will reach 235 billion dollars. The institute of Research and Development and Power (the former USSR) counted that the price of Chernobyl will be 358 billion dollars. The institute noted that this figure exceeds the cost of all nuclear energy developed in the USSR till 1986.

Yes, one accident crossed out economy of all nuclear industry. Is it better to spend a trifle for introduction of Smart-MES system, than to lose everything at always possible destructive accident.

But here Accidents which were only in 2013 in a chronological order.

**10.01.13.** Romanian NPP; **12.01.13.** Pavlodar CHPP-3; **12.01.13.** Kola NPP; **18.01.13.** Rostov NPP; **21.01.13.** Kalinin NPP; **14.02.13.** Rostov NPP; **25.02.13.** Pakistani HUBCO; **29.03.13.** Ugegorsk thermal power plant; **05.04.13.** Balakovo NPP; **07.06.13.** Leningrad NPP; **09.06.13.** Balakovo NPP; **24.06.13.** French NPP; **05.07.13.** South Korean NPP; **04.08.13.** NPP of Alabama of the USA; **06.08.13.** NPP of the Czech Republic; **11.09.13.** Leningrad NPP; **29.09.13.** Beloyarsk NPP; **26.10.13.** Ukrainian NPP; **26.10.13.** Slovenian NPP; **12.11.13.** American NPP; **24.11.13.** Kola NPP; **25.11.13.** Kalinin NPP; **10.12.13.** Kursk NPP.

We see that accidents, as if they did not call official structures, happen and will occur further, serious measures for the prevention of emergencies on the NPP and on thermal power plant will not be taken yet.

It is possible to draw one more unfavourable conclusion that the state nuclear and thermal electrical power branches regarding the modern prevention of emergencies is in all corners of the world at the backward level.

From outside very ridiculously to observe this world behind the looking-glass of the top management of Great Russia. He proclaimed the major directions for financing of projects: nuclear power industry, safety, energy efficiency, information technologies. And here we at all levels offer the innovative complex Project in these directions which besides is already developed for 100% without state financing. But the Ministries send us to venture funds supposedly there wander with a cap in hand. And after all financing is not necessary for us, we need only recognition.

And the most important that and close is not present similar development in huge granaries of the immense Homeland. So, accident-free technology of operation of the NPP is something in general magnificent which changes all existing views of nuclear safety at all. And the technology of creation of the self-organizing IT Systems would allow Russia to occupy in general world leadership in industrial IT. But also the technology of economy of fuel of thermal power plant also is in general the latest approach to economy of energy resources.

## **22. Smart-MES as virtual Model of any power plant**

Firm InformSystem developed innovative Smart-MES "MES-T2 2020" System for realization of technology of economy of fuel and for increase in energy efficiency of thermal power plants and which is virtual Model of combined heat and power plant, state district power station and the NPP.

The virtual Model does not set as the purpose simply to display real resources of power plant in program objects. Its purpose is wider: to create the virtual environment of the typified objects (package boilers, turbine units and others), manipulating with which, it is possible to make management of real objects of much more effective. Thus, the binding of business processes to virtual objects gives flexibility in a manipulation resources of power plant.

Therefore, automation on the basis of virtual Model assumes creation of virtual space in which standard objects of power plant and standard operations over them are presented. The scheme of automation reflects the standard scheme which is most fully answering to specifics of concrete power plant. But it does not depend on a reality of the objects involved in electricity generation and is warm.

In the elementary look it is possible to get acquainted with virtual Model by means of the Founder of System. So on a form in separate lines on power and to boilers, and on turbine units its brand and station number are specified for each unit of equipment. After that the button is pressed and in some seconds you receive completely ready System adapted for concrete power plant. This System allows to make minute, half-hour, daily and monthly calculations of the actual and standard TEP in real time with automatic or with manual input of basic data.

The main innovative features of the received virtual Model of power plant are the easiest adaptability and the highest speed of performance of calculations. With huge confidence it is possible to tell that adaptability is easier, as well as to realize the speed of calculations simply not perhaps quicker. Here we reached an extremum of improbable tops, to subdue

which we managed only. All foreign development of this plan is much worse on the realization.

Why it is necessary over the easiest adaptability? All technological tasks are made out on simple META language in the form of text Projects which by means of the built-in tool means "the Designer of Projects" the Technologist without programmers and without special knowledge can easily correct or create new without restrictions. The prepared Projects, when pressing one button, are compiled. As a result, all changes or new tasks are automatically built in created or the existing System, providing its reliable functioning.

But if new changes in algorithms of tasks so easily and without damage of reliability are realized, it means that the virtual Model will always strictly correspond to the actual technology at power plant, and, therefore, and will bring the greatest economic benefit.

Why it is necessary over the highest speed? The general calculation of all actual and standard TEP including 20000 initial and intermediate indicators is carried out less than one second. Therefore on this Virtual Model it is possible to calculate in only one minute prior to 100 various technological configurations and to choose the most optimum option from a position of economy of fuel.

Basic provisions and the principles of the virtual Smart-MES Model are given below.

### **Basic provisions of the concept of the Virtual Model (VM).**

1. VM - as the technological scheme. The virtual Model of power plant is the system of program elements (objects) reflecting standard technology of works within concrete power plant. VM, in fact, enters the new level of management of power plant based on information technologies of management.

2. VM - as the instrument of automation. VM is created by business analysts, as the instrument of optimization of process of automation of this power plant.



3. VM - as the scheme of the account. Operations over virtual objects allow to present all life cycle of real objects: planning, creation, use, reconstruction, repair.

4. VM - as model of effective management. VM as Model describes all business processes of power plant, from the point of view of automation of information streams which are a basis of management of these business processes.

5. VM - as means of optimization. The manipulation virtual objects means, eventually, management of real resources of power plant, only indirectly. But this distance also allows to count options of life cycle of power plant and to compare these options among themselves, in search of optimum option.

### **Basic principles of Virtual Model.**

1. Principle of information sufficiency. At total absence of information on concrete power plant creation of its Model is impossible. There is some critical level of aprioristic data on calculations of the actual and standard TEP (level of information sufficiency) at which achievement its adequate Model can be constructed.

2. Principle of feasibility. The virtual Model provides achievement of a goal of research with probability, significantly different from zero, and for final time.

3. Principle of plurality of models. This principle is key. It is that the Model reflects first of all those properties of real power plant which influence the chosen efficiency indicator. Respectively, when using any concrete Model only some parties of reality are learned. A number of the Models allowing from the different parties is necessary for its fuller research and with different degree of detail to reflect the considered process. For example: Calculation of the actual and standard TEP, Prevention of emergencies, etc.

4. Principle of aggregation. In most cases the power plant can be presented consisting of units for which adequate mathematical description there are suitable some standard mathematical schemes. The principle of

aggregation allows to reconstruct, besides, rather flexibly Model depending on research problems.

5. Principle of parametrization. In some cases the modelled power plant incorporates some rather isolated subsystems which are characterized by a certain parameter, including vector. Such subsystems can be replaced in Model with the corresponding numerical sizes, but not to describe process of their functioning. If necessary dependence of values of these sizes on a situation can be set in the form of the table, the schedule or analytical expression (formula). The principle of parametrization allows to reduce the volume and duration of modeling.

Thus, the Smart-MES System as virtual Model of power plant this latest word in information technologies which can bring all power industry of Russia to the advanced positions and makes it more attractive to investors.

### ***Innovative Model of power plants***

The innovative Model of functioning of a thermal power plant simply looks as follows:

Fuel Fact → Steam → Electric power → Fuel Norm

In this case, innovation is that in real time no more than half an hour pays off with an interval standard fuel which is compared to the actual. It never was, and now is not present on one thermal power plant in Russia. The actual fuel consumption on each time interval is always more or is equal to a standard cost. The problem of functioning of this Innovative Model consists in that on each time interval the actual fuel consumption was close to the standard. In this case the most optimum option of receiving the maximum profit by the Generation companies due to big economy of fuel will be reached.

Here the solution of a question of optimization of loading of the equipment expands possibilities of this Model only a few, but in any way it does not substitute. Now on thermal power plants the steady following situation is observed. In the afternoon at the maximum loading of the equipment the actual fuel consumption is close to standard, and at night at

the lowered loading the actual expense exceeds standard more than for 30%. Thus, at night power efficiency of power plants sharply falls.

Say to us that it occurs because of 10 ton coppers. But there is a simple concept - management with an advancing, i.e. considering a big lag effect of power coppers, it is necessary to reduce their loading slightly earlier, than the need for the electric power will fall. All this can be made easily only by means of Smart-MES System.

The mathematical Model of power plant represents full calculations of the actual and standard technical and economic indicators (TEP) which expeditious half-hour calculations of a standard cost of fuel are result. In this case management of power plant looks as follows. At the end of each half an hour the actual fuel consumption and standard is known. Further management at excess of the actual expense over the standard is directed on elimination of this divergence at implementation of the schedule of delivery of the electric power and heat. But in the same way this analysis can be made and with an interval one minute. Then the delay of the operating influence will be minimum.

All this is realized quickly by easily adaptive and high-speed Smart-MES which contains a big set of analytical, optimizing and intelligent convenient tools.

We are asked often, what supposedly what Model at you is realized? But the concept "Model" - very wide, i.e. from physical designing to a mathematical formulation. Therefore the matter is simply illiterate and smells slightly of pompous academism, at the heart of which - emptiness. In this case our answer is simple - we in general have no Model. But on other end of a wire bewilderment with insanity is at once felt. How it is possible to automate calculations of TEP of power plant, without having Model? And all our further reasonings concerning the Self-organizing System in general sink in the abyss of dense misunderstanding of elementary messages concerning the text description of Projects of technological tasks.

Many, it is natural, severe and with huge indignation are indignant that supposedly why to invent the bicycle when at all power plants there is long ago an automated workplace of PTO which perfectly counts TEP. And, in this case, it is absolutely unimportant that these monthly

calculations of standard TEP in a root are methodologically not right. Also they are not faithful because of curvilinearity of a set of standard schedules. And it is absolutely unimportant that these monthly calculations of TEP are is easy and everywhere adjusted that the standard cost of fuel was equal to the actual expense. And it is absolutely unimportant that this automated workplace of PTO does not make absolutely any profit for the Generation companies but only misleads that provides the distorted picture about imaginary wellbeing of power plant.

But after all always better bitter, but truth! And unless it is bad if the operational personnel in real time has comparative current information on the actual and standard cost of fuel that with open eyes not to squander it thriftlessly?

In modern market conditions for the Generation companies this Innovative Model of functioning of power plants is the best exit quickly to correct the financial state without any capital expenditure.

### ***Modeling of process of an excessive consumption of fuel***

The thermal power plant develops the electric power and heat power according to the schedule of their delivery. This process the operational personnel operates. Thus, the developed electric power (E) and heat (Q) are functions from time.

$$E = e(t); Q = q(t); \text{ where } t - \text{time interval (minute, half an hour)}$$

Actual (Bfakt) and standard (Bnorm) fuel consumption depend on necessary power generation and heat. And, the actual fuel consumption in addition includes also a human factor of  $H = h(t)$  which is also function from time.

$$B_{\text{fakt}} = F_f [E, Q, H] = F_f [e(t), q(t), h(t)]$$

$$B_{\text{norm}} = F_n [E, Q] = F_n [e(t), q(t)]$$

The excessive consumption of fuel is a difference between actual and standard fuel consumption.

$$B_{\text{per}} = B_{\text{fakt}} - B_{\text{norm}} = F_f [e(t), q(t), h(t)] - F_n [e(t), q(t)]$$

The total excessive consumption of fuel on a monthly interval is defined by integral calculus.

$$B_{per \ m} = \text{INTEGRAL} \{ F_f [e(t), q(t), h(t)] - F_n [e(t), q(t)] \} dt \text{ or}$$

$$B_{per \ m} = \text{INTEGRAL} \{ F_f [e(t), q(t), h(t)] \} dt - \text{INTEGRAL} \{ F_n [e(t), q(t)] \} dt$$

Now we will consider two extreme options of the actual fuel consumption at the maximum and minimum loading of power plant. At the maximum loading of power plant the actual fuel consumption corresponds standard since in this case there is strictly regulated mode of the maximum loading of coppers and turbines with known fuel consumption. At the minimum loading of power plant the range of possible options of fuel consumption which completely depends on the human factor operated by loading of the equipment considerably extends.

If at the maximum loading of the equipment the actual fuel consumption is equal standard, therefore, the excessive consumption of fuel is equal to zero at total absence of influence of a human factor.

$$B_{per} = B_{fakt} - B_{norm} = F_f [e(t), q(t), 0] - F_n [e(t), q(t)] = 0$$

Then under these conditions it is safely possible to write down:

$$F_f [e(t), q(t), 0] = F_n [e(t), q(t)]$$

But the human factor reflects only subjectivity of a choice of technological management and does not influence algorithm of calculation of TEP. Thus, follows:

$$F_f [e(t), q(t), 0] = F_n [e(t), q(t)] = F [e(t), q(t)]$$

And the excessive consumption of fuel looks so:

$$B_{per} = B_{fakt} - B_{norm} = F [e(t), q(t), h(t)] - F [e(t), q(t)]$$

And now we will ask a question: whether the negative excessive consumption of fuel or in other words - economy of fuel is possible in principle?

$$F [e(t), q(t), h(t)] < F [e(t), q(t)] ???$$

Any sane certainly will tell according to dependence that it cannot be since the human factor negative cannot be, and all other components of functions identical.

Thus:

$$F [e (t), q (t), h (t)] > F [e (t), q (t)]$$

Therefore, at loading of power plant it is less maximum always there is an excessive consumption of fuel.

$$B_{per} = B_{fakt} - B_{norm} = F_f [e (t), q (t), h (t)] - F_n [e (t), q (t)] > 0$$

The natural conclusion arises: to minimize an excessive consumption of fuel, it is necessary to minimize influence of a human factor, i.e. as much as possible to narrow the range of the decisions on fuel consumption made by it. Now in the estimated range of people for a choice uses the natural normal probabilistic law of distribution. If approximately to tell, the person intuitively chooses the middle of range which size is known to nobody.

It follows from this that at night at smaller loading of power plant in everyone half an hour always occurs a bigger excessive consumption of fuel, than in the afternoon for same half an hour when loading increases. And in this case does not play at all a role of qualification of the operational personnel since it regarding the current excessive consumption of fuel operates power plant simply blindly.

Let's tell, you go to shop and always pay for goods so much, how many it costs. And now present that goes to shop blind and it does not see, how many money it gives to the seller. If you give the smaller sum, than the goods price, the seller, naturally, will tell you that it is not enough. If you give a large sum, the roguish seller will not tell about it, and will simply give you goods, and a difference will put to himself in a pocket.

The thermal power plant looks regarding fuel consumption by simply bewitched swindler with the strange principle now - neither itself and nor to people. Not only that it impudently it is also useless takes away a difference of excessive fuel, but also the price in the form of a standard cost of fuel is not known in advance. And she does not fill the pocket with this

difference of fuel, and simply releases into the atmosphere, it polluting. Well, and the generation company meanwhile loses a half of profit.

Why with this state of affairs still the cleverest management of the generation companies should be measured? Yes because it is impossible to embrace the immense. Yes because it is brought up in constant lie about absence on thermal power plants of a huge excessive consumption of fuel. And in it the fault both on the MINISTRY OF ENERGY of the Russian Federation and on branch science which are now deaf and blind completely lies.

The order of the Government of the Russian Federation of December 27, 2010 No. 2446-r approved the State program of the Russian Federation "Energy saving and increase of power efficiency for the period till 2020" which executive is the Ministry of Energy of the Russian Federation. But in the subprogramme "Energy saving and increase of power efficiency in power industry" is not present even a hint about need of the operational accounting of an excessive consumption of fuel.

And after all the Technology of increase in energy efficiency of power plants offered by us allows to cut almost without expenses and quickly fuel consumption on all thermal power plants for 10% and, therefore, on as much to reduce harmful emissions in the atmosphere.

The letter No. 13 on this matter is sent of 22.01.2011 by us to the Minister of Energy of the Russian Federation Shmatko S. I. Rezultat, naturally, will be zero. Here such modernization in our country... Clever people advise us: look for investors abroad. But investments that are not necessary to us. The most up-to-date Technology is already developed by us, innovative Smart-MES is already developed by us for any power plant of OGK and TGC. We are ready to fast practical realization!

### ***Mathematical Model of power plant***

We made the unexpected conclusion that the Smart-MES System developed by us is universal mathematical Model of any Power plant. And this mathematical Model uses the principles of "a black box" and the Cartesian system of coordinates.

The power plant, from the point of view of mathematical Model, represents "a black box" with entrances: fuel, water, and with exits: electric power, heat. The power plant includes coppers and turbines which also represent "black boxes" with the entrances and exits. Thus, the Mathematical Model of Power plant consists of set of the interconnected "black boxes". By the principle of "a black box" we are not interested in the difficult dynamic processes happening in it, and interest only entrances, exits and dependences between them.

The mathematical Model of Power plant of Smart-MES coordinates "black boxes" of the same equipment in groups in the Cartesian system of coordinates where on abscissa axis these settle down "black boxes" or objects, and on ordinate axis entrance and output technological indicators. It gives the chance in META the description of dependences between indicators their single use for all objects that sharply simplifies control of mathematical Model for concrete Power plant. Designation of an indicator consists of coordinates of Y and X. It allows to operate easily with calculations in the Cartesian system of coordinates.

Storage of all technological indicators is carried out in a uniform information database for different time intervals: minute, half an hour, days, month. Joining various group "black boxes" is carried out through the same information database.

The mathematical Model of Power plant consists of two parts: static and dynamic. The static part is a Wednesday in which the mathematical Model is formed and functions. The dynamic part is text META the description of dependences of indicators which gives rise to life of mathematical Model by means of compilation.

The mathematical Model of Power plant of Smart-MES with ease allows the modification and unlimited development without modification of static part. It is enough to correct the text description and to execute compilation. All mathematical Model in this case will be modified without loss of technological information.

The mathematical Model of Power plant of Smart-MES allows to conduct quickly calculations of TEP for the purpose of increase in energy efficiency with use of optimization of resources, to accompany tests of the equipment and to carry out tasks of the prevention of emergencies. This



mathematical Model also with success can be used at the level of TGC and OGK.

### ***Dynamic Model of power plant***

The model of power plant is the set of mathematical formulas reflecting technological process from an entrance (fuel) to an exit (thermal and electric energy). The Model is more exact, i.e. the more technology factors (loss, expenses on own needs) it considers, the better it reflects real production.

The dynamic Model has to consider all technological changes quickly.

Now present that these changes are realized automatically the System. Then it is possible to speak about self-organization and about self-learning ability.

Certainly, it is a fantasy! But this fantasy at desire of OGK and TGC on Smart-MES System can easily be realized.

It is possible to approve it with big confidence, proceeding from design features of Smart-MES which includes two elements: static part - the empty executive module (Designer ARM program) and dynamic part - the text description of tasks in the form of Projects. All System is automatically adjusted from these text Projects.

Now, by means of feedback having automatically made change to the text of the Project and having performed automatic tuning, this change will be made to DLL programs of calculation. Here to you and the self-trained Model.

Than the Model of power plant, subjects is more dynamic it reflects technological, so and economic components more precisely.

Expeditious forecasting and planning by means of dynamic Model on Smart-MES System will provide to power plants the best economic indicators in comparison with other static systems.

Here only some KNOW-HOW of Innovative Smart-MES System:

- 1) The description of ARMs (a set of technological tasks) on simple human META language of the 4th generation in the form of the text Project;
- 2) Automatic control of all System of calculations from the text Project;
- 3) Automatic creation of settlement DLL programs;
- 4) Automatic control of operation of application the Client/server on 3-unit structure with any SQL Server.

## **23. A paradigm of the Self-organizing innovative Smart-MES**

Self-organization is understood as the irreversible process bringing in result of cooperative interaction of subsystems to formation of more effective structures from a position of computer system. Use of a phenomenon of self-organization is a necessary condition of maintenance of competitiveness of system and creation of new competitive advantages. The phenomenon of self-organization of our system is the unusual phenomenon and very rare fact, i.e. it that it is difficult to comprehend.

Thus, ability of IT systems to complicate own structure is called as self-organization. The firm of Information Systems developed revolutionary technology of creation of such self-organizing IT systems which can be used for development of systems of any level: ERP, MES, SCADA.

Self-organization introduces new quality in system. For example, Smart-MES as a result of self-organization can easily calculate 1000 tasks from 500000 indicators for only 10 sec. The same quantity of tasks without self-organization will pay off about two hours, i.e. somewhere by 500 times more long.

The self-organizing Smart-MES system represents self-organization of the second degree. But it is possible to create self-organization and the third degree, it when the multiagentny system consists of the self-organizing systems of the second degree. Here the first degree makes self-adjustment and the easiest adaptability, the second degree provides the greatest speed of calculations, the third - allows independent functioning of system without participation of the person.

However, the science "Synergetics" claims that the self-organizing IT systems in the nature cannot be since the self-organization paradigm has no relation to IT. But IT and scientists declare long ago that the future behind the self-organizing systems. Here it is only not clear, why future? What there will be other element IT base or brains at IT developers will be much better?

There is such impression that IT and scientists saw enough of the western software which always was in huge authority, and draw this strange conclusion about a self-organization inaccessibility in IT. And already created self-organizing Smart-MES system is not allowed to practical use not to destroy the myth about impossibility of this self-organization. To whom is it favorable? It is clear that to IT monopolists. After all if to give to this system life, it will quickly patch a set of holes, and to monopolists it will be very sad due to the lack of a bottomless feeding trough.

And now about a self-organization paradigm. To be fair it is necessary to notice that in self-organization this "egoism" is not present and there cannot be it it is simple a word-play. Self-organization is only that development happens in a bifurcation point - and subjectively it seems that it. Though at it constantly there are objective processes. Thus, in the nature no self-organization is present, as well as there are no others, and there is a process of communication with disappearance of one and the birth of other phenomenon. But conditionally it is called - self-organization.

By G. Haken's [6] definition, self-organization - spontaneous formation of the high-ordered structures from germs or even chaos, spontaneous transition from the disorder state to ordered due to joint, cooperative (synchronous) action of many subsystems. Self-organization acts as a source of evolution of systems as it serves as the beginning of process of emergence of qualitatively new and more difficult structures in development of system.

And now the same words in relation to Smart-MES. Self-organization of system - "spontaneous" formation of the high-ordered structures of a machine code from the text disorder description of tasks due to joint action of many subsystems of the EXE module. Self-organization of Smart-MES acts as a source of evolution of system as it serves as the beginning of process of emergence of qualitatively new and more difficult structures in development of system that provides the easiest adaptability and the highest speed of calculations.

As we see, practically too most. Thus, I easily applied the general principles of self-organization to our IT system. After all if in the nature there is no self-organization, and there is a convention meaning a certain

development, I am quite free to apply this term to IT system especially as the uniform judgment among scientists about this self-organization in general is not present.

On the other hand, there is a developed Smart-MES system. But how shortly to characterize its opportunities? For this purpose there has to be the corresponding thesaurus, and its that just and is not present, since our system in this class - only. All concepts: plug-and-play, self-adaptable, self-configured, self-checked, self-restored, self-scaled - are incomplete reflection of possibility of system. For this reason the term "Self-organizing System" especially as at superficial comparison with a self-organization paradigm, is much in common is also entered.

Achievements of Russia entirely depend on new technologies, on their modeling and forecasting both on the scale of the separate enterprise, and on the scale of all Russia. And all this to well self-organizing Smart-MES system.

But it cannot quickly be checked, and to believe very difficult because of the settled mentality of neglect to domestic IT development. But this situation all the same will ever change.

Smart-MES is manufacturing execution system which connects together all business processes with productions of the enterprise, quickly providing objective and detailed information to the management of the company. The methodology of creation of Smart-MES is focused on easy realization of any algorithms in any quantity without programmers. It contains full set of modern opportunities. It both text projects of technological tasks, and self-adjustment of all system, and self-organization according to the current context, both analytics, and graphics, and optimization. And all this is possible in any configuration the client server.

The Smart-MES system is initially not focused on the solution of any specific objectives, but in it all prerequisites for future concrete realization are put in the form of the EXE module. The EXE module gains ability to solve specific objectives, being trained for some seconds. The EXE module includes means of control and means of functioning by results of this control [1].

Control is carried out in the course of transformation of text projects of tasks which structure very simple and consists of the description of columns and lines of the table. One table corresponds to one task with a set of algorithms of calculation with a screen form and the report.

At compilation of projects all databases, screen forms, settlement DLL programs, reports are automatically created. In order that the system was adapted and could function at concrete power plant, except the EXE module and text projects of anything else it is not necessary. If in the course of functioning of system it is necessary to make change or addition, the text project is corrected and compilation on the functioning system is started. In this case all changes will rise on the places without loss of the current technological information. The special advantage of this technology also that it provides absolute program reliability at any amount of the realized technological algorithms of calculation for any production.

The system conditionally consists of basis and a superstructure. The basis is an executive EXE module which has no technological stuffing. The superstructure is text projects of technological tasks. The basis is always invariable since is the developer's prerogative. The superstructure is subject to continuous changes and is a prerogative of technologists for development of production tasks. Text projects of technological tasks define area of their use and provide real functioning of the EXE module.

The concept of self-organization of the developed Smart-MES system for many years advances modern outlook of creation of other MES systems.

The technology of creation of the self-organizing IT systems surely has to include five stages:

- 1) translation of a problem definition into the technologist's meta language;
- 2) transformation of meta language on macrolanguage (self-adjustment);
- 3) transformation of all tasks on macrolanguage in one task (self-organization);
- 4) transformation of a uniform task on a programming language;
- 5) transformation of a programming language to the resulting machine code.

The first stage occurs with the assistance of the person, and all others are carried out automatically. Further is more detailed about each stage.

1) Translation of a problem definition into the technologist's meta language.

In this case tool means (The designer of text projects) for operating by templates for the purpose of the maximum simplification of a set of algorithms of technological tasks which are presented in the tabular form is used. For example: columns designate types of the equipment and a result, and lines - indicators.

2) Transformation of meta language on macrolanguage.

This stage makes full self-adjustment of system. As a result all elements are automatically formed: databases, reference books, the menu of tasks, screen forms, calculations on macrolanguage and reports. This stage is necessary for debugging of algorithms in the interpretation mode since at the subsequent stages she is not possible. Here to each cage of a screen form the algorithm of calculation of this indicator is put in compliance.

3) Transformation of all tasks on macrolanguage in one task.

This stage makes self-organization of system. All tables of separate tasks in a special way connect in one big table to reformatting of addressing in all algorithms of calculation of indicators, creating one general task with the most difficult structure.

4) Transformation of a uniform task on a programming language.

During this transformation all multiple recursions therefore process of full calculation happens for one pass from top to down are liquidated. At this stage as a programming language there can be any language: Pascal, C, etc. In Smart-MES system Pascal is used.

5) Transformation of a programming language to the resulting machine code.

Here the corresponding translator from the used programming language is used. As a result the program DLL which is used as an application server turns out.

Ignoring of any of the listed stages will not yield desirable result of true self-organization of system with possibility of adaptation for concrete production and high speed of calculations.

Two unique languages of the top and lower levels of system are necessary for realization of the self-organizing system. Language of the top level, or engineering meta language, is necessary for technologists for a formulation of algorithm of a task. It is most approached to a natural language. Language of the lower level, or macrolanguage, is necessary for interpretative debugging of algorithms.

In addition to the self-organizing system the dispatcher of a context who will constantly analyze the current production context can be used and in case of need will automatically make changes to text projects of technological tasks, i.e. will execute the first stage and will start self-organization of all system. So the system will start adapting for all changes without participation of the person.

But if the separate self-organizing systems to present these as agents with an interconnection under special protocols, the self-organizing multiagentny system will turn out.

The main objective of any self-organization is achievement of constructive extrema of any aspects. Otherwise this self-organization to the nature would be and is not necessary. After all self-organization is resulted by development of everything. Therefore when scientists in the field of IT appropriate various distinctive characteristics to the self-organizing systems, it can only be apprehended, as their hypothetical attitude. After all they alive did not see any self-organizing program system since are very far from them on the practical level.

When I contacted one of scientific patriarchs on the self-organizing systems and declared to him that we developed this most self-organizing system for a long time, reaction was very far from the expected. I by naivety thought that the scientist who wrote the mass of articles on this subject, will be glad for simple Russian engineers who in this plan overtook itself the USA, and will wish to learn how we managed to reach life such. But this scientist only struck a pose of an inaccessibility and filled up with the thought-up criteria.

I, naturally, did not consider it necessary something to prove. After all, apparently, when on scales on the one hand there is a naked thought-up theory, and with another - the ready working system, certainly, the system would have to draw. But there is it not so. Everywhere the corporate



interests, but not interests of Russia work. Otherwise our most perspective system would not become dusty more than 3 years on the shelf, and would be long ago in great demand in power industry.

And now directly about the self-organizing Smart-MES. Here answer such question. When the system in an initial state is able to do nothing and suddenly after training everything is able. When the system has no as a part of any really operating task, has no database, has no screen forms, has no reports, has no realized algorithm of a technological task, and after compilation of the text in engineering language, everything appears. That is self-organization or not?

Say to me that it is elementary work of algorithm of transformation of the text to the making systems. I do not argue. And who told, what at biological systems self-organization happens without algorithms? After all if there is no algorithm, there is no extremum of the purpose of self-organization also, therefore, there is no self-organization also. Another thing is that these algorithms are made by the nature.

Thus, extrema of the purpose of self-organization of Smart-MES are: minimization of actions of the technologist at adaptation of system to specific working conditions and maximizing speed of calculation of technological algorithms. And these extrema in system are not simply easily reached, and have such values which to surpass simply not perhaps.

Minimization of actions of the technologist is provided with the built-in tool means "The designer of projects" of technological tasks in text form. Each task in engineering language is formulated in a tabular look with which the person interacts. The maintenance of columns of the table and its line is separately described. All algorithms are designed from templates. Designation of indicators have writing, habitual for technologists, with the top and lower indexes.

Maximizing speed of calculation is provided with four multiple transformation of a problem definition to an executive machine code. Here it is necessary to stop especially on optimization of a machine code by the principle of one pass from top to down. For example, when the problem in MS Excel is solved, always happens that arguments in the top cages pay off below. Thus, there is a need of repeated pass of the table. In our case it

does not occur since at the time of transformation to a machine code the order of calculation changes for future single pass.

The main competitive advantage of a phenomenon of self-organization of Smart-MES is almost instant transition of mathematical model of power plant or other enterprise from a situation "as is" to a situation "as has to be". This change happens at rate of functioning of the system and actually with the minimum participation of the person. The phenomenon of self-organization provides boundless development of system regarding technological functionality which can be used both at the level of power plants in all shops, and at the level of the Generating and Network companies.

And now present a situation when the system itself reacts to change of the current context and instantly starts self-organization. In this case the effect of a context can have extensive influence on marketing and consumer decisions especially in market conditions of uncertainty.

Generally, this phenomenon of self-organization when all huge system in any configuration is developed from the usual text by pressing of one button or if you wish, a voice signal, it is actually difficult to comprehend. Maybe for this reason management of the Generation companies does not decide to attract this system to the operational accounting of an excessive consumption of fuel at power plants. Probably, so far it is simpler to IT management to operate with the existing western technologies, which not in leaders for a long time.

The similar phenomenon of self-organization of system allows to refuse development of various programs in general. And in this case thousands of programmers will be compelled to pass into other spheres, for example, in bigger scale to produce toys and manuals. All production sphere will be easily blocked by the self-organizing system. After all to provide any expeditious calculations in any quantity and any complexity at any enterprise, it is enough to reflect of it in the text. More it is necessary nothing. All the rest will be made by self-organization of this system.

And the most important, self-organization does not enter new mistakes into the new created system since it operates with new meta information, and the main skeleton of system remains invariable. Absolute reliability of a production system is guaranteed to these.

## **24. Concept of dynamic adaptation of Smart-MES**

In the Penza article "Methods of Adaptation and Generation of Development of the Software" [13], it is told: "Development of more powerful programming languages and object libraries, use of Case-design tools and creation of program systems, unfortunately, did not give the expected effect against grandiose opportunities of modern computers and computer networks owing to passivity of program and technical systems and a weak changeability of the created software".

But Firm InformSystem developed the Innovative Dynamic Self-organizing Smart-MES for a long time.

Very strange picture when scientists state about strong lag of development software turns out, we most software already created this. So our article "Automated Control System for Production of Power Plant of MES-T2 2007" [2] in which questions of full self-adjustment of Smart-MES are taken up is published in the collection of materials of the third international conference "Management of Development of Large-scale Systems (MLSD'2009)". And it in a root disproves passivity software and its weak changeability.

The next generations of development are given in the Penza article software:

- 1) software turnkey;
- 2) software with installation and installation;
- 3) software with the built-in means of completion;
- 4) software on the basis of design, and self-adjusted software;
- 5) Self-organizing software.

In this article it is told that "it is essential to increase quality and term of operation with basic decrease in labor input and costs of creation and support of systems allows only self-organizing software. Is self-organizing

software, capable long (potentially infinite) time to be adequate to environment on the basis of adaptation to changes of environment (the solved tasks, objects of interaction) and the internal organization of system (volume of data, their placement etc.)".

And now we will show that our Smart-MES system completely corresponds self-organizing software, agrees essentially new properties given in the Penza article. Thus for a decade of the formation this system took place the transferred all five generations of development software from "turnkey" to "Self-organizing". And so:

1) "The self-organizing system has to be autonomous, active, intensive, and capable independently function in a certain changing environment".

The Autonomous System (AS) has to have own purpose - longer existence that demands its adaptation (adaptation) and a survival in the changing environment. One of the most important conditions of a survival AS is performance of a certain useful function by her for environment.

Our Smart-MES externally consists of the EXE file (the Designer ARM) and a set of text descriptions - Projects of technological tasks. The designer as the newborn child, regarding technological functionality is absolutely empty, i.e. for performance of concrete useful work it should be trained. Training process, as well as the person, occurs through the text. Training of the Designer is carried out in real time at rate of performance of useful work by it and happens constantly, as well as the person. Now the field of activity of Smart-MES extends on process productions, but the same principles of training can be underlain in creation of system and for discrete productions.

2) "The self-organizing system has to be the organization opened at all levels: structural, functional, interface and data structures".

By the definition accepted by IEEE POSIX 1003.0 Committee, the system which realizes open specifications on interfaces, services (service of the environment) and the supported formats of data is called as open information system. Main properties of open systems: expansibility, scalability, shipping, interoperability, ability to integration, high readiness.

Our Smart-MES possesses all these properties. In it standard interfaces of access to databases are used, completely there are no restrictions on quantity and dimension of technological tasks. It carries out interaction, both with the lower level of data collection, and with the top level of business processes. In Smart-MES all services are adjusted after its training for concrete use.

3) "The self-organizing system has to function mainly on the basis of own purpose and internal requirements taking into account nonspecific influences of environment".

The requirement is a need for any benefit. The benefit for system is existence of its correct constant working capacity. It as at the person a main objective - to be full and healthy.

Our Smart-MES, using the current ZIP archiving, in case of failure for any reason she automatically restores herself as there is a regeneration at live organisms. In this case to it global damage or removal of all databases and settings is not even terrible.

4) "The self-organizing system has to provide a correctness and high level of reliability and efficiency of functioning in the changing environment".

Our Smart-MES as it was already told above, in a starting position consists of two philosophical elements: basis (EXE) and superstructure (Text). Basis - a program skeleton or essence of information system. A superstructure - set of the algorithms in engineering language generated by basis and which are actively influencing it. In other words, the EXE

module prepares the Text, in this Text, it forms databases and templates of screen forms and reports, and also DLL programs for calculations, and, using this environment, the EXE module functions for performance of production tasks.

Thus, the EXE module is completely a prerogative of the Developer and to concrete technological object has no relation. The text on the contrary is a prerogative of the User who in engineering language formulates technological tasks for concrete object. It reaches independent continuous development of system and technological functionalities, as provides the highest level of reliability and efficiency of Smart-MES.

5) "The self-organizing system has to provide interaction with environment at the semantic level and provide the simple interface of interaction hiding high internal complexity of system from environment".

Our Smart-MES provides the language of a formulation of technological tasks which is most approached to reality in a tabular look. The maintenance of columns (Equipment) and is separately described lines (Indicators). The description of lines includes: designation, unit of measure, name and algorithm of calculation. Designation of an indicator is written in a natural look: Pp - a vapor pressure. The algorithm of calculation registers in a usual look:  $N_i = E_i/t_i$ .

6) "The self-organizing system has to have ability eventually to provide to environment (users) more and more ample opportunities according to the solution of tasks, the organization and data processing".

Our Smart-MES constantly develops by release of new versions. Therefore, for acquisition of new system functionality it is rather simple to Users to replace the EXE file. The text allows Users to increase technological functionality without restrictions.

7) "The self-organizing system has to have ability to arise and be formed in the natural way without participation of programmers and developers".

Our Smart-MES allows creation of the big working system from pressing of one button. In this case at compilation of the Text all components are automatically created: databases, reference books, menu, screen forms, reports, DLL programs and Application server.

However, in the Penza article the strange conclusion is drawn that "now practically there are no program systems at which the specified properties would rather accurately be shown. Thus, creation of program systems of this class is business of the future and, perhaps, will mark itself the third revolution in the software area".

And so, note all scientists and, especially, in the field of informatics, the third revolution in the software area came true for a long time, and it was marked by the birth of the Innovative Dynamic Self-organizing Smart-MES "MES-T2 2020" System. It is a pity that in scientific community annoyingly passed this fact.

We reached impossible, i.e. double high-speed, apparently, mutually exclusive effect: at adaptation of System for any power plant and at the solution of any problems of TEP (technical-economic indicator).

It is known that this still managed to be settled to nobody two clashing problems. It, as water and ice. This Wednesday either liquid, or firm. But we could make this Wednesday at the same time both liquid, and firm.

So, if the System for calculation of TEP easily adapted for various power plants, it has the low speed of the solution of tasks because of the interpretative mechanism of calculation. The tasks realized "in a forehead" i.e. without possibility of flexible adaptation have the high speed of performance. This fact to experts is known long ago.

But our Smart-MES system both easily adaptable, and high-speed.

That we managed to realize innovative means, completely overturns all earlier existing outlook about the big information and operating Systems. These our innovations still are fully not realized.

Perhaps, for this purpose there are objective reasons. In this case, for a choice of program realization the crucial role is played, first of all, by the size of the IT company and its image, but not innovations.



## **25. Smart-MES as Super-SAPR of the Self-organizing Systems**

---

Firm InformSystem presented the Smart-MES system developed and approved by it as SAPR (system of the automated design) for fast generation of the big self-organizing systems for the industry. This system easily realizes any mathematical models for the purpose of increase in profit and for the purpose of optimum expected development of the enterprise. This system can be involved in multiagent technology for realization of cognitive functions of management of any industrial company. This system will allow to come nearer as much as possible to realization of intellectual opportunities due to the easiest adaptability and the highest speed of calculation.

It would seem, SAPR is intended for automation of design of objects, but the program is the same object. This SAPR Smart-MES will easily cope with any settlement tasks and with any mathematical models, especially for the enterprises with continuous nature of production.

This SAPR generates self-organizing systems which in the nature except our Smart-MES are not present more. Any SAPR is intended for search of the best decision by a trial and error method. Therefore no other system can be carried to SAPR since it does not allow to realize instantly a set of options software. The Smart-MES system due to the self-organization opposite easily it allows.

SAPR Smart-MES allows to generate the self-organizing systems for realization of any dynamic economical and technological mathematical models in any quantity and any volume for any enterprises of any industry, including the defensive. Thus at once it is necessary to notice that 1000 tasks on average on 500 indicators at the expense of the superspeed of Smart-MES pay in only 10 seconds that when modeling difficult dynamic objects is simply invaluable.

The self-organizing system for itself creates all structural components which allow it to function in concrete mission. For this purpose the system consists of the basic EXE module and superstructures in the form of text projects. The EXE module designs these superstructures and on them carries out double bifurcation (high-quality reorganization), creating automatically all elements of big system: databases, screen forms, reports, settlement DLL programs.

Why this open source software of SAPR Smart-MES is capable to solve many problems quickly? First, this technology of self-organization is already realized by us and there is a ready working prototype. Secondly, it is not possible to repeat independently realization of this technology almost since at us on it iterative decade of tests and mistakes left. Thirdly, for repetition of this technology it is necessary to be completely free from the western IT paradigm which and close does not create the prerequisite for self-organization, but such experts of unit and all of them at us. Fourthly, the systems only self-organizing in modern market economy are capable to provide production progress by means of instant adaptability to constantly changing conditions. Fifthly, for development of technological functionality in system programmers are not necessary. Sixthly, SAPR will allow to generate a set of the self-adjusted systems at the concrete enterprise.

What will the open source software of SAPR Smart-MES allow? First, it is possible to use free of charge ready software and independently to realize at itself at the enterprise various technological and economic calculations in any volume and to use them in the interactive mode or in real time with elements of optimization and with analytics. And also to realize functioning of system in any multiuser configuration. But good instructions and training are for this purpose necessary. Secondly, it is possible to use free of charge our source texts and creatively to process them, having provided thereby further development software from already reached level. But detailed descriptions of all subprogrammes of system and training are for this purpose necessary.

What now it prevents this perspective software SAPR of Smart-MES to be shown on light? As always stirs indifference and ignorance of officials which are very far from IT, and stirs experts in IT tunnel thinking because of the western IT paradigm based on SQL (language of the structured inquiries). Both that, and another it is possible to overcome only at the top level at desire something to change in modern conditions.

Here you only imagine, what power SAPR gives. We provide it a package of in advance prepared text projects of technological tasks, and after pressing one button all huge system is automatically developed and comes to life. We palm off on it other package, and it develops other system nearby. Data of systems can be as much as necessary. And on all this some seconds are required only. The system is not afraid of neither viruses, nor the most cruel intervention of the layman since having revealed an incorrectness at all, it independently restores herself.

But the most important that the historical chance to take the leading positions in IT on creation of the self-organizing systems for the industry is provided to Russia, or this chance will be lost. Realization of self-organization in IT it absolutely other outlook which needs to be imparted from higher education institutions that experts for IT did not duplicate the western technologies and would not work on their canons, and would create the domestic IT industry based on the principles of self-organization. In the West long ago work on this problem, but unsuccessfully because of incorrectly chosen paradigm. That we incidentally managed to solve this problem, is a great luck for Russia, and not to use it means elementary wrecking and treachery of interests of Russia, especially in the conditions of opposition with the West.

It is necessary to understand one that progress in IT is relentless, but a question only in the one who will head it: Russia or West. Now Russia has all opportunities to use our practices and to extend our experience in all industries, but the most important in the defensive industry where the new weapon is created. Quickly realized self-organizing mathematical models are necessary for each type of weapon and for each strategy. And SAPR

Smart-MES easily will provide it without traditional programming, without heap of system glitches, with an unprecedented speed of calculations and with the easiest adaptability to new conditions.

Any set of mathematical dependences attached to economy or to technology is model. But the program which either is used ready is necessary for real functioning of model, or is specially developed. But in our progressive time to create the new program it is the sheer marasmus when for this purpose there are powerful Smart-MES tools. Why these programs after all are still developed with attraction of huge staff of programmers? Yes because management fondly believes that they will create the program better than Smart-MES system.

But it is not real, and that is why. Any model is only the approached description of object since to create the identical copy in the form of virtual model simply not perhaps, but it is possible by means of infinite iterations to come nearer to it. And for this purpose the tools have to be self-organizing as it is necessary to provide the easiest adaptability and the highest speed of performance of calculations. But the similar self-organizing systems, except us the created Smart-MES, in the world are not present. And on its creation decade of work of the best programmers of Yekaterinburg left.

In this case the platform does not matter since more here we speak not about concrete program realization, and about the principles which can easily be used in various other platforms. This realization in the form of Smart-MES "MES-T2 2020" system can be considered as the ready working prototype or a sample.

Once again I will notice that it is better to make our system it is impossible (the user interface or other lotions does not mean here) since at us so the easiest adaptation and the highest speed of calculation is reached. To come nearer to our opportunities, probably, really, but why to spend for it the mass of efforts when all the same not to catch up with us and more simply to use our ready system and technology on the scale of all Russia, including defense industry.

Now about our adaptation. At such easiest adaptation the technologist's plan without participation of programmers is instantly realized into the working software. Necessary current changes in algorithms of calculation or addition of new tasks are instantly realized at rate of functioning of system without loss of the current technological data. For designing of the text project of tasks ready templates are used, and engineering language of the technologist is available even to the school student. The conceptual line in the project consists of trivial components: designation of an indicator, the name, a unit of measure and algorithm of calculation, thus all indicators in algorithm have designations, habitual for technologists. Where it is even simpler?

In the course of self-organization of system to which gives rise of people or other mechanism, two points of bifurcation in which there is a change of structure from simple to difficult and from chaos to orderliness meet. In the first point of bifurcation self-adjustment of all system, i.e. transformation of text projects to all components of system is carried out: databases, screen forms, reports, interpretative calculations, etc. In the second point of bifurcation interpretative calculations of a set of tasks will be transformed to one task in machine codes with their optimization.

In this case the greatest possible speed of calculation is carried out by formation of one program on DLL (dynamically connected library) for all tasks without excess analyses with one pass from top to down. Manually it is not possible to write such huge program including millions of indicators simply but if it is possible, its expeditious correction will not be real at all. At us it is generated automatically.

Models are necessary for improvement of the current functioning of the enterprises for the purpose of increase in productivity and profit and for their expected development. And, therefore, and for progress of all Russia. And for this purpose already developed self-organizing Smart-MES system best of all approaches. But, unfortunately, the paradigm of the existing IT community in Russia does not allow dissidents to lean out.

The paradigm is that unites IT community. Now at very long influence of the western paradigm on minds of IT community led to stagnation and rotting of this paradigm. And the new Russian IT paradigm for the industry is not present. But the technology of creation of the self-organizing systems could be this paradigm.

In our country for needs of IT for one million enterprises in the industry, in the scientific sphere and in defense industry the trillionth sums are annually obviously and implicitly spent, and Russia could spend for it one thousand times less, having used open self-organizing software. Here also there would be a rapid general progress. And programmers would not multiply ideologically outdated western software, and developed the domestic. And we not simply would catch up with the USA, and through it easily would jump.

SAPR Smart-MES contains the developed system functionality from various methods of optimization (dynamic programming, a simplex method, etc.) to various analytics. The generated systems can function in various configurations the client server with three-unit structure with the SQL Server and without it. In this case the application server is generated automatically. There is the graphic vector editor for formation of schemes of treelike structure. Also possibility of placement of calculations and analytics is available the Internet. In this case the SQL application and the Web application are adjusted automatically.

Philosophical concepts successfully are suitable for figurative representation of SAPR Smart-MES: basis and superstructure. In this case the basis is presented by the EXE Module, and a superstructure - text projects of tasks. The basis creates a superstructure, and the superstructure defines Basis and its functioning.

Thus, the technology of the self-organizing systems marks revolutionary revolution which can quite bring Russia out of IT crisis.

But so far at us in Russia progress simply marks time because of global corruption and because of absolute unwillingness of the leadership

of Russia to meet requirements of unknown innovators. Already decently become dusty unique innovative Smart-MES system can be a striking example. And such examples many thousands. After all the most awful that ingenious development can be lost on eyelids for future generations.

In the book "Innovative Economy (Road Map 2040)" [5] Svyatoslav Martynov writes: "And reasons for alarm are:

1. The few people - carriers of sacral knowledge are not young any more and pupils of middle age are not present or nearly is not present.
2. Only the qualified team can realize a grand design (in an ideal already with experience of certain achievements).
3. Introduction of global innovations possibly only at nonresistance of national elite".

In the present time this most national elite simply tries not to notice the revolutionary revolution which is already made by us in the sphere of IT.

But on the other hand we will ask a simple question and how to national elite to reveal this most ingenious development? How to emit them rational grain from the mountain of garbage? But it can be defined only at the level of experts. And that experts are just not present these and cannot be. Because if such experts would be, the Russian economy would be already ahead of the planet only long ago. After all the real experts because of indifference of officials left for a long time in the USA and successfully work for Uncle Sam. And those who themselves carried to experts, i.e. those who takes out the conclusion, are simply approximate to the power and no more than that.

In the people there is an opinion that the standing innovation independently will open the way of itself. Otherwise - it not standing. In the government consider that investors will define that it is favorable to them. But let's not confuse "iron" to software. If the innovative device is obliged to make profit, IT directly - never. Therefore to hope for investors in advance of perspective IT it is useless.

Here consciously all talk on design features of SAPR Smart-MES since they are useless falls. On any my argument in reply I will hear one thousand denials. The criticism is important and very necessary, when it in detail. For example, none of IT specialists plainly will not explain need of a DB of SQL? After all if IT process can be carried out much better without these SQL, apparently, about what to speak? An, no! The western canons will drive consciousness of domestic IT specialists for a long time.



## **26. Structure and innovative opportunities of Smart-MES**

The logical structure of Smart-MES system consists of two parts. To the first part there corresponds the designer ARM (the automated workplace). The designer always one for any appendices, is the EXE file. To the second part there correspond appendices, these are templates with an open code for their further development and change as each appendix is unique. In the Designer models of information objects are described. Everything that we described in the Designer, is realized in appendices. We can correct everything that described in the Designer - changes instantly through compilation will appear in appendices without reprogramming.

Structurally Smart-MES includes four components: Designer ARM, SQL application, Graphic editor, Web application [2]. The basic is the Designer ARM. The SQL application and the Web application work on its settings. The Smart-MES system has no means of data collection directly from sensors, and carries out their import from the automated means of the lower level existing at power plant: PCS, ASKUE (electric power), ASKUT (heat), ASKUG (gas), etc. In the absence of any basic data manual daily input with the subsequent transformation of the minute calculations given on level is used.

The designer ARM carries out full adaptation of Smart-MES to conditions of concrete power plant and the client server without SQL DB (database) can be exploited in the multiuser configuration. In this case the designer ARM carries out two functions: as a workplace of the administrator of system for introduction of various corrections and as the client with a set of functions. In this case there is one very important feature: the client server of three-unit structure is used. The similar configuration without SQL DB cannot be in one other system, this our know-how. Advantages of such configuration the client server are: lack of SQL DB, high speed of calculation, huge number of analytics and other opportunities.

The configuration the client server of three-unit structure without SQL DB is a new word in development of information technologies. When everything is universal passed on the client server with the western SQL DB, we gave unlimited opportunities to our configuration the client server with direct access to a DB without use of sluggish SQL language. In our case there is a server of information databases, an application server and the "fat" client. All calculations are carried out by an application server on the DLL program.

The SQL application realizing a configuration the client server with SQL DB turns on the SQL server, the "thin" client and an application server on the DLL program. In this case the SQL server is used what is preferred by power plant. At the beginning of functioning all settings and databases, and Smart-MES system in a configuration download to the SQL server from the Designer ARM the client server with SQL DB is ready to work.

The graphic editor was developed by us as the independent software product for creation of archival thermal and electric circuits of hierarchical structure in a vector format with possibility of submission of dynamic information (The certificate of Rospatent No. 2002610180 on the state registration of the computer program, 2002). At creation of Smart-MES system the graphic editor was integrated into it.

The web application is the exotic software product. He allows to post online all calculations of TEP with manual input of basic data and with analytics.

Such multilateral realization of Smart-MES system allows to satisfy many requirements of the Generation company for economy of fuel for the purpose of increase in energy efficiency of power plants and considerably to increase its appeal to investors. In the same system tasks of the prevention of all emergencies are easily realized.

The program then will be useful at power plants when it is capable to adapt for all changes quickly. But after all even simple calculations of TEP

not always have transparent realization, not to mention continuous changes in technology of the power plant.

Process of drawing up calculation in the text project in Smart-MES system and debugging of these calculations is carried out easily. In calculations all indicators have the designations habitual for technologists, and all algorithms of calculations can be accompanied easily. Changes can easily be made to technological tasks by technologists of power plants.

We developed the theory of mathematical modeling of any combined heat and power plants, state district power station, hydroelectric power station, the NPP and it is realized in practice in the form of the innovative self-organizing Smart-MES system for calculation of TEP and production management of power plant with minimization of an excessive consumption of fuel.

The theory of modeling consists some main Postulates directed on implementation of functioning of full mathematical model of the power plant including expeditious calculations of the actual and standard TEP with possibility of optimization of resources by method of dynamic programming.

**Postulate 1.** Designation of all technological indicators has to be in a look: <Indicator> [<Object> <Number>]. The indicator is a usual engineering alphabetic writing of technological parameter. The object is a symbol of the Copper <K>, Turbin <T>, etc. Number is station number of the equipment. For example: Qk\_br\ug [K8] - Development is warm a copper No. 8 on coal and gas, Ettsi\sn [T5] - the Expense e/e on SN of shopping center of t No. 5. All settlement algorithms have to be formulated with use of these designations of indicators. For example:

$$Qk\_br \at = [Dop \at * [ipp-ipv] + Dpr \at * [ikv-ipv]] * 1e-3 + Qotop.$$

**Postulate 2.** All technological calculations have to be made out in the form of the text Project. The project of a task has to consist of two main parts: Objects and Indicators. Objects are a description of columns of screen and calculation tables. Indicators are a description of lines of screen

and calculation tables in a look: Designation, Unit of measure, Name and Algorithm of calculation.

**Postulate 3.** All system has to be adjusted automatically at compilation of text Projects of tasks. That is, databases, screen and calculation tables, reports and the conductor of tasks have to be generated automatically. The executive Module has to remain invariable and has to function on settings of system.

**Postulate 4.** According to the generated calculation tables the DLL program with optimization of a code for the general calculation of half-hour, daily and monthly tasks has to be created automatically. In the DLL program all calculation has to be made for one pass from top to down. Dynamic optimization of diversity has to be made on this DLL program.

**Postulate 5.** All standard schedules of work of the equipment have to be entered in a graphic look and automatically be digitized for their use in calculations.

**Postulate 6.** All technological algorithms in mathematical model have to correspond to the current calculations of PTO of power plant executed, for example, in MS Excel.

The Smart-MES system has some instruments of optimization of resources of power plant.

Need of optimization of TEP at power plants is defined by existence of diversity of adoption of the operating technological decision by the operational personnel. The power plant is faced, apparently, by a simple task: To implement the plan of delivery of the electric power and heat on the existing working equipment at a minimum of expenses of fuel. Now still the person without operational accounting of an excessive consumption of fuel, i.e. absolutely in the dark tries to carry out this task. It follows from this that the predominating criterion function on fuel consumption minimization is not carried out at all.

Here it should be noted, as existence of powerful optimization does not solve this problem without the current accounting of an excessive consumption of fuel on half-hour intervals. Optimization in this case speaks as it is necessary to make, and the account shows that as a result of management it turned out, i.e. the account is feedback. But now there is no this feedback, therefore, and there is no optimum control. And on the other hand even at the accounting of an excessive consumption of fuel, but in the absence of optimization also there cannot be this optimum control. Very gloomy picture of today turns out: there is neither optimization of resources, nor the accounting of an excessive consumption of fuel. Let's note also that the accounting of an excessive consumption of fuel are half-hour calculations of a difference of the actual fuel consumption and a standard cost in real time with granting monitoring analytics for BCP.

And now about instruments of optimization of TEP is more detailed. There are two approaches to optimization: local and the general. Local optimization considers only part of the equipment without coordination with other part, for example, optimization of loading of turbines. The general optimization operates at once with all model of power plant. Certainly, the general optimization most correctly defines the best decision since considers all processes in interrelation. In Smart-MES system general optimization is realized.

It is possible to carry to instruments of optimization: Linear optimization by a simplex method, Dynamic optimization and HOP optimization.

**Linear optimization.** The task for this optimization represents system of the linear equations and criterion function. This task does not exist somewhere aside, and directly joins in mathematical model of power plant. By the way, such problems of linear optimization in calculations can be as much as necessary, united in uniform model of power plant for expeditious calculation in real time of the actual and standard TEP. All these systems of the linear equations decide modernized a simplex method which surely leads to the concrete decision.

**Dynamic optimization.** This optimization though is not present at the body of mathematical model of power plant, but operates with all this model. The dynamic optimizer contains data of the defining factors for which possible minimum and maximum values are set, and given to minimax strategy for which the minimum or maximum values with their ranging on a priority are also set. The essence of dynamic optimization is that for all defining factors alternately with a certain step values from minimum to maximum are set and the resulting indicators on full model pay off with their fixing. Thus, all combinations of the defining factors are checked. The second stage is the choice of optimum option from all variety according to minimax strategy.

**HOP optimization.** This type of optimization also operates with full model of power plant. Both in it, and in above the described options the model of power plant represents a full set of calculations of the actual and standard TEP. HOP (Characteristic Relative gain) is the schedule of differentials of an indicator ( $dy/dx$ ) from minimum to the maximum value ( $x$ ), and optimization is definition of an extremum of this schedule. The task as follows is formulated: To find such distribution of resources at which the increase in power of the electric power at a certain size will require the smallest increase in expenses of fuel.

Innovative Smart-MES by all these types of optimization has the adjusted tools, i.e. they are not realized "in a forehead", and can change easily in use.

But it is necessary to stop especially on shares of influence on economy of fuel of optimization of resources and the accounting of an excessive consumption of fuel. So, optimization of resources can give economy of fuel in only 3%, and the accounting of an excessive consumption of fuel has opportunity to save more than 10% of fuel. Here the interesting picture appears that at realization of optimization of resources and without an excessive consumption of fuel even these 3% can and be not reached since everything can eat an uncontrolled excessive consumption of fuel. And here, joint realization and the accounting of an

excessive consumption of fuel, and optimization of resources easily will give economy of fuel more than 13%.

### **Specification of the tool program Smart-MES complex:**

1) The PTO professional Complex - the version 6.x, in structure:

\* the Designer ARM (the Automated Workplace)

- The founder of System for any power plant
- Designer of Projects with automatic control of the Complex
- Processing of standard schedules on the equipment
- Import of data from ASKUE, Excel, dBase, Access, SQL server
- Export of data to Excel and Word for any reports
- The designer for preparation of daily and monthly magazines
- Designer of reports, generator of composite reports
- Calculation of indicators for changes, days, months and

calculation for any period

- The review of Indicators with digital and graphic analytics
- Agent of safety (Prevention of Emergencies)
- Test of the equipment and the Regime card on the equipment
- The dynamic Optimizer with minimax strategy
- Plotter HOP (Characteristic Relative Gain)
- Operational Magazines with graphic analytics
- Expeditious Monitoring and Forecasts
- The express - the Analysis

\* Processing of chart tapes by means of the scanner

\* the Agent on the Prevention of Emergencies in real time

\* Manager of Archives of databases, projects, settings, etc. files

\* Examples: over 150 Projects with 3000 standard schedules

\* Documentation (Book 2005, 2006 in electronic form, book 2007

in printed form)

2) The Client / Server 2 appendix - the version 7.x

Uses settings of the Designer ARM versions 6.x

\* Works on three-unit structure with SQL - Servers: Oracle, MS SQL Server, Sybase, SQLBase, Interbase, MySQL and others

3) WEB - The appendix for the Internet - the version 7.x:

Uses settings of the Designer ARM versions 6.x

\* Preparation of a DB and settings for placement for IIS WEB -  
Server

\* CGI - a script (performance of calculation on the Internet)

4) Graphic Thermal power plant Graf system - the version 5.x:

\* the Graphic editor for Monitoring of Indicators of TEP

\* Examples: about 400 schemes and forms on KTTs, ETs and HTs



## **27. Intellectuality of the Self-organizing Smart-MES**

The intellectual system is capable to synthesize the purpose, to make the decision to action, to provide action for achievement of the purpose, to predict values of parameters of result of action and to compare them with actual data, forming feedback, to correct the purpose or management. For this purpose it possesses a stock of knowledge and has methods of the solution of tasks.

The production activity contains two main processes in the Generation company.

1) Ensuring power generation and heat each power plant according to their schedule of delivery at a zero excessive consumption of fuel. By us it is proved that optimization of resources in this process plays a smaller role, than elimination of an elementary human factor in an excessive consumption of fuel which can be reached only by half-hour calculations of the actual and standard TEP in real time with monitoring of an excessive consumption of fuel for BCP.

2) Forecasting of purchase of fuel for each power plant according to plans of delivery of the electric power and heat. In this case for decrease in penalties it is necessary to calculate precisely the sizes of necessary fuel with breakdown according to the schedule diagram.

Production of power plant is described as follows:

$$B = f(E, Q), \quad (1)$$

where: B - amount of fuel, t.u.t.;

E - quantity of the electric power, MW · h;

Q - amount of heat, Gcal.

At optimum production and at a zero excessive consumption of fuel to each couple (E, Q) on a half-hour piece there corresponds strictly certain amount of fuel (B).

Having the knowledge base with a set of various combinations (E, Q, B) for half-hour intervals and the plan of delivery (E, Q), the Smart-MES system will instantly calculate (B) for any period. In this case specific fuel

consumption and other difficult calculations for planning and forecasting are not necessary at all.

The same concerns also the current production. Also according to the knowledge base, but with other set of combinations (E, Q, Ri) according to the schedule of delivery (E, Q) the system will choose an optimum set of operating modes of the equipment (Ri - thermal loadings of coppers, electric loadings of turbine units, etc.). In this case there is no need to solve optimizing problems of loading of the equipment and highly skilled technologists for management of power plant are not required. There is enough only in real time by means of Smart-MES to control an excessive consumption of fuel.

Training or formation of the knowledge base of Smart-MES happens in the current production. On half-hour intervals at a zero excessive consumption of fuel and at optimum loading of the equipment fixation of this cut (E, Q, B, Ri) in the knowledge base is made. The full cycle of training of system, naturally, will require one year because of various seasonal requirements of the electric power and heat.

In practice management of power plant with use of Smart-MES looks as follows. On BCP (block control panel) of power plant monitoring of Smart-MES represents in real time of graphics and value of minute and half-hour excessive consumption of fuel. If there is a minute excessive consumption of fuel, changes are quickly made to production. If there is no excessive consumption of fuel on a half-hour piece, and this production cut is absent in the knowledge base of system, he automatically registers in base. The list of technological parameters of a cut is adjusted in advance. In the transitional modes (day, night) process of fixation of a cut is also made after installation of zero value of an excessive consumption of fuel.

Upon transition out of one production situation to another (change of necessary number of power generation and heat) from the knowledge base in monitoring of Smart-MES it will be brought some advising cut options (a set of technological parameters) to operation personnel of BCP for the purpose of simplification of fast acceptance of the operating influence. If the suitable option is not present, the dynamic optimizer for search of optimum loading of the equipment is started. In the course of training need to use the optimizer gradually will be reduced.

Thus, intellectual Smart-MES, using the schedule of delivery of the electric power and heat, by means of the knowledge base will unmistakably prompt the best decisions in concrete production situations, and monitoring of the current excessive consumption of fuel in real time will promote its economy. And it already the highest level of the organization of management of power plant.

The power plant works effectively when the actual excessive consumption of fuel for each half an hour and, therefore, in a month, completely is absent. Now at one power plant the exact actual excessive consumption of fuel which has to turn out only integral calculus from half-hour TEP [4] is not known. And that excessive consumption of fuel which appears in monthly reports, is far from reality since monthly calculations of an excessive consumption of fuel are made by incorrect techniques, including the distorted standard schedules by polynoms. Thus the excessive consumption of fuel should not be confused with its overburning which is dictated by technology.

For some reason, when the speech comes about the software for calculation of TEP (technical-economic indicator) of power plants, the question of need of existence of intellectual opportunities is not even considered. Therefore at all power plants there are dull and methodologically miscalculations of TEP which not only do not bring any benefit and profit, and do obvious harm, hiding huge reserves of increase in energy efficiency of combined heat and power plant and state district power station.

Everyone will tell that it is possible to do without navigator if of course well you know the district. And if you do not know? And if the blind? And if you do not suspect where traffic jams, and it is necessary urgently? And so the Smart-MES system at power plant is the same navigator. Thus, the system supplies the operational personnel with intellectual additional sight without which now it simply is active in a darkness with a candle in hands.

The concept "intelligence" and scientific and uneducated is treated by all in own way. Accurate uniform definition is not present and cannot be. If there is no clear understanding even as the person thinks. Usually say that this scientist has big intelligence since he knows much. And here about

the working drunk so will not tell though he provided with the rationalization wellbeing of plant. But if there is no concrete definition of intelligence for the person, it especially cannot be and for system.

Here we will not give all variety of statements on intelligence in general and artificial in particular. And I will state the laconic definition: The intelligence is characterized by existence of dynamic memory of knowledge at system. You only observe a tiger as he prepares for attack. Well, unless it due to the lack of intelligence? Yes, at everyone it the, at someone bigger or smaller. But it all the same intelligence.

The intelligence of the person is conditionally subdivided on behavioural and into the creative. The behavioural intelligence is focused on service of itself, and creative on service of others. The behavioural intelligence is base for creative intelligence. The intelligence surely includes three components: knowledge base (memory), training and use. In this case training happens constantly.

And now we will prove that Smart-MES has intelligence. For this purpose it has to have all components of intelligence as the person, i.e. has to have an existence of the behavioural and creative mechanism, and everyone has to have the knowledge base, and have possibility of training and use of this knowledge in real time.

The behavioural Smart-MES mechanism turns on the adaptable device based on compilation of text projects of technological tasks for formation of the knowledge base of algorithms of calculation and all settings. It is also training of Smart-MES for performance of various behavioural functions: formation of screen forms and reports, performance of calculations and analytics. Such training happens in the course of functioning of Smart-MES. It reaches full constant identity of mathematical model to real production at power plant.

The creative Smart-MES mechanism turns on the device of formation of the knowledge base of half-hour technological cuts of the modes of the equipment with the set parameters of power generation and heat at a zero excessive consumption of fuel. Automatic training and granting the optimum modes of the equipment is carried out in real time. Here the creative mechanism is based on the behavioural Smart-MES mechanism.

As we see, this design of Smart-MES completely corresponds to a design of intelligence of the person. Therefore, Smart-MES has intelligence. The objection that intelligence of the person creates something new, i.e. possesses creativity, is also easily parried. Only here it is necessary to consider one subtlety that the composer trained in music can compose generally various, but music, and not to design plants in any way.

Creativity of Smart-MES is that it, using the knowledge base about technological cuts, can precisely predict volumes of necessary fuel for any period. Any calculations not to master such accuracy. It completely creativity of Smart-MES. Here, as well as in music, there can be successful options and not really.

And now about innovative break. As it was already told that now at all power plants of all Generation companies the operational personnel regarding an enormous excessive consumption of fuel operates these power plants blindly, providing the most irrational fuel consumption. Whether they need to save fuel or it is not necessary to carry out directives of the Russian President on increase in energy efficiency of power plants it already on conscience of management of the Generation companies at all.

But Smart-MES due to the intelligence is capable to create conditions for a complete elimination everywhere of the existing huge excessive consumption of fuel. Ignoring of this fact does harm not only to investors, not only image of the Ministry of Energy of the Russian Federation, but also all Russia in general.

However, in the letter from Department of an operating control and management in power industry of the Ministry of Energy of the Russian Federation No. 10-2382 of 22.10.2013 signed by the Deputy director Bobyliov P.M. it is said that for introduction of the developed technologies on MES-T2 2020 MES System it is necessary to participate in tenders. Also it is reported that the Ministry of Energy according to the Law No. 135-FZ has no right to carry out the actions violating competition conditions.

Thus, the Ministry of Energy responsible for economy of energy resources, simply elementary withdrew from recognition existence of the developed intellectual innovative technology of economy of fuel on thermal power plants which can easily prevent a further uncontrolled

expenditure of fuel which sizes are equivalent to annual losses in 100 billion rubles.

The question with the tender sounds simply ridiculously since the intelligence was equated due to a misunderstanding to bolts and nuts. It is equivalent as though in the past between various abacus with bones would announce the tender. And here the modern computer appeared before all of them. So it would be thrown simply bones because of denseness. Is not present, it is better we will patiently wait when we are politely invited for implementation of innovative break.

Well and why in general the intelligence is necessary in calculations of TEP? Question strange, but lawful. For example, you as what expert will prefer to employ to yourself: with intelligence or without? And there is other question: The overpayment for intelligence is justified or not? Probably, anybody to overpay to the janitor for special intelligence and will not be. But really management of the Generation companies really considers, what automation of calculations of TEP of power plants a place only on distant boondocks? But whether the most valuable tools what the correct and expeditious calculations of TEP are time, including also an excessive consumption of fuel, to use in the benefit for receiving additional profit. Here that not to do without intelligence.

The intelligence surely operates with memory. In our case if at a certain structure of the working equipment and the plan of delivery of the electric power and heat once by means of various optimizing mechanisms and high qualification of the expert, the best operating modes of the equipment at a zero excessive consumption of fuel were set, at a similar situation, why is repeatedly long to look for this best decision? Whether it is simpler than it to take simply from memory?

And now present that for various production situations in memory all information on optimum loading of resources collected over time, then this highly skilled expert for routine operational management of power plant simply is not necessary any more, and he can be used in other top-level quality. And the power plant will successfully continue to function with the maximum energy efficiency. With use of the same memory then it will be already simple to predict elementary authentically and purchase of fuel for any period.

We say that we will introduce Smart-MES system with intelligence. We are answered that we accept MS Excel with adjustment of results. We say that at power plant very big excessive consumption of fuel and we prove it. We are answered that you are not technologists and it do not understand. We say that the Generation companies by means of our system will be able easily to increase annual profit from each power plant by 300 million rubles. We are answered that all power plants various and it cannot simply be. Generally, the sheer dissonance! And at this time at power plants persistently rivet development with ideology of day before yesterday day.

Here you come on any power plant and ask what size of the current excessive consumption of fuel, for example, since the beginning of month with breakdown on days and on half an hour? Any expert of it will not tell since simply this account traditionally is not kept. And so across all Russia. The operational personnel regarding the current excessive consumption of fuel operates power plant simply blindly. And all this overexpenditure it is reserved joins in tariffs. Not the huge excessive consumption of fuel, but its economy, owing to elementary adjustment appears in monthly reports.

Naturally, this poor outlook quickly will not exchange since it took root into minds many years together with MS Excel which it was simply not able, and will not be able.

In scientific community there is a secret competition regarding conceptual determination of intellectuality and self-organization for computer program systems but with existence they this intellectuality and self-organization in the nature still do not have of which, except our Smart-MES.

But I am an engineer I will dare to argue with scientists and at all to disprove their definitions which are considered by them in isolation from each other. I am intellectuality and I consider self-organization only in close interrelation and I consider that without intellectuality there is no self-organization, and without self-organization there is no intellectuality. Therefore if there is a self-organization, that is and intellectuality.

I will give definitions of intelligence and self-organization from Wikipedia. Intelligence - the quality of mentality consisting of ability to adapt for new situations, ability to training on the basis of experience, to

understanding and application of abstract concepts and use of the knowledge for management of environment. Self-organization - process of streamlining of elements of one level in system at the expense of internal factors, without external specific influence. But unless ability to adapt and process of streamlining not of the same order?

Let's tell, the adult, certainly, has intelligence and self-organization, and here the baby does not possess them. And for this purpose that it would possess them, it should be learned long. But in the baby mechanisms of perception of this doctrine are already put. As a result of training and self-organization there is an intelligence.

The concept - artificial intelligence, when there is no natural intelligence since the intelligence is the acquired properties of a brain, i.e. the mechanism capable to remember and operate with this knowledge is for some reason entered. And in this case there is no difference or it is a biological brain, or it is the computer with the program capable to be trained. Therefore existence of the term "Artificial intelligence" is the most main error of a scientific world.

After all still nobody proved that if computer system to train 20 years the same as the baby, and to enclose in it as much dynamic information, she will not be capable to create something new.

And now I will give only two of a set of foggy definitions of scientists:

1) In the book "Informdynamic or Way to the World of Open Systems" [14] it is told: "The intelligence is, first of all, process. When the knowledge stops being process, and the context is predetermined - the intelligence disappears".

But how the intelligence can disappear? After all it or is, or it is not present. Another thing is that it is possible to speak about the level and quality of intelligence since at all live if there was a training process, it is obligatory to eat intelligence, and it does not disappear anywhere. As well at information systems, it is possible to speak only about I.Q.

2) In the lecture "Information and Self-organization of Systems" it is told: "The system is self-organizing if it without purposeful influence from



the outside finds information or functional structure. Example. One macrostructure (ice) when heating passes into other macrostructure (liquid) with absolutely other properties".

Here it is so healthy! The elementary physics was equated to self-organization. But without intelligence there cannot be a self-organization. And it only natural physical, biological and other processes at the level of micro and a macrocosm.

Generally, each scientist in the thesis and in the articles tries to present the new conceptual material concerning intellectuality and self-organization of computer information systems and in a separation from each other. But as it is possible to give these concepts, without having at itself behind the back the slightest experience of development of similar systems. After all not concepts, and those directions financed by the State which are headed by these scientists are terrible, giving an incorrect vector to development of information technologies. And it is similar to diversion since because of it the domestic IT science marks time.

Very strange picture turns out that these all doctors and candidates of science IT developers with the huge experience teach us how it is necessary to develop system, and what system is considered intellectual, and what self-organizing.

Let's return again to the baby and it is representable that his 20 years kept in the closed space and only fed. And what his biological brain something will think? Absolutely not. Therefore, at the heart of intellectuality and self-organization training lies. So, when there is this intellectuality? It appears at once after the first lessons of training when the biological or artificial brain starts receiving information when this information stacks its internal mechanisms of self-organization on shelves when there is the return reaction by results of this training.

Therefore scientists should not exaggerate useless definitions of artificial intelligence, and to enter its quantitative conceptual measures. For example: Baby, Child, School student, Student, Engineer, Scientist, Academician. And at once it will become clear to all that, let us assume, this system has intelligence of the School student. After all for some reason in computer graphics left from two-colored representation of the world long ago, i.e. black and white. And it gave sharp break in development.

And in such important issue as informatization, the science got stuck only in this framework - there is an intelligence or not intelligence.

After all if the system has opportunity to be trained, I.Q.s big, than at the person are subject to it. Here we will tell if the person was trained for the engineer-miner, it is possible to retrain quickly it on the engineer-architect? Yes, never. And here system it is possible.

Our Intellectual Self-organizing Smart-MES System also is such. It, as well as the person, is trained through the Text. In an initial state is a baby, but in some seconds after training it already has intelligence. If necessary she again can instantly become a baby and to be ready to perception of other intelligence.

The internal machine code of intelligence of Smart-MES after training is not known in advance at all since it creates it itself by means of self-organization. The system has no restrictions on training level. In it the Text of any size can be put. So far our system is focused for process productions. But on this technology of self-organization it is very easy for Smart-MES to create and for discrete productions.

## **28. The self-organizing Smart-MES - Informdynamic's wreath**

---

Whether not too this demand for a wreath is self-confident and whether smells slightly of usual adventurism and ignorance here, and even a certain narrow-minded neglect to the newest science of "Informdynamic" (information dynamics)? Absolutely not. The matter is that Smart-MES was developed by the turn, even without suspecting that the latest science is in parallel formed.

Here before me the Book - "Informdynamic or the Way to the World of open systems" [14] which is devoted to formation of fundamentals of new science of "Informdynamic". In Chapter 8. "Engineering of systems of an intellectual orientation" two systems are given: "qWord" and "Tekram" as models of achievement of Informdynamic. Let's note that these systems are developed for discrete productions.

But if the Smart-MES system which was initially created for power plants and for process productions, has methodologically the best realization, it and is a wreath. Here it is necessary to tell that some questions which in the Book are designated as not feasible, in our Smart-MES and are successfully realized long ago. Below separate excerpts from the Book are shortly considered and comparison with our system is given.

1) The book - part 8.1. Three main approaches.

"We will not consider the approaches connected with design of difficult information system in universal algorithmic language of this or that level. It proceeding from notorious bulkiness of the received decisions, their too obvious cybernetic level and a known problem of impossibility of a little effective correction of structures of information bases at design approach, inevitable for languages."

In Smart-MES, on the contrary, correction of structures of a DB on the basis of engineering META of language of the text Project of technological tasks is very effectively carried out. Correction of structures of databases which can be caused by expansion of technological functionality of system, is made at any time without loss of technological information.

2) The book - part 8.3. Second approach. Ideology of tool system.

"Both with practical, and from the theoretical point of view the tool qWord system as realization of technology of open control systems of data is represented not less interesting. One of the main provisions of qWord-technology - full integration of tool and applied systems into a whole."

In Smart-MES tool and applied parts of system are structurally located in one executive Constructor\_ARM.exe module which is intended for a complete set of the workstation of the administrator responsible for correction of algorithms of technological tasks, in a configuration the client server, but also the client server can carry out functions of workstations of technologists in a configuration. A configuration SQL application the client server and the Web application work on the settings which are created in Constructor\_ARM.exe.

3) The book - part 8.3.6. The tool concept - the qWord technology.

"Let's note only that it not the compiler, qWord generated system and constantly accompanies it - supports process of its existence. In general CRR approach demands existence of the interpreter, differently the same object approach which is inevitably following from compilation will turn out. qWord actually is the virtual computer."

Our Smart-MES contains both the compiler, and the interpreter. As a result of compilation of text Projects of technological tasks all databases, all settings for formation of screen forms and reports, all calculation tables for operation of the interpreter and the DLL program for performance of

calculations without interpretation are created. The interpreter is used only at a stage of debugging of technological calculations. All work of compilation without creation of DLL programs takes some seconds. In this case presence of the Designer of Projects of technological tasks and their compilation with creation of all information environment of system is a clear advantage of Smart-MES.

4) "It is characteristic that it is simply impossible to break structure of system any actions of the user, the truth it is possible to achieve very high degree of its inefficiency and it will be very difficult. Here we receive qualitatively other tool for work with information and other technology not only in development, but also in approach to use of IS."

The question in a break of structure in Smart-MES in general is not necessary since all structure is quickly created at compilation of Projects with recovery of data from a DB of the previous calculations.

5) The book - part 8.3.8. Problems of spontaneous bases.

"With the advent of the first applied products of tool technology there was also a temptation to train system in a natural language of the person, using the same tools and technology. And expenses, and it is obvious - considerable, will pay off overall performance of appendices. However here all also came to an end without having begun."

But in all this Smart-MES it is successful and excellently solved. Thus, on tasks statements of technologists in a format: Designation of an indicator, the Unit of measure, the Name of an indicator, Algorithm of calculation of an indicator - in the same way are also entered in text Projects of tasks by means of the Designer of Projects who is a part of the executive Constructor\_ARM.exe module. And, the algorithm of calculation is formed in a usual engineering view with use of designations of indicators habitual to the technologist.

6) "Among other things, there was extremely important rather unexpected, but general fact. Since some and very small level of a full automation and naturalness of the interface, the user stops thinking not only about logic of data, but also about logic of PS, i.e. external logical model and about logic of own work. It turns out that more simply and much more effectively nevertheless to force the user to acquire a necessary minimum of the system diploma for the benefit of its own activity."

In our Smart-MES everything is executed harmoniously and clearly for technologists. The person thinks better and operates with concept - the table. In our case one table corresponds to one subtask where the column designates the concrete equipment, and a line - a technical and economic indicator of this equipment.

7) The book - part 8.3.9. Why in Cache '-technologies?

"All that is possible in Cache' - technologies perhaps and in other technologies but only if the Designer of System manages to overcome all traps and traps which construction are an integral part of more rich languages."

Our Smart-MES does not use Cache '-technology since it is simply not necessary to it, but all issues are resolved when using rich META language. Naturally, it was given not at once, and another to pass our way simply not perhaps since our previous experience and our brains are for this purpose necessary.

8) "If someone has a desire to overcome difficulties - overcome. It will turn out (at success of such fight) maybe better in some aspects, and, generally, the same, but very much and very even not cheap. Now, coming back to the first approach, it is possible to answer a question, than Cache' - the technology is better any another for work with opened (i.e. real) systems? This lack of need to overcome difficulties better."

Before final development of Smart-MES "MES-T2 2020" we developed the Program Complexes "Technological Office", "MES-T2 2007", "MES-T2 2010". It was not aspiration to reach some beforehand set result. This simply creative innovative creation. And when say that Cache'-technology is better any another for work with open systems, I will tell that this absolutely incorrect statement. And example of it, our Smart-MES.

9) The book - part 8.5. Self-improvement of ISU.

"Systems possess opportunity to develop, change the structure after change of problem area and set of tasks that, apparently, where it is most important together than the taken cunnings and specific receptions in systems of AI, especially if to speak about real, but not toy situations, formally designed habitats of system chess, logical, etc."

Our Smart-MES was created at once with need of the maximum control of all elements of system for power plants. But something concrete, peculiar only to power plant, in a kernel the system absolutely is not present. Therefore Smart-MES can be easily used for any process productions: power industry, chemical industry, oil and gas industry, metallurgy, etc. But it is not intended for discrete productions, for warehouses and for accounts department at all.

10) "In the transferred systems the mechanism of development of structure of system obviously appears only in case of multiple interaction of active components - both system, and users, i.e. is well identified only in big and difficult systems."

The mechanism of development of structure is involved in our Smart-MES from the very beginning of adaptation of this program Complex to concrete realization. Thus, at the beginning the Complex is represented simply empty, i.e. absolutely anything is not present neither databases, nor screen forms, reports. And all this automatically starts being created after compilation of the first text Project of a task. By drawing up new Projects all Smart-MES system can infinitely increase.

11) "In all considered cases the natural structure organizing system is obviously and accurately shown. Over a layer of static data there is a hierarchy from three virtual computers of management of hierarchy of data. Let's remind, it: a) actually model of data (MD), i.e. realization of the B\* trees mechanism, display of data to physical structures of memory; b) model of metadata (abstract MD), that in Cache' TMMD is called; c) generator of abstract MD. In order that this system of virtual computers could create itself, the fourth layer of a superstructure - the virtual tool computer which is necessary for self-creation of both a tool layer, and appendices is required."

Our Smart-MES also has all these layers of models with only that difference that the B\* trees mechanism is not used and Cache is not used'. After all ingenious - is simple. And at us the outer user side of system looks so simple, and its internal contents, but it not for users is submitted so difficult.

12) "As literally the same hierarchy of virtual computers arises from absolutely various concepts, naturally there is an assumption that such structure of high-organized information systems not a consequence of some approach or approaches, but a consequence of such device of the phenomenon, information phenomenon."

It is possible to agree with it completely! We, developing the Smart-MES and without knowing a basis of "Informdynamic" at all, other developers of systems of other orientation came to the same results, as. In this case, probably, there is a general need of emergence of Self-organizing Intellectual Systems.

13) The book - part 12.6.2. Destruction at a metrization of data

"As we already spoke above, specialists in the theory of management and all know, the experts programmers creating and accompanying information systems too know - it is necessary to correct simply model of data and to restructure a DB own hands, and it is even better - something



adaptive and algorithmic. And to call all this the system founded on knowledge or intellectual."

In this case it is necessary to recognize that we also are such experts programmers who developed the best in the world Self-organizing Innovative Smart-MES System for power plants. It is possible to speak about its technical and intellectual capabilities long. But I will stop only on some. Calculation of 20000 indicators with unique algorithms of calculation with use of 300 standard schedules is made less than in 1 second. Entering of any changes into structure and algorithms of calculations is carried out in 5 seconds. The intelligent mechanism is capable to register automatically in the Knowledge base technological cuts of power plant with a zero excessive consumption of fuel and to advise the operational personnel optimum options of loading of the equipment.

Uniqueness of innovative Smart-MES system is that it consists of a huge set of the KNOW-HOW:

1) The description of ARM (the automated workplace - a set of technological tasks) on simple human META language of the 4th generation in the form of the text Project;

2) Automatic control of all System of calculations from the text description of ARM, i.e. automatic creation of Conductor ARM, the Menu of tasks, Information databases, Screen tables and Reports;

3) Automatic creation of settlement DLL programs and SQL Server of the Appendix;

4) Automatic digitization of standard schedules of power characteristics of the equipment of any complexity;

5) High-speed debugging of calculations of Indicators for their digital values;

6) Realization of optimizing tasks modernized the Simplex method;

7) Automatic control of operation of application the Client/server on 3-unit structure with any SQL Server (MS SQLServer, Oracle, Interbase, MySQL, Informix, Sybase, SQLBase, PostgreSQL);

8) Automatic control of work of the Web application for the Internet on the IIS Web Server;

9) Dynamic modeling of work of power plant and optimization of resources on minimax strategy with variable number of the optimized factors;

10) Automatic construction HOP (characteristic of relative gain) on real model of power plant.

The special role Smart-MES is played by two moments: DLL calculations and Self-adjustment of the Complex for any power plants: Combined heat and power plant, state district power station, PGU, hydroelectric power station, NPP; and also for any process productions.

## **29. The Multiagent of the Self-organizing Smart-MES system**

Multiagent systems and the multiprocessor computers are urged to increase possibilities of information technologies. But if computers, including even gadgets, already all became the multiprocessor, multiagent systems for industrial productions are practically not present. Why? Yes because program agents have to be self-organizing, and anybody in the world is not able to do it. But we incidentally managed to solve this problem.

You only present a great number of "dead" identical program agents who else are not able to do anything. And here they start coming to life, taking from "shelf" for themselves a task, i.e. a set of text projects, and by means of self-organization are instantly trained in skills. They exchange words among themselves under the protocol: "the first, first, I the second, assumed functions of the account" or "everything, everything, me lined, assume my functions of management". According to the current production context agents independently quickly can change the skills. Thus the agent "kills" himself and from "shelf" takes the next task for self-organization and is again ready to action.

It is not possible to destroy such multiagent system since like Zmey Gorynych at whom at an chop off of the head grows new, and at system in case of death of one agent, his place is taken by another. What function is carried out by this or that agent anybody out of system does not know. In this case there is a two-level self-organization: at the level of the agent and at the level of all system.

The agent (Latin *agere*) everything is considered that works. But it is supposed that computer agents have some other attributes which differ from usual computer programs [8]. Such as: ability to function under an off-line control, to perceive the environment, to exist during the long period of time, to adapt for changes and to possess ability to assume achievement of the objectives, put by others. The agent who acts is called as the rational

agent so that it was possible to reach the best result or, in the conditions of uncertainty, the best expected result.

Multiagent technologies allow to solve problems for which frequent and unpredictable changes are characteristic and difficult dependences between elements take place. Unlike traditional systems in which the solution is found by means of the centralized, consecutive and determined algorithms, in multiagent systems the decision is reached as a result of the distributed interaction of a great number of agents - the autonomous program objects aimed at search, perhaps, not so much optimum, how many the most adequate and actual decision on each timepoint.

Thus, one and too software Smart-MES is used as agents for coppers, for turbines, for give of heat and for give of the electric power, for the accounting of losses and for the accounting of own needs, for chemical water treatment, for station actual TEP and for standard TEP. Here the given agents do not substitute the existing PCSs, and them supplement. These agents can control a condition of pipelines and wear of the equipment, and many other things. All agents are among themselves connected by protocols of a constant exchange. All agents work in parallel in real time and all in a complex are aimed for achievement of the maximum profit on electricity generation and heat.

Thus I will not claim that this multiagent system will at once solve all problems of power plants, but it will allow the generation companies to be ahead of the planet of all.

Here before me the monograph about Stewart Russell and Peter Norviga's intellectual agents [9]. All modern achievements are presented in this book and the ideas which became incentive to development of artificial intelligence as sciences of design of rational agents are stated. In this book it is told that the artificial intelligence is not magic and not science fiction, but an alloy of methods of science, equipment and mathematics.

Thus, the science about intellectual agents is, modern gigahertz and gigabyte computers are, the self-organizing Smart-MES system is. Remains

very little, namely, to realize this alloy, for example, in the environment of power industry.

After all we want it or not, not to stop progress on multiagent technologies any more, but it is possible to appear easily on its roadside, losing thus multi-billion profits on lack of intellectual management of power plants. I remember how 20 years ago ideas of PGU hard moved ahead, and now they became, nearly panacea of energy efficiency. But many years for increase of economy of Russia are dully missed.

On the SmartGrid of the power engineering specialist of the future portal under the direction of "FGC UES" at full speed there is a discussion of questions of introduction of multiagent control systems for intellectual networks.

In the article "Use of Multiagent Systems in Power Industry" [10], it is told: "The beginning of development of specialized expert systems and artificial neural networks became the appeal of power industry to area of artificial intelligence. Systems (IAC) can become the following step in this direction multiagent. Expect the flow of information following an energy stream from transition to intellectual networks (Smart Grid)".

Well, really the generation companies will allow that networks were intellectual, and power plants and would remain in "bast shoes".

Creation of multiagent systems for the industry, unfortunately, still remains a prerogative only of scientists since agents with self-organization are for this purpose necessary, and they are not present. Even for the West the multiagent technology for the industry is exotic.

And meanwhile, the Firm of Information Systems developed and approved the self-organizing Smart-MES system which can be involved in multiagent technology for realization of cognitive functions of management of any power plant and any industrial enterprise.

However, in "FGC UES" development and deployment of multiagent system at which self-organization functions are declared is planned. But to

tell - one, and really to make is absolutely another. And here neither huge state investments, nor huge team of developers will not help. As a result it for certain will be pseudo the multiagent system consisting of "lame" agents.

We on realization of this self-organizing system needed 10 years as a result of which seven generations were developed ON, and we developed them, without representing final part, and is absolute in a separation from researches of scientists. As a result only the last generation became deification of self-organization in IT. To create similar system, knowing our principles of self-organization, now it is possible much quicker, but they should be known. Here roles a platform, neither a programming language, nor a database do not play. To create without us something similar or even the best, probably, it is possible. But miracles do not happen.

For example, we will remember Tesla. He claimed that in the condenser consisting of the earth and an upper atmosphere is concentrated energy in thousands of times the exceeding all needs of the electric power for the world, and that everyone can use on its technology it as much as necessary. Neither power plants, nor power supply networks are not necessary. But monopolists of the USA destroyed all its practices. And now anybody cannot repeat them. And time so, it is given simply for a bluff.

And I will dare to declare that our technology of self-organization ON is similar to technology of obtaining energy from air at Tesla. Only at Tesla it marked revolution in power, and at us in IT. And relation to them of monopolists and state just the same, i.e. regrettably short-sighted.

It is asked, than agents differ from services, or in other words: why the multiagent system is necessary?

Here simple example. For development of the major state decision two teams are gathered. In the first (services) experts only from one corporation, and in the second (agents) - from different corporations are involved. And how you think, what team had the best and more weighed

decision? Naturally, at the second since this team was not limited to the settled principles only of one corporation.

Thus, first, services use the determined algorithms, and agents work in the conditions of incompleteness of information and therefore use intuition. Secondly, above services there is an operating arbitrator who coordinates their work, and over agents the arbitrator is not present, and they function absolutely independently. Thirdly, each service has accurate mission, and for the agent it not essentially since he can perform any tasks, possessing self-organization and self-training.

And now about management of power plant. It is absolutely clear to all that the person operates power plant much worse, than automatic system with intelligence elements. Though the person also uses intuition, but he is not able to operate with thousands of factors in the conditions of uncertainty, providing thus implementation of the daily schedule of delivery of the electric power and heat at a minimum of expenses and in the absence of thus accident. In other words, main objective of management of power plant this providing the maximum profit.

The usual automatic system in the conditions of constantly changing market of the electric power will not pull it since in this case it is necessary to make not optimum decisions, but the best taking into account all risk factors exactly at present.

The matter is that electricity generation and heat is so unique because of impossibility of their accumulation. In other words, if it is developed the electric power and heat it is more, than for it it is paid, these are simply thrown out money spent on the spent too much fuel is useless. But multiton power coppers have a big lag effect, and it means that if fuel supply, but sharp steam still is stopped some time will be useless to be developed. Therefore in management the principle of the intuitive advancing influence has to be used that the person is not able to provide.

Here it is necessary to understand that at power plant there is a set of sites which needs to be operated in interrelation, and the great number of

agents who are capable to assume management of any site has to be for this purpose involved, thus the quantity of sites and number of agents can not coincide. In this case agents quickly use the principles of mutual assistance.

It was told about intuition which, as well as the person, program agents have to possess above. But unless it is possible? Intuition - the direct comprehension of truth without logical analysis based on the previous experience. But subconsciously the person in the conditions of uncertainty operates with probabilistic methods which are given for intuition.

In the agent Bayes's theorem for this purpose can be used [11]:

$P(A|B) = P(B|A) \cdot P(A)/P(B)$ , where

$P(A|B)$  - probability of a hypothesis of A at approach of an event of B;

$P(B|A)$  - probability of approach of an event of B at the validity of a hypothesis of A;

$P(A)$  - aprioristic probability of a hypothesis of A;

$P(B)$  - probability of approach of an event of B.

This simple equation is the cornerstone of all modern systems of artificial intelligence for a probabilistic or intuitive conclusion. Bayes's rule allows to calculate unknown probabilities from known conditional probabilities.

Uncertainty arises at power plants and because of economy of efforts, and due to the lack of knowledge. Uncertainty cannot be avoided in difficult and dynamic productions. Existence of uncertainty means that many simplifications, possible in a deductive logical conclusion, become any more admissible.

The agent can count probabilities of not observed objects on power plants and use them for adoption of the best decisions in comparison with what are accepted by simple logical service.

The power break declared by JSC FGC UES in power industry regarding IT assumes use of nonconventional approaches since if they



usual, no break can be, and without innovative IT power having dug no more than visibility.

"FGC UES" holds the second year the All-Russian competition "Energoproryv", for the purpose of attraction of breakthrough projects in the field of intellectual power, urged to combine efforts and knowledge of representatives of different areas of science and equipment for creation of power of the future. But the power of the future assumes use of IT of the future.

But what actually has "FGC UES" by results of competition for 2014? On competition 270 projects were submitted, from them with IT are connected 67 that makes 25%. 12 projects became finalists, from them with IT are connected 9 that makes 75%. It would seem, the good tendency towards IT is observed. Also we will notice that among all projects which are not connected with IT only 1,5% received attention. It means that the vector "Energoproryv" is really directed towards intellectual power which is naturally possible only with intellectual IT.

By the way, among 9 finalists in the field of IT, there was also our project: The self-organizing information Smart-MES "MES-T2 2020" System. Other 8 projects are connected with monitoring, with exercise machines and with diagnostics. Here I will notice that only our only project is most approached to realization of intellectuality in power, but he did not take a prize.

It would seem, the absolute nonsense is observed. "Energoproryv" in search of intellectuality and a multiagent rejects this most perspective intellectuality and a multiagent, having equated them to "bolts and nuts". Why? And to it there is an explanation.

All experts in power industry can conditionally be divided into two groups. Production workers and technologists who are far from IT treat the first group. Experts of IT who are far from electrical power technology treat the second group. Here at once it should be noted that all experts of IT

in Russia were learned on the western ideologies in IT since domestic simply is not present.

And here on court the Russian innovative IT system realized not on the western canons is presented to the commission. Naturally, in this case owing to the competence only IT specialists can have opinion. But this system is alien to them since they do not see in it habitual western terms and brands. In this case, undoubtedly the verdict can be only negative.

### **30. The newest understanding of Smart-MES for power plant**

In Russia more than 300 power plants which are distributed between the Generation companies function and are territorially scattered. All combined heat and power plants and state district power station different in technology and structure of the equipment. Power plants treat category of process production, i.e. every minute for power generation and heat a certain amount of fuel is burned. The general for all power plants is approach of technologists to their management, i.e. technologists conditionally work with technological cuts which are dictated by the plan of delivery of the electric power and heat in concrete periods of days and taking into account their feasibility.

These cuts differ on duration and on number of the parameters participating in management depending on structure of the working equipment. But it is possible to allocate the general principle of management. At power plant there are stable and transition processes. For the stable and slowly changing processes it is possible to accept cut duration in half an hour, and for transition processes - one minute.

The purpose of functioning of the Generation company and power plant is the profit. The size of profit is in direct dependence on quality of implementation of the plan of delivery of the electric power and heat, on expenses of fuel and fail-safety.

At management of power generation and heat it is necessary to achieve a zero excessive consumption of fuel in each current cut by optimization of loading of the equipment. In other words, for each developed quantity of the electric power and heat there are settlement standard costs of fuel, and its actual expenses should not exceed these standards. For this purpose the system solves the following technological problems:

**1) The automated data input from the existing means of collection of information.**

On each of 300 power plants there are funds of data collection from sensors of pressure and temperature and from electric power counters:

ASKUE, ASKUT, ASKUG (the automated systems of the commercial accounting of the electric power, heat, gas), the PCS, "Bee", "Delta" and others. All of them have different developers, various ideology and the databases. Intervals of poll of sensors - of several seconds. Therefore from all these databases it is necessary to collect necessary information in uniform base with restoration of missing signals in necessary intervals of time - minute or half an hour.

## **2) Manual input of daily allowance and monthly data.**

Monthly data input is used for an institution of planned indicators for monthly tasks. Daily input is used for missing initial parameters of the automated input and for conditional and constant indicators. In this case daily values are transformed to half-hour and minute databases. And if necessary for bigger reliability they can be processed by regression dependences together with parameters in which there are sensors.

## **3) Calculation TEI (technical and economic indicators) of the equipment and power plant in general.**

All technological tasks are made out in the form of text projects on simple engineering meta language of the technologist by means of tool means "The designer of projects" [3] where algorithms are formed by means of templates. The project includes two main descriptions of a task in a tabular look: the description of columns with station numbers of the same equipment (a copper, the turbine) and the description of lines with initial and settlement indicators of this equipment in the following look: designation, unit of measure, name, algorithm of calculation.

After compilation of projects databases, screen forms, reports and settlement DLL programs are automatically created. As a result full calculation of TEP (calculation of the actual and standard TEP, give of heat, costs of own needs and losses of the electric power and heat) of any power plant is carried out less than 1 second.

## **4) Monitoring of the current excessive consumption of fuel and other indicators on BCP (block control panel).**

Expenses of fuel make more than 50% in prime cost of the electric power and heat therefore minimization of these expenses is the main

criterion function of production management of power plant. Only elimination of an excessive consumption of fuel uncontrollable now will give economy of more than 10% of its expenses.

The excessive consumption of fuel comes to light as a result of full calculation of TEP. Continuous monitoring of the current excessive consumption of fuel on BCP creates compulsory motivation of the operational personnel in economy of fuel. In the absence of monitoring any highly skilled personnel allows an excessive consumption of fuel on each technological cut since he knows nothing about this overexpenditure.

The excessive consumption of fuel in a month is summarized from all overexpenditures in each cut. The monthly and daily calculations of an excessive consumption of fuel existing now are methodologically incorrect because of curvilinearity of standard schedules. Ignoring of it conducts to concealment of a reserve of increase in energy efficiency of power plants.

#### **5) Development of recommendations about optimum loading of the capital equipment.**

There are some approaches of optimization: a simplex method of the decision of system of the linear equations, a method of dynamic optimization on full model of power plant with minimax strategy, the HOP (Characteristic of Relative gain) of Optimization method. It should be noted that the decision of system of the linear equations is realized as a usual technological task on the text project.

#### **6) Calculation of necessary expected amount of fuel.**

For calculation of expected amount of fuel specific costs of fuel of power generation are usually used and is warm. But there is more exact method of calculation which uses information on technological cuts in the knowledge base at a zero excessive consumption of fuel. For this purpose it is enough to set the planned schedule of delivery of the electric power and heat, and also data on the working equipment.

#### **7) The analysis and identification of false operations of signals and operator's mistakes at emergencies.**

In this case with the minimum interval of the automated data input current state of discrete parameters is compared to the previous. At

identification of change its correctness is analyzed. In case of an incorrectness the message is issued for BCP. Also analog parameters can be in addition involved. Algorithms of a correctness are described also in text projects to similarly technological tasks.

#### **8) Representation of retro and current analytics of initial and settlement indicators.**

For analytics the set of tools is presented: the review of indicators with control for other analytical tools, the operational magazine, expeditious monitoring, the express analysis with possibility of creation of hierarchical schemes without graphic editor. By an analytics call the magazine on the set indicator for all units of the concrete equipment is automatically formed of a screen form and the schedule is output. The analytics can be looked through in a section of half an hour in days, in a section of days in a month, in a section of months in a year, and also in a section of watches in a month.

#### **9) Transfer of necessary data on the top level.**

On the Internet any information can be transferred, including also operational data on an overexpenditure to fuel and the main current indicators of power plant.

#### **10) Formation of monthly reporting documents.**

Reporting documents are formed as monthly tasks in the form of the text project. Monthly data turn out accumulation of daily data, and daily and replaceable - accumulation half-hour. Monthly data on watches are formed of data on changes on the basis of the schedule of watches.

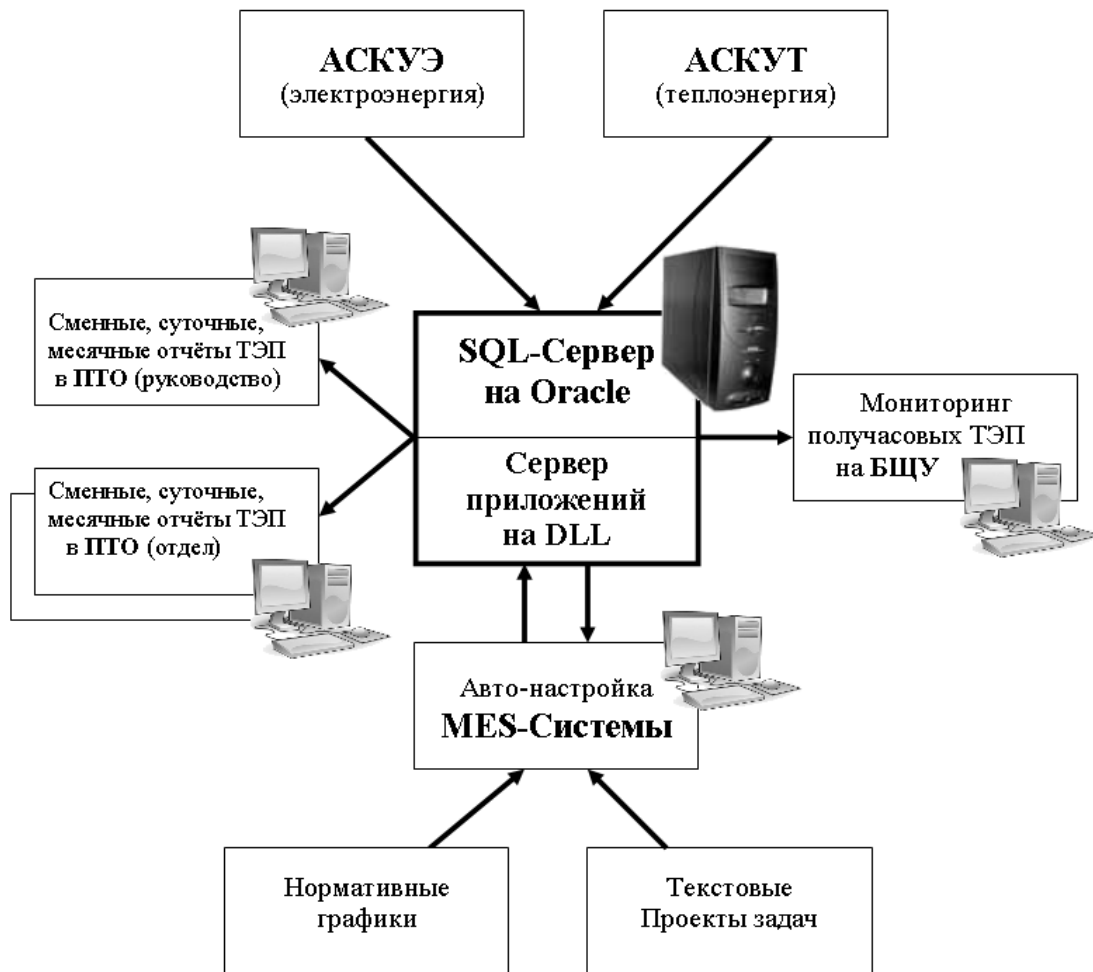
#### **11) Creation of electric and thermal graphic circuits with a conclusion of dynamic information.**

The graphic vector editor allows to create hierarchical technological schemes with representation of power primitives, drawings and texts. It is possible to bring the current analog and discrete information to these schemes.

#### **12) Current modification of algorithms of technological tasks.**

All vitality of system is provided with ease of entering of any changes by technologists into structure of calculations and in algorithms of tasks. All changes are made by means of correction of text projects with the subsequent their compilation.

## Scheme of functioning of Smart-MES system





## **31. Imperception of the Self-organizing Smart-MES System**

To us it was declared that this lies about self-organization and any this system which is not self-organizing time is a task for a configuration, and intellectual systems do not happen in principle.

The strange thing turns out that terminology is much more important than the essence of this system which nobody surpassed in adaptation and high-speed characteristics. Our Smart-MES system is already developed and approved, and from what nickname will obtain, it will become better or worse not.

But there is a scientific world which thinks out concepts and problems, with them connected. Same concerns also the concepts "Self-organizing System" and "Intellectual System". To these concepts scientists attribute various criteria. In other words, if the system corresponds to these criteria, this system can quite approach under this concept. Then it is only necessary to prove it. Only trouble that different scientists appropriate to these concepts different criteria.

But when we developed innovative system, and scientists say that the self-organizing system can be created only in the far future why to us, comparing the theory of scientists to our engineering realization, not to be indignant and not to show to the whole world that she already is.

G. Haken [6] declares: "We call system self-organizing if it without specific influence from the outside finds new functional structure". In our system in addition to technologically empty EXE module there is a text where in engineering language technological tasks are formulated, and this text is simply a source of knowledge, i.e. nonspecific influence. That's it it also served as a subject of the most severe criticism. Thus, it is claimed that time is the text in which parameters are specified, it is allegedly elementary specific influence, therefore, the system is far from self-organization.

Well, it is necessary to defend the engineering pride, time got into a scientific jungle. Here we will not speak in detail about the person who is trained by 20 years, but he is the self-organizing system. The critic noticed, apparently, superficial discrepancy. But it was actually fair about five years ago when this system was called "Plug-and-play", and it was just previous generation. Now it grew to self-organization when it independently makes

transformation of multitask structure in single-task in general without external influences. In this case the self-adjustment is used only at a stage of on tasks debugging. The result of self-organization functions as an application server of the general calculation on the DLL program.

I will try it to explain. All calculation of the actual and standard TEP with automatic data input and with an exit to standard specific fuel consumption makes some tens tasks of various means of the lower level. Such as: actual and standard calculations for coppers and for turbines, calculations for fuel, calculations of give of heat, calculations of balances, calculations of losses and costs of SN of the electric power and heat, calculations of emissions, well, etc.

Each such task has a screen form in a tabular view where the column corresponds to object (a copper, the turbine, etc.) with the station number, and a line - to an indicator. To this screen form there corresponds other table with algorithms of calculation. Process of the solution of a task looks as follows. At start of a task basic data are read out in a form from information database, calculation is started and then the result registers back in the same information base.

But our researches showed, what even the consecutive automatic call of all tasks on performance is pretty long process. Therefore it was decided to integrate all tasks into one, and for this purpose it was necessary to connect somehow all screen forms and calculation tables in one big screen form and in one huge calculation table. Here present that there are 40 tables of various dimension, on average on 10 columns and till 50 lines, and these are  $40 \cdot 10 \cdot 50 = 20000$  indicators.

At the maximum number of columns in 20 resulting table will be already dimension 20 on 2000. And that's it this organization allowed to reduce calculation time for some orders. So these 20000 indicators now pay off less than 1 second. It is not possible to execute these calculations in principle quicker. Why such speed is necessary? It is necessary for performance of tasks of optimization of resources by method of dynamic programming on full model of power plant when for a certain period it is necessary to count as much as possible options.

Thus, process of self-organization of system by automatic transformation of all tasks from the text projects issued in engineering language by means of templates includes the following stages:

- 1) Transformation of all tasks from engineering language on mnemonic language;
- 2) Transformation of all tasks in mnemonic language in one task;
- 3) Transformation of a total task from mnemonic language on Pascale;
- 4) Transformation of Pascal to a machine code with formation of DLL.

But let's return again to terminology "The self-organizing system" applicable to information systems in definition of modern scientists. Shortly I give these criteria:

- 1) The self-organizing system has to be autonomous and active;
- 2) The self-organizing system has to be the organization opened at all levels;
- 3) The self-organizing system has to function on the basis of own purpose;
- 4) The self-organizing system has to provide a correctness and high level of reliability;
- 5) The self-organizing system has to provide interaction at the semantic level;
- 6) The self-organizing system has to give more and more ample opportunities;
- 7) The self-organizing system has to arise and be formed without participation of programmers.

And so under each point it is possible to subscribe that Smart-MES have all this. Therefore it, certainly, is self-organizing. And why then critics and scientists do not blow a fanfare? Everything is very simple when already there is in the nature a self-organizing Smart-MES system, to their further infinite and pointless fabrications, naturally, the place is not present.

But why power plants need this self-organizing Smart-MES system in particular and power industry in general? Though actually it is suitable for any industry, especially with continuous nature of production, but I speak about power industry because I am closely connected more than 30 years with it and well I know it.

The matter in the past would sound so: why the bulb when there is a candle is necessary? For a candle it is necessary nothing, and for a bulb the power plant is necessary. But with a bulb progress is possible, and with a candle is not present. And with the self-organizing system further progress

is possible, and with the existing software at power plants he is not possible in principle, like a candle.

Here it is necessary to stop especially on thermal power plants which are more mobile in respect of progress in comparison with the NPP and with hydroelectric power station. After all at all combined heat and power plants and state district power station there is a big percent of the outdated and worn-out equipment to which modern PGU and other technologies in addition are established. Here also such mad hybrid old with turns out new which in total it is necessary to watch in real time, making constant calculations of the actual and standard TEP. But at one power plant it is not present.

But only continuous search of a reserve of increase of profitability of power plants will allow the Generation companies to increase the profit. And for this purpose already there is a self-organizing Smart-MES system which can easily reveal and provide these reserves.

It is considered to be that the scientific world prepares "soil" for future development of the industry. And if scientists of IT predict emergence of the self-organizing system as revolutionary break not only in IT for the industry, but also the industry which not especially shines with innovative development, probably, it has to deserve attention from the leadership of Russia.

But here, the Firm of Information Systems developed the Intellectual Self-organizing Smart-MES System for a long time, but it not demanded lies on the shelf and becomes dusty. Or perhaps at all power plants for calculation of TEP other self-organizing systems are already involved? But except ours in the world similar systems simply are not present. Or perhaps at all power plants of IT do progress miracles? But then would not be at power plants of a huge excessive consumption of fuel. Or perhaps it is also not present, this most notorious overexpenditure? But, unfortunately, nobody knows it and does not wish to know since at one power plant there is no elementary operational accounting of an excessive consumption of fuel (the fact - the standard) which comprises big reserves of increase of profitability of thermal power plants. This uncontrollable excessive consumption of fuel in a year across Russia is equivalent to 100 billion rubles which dully jump out station pipes, poisoning the atmosphere with harmful emissions.

Just in Moscow in YIP RAHN passed the XII All-Russian meeting on problems of management [1] in which Works more than 1000 articles of scientists from all Russia are published, including also our Report: "The new concept of a self-adjustment of MES-T2 2020 MES System for management of any process production and power plants". There is a wish to notice that except us, none of great scientists did not offer the ready principles of creation of the self-organizing information systems.

However scientists declare that the self-organizing systems existing now in the nature (not in IT) have the physical nature in which self-organization is carried out at the expense of unformalized, until the end of not understood physical processes. And here Aristotle's philosophy as the concept of "self-organization" implies action of internal, i.e. Aristotelean, driving forces comes out on top: *causa formalis* (formal reason) and *causa finalis* (target reason). Proceeding from it, for scientists and interesting the problem of use of this device in the field of informatics, namely, for creation of the self-organizing information systems [12] is represented important.

Of course, ridiculously to watch these tortures of scientists and it is offensive for Russia in general. Ridiculously because such information system is already created by us (Registration in Rospatent No. 2014618991 of 04.09.2014 of the program: The self-organizing information Smart-MES "MES-T2 2020" System). And it is offensive because this greatest achievement of engineering thought knock in different structures of power industry and governmental bodies for a long time, but everything is useless. Probably, has to pass some time for judgment of the come true revolution in IT.

And now about the Aristotelean principles of self-organization which are realized in our Smart-MES system.

Self-organization is the main process of evolution of difficult systems consisting of irreversible consecutive processes of streamlining. Evolution of self-organization of systems of a teleologichn in the sense that in itself conducts to more perfect structure and dynamics of information. One of founders of synergetics G. Haken [6] defines this concept as follows: "We call system self-organizing if it without specific influence from the outside finds new functional structure".

Whether the new functional structure at self-organization of Smart-MES system without specific influence is so created from the outside? Here

as specific influence it is understood such which imposes to system structure.

It is simpler to analyse it on our real system in which in a starting position there is no database, there are no reference books, there is no menu of tasks, there are no screen forms, there are no reports, there are no the realized algorithms of production calculations, i.e. it is absolutely technologically empty EXE program and in general without structure. In addition to it there is a text where in engineering language the technological task is formulated, and this text is simply a source of knowledge, i.e. nonspecific influence. Further the EXE program itself it is trained to this knowledge of this text and the working system with all necessary attributes and with all system structure is created.

Then the trained system starts living, carrying out technological calculations and analyzing the current production context. At change of a context she makes changes to the installations or further is improved, by absorption of new knowledge.

Thus, the Aristotelean driving force of *causa formalis* (the formal reason) of self-organization consists in transformation of chaos, i.e. lack of harmony, in harmonious efficient system. Other driving force of *causa finalis* (the target reason) of self-organization is focused on realization of the easiest adaptive opportunities and on high-speed royal characteristics.

Now let's fluently look at the actual reaction of the official government institutions which are responsible for development of IT and the industry to emergence of the unique self-organizing system.

In the letter No. 14-PG-MON-5087 of 19.03.2014 from Department of science and technologies of the Ministry of Education and Science of the Russian Federation it is told: "You can address to Fund of development of the Center of development and commercialization of new technologies - Skolkovo Foundation".

In the letter No. P11-5898-OG of 24.03.2014 from Development department of branch of IT of the Ministry of Telecom and Mass Communications of the Russian Federation it is told: "We recommend to you to send detailed information on your project to venture funds".

In the letter No. OG-D19-2075 of 25.03.2014 from Department of innovative development of the Ministry of Economic Development of the

Russian Federation it is told: "We recommend to address to the organization the coordinator of a technological platform".

In the letter No. PG-12-1972 of 22.05.2014 from Strategic development department of Minpromtorg of the Russian Federation it is told: "We recommend to you to participate in competitive procedures of purchase".

So that scientists strenuously puzzle over creation of similar system if it is necessary to nobody? It is clear that scientists see further production workers and officials. They perfectly understand that creation of artificial intelligence not possibly without self-organization. After all what would not be power of computer facilities without the self-organizing information system not to manage since in this case different researches and experiments have to be conducted without programmers.

Our self-organizing Smart-MES system is capable to absorb an infinite number of algorithmic knowledge without programming. And according to the law of dialectic materialism change of quantity will surely result in new quality, and it already and there is a new creativity which progress in all industry will follow.

But why the power industry ignores this the most powerful self-organizing tools which were created especially for them and with direct participation of technologists from power plants?

Simply Generation companies already got used that money to them flows in pockets. I remember that at once after reorganization one manager accurately declared that now no optimization is necessary to them at all. It is much simpler to them to buy cheaper fuel and more expensively to sell the electric power, thus to have a decent margin.

However, already other time when fuel price only grows, and prices of electricity restrain the state. In this case actually no-cost technology of economy of fuel on Smart-MES would be by the way. Especially as it to technologists of combined heat and power plant and state district power station without developers and the more so without programmers allows to reveal quickly the hidden reserves of profitability of power plant by automation of all repartitions of logistics.

But if the network companies strenuously introduce recently various Smart-Grid and Multi-Agent technologies, power plants not to be a weak

link, should not lag behind. Also the multipurpose self-organizing Smart-MES system which introduction in the ideological plan will allow the Generation companies to leave for a long time behind itself the network companies is for this purpose already developed and approved.

In this case progressive true harmony in all power industry of Russia will also be reached.

In the developed international situation vulnerability of the strategic information systems installed at the domestic enterprises is very high. There is an opinion that use of the "bugs" capable to paralyze the software at power plants does Russia by the hostage in hands of the western states. After all if all listens to the USA, there is no guarantee that all western software is not larded by "bugs".

What is "bug" and than it differs from a virus. Everything is simple. The virus is written at the ordinary hacker level, and "bugs" are established in software at the state level by intelligence services. If it is possible to get rid of a virus, of "bug" not perhaps. If the virus is visually shown, "bug" never.

Now, when at Russia there are 70% of the western software, it can be a collapse prolog in the all-Russian scale. For example, Russia can be brought down pressing one button, having given command on the Internet to all "bugs" to action since by means of same "bugs" all cherished secrets about each power plant are in archives of the West for a long time. The software under the influence of "bugs" will be paralyzed, introducing chaos and an emergency at the same time on all power plants. And all power plants at once will stop, and behind them and all industry.

It is possible to trust or not to trust, it is possible to calm itself thought, what after all still anything similar is not present. Everything is correct since there did not come time of "X" yet. But for some reason the government first of all transfers to domestic software of civil service, without caring of the Generation companies.



## **32. Principles of Smart-MES as Innovative Project**

---

The principles of the self-organizing Smart-MES system developed by us for power plants with success can be used for the global project suitable for any industry.

### **Project purpose**

Creation of the self-organizing information system for all industry which would allow to realize and change instantly any most difficult algorithms of calculations in engineering language without programming, completely organizing from scratch all elements of big system: databases, screen forms, reports, DLL programs for calculation, analytics and optimization.

### **Relevance of a problem**

Self-organization of system does not demand traditional programming at creation of programs for any difficult calculations and for mathematical modeling. Writing and correction of algorithms in simple engineering language will allow technologists to make experiments on mathematical model without participation of programmers. It in turn will strongly reduce time from a plan before realization, and also will reduce costs of development of various software and its correction.

### **Assessment of importance of the tasks solved in the project**

Fast realization of any calculations and creation of any mathematical models without programming allows to accelerate realization of production technologies. The similar self-organizing system is not present in Russia, abroad. Scientists just predict in the far future emergence of the self-organizing systems as the major scientific achievement in IT. We already developed this system and creations of the self-organizing systems of the industry of Russia are ready to transfer all technology.

### **Novelty of ideas and technical solutions**

- 1) The description of a set of technological tasks on simple META language;
- 2) Automatic control of system from the text description of the Project;

- 3) Automatic creation of high-speed settlement DLL programs;
- 4) Built-in realization of optimizing tasks;
- 5) Automatic Client-Server SQL applications control;
- 6) Automatic Web applications control.

Realization of System is possible in 2 modifications: Client-Server with 3-unit structure without SQL Server and Client-Server with 3-unit structure with the SQL Server.

### **The description of the principles which are the cornerstone of the project**

Structurally the system includes four components: Designer ARM (the automated workplace), SQL application, Graphic editor, Web application. The basic is the Designer ARM. SQL applications and WEB work on settings of this Designer ARM. The system has no means of data collection directly from sensors, and carries out their import from the existing automated means of the lower level.

The designer ARM carries out full adaptation of system to specific conditions and can be exploited in the multiuser configuration of Client-Server without SQL Server. The similar configuration without SQL Server cannot be in one other System, since this our know-how. Advantages of such configuration of Client-Server are: lack of the SQL Server, 10 times more calculation speed, huge number of analytics and other opportunities.

In system all aspects are executed on technology of a radical innovation. The special role in innovative system is played by two moments: self-organization of all complex and DLL program for calculation.

Self-organization of a complex does opportunity deployment of the big automated system from pressing of one button. Thus text Projects of technological tasks will be transformed to necessary components of a complex. All tuning of a complex is performed for some seconds automatically.

Unique DLL programs are automatically created in machine codes at compilation of text Projects. It reaches the highest speed of calculations.

It is possible to speak much and about intellectual opportunities of system with use of technological cuts, and about HOP (characteristic of relative gain) of optimization, and about the built-in simplex method of the

solution of problems of linear programming, and about the solution of optimizing tasks by method of dynamic programming with minimax strategy, and about innovative algorithms of the prevention of emergencies.

But I will stop only on two important moments, i.e. the system is completely our own development which analogs are not present even abroad, and improbable ease of modification of technological tasks by technologists.

In the course of long system development we carried out draft adaptation of a complex at two tens combined heat and power plants, state district power station and the NPP for calculation of TEP.

### **The existing obstacles in a problem solution**

This system is developed long ago by us for power industry. But after reorganization all power industry "sat down" on the western IT having the untwisted brands. Therefore the most powerful development of small firm arouses mistrust. To break through on the market in the Generation companies and at power plant without corruption communications and without support by the Country leaders simply became possible not.

### **Scientific and technical reserve**

Use of self-organization is a necessary condition of maintenance of competitiveness of system and creation of new competitive advantages. Self-organization of our system is the unusual phenomenon and very rare fact, i.e. it that it is difficult to comprehend.

Extrema of the purpose of self-organization of Smart-MES system are: minimization of actions of the technologist at adaptation of system to specific conditions and maximizing speed of calculation of technological algorithms.

Minimization of actions of the technologist is provided with the built-in tool means "The designer of projects" of technological tasks in text form. Each task in engineering language is formulated in a tabular look with which the person interacts.

Maximizing speed of calculation is provided with four multiple transformation of a problem definition to an executive machine code.

And the most important, self-organization does not enter new mistakes into the new created system since it operates only with new meta information, and the main skeleton of system remains invariable. Absolute reliability of production program system is guaranteed to these.

### **The expected scientific and technical result of the project**

In what uniqueness of technology of creation of the self-organizing systems? Everything is very simple. She was born not as a result of thoughtful scientific researches of academicians, and in the course of long-term creative activity of simple Russian engineers. And we, eventually, achieved absolute self-organization of system with the adaptation and high-speed characteristics, best in the world. The structure of such system is unlike one western technology.

In this case the text in engineering language is compiled, and as a result of multistage processing all templates and DLL for calculation are created. In other words, absolutely empty EXE pig in the technological plan prepares the text, it processes and then with the received material functions.

This process of self-organization completely coincides with training of the person, but with three huge distinctions. First, the person is trained 20 years, and system some seconds. Secondly, the trained person for himself does not prepare texts since is not able, and the system, on the contrary, easily does it. And in the third, the person, having trained once, it is not capable to be retrained completely any more, and the system easily and is instantly capable to nullify all knowledge and to load new, but besides, it is capable to operate with a set of various knowledge at the same time.

Possibilities of this self-organizing system are simply huge which are defined by the following 4 main components: Main Module, SQL Module, Graphic Module and WEB Module.

The main Module has the Designer of Projects tools for fast preparation of texts with algorithms of calculations in engineering language. These tools process all prepared texts, optimizing the resulting machine code. The same Main Module carries out all generated calculations with granting the developed analytics. Besides it provides functioning of the multiuser system on 3-unit structure (the server of databases, an application server, the fat client) without the DB SQL Server.

Why the self-organizing system is necessary in principle? The matter is that scientists, analyzing stages of development of program systems, predicted emergence of self-organizing systems as the benefit for the whole world in the future. But irrespective of them we already created such system. Therefore self-organization is command of a century. And we were lucky to be the first. It turned out because we refused at once all western dogmas of creation of the big systems based on their SQL databases.

The idea was put following here manually not to create any component of system which treat: the menu of tasks, screen forms, reports, calculations in machine codes, reference books, databases and analytics. Special engineering language of a tabular form was for this purpose developed. The knowledge of this language is not required at all since it is formed automatically of templates in the Designer of Projects. Thus, there is a multistage transformation of statement of a technological task to a real machine code.

Though this system was also developed for calculation of TEP PTO (Technological Department) of power plants, but actually as a result it turned out that on it it is possible to realize in general any calculations for economy, for defense industry, for oil and gas and chemical industry, and even to build experiments on creation of artificial intelligence. And if it is short, our principle of self-organization is suitable in general for any program systems.

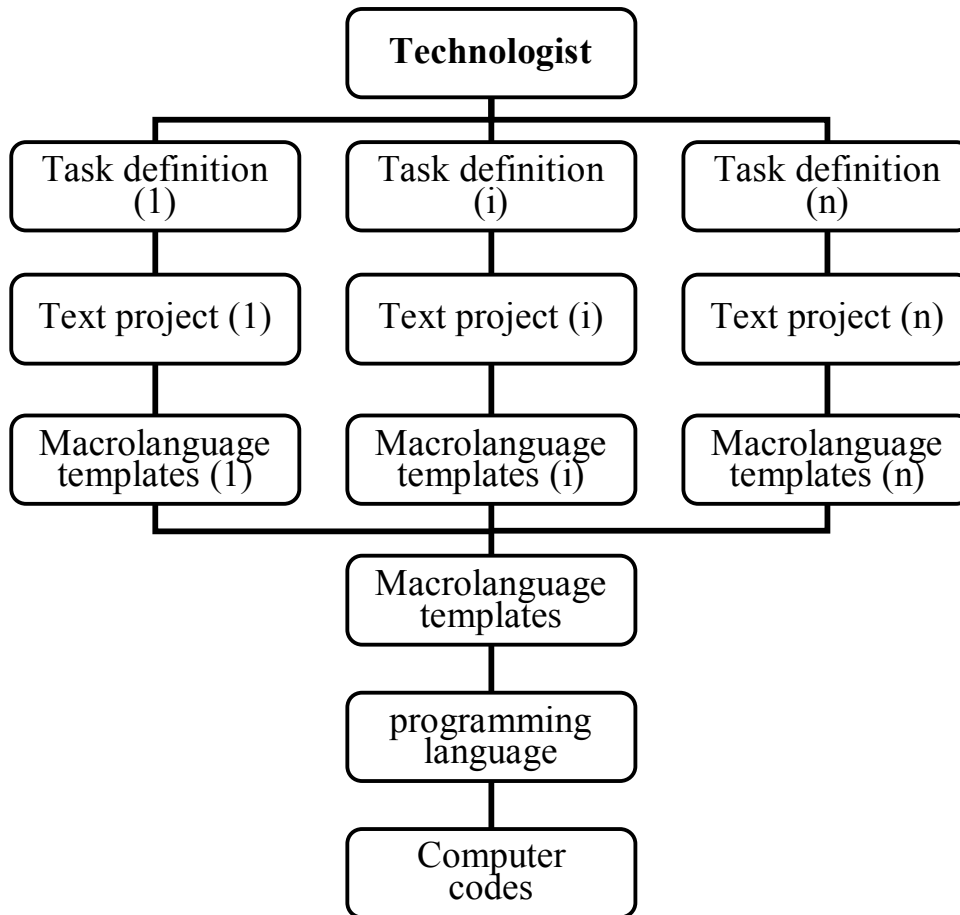
This principle of self-organization allowed us to improve as much as possible adaptation and high-speed characteristics of system which in the future will provide significant progress in IT.

Now it is safely possible to declare that it is not possible to create other system with easier adaptation functionality, as well as it is not possible to create more high-speed system.

### **Justification of a choice of technical solutions**

Self-organization of big system allows to realize a huge circle of plans in general without traditional programming.

In this case 5-fold transformation of a problem definition to a machine code by the following scheme is used:



1) The problem definition will be transformed to the tabular text Project.

2) Engineering language of the Project will be transformed to interpretative macrolanguage language with simultaneous creation of databases and templates of screen forms and reports.

3) All tasks on macrolanguage will be transformed to one general task.

4) The general task on macrolanguage will be transformed to a programming language, for example, by Pascale.

5) The programming language will be transformed to a machine code DLL.

### **The expected results**

The self-organizing system possesses the easiest properties of adaptation to various conditions and has the highest speed of performance of calculations.

So 20000 (40 tasks) the most difficult calculations of the actual and standard technical and economic indicators of PTO of average power plant with use of 300 graphic power characteristics of the equipment are realized less than in 1 second. Entering of any changes into algorithms of calculation happens in 5 seconds.

### **33. It is easy for Smart-MES to use, but it is difficult to create**

By and large, whether without difference difficulty or whether it is easy for Generation company to create system for automation of calculations of TEP since she all the same will not finance its full development because in the market enough organizations proposing ready solutions. And as for this Smart-MES system, whether that it is possible to create the similar? It is possible! But whether it will be better than this? Never! Why? It is not possible to repeat all our innovations simply!

At system the main technical characteristics it is functionality, an adaptability and speed of calculation. Naturally, it is possible to object, what supposedly why huge speed? On the server so there are powerful processors so programs work quickly enough. Here everything depends on the tasks set for system. If confused automation of calculations of TEP (technical-economic indicator) is simply necessary, any system really will approach. After all and MS Excel copes with it. If the Generation company prefers to have additional profit then our Smart-MES is necessary from introduction of system. And speed is necessary for realization of optimizing and intellectual tasks with use of full economic-mathematical model of power plant and for automation of calculation of the actual and standard TEP in real time, and also for the prevention of emergencies.

There is a bewilderment that, and in this case emergencies. All the matter is that on our Smart-MES any analysis algorithms of a correct mutual condition of discrete and analog parameters according to technological process that is necessary for the prevention of emergencies are very easily realized as any calculations of TEP for any power plant in unlimited number, and. But after all and the big uncontrollable excessive consumption of fuel in real time can also be an emergency harbinger. In addition and wear of pipelines has to be coordinated with the working pressure of water and couple.

Now in each Generation company the steady design was created, i.e. there is an IT manager, and there is the pocket IT firm. This IT firm successfully introduces ASKUE, the PCS, ERP. Here it is also asked, why they need still some Smart-MES which the IT manager and IT firm is not

wished to be seen in an emphasis. After all only present a dreadful situation that introduction of Smart-MES in a year at once will begin to bring to the Generation company huge additional economic effect, and these IT firms constantly "milk" some years the Generation company, and I pound is not here. The IT manager cannot recognize it in any way.

The matter is that IT policy in the Generation company the IT manager since he should understand information technologies directs. But to it that is more convenient to work with the pocket IT firm because of worthy economic feedback. And not to allow to a feeding trough of other IT developers to the course there are various lethal receptions, type: they have a system not of that platform, they have an outdated database, and, in end, for them does not work anywhere. After these recommendations no director of the Generation company and will want to hear about this IT developer any more.

But in this case the major subject is simply consciously substituted. After all the Generation company exists for generation of profit from delivery of the electric power and heat, but not for implementation of the academic IT projects. Therefore, everything that is capable to increase profit without big expenses, it is necessary to introduce urgently. But it easily is solved with "iron" since all management of the Generation companies is closer to technologists, and they are absolutely far from information technologies. Especially, very seldom happens that the computer program on production can make profit.

And so, we, taking into account my extensive experience in power industry and taking into account practical draft introduction of Smart-MES on a number of combined heat and power plant, state district power station and the NPP, noticed two negative features, characteristic for all thermal power plants of Russia. After all these two awful features represent our domestic power plants in the world market in scary unattractive light before foreign investors. Well, tell on favor, what stupid has to be an investor to put blood in antediluvian power plants where even there is no elementary accounting of an excessive consumption of fuel and where at all the emergency is not diagnosed.

The first negative feature consists in total absence of the operational accounting of an excessive consumption of fuel which corresponds to a



difference between the actual expense and a standard cost of fuel for concrete periods which should not be more than half an hour. In this case an excessive consumption of fuel on each interval, especially at night at the lowered loading, it will be obligatory for many reasons. The complex analysis of all these reasons with the subsequent their minimization will surely lead to elimination of this overexpenditure through compulsory motivation of the operational personnel on economy of fuel.

The second negative feature concerns absence of the prevention of an emergency which can arise at any moment of or because of wear of the equipment, or because of spontaneous operation of automatic equipment, or because of a mistake of the person. In this case it is not necessary to confuse to antiemergency automatic equipment which does not allow accident. If automatic equipment worked, it says that the emergency already existed a long time which led to an equipment stop with violation of a production cycle. In case of timely detection of an emergency it is possible to eliminate easily its reason without violation of this production cycle, and, therefore, and without loss of profit.

But after all by means of our Smart-MES system these two negative features can easily be corrected with receiving average additional annual profit in 300 million rubles from each power plant. But the Ministry of Energy of the Russian Federation instead of assistance in an explanation to the Generation companies of importance of elimination of these century defects concerning a huge excessive consumption of fuel and continuous accidents simply frankly ignores their existence, thereby, doing huge harm to policy of the Russian President on increase in inflow of investments into Russia.

Long ago passed those times when for us the fact of draft introduction therefore earlier we with ease agreed to realization of calculations of TEP for low price was the major and even participated in foolish competitions. In the present time we categorically do not participate in these archaic competitions since to us did not stick any more to behold as the hi-tech product is stupidly equated by the commission from bureaucrats to bolts and nuts.

In this case all our reasonings concerning prospects of introduction of our most urgent software product the very simple. If the Generation

companies need additional profit and if they wish that their power plants functioned without accidents then they will face our Smart-MES. And otherwise, that for the sake of vain to throw beads.

Therefore our today's policy is directed on intensive promoting in analytical press releases of various parties of our innovative Smart-MES system and on opening of vicious backward practice of functioning of today's power industry.

Here it is pertinently courageous to declare that we have great difficulties with search of the real Customer. And what Smart-MES "died"? By no means! The matter is that the most important feature of Firm of Information Systems consists in its floodability. And Smart-MES is constantly modernized, comprehended according to new realities and patiently waits for the hour of triumph. And at once at the first introduction the latest Smart-MES version will be realized already: "MES-T2 2020". For now the cost of its introduction constantly only grows. It will pass for 10 million rubles soon.

But all the same this sum is so ridiculous in comparison with the guaranteed average profit in 300 million rubles. Here you can declare with a grin that it only silly imaginations of my incompetence. It quite agrees that I am not a technologist and was not at the helm power plants. But I successfully in the past introduced the automated systems on 7 nuclear power units, and we completely developed perspective Smart-MES which analogs are not present even abroad. We tested the previous versions of this system at ten combined heat and power plants, state district power station and the NPP. So I am down on to all calculations of the actual and standard TEP.

Now I appeal to your reason, and let's analyse a situation in power plants, using the principle of "A black box", i.e. there are entrances: fuel and water, is also exits: electric power and heat. The essence of technological process in it "A black box" is not important at all. The approved standards for concrete power plant show that development of a certain quantity of the electric power and heat in each interval of time requires quite concrete amount of fuel. But actually that of this fuel turns out more. Why? If it not the mistake in standards, means it flaws of technological process.

Now we will look that is created with this excessive consumption of fuel (the Fact - the Standard) within a day. It appears that in the afternoon this overexpenditure is close to zero. It follows from this that standards absolutely correct. But if at night the excessive consumption of fuel reaches 30% of its actual expense, therefore, not everything is fine with management at power plant. So and in this case my incompetence in technology. But these half-hour calculations are not present at one power plant, especially there are no constant calculations, and they are necessary in transitional working hours of power plant. Here it is necessary to consider a lag effect of power coppers since at decrease in need for the electric power reduction of supply of fuel should be made with some settlement advancing.

Now we will go further. Here the Smart-MES system works and Monitoring on BCP provides operational analytics on the current excessive consumption of fuel. In need of system additional tools for optimum loading of the equipment are started. Here already there is an opportunity to fix technological cuts with a zero Excessive consumption of fuel. And on the basis of these cuts it is already easily possible to predict also need for fuel.

Here to you and complex solution of the problem of economy of fuel!!!

Now, when the income from sale of the electric power and heat is actually stopped because of regulation of tariffs by the State, for increase in profit it is necessary to cut expenses, and more on fuel. But in all Generation companies there is a huge uncontrollable excessive consumption of fuel which on average on each combined heat and power plant and state district power station is equivalent 300 million rubles a year as it was already told above. Thus there is an unjustified excess of harmful emissions in the atmosphere at night more than for 30%. Economic annual losses from ignoring by management of introduction of no-cost perspective energy saving technology on Smart-MES system for each Generation company make 5 - 20 billion rubles. And in general across Russia it already pours out in more than 100 billion rubles.

For the Management and for Investors of the Generation companies I give an intelligible explanation of an uncontrollable source of their multi-

billion losses. Development of a certain quantity of the electric power and heat every minute requires strictly certain amount of fuel which easily is defined by calculations of standard values in real time. All fuel which is spent over calculated values, is an overexpenditure. Type excuses that is technological burn through, are from crafty since simply at power plants elementary there is no Smart-MES for an operating control over this overexpenditure. That's it for this reason since completely there is no current settlement information, in general anything not possibly to prove.

Here it is necessary to distinguish strictly work of power plant during the day period with the maximum loading and work of power plant during the night period with half loading. Between these periods there are slow transition processes for decrease in delivery of the electric power and for increase, too most happens and to fuel. But thus surely it is necessary to consider a huge thermal lag effect of multiton power coppers, and also penalties for short delivery of the electric power according to the established daily schedule. By us it is investigated that during the day period the excessive consumption of fuel completely is absent, and in the night reads off scale for 30%. Therefore, all losses of profit happen exactly at night.

But there is more to come. At night, when people peacefully sleep, all power plants is useless for itself plentifully irrigate surrounding clean air with harmful emissions that for people is simply deadly factor. It turns out that the Generation companies because of a huge uncontrollable excessive consumption of fuel not only lose multi-billion profit, but also harmful influence all population of Russia.

And now too most on fingers. The excessive consumption of fuel in every minute is equal to a difference of the actual and standard cost of fuel in this minute:  $dbi = Bfi - Bni$ . But in the afternoon it looks so:  $Bfi - Bni = 0$ , and at night through day fuel consumption so:  $0.8Bfi - 0.5Bni = 0.3Bfi$ . It means that when at night the need for the electric power decreases twice, the actual fuel consumption is cut for only 20%. Therefore, 30% of the actual day fuel consumption are useless the multi-billion profit departs to pipes, and together with it also. And has to be at night, as well as in the afternoon, i.e. so:  $0.5Bfi - 0.5Bni = 0$ . But, tell how it is possible to hit the mark, without seeing the purpose?

I give an unpretentious example with a pan. Let's assume, there is a task to gather a full pan of water with the minimum modulation, and you easily do it since see edges of a pan. But here the second task will be more difficult. It is necessary to gather strictly a half of a pan, and for an incomplete filling - death. In this case all on pain of this death more than a half since where this half not to see because label that is not present will always pour water in a pan obviously.

Same most occurs on all thermal power plants where risks the Smart-MES system has to carry out a role of this, and her that anywhere and is not present. After all when the operational personnel on BCP constantly sees the current constant fuel consumption in comparison with calculated standard values, it involuntarily has a compulsory motivation to think over and ask a question: why right now the actual expense is more than standard.

In this case all focus here that all deviations from standards can be observed in real time, and, therefore, appears opportunity quickly and in due time to interfere with technological process for minimization of the current losses, well and for rescue of multi-billion profit.

It is for some reason clear to all that when the person has a road accident, he urgently should be carried to hospital on operation since otherwise the lethal outcome is possible. But now on all thermal power plants go on the way of this lethal outcome of rather huge excessive consumption of fuel since with the existing monthly calculations of TEP do not hurry to adjust normal and healthy production. But thus all costs of funeral services for a funeral of multi-billion profit enter tariffs and are for some reason shifted to all consumers of the electric power and heat.

All in power industry with a clever look argue on specific costs of fuel of the released electric power and heat which in monthly miscalculations turn out distorted and bring nobody any benefit. And nobody wishes even to hear about a huge excessive consumption of fuel. In the Ministry of Energy of the Russian Federation frankly say that this business of the Generation companies.

How so? Our native Generation companies supplying us with the electric power and heat because of miscalculations in techniques at early boundaries of socialism the Ministry of Energy of the Russian Federation,

now sustain multi-billion losses, and the State declares that creep out from them the created denseness and completely denies the methodical assistance in market conditions.

It is good still that our Firm in due time revealed all these flaws and now blows to all Russia: Where you rush, Russia? Stop is useless to throw out many and many billions in pipes!

Firm InformSystem opened the basic innovative principles of creation of Smart-MES and compared them with outdated which it is engaged now move ahead in the Generation companies for realization of mathematical model of calculation of TEP of power plants.

For creation of mathematical model of power plant two principles of creation of structure of calculations are possible: linear principle (database) and rectangular principle (table). Linear - all calculations are attached to database indicators. Rectangular - calculations are presented on tasks in the table form, as in MS Excel. Linear - for a long time outdated, and tabular - the most progressive since the person thinks of settlement categories only on tasks in the form of the table, i.e. a column (object: copper, turbine) and line (indicator).

It is unnatural to think of linear settlement category without binding to a specific objective for the person in general. And, therefore, creation of mathematical model of power plant with several thousand indicators on the linear principle is marasmus. After all the person should work with this model, to serve it, to make changes to algorithms of calculation and to carry out their debugging on figures.

Realization of tabular on tasks approach to calculations with a uniform database in big information system is much more difficult. Here innovative approaches which are successfully used in Smart-MES system are necessary.

Those Generation companies which on ignorance choose linear realization of mathematical model, doom themselves to technological difficulties in advance. However, at big financing they, perhaps, are also surmountable, but as innovations here definitely does not smell.

## **34. Conclusion**

---

Dmitry Medvedev at a meeting of the government paid 25.10.2013 special attention to a question of development of information technologies. The chairman of the cabinet is sure that depends on the correct vector of development of IT technologies the future of Russia and its competitiveness in the international market.

It is considered to be that our market of information technologies lags behind from foreign approximately for about five years. But also concerning import software scientists also draw a conclusion that now practically there are no program systems with properties of self-organization. Thus, creation of the program self-organizing systems is a matter of the distant future and, perhaps, will mark itself the third revolution in the software area.

But it appears that the third revolution in the software area already came true, and it was marked by development in the Ekaterinburg Firm InformSystem of the innovative self-organizing Smart-MES "MES-T2 2020" system. This system already now with huge success can be used for realization of technology of economy of fuel at any combined heat and power plants and state district power station and for implementation of absolutely accident-free operation of the NPP.

Thus, regarding creation of the self-organizing production MES Systems Russia not simply does not lag behind foreign technologies, and considerably of them is ahead. But this fact is not realized in the Generation companies yet. And could use it for increase in the profit and the image. After all that Smart-MES can, far cannot any other system, in Russia, abroad.

We are invited often to participate in competitions and are interested about our positive introduction. But we do not participate in fictitious competitions any more and we do not open our last experience yet. We will cooperate only with those who will rely on us who will want to get

additional profit on economy of fuel who together with us will be interested in success.

### **Essence of technology of the creation self-organizing software**

This technology represents multistage automatic transformation of actually book engineering text of a formulation of a technological task to an executive program code with simultaneous formation of all elements of big System from a database to reports. In the course of this transformation easily readable text of a task will be transformed at first to interpreter language for debugging of tasks, and then to Pascale with optimization of a code and, at last, to the DLL program. And all this occurs for some seconds without participation of the person.

In other words the System is trained in concrete skills for some seconds. Thus the volume of the put knowledge is limited to nothing. All this knowledge it is possible to remove and load the new instantly. Such dynamism gives huge opportunities to scientists in creation of artificial intelligence for realization of heuristic functions. This technology can be used in any industry, including space and military. After all all new technological problems are solved quickly and without programming.

In this case the computer platform has no value. The Smart-MES system developed by us or MES System (Manufacturing Execution System - a control system of productions) is only a prototype and the proof of feasibility of the principles of self-organization of Systems.

### **Shortly about Smart-MES "MES-T2 2020" system**

The system externally consists of the executive module and a set of text descriptions. The executive module regarding technological functionality is absolutely empty, i.e. for performance of concrete useful work it should be trained. Process of training happens through the Text.

Thus, in the philosophical plan our System in a starting position consists of two logical elements: basis (EXE) and superstructure (Text). The basis represents a program skeleton or essence of information System.



The superstructure is a set of the algorithms in engineering language generated by basis and which are actively influencing it. In other words, EXE prepares the Text, in this Text it forms databases and templates of screen forms and reports, and also DLL for calculations, and, using this environment, EXE functions for performance of production tasks.

Here the executive module is completely a prerogative of the developer and to concrete technological object has no relation. The text on the contrary is a prerogative of the user who in engineering language formulates technological tasks for concrete object. It reaches independent continuous development of system and technological functionality, as provides the highest level of reliability and efficiency of Smart-MES.

This System provides the language of a formulation of technological tasks which is most approached to reality in a tabular look. Our System constantly develops by release of new versions. Therefore, for acquisition of new system functionality it is rather simple to Users to replace EXE. The text allows Users to increase technological functionality without restrictions.

Thus, Smart-MES allows creation of the big working System from pressing of one button. In this case at compilation of the Text all components are automatically created: databases, reference books, the menu, screen forms, reports, DLL for calculation and the Application server.

Smart-MES includes the 4th components: Designer ARM, SQL application, Web application and Graphic Editor. Entering of any changes into algorithms of calculation is carried out in 5 seconds. 20000 technical and economic indicators pay off less than one second.

#### **Main advantages of Smart-MES system:**

- 1) The description of a set of technological tasks on simple human META language in a text editor in the form of the Project;

- 2) Automatic control of all system from the text description, i.e. automatic creation of the Conductor of tasks, Information databases, Screen tables and Reports;
- 3) Automatic creation of high-speed settlement DLL programs;
- 4) Realization of optimizing tasks: Simplex method, HOP-method (Characteristic Relative gain) and method of Dynamic programming;
- 5) An automatic application tuning the Client/server with any SQL Server (MS SQL Server, Oracle, Interbase, MySQL, Informix and dr) on 3-unit structure;
- 6) The automatic Web applications control for calculations on the Internet.

Realization of Smart-MES System is possible in 2 modifications: Client-Server with 3-unit structure without SQL Server and Client-Server with 3-unit structure with the SQL Server. the 3-unit structure means that in both cases there is an application server of the general calculations of TEP which is executed on the DLL program formed automatically. Client-Server with the SQL Server works with any SQL Server (Firebird, MS SQL-Server, Oracle, Interbase, MySQL, PostgreSQL, etc.). The structure of Client-Server with the SQL Server is automatically adjusted on settings of the Complex.

The main innovations in Smart-MES are: adaptability and speed. Easy adaptation of Smart-MES to any enterprise is reached by that all technological tasks are made out in the form of text Projects on very simple META language, and all making Smart-MES systems (Databases, Screen Forms, Reports, Settlement DLL Programs) are automatically generated at compilation of these Projects. The highest speed of performance of the general calculations, i.e. at once all tasks of the actual and standard TEP, is provided with one DLL program which is automatically generated with optimization of a code. In other words, it is simply impossible to execute calculation quicker.

Important competitive advantage is also that Smart-MES is the only domestic self-organizing system intended for power industry and other any

process productions. Its difference from foreign systems is that it easily adaptable and high-speed.

### **Practical use of the self-organizing Smart-MES**

The intellectual self-organizing Smart-MES system, using the schedule of delivery of the electric power and heat, by means of the knowledge base will unmistakably prompt the best decisions in concrete production situations, and monitoring of the current excessive consumption of fuel in real time will promote its economy. And it already the highest level of the organization of management of power plant.

In multiagent system one and too ON Smart-MES it can be used as agents for coppers, for turbines, for give of heat and for give of the electric power, for the accounting of losses and for the accounting of own needs, for chemical water treatment, for station actual TEP and for standard TEP. These agents can control a condition of pipelines and wear of the equipment, and many other things. All agents are among themselves connected by protocols of a constant exchange. All agents work in parallel in real time and all in a complex are aimed for achievement of the maximum profit on electricity generation and heat.

The serious perception us the created Theory of accidents and possibility of the self-organizing Smart-MES system according to the prevention of emergencies will allow to look absolutely in a new way at these destructive processes and to keep billions of rubles which are necessary for creative activity of society. According to this Theory some incorrect indignations which appear spontaneously during various periods are necessary for accident. And if we in due time liquidate the first indignation, we will rescue the NPP from accident.

In modern calculations of TEP at all power plants the most negative sides are collected. Under these conditions to speak about increase of energy efficiency of thermal power plants in general it is problematic. The exit consists only in introduction of no-cost technology of economy of fuel on the self-organizing Smart-MES system. Calculation of indicators for an

excessive consumption of fuel has to be made only on each half-hour interval. All replaceable, daily, decade, monthly, quarter and annual TEI (Technical and Economic Indicators) have to turn out from half-hour values by an accumulation method (summation, averaging or weighing), but not calculation for formulas. The monthly calculations of TEP existing everywhere are not right since for calculation of standard TEP nonlinear power characteristics of the equipment are used.

The Innovative Self-organizing Smart-MES System can easily solve all these and many other problems.

## **Bibliography**

---

1. Chernov V. F., Chernov I.V. The new concept of a samonastravayemost of MES-T2 2020 MES System for management of any process production and power plants//the Collection of reports "the XII All-Russian meeting on problems of management VSPU-2014: Works". - M.: YIP RAHN, 2014. - Page 8751-8761. - ISBN 978-5-91450-151-5

2. Chernov V. F., Chernov I.V. Automated control system for production of power plant of "MES-T2 2007"//Collection of materials of the third international conference "Management of Development of Large-scale MLSD'2009 Systems". - M.: YIP RAHN, 2009. - Page 290-292. - ISBN 978-5-91450-038-9

3. Chernov V. F., Chernov I.V. Experience of adaptation of innovative system "MES-T2 2007" for PTO of power plants//Automation & IT in power. - 2009. - No. 1. - Page 55-57.

4. Chernov V. F., Chernov I.V. The innovative MES System "MES-T2 2010" saves fuel of power plants//Automation & IT in power. - 2011. - No. 10. - Page 22-28.

5. Martynov S. A. Innovative economy (Road map 2040)//Moscow pedagogical state university. - 2013.

6. Hagen G. Sinergetika//M.: World, 1980.

7. Chernyak L. Adaptiruyemost and adaptability//Open systems. - 2004. - No. 9.

8. Gorodetsky V. I., Grushinsky M. S., Habalov of A.V. Mnogoagentnye of system (review)//News of artificial intelligence. - 1998. - No. 2. - Page 64-116.

9. Russell Stewart, Norvig Peter. Artificial intelligence: modern approach. - 2nd prod.: The lane with English - M.: "Williams". - 2006. - 1408s. - ISBN 5-8459-08887-6 (Russian)

10. Rygalov A.Yu., Kubarkov Yu.P. Use of multiagentny systems in power industry//Works of the Kola Russian Academy of Sciences scientific center. - 2012. - No. 1. - Volume 4.

11. Gmurman V. E. Probability theory and mathematical statistics, - M.: The higher education. 2005

12. Drozhdin V. V., Zichenko R. E. Prerequisites of creation and architecture of the self-organizing information systems.//Electronic magazine "Biokosmologiya - Neo-Aristotelizm", ISSN: volume 1, release 4 - fall 2011. - Veliky Novgorod. - page 446-458.

13. Bakanov A.B., Drozhdin V. V., Zinchenko R. E., Kuznetsov R. N. Methods of adaptation and generation of development of the software.//News of the Penza pedagogical university. - No. 17. - 2009

14. Lachinov V. M., Polyakov of A.O. Informodinamik or Way to the World of open systems//Russian Academy of Sciences, St. Petersburg institute of informatics and automation. - 1999

15. Poston T., Stewart And. Theory of accidents and its appendix//World. - 1980

16. Smutnev V. I. Prakticheskaya culture of safety of operation of the NPP//Term paper. - 2007

17. Chernov V. F. Automation of production management of the electric power and heat//Chief power engineer. - 2015. - No. 2. - Page 13-21.

18. Lithuanian Jew V.V., Matveev A.S., Shevelyov S. A. Optimization of operating modes of turbine plants of thermal power plants with use of characteristics of relative prirost//URL: [http://www.lib.tpu.ru/fulltext/v/Bulletin\\_TPU/2009/v314/i4/05.pdf](http://www.lib.tpu.ru/fulltext/v/Bulletin_TPU/2009/v314/i4/05.pdf) (Date of the address: 23.03.15)

19. For investors the sector of power industry looks dreadful//URL: [http://www.nord-news.ru/energo/?\\_energoid=36525](http://www.nord-news.ru/energo/?_energoid=36525) (Date of the address: 23.03.15)

20. Vissarion Grigoryevich Belinsky - the Quote//URL: <http://tsitaty.com/tsitata/130317> (Date of the address: 23.03.15)

21. Modernization of power industry was estimated at 11 trillion rubles//by URL: <http://lenta.ru/news/2011/08/26/trillions/>(Date of the address: 23.03.15)

22. Development of strategy of development of power industry of Russia and ENES//URL: <http://www.enin.ru/activities/development/>(Date of the address: 23.03.15)

23. Without criteria an energy audit of power plants - a poppycock//URL: [http://professional.ru/Soobschestva/energoberezhenie\\_i\\_tehnologii/bez-kriteriev-energoaudit-elektrostantsij-92587117/](http://professional.ru/Soobschestva/energoberezhenie_i_tehnologii/bez-kriteriev-energoaudit-elektrostantsij-92587117/) (Date of the address: 23.03.15)

24. Crash of the Russian power industry//URL: [http://professional.ru/Soobschestva/generalnye\\_direktora/krah-rossijskoj-elektroenergetiki/](http://professional.ru/Soobschestva/generalnye_direktora/krah-rossijskoj-elektroenergetiki/) (Date of the address: 23.03.15)

25. Digital chart of Vukalovich//URL: <http://www.studfiles.ru/dir/cat34/subj1334/file14170/view153255.html> (Date of the address: 23.03.15)

26. E.A., Zhulina E.G. Shpargalka on management bases//is slowed down by URL: [http://modernlib.ru/books/zamedlina\\_e/shpargalka\\_po\\_osnovam\\_menedzhmenta/read/](http://modernlib.ru/books/zamedlina_e/shpargalka_po_osnovam_menedzhmenta/read/) (Date of the address: 23.03.15)

27. Energy efficiency checks//URL: [http://taxpravo.ru/analitika/statya-143632-proverki\\_energoeffektivnosti](http://taxpravo.ru/analitika/statya-143632-proverki_energoeffektivnosti) (Date of the address: 23.03.15)

28. Business will receive tax privileges for economy of the electric power//URL: <http://www.audit-it.ru/news/account/196212.html> (Date of the address: 23.03.15)

29. Generation. Thin control//URL: <http://energypolis.ru/portal/2010/307-generaciya-tonkaya-nastrojka.html> (Date of the address: 23.03.15)

30. What is the energy efficiency?//URL: [http://kyivenergo.ua/ru/shco\\_take\\_energoefektivnist](http://kyivenergo.ua/ru/shco_take_energoefektivnist) (Date of the address: 23.03.15)

31. Development of power system and hydropower//URL: <http://energetika.in.ua/ru/books/book-3/part-1/section-1/1-1> (Date of the address: 23.03.15)

32. Optimization of logistic expenses of the company//URL: <http://rosinvest.com/page/optimizacija-logisticheskikh-zatrat-kompanii> (Date of the address: 23.03.15)

33. JSC Firm of Information Systems Development and deployment of MES Systems//URL: <http://inform-system.ru/>(Date of the address: 15.01.15)

34. MES-T2 2020 MES System in power industry//URL: <http://mes-t2.blogspot.ru/>(Date of the address: 15.01.15)

35. New Forum of Power engineering specialists & IT//URL: <http://e-generation.forum2x2.ru/>(Date of the address: 15.01.15)

36. METHODOICAL INSTRUCTIONS ON DRAWING UP the REPORT of POWER PLANT AND JOINT-STOCK COMPANY of POWER AND ELECTRIFICATION ON THERMAL PROFITABILITY of the EQUIPMENT//URL: <http://docs.cntd.ru/document/1200008390> (Date of the address: 02.04.15)

37. Integrated indicator of energy efficiency of power plants//URL: <http://www.energotrader.ru/forum?g=posts&m=129973> (Date of the address: 02.04.15)

38. Cloudy technologies//URL: [http://otherreferats.allbest.ru/programming/00295717\\_0.html](http://otherreferats.allbest.ru/programming/00295717_0.html) (Date of the address: 02.04.15)

39. METHODOICAL INSTRUCTIONS ON FORECASTING of SPECIFIC FUEL CONSUMPTION//URL: <http://files.stroyinf.ru/Data2/1/4294816/4294816596.htm> (Date of the address: 02.04.15)

40. 17 moments of spring//URL: <http://kinomusyk.ws/forum/showthread.php?t=6522> (Date of the address: 02.04.15)

41. Consciousness//URL: <http://murzim.ru/nauka/filosofija/24839-soznanie.html> (Date of the address: 02.04.15)

42. In Russia transition to new bulbs how many will manage?//URL: <http://lenta.ru/conf/philips/?qall=yes> (Date of the address: 02.04.15)



43. The federal law of the Russian Federation of November 23, 2009 N 261-FZ//URL: <http://www.rg.ru/2009/11/27/energo-dok.html> (Date of the address: 02.04.15)

44. The order of the Ministry of Energy of the Russian Federation of April 19, 2010 No. 182 About the approval of requirements to the power passport made by results of obligatory power inspection, and to the power passport made on the basis of project documentation, and rules of the direction of the copy of the power passport made by results of obligatory power inspection//URL: <http://base1.gostedu.ru/58/58688/>(Date of the address: 02.04.15)

45. Energy efficiency vector//URL: <http://alldoma.ru/press-relizy/vektor-energoeffektivnosti.html> (Date of the address: 02.04.15)

46. INTEGRAL CALCULUS//URL: [http://sernam.ru/book\\_e\\_math.php?id=47](http://sernam.ru/book_e_math.php?id=47) (Date of the address: 02.04.15)

47. Power inspection//URL: <http://www.unitex-pro.ru/article/11> (Date of the address: 02.04.15)

48. Energy audit//URL: <http://www.e-audit.ru/audit/>(Date of the address: 02.04.15)

49. Ilyasov F.N. Razum artificial and natural//URL: [http://www.iliassov.info/article/isk\\_intellekt.htm](http://www.iliassov.info/article/isk_intellekt.htm) (Date of the address: 02.04.15)

50. Programs for management of power - Optimization of the combined production of heat and the electric power on electric power plants//URL: <http://www.myshared.ru/slide/398646/>(Date of the address: 04.04.15)

51. RULE OF CONTRARIES//URL: [http://dic.academic.ru/dic.nsf/enc\\_philosophy/349/ДОКАЗАТЕЛЬСТВО](http://dic.academic.ru/dic.nsf/enc_philosophy/349/ДОКАЗАТЕЛЬСТВО) (Date of the address: 04.04.15)

52. Index of profitability of the project//URL: <http://economuch.com/finansovyy-analiz/indeks-rentabelnosti-proekta-6305.html> (Date of the address: 04.04.15)

53. Questions of the establishment of criteria accepted (admissible, inadmissible) risk of accidents on hazardous production facilities//URL: [http://riskprom.ru/publ/voprosy\\_ustanovlenija\\_kriteriev\\_priemlemogo\\_dopustimogo\\_nedopustimogo\\_riska\\_avarij\\_na\\_opasnykh\\_proizvodstvennykh\\_obektakh/19-1-0-231](http://riskprom.ru/publ/voprosy_ustanovlenija_kriteriev_priemlemogo_dopustimogo_nedopustimogo_riska_avarij_na_opasnykh_proizvodstvennykh_obektakh/19-1-0-231) (Date of the address: 04.04.15)

54. About establishment of criteria of the acceptable (?) risk of accidents on hazardous production facilities//URL: <http://riskprom.ru/news/2011-10-25> (Date of the address: 04.04.15)

55. Explosions on the ground near Samara//URL: <http://www.rg.ru/sujet/4412/index.html> (Date of the address: 04.04.15)

56. Sweeping aside logic of circumstances//URL: <http://www.postsovet.ru/blog/russia/536597.html> (Date of the address: 04.04.15)

57. In Tomsk create a safe nuclear reactor for science//URL: [http://www.strf.ru/material.aspx?CatalogId=222&d\\_no=53039#.VSExIca1Y3I](http://www.strf.ru/material.aspx?CatalogId=222&d_no=53039#.VSExIca1Y3I) (Date of the address: 04.04.15)

58. Way and device of localization of fusion of an active zone of a nuclear reactor//URL: <http://neftegaz.ru/science/view/1002> (Date of the address: 04.04.15)

59. Accident in the Moscow subway//URL: <http://www.rg.ru/sujet/5256/>(Date of the address: 04.04.15)

60. Kogan I.R. EVOLUTION of the NPP DLYA VVER PCS, PROBLEM, UNRESOLVED QUESTIONS, NEW THREATS AND POSSIBLE DIRECTIONS of DEVELOPMENT//URL: <http://vspu2014.ipu.ru/proceedings/prcdngs/4200.pdf> (Date of the address: 17.02.15)

61. Mengazetdinov N. I., Poletykin A.G., Byvaykov M. E., V.G.'s Crafts, Hot E.F., Smirnov V. B., Akafyev K.V. AUTOMATION of NUCLEAR POWER PLANTS - EXPERIENCE to YIP of the Russian Academy of Sciences//URL: <http://vspu2014.ipu.ru/proceedings/prcdngs/4219.pdf> (Date of the address: 17.02.15)

62. Byvaykov M. E. INTEGRATION of DATABASES BY DEVELOPMENT OF SYSTEMS of the TOP (BLOCK) LEVEL of

industrial control system of the NPP//URL: <http://vspu2014.ipu.ru/proceedings/prcdngs/4687.pdf> (Date of the address: 17.02.15)

63. Quasigame phenomena in culture (The mathematical theory of games and the mathematical theory of the conflict)//URL: <http://www.socionauki.ru/journal/articles/153067/>(Date of the address: 04.04.15)

64. Leningrad NPP: the power unit No. 4//URL is stopped: <http://www.atominfo.ru/newse/10472.htm> (Date of the address: 04.04.15)

65. The power unit No. 2 of the Balakovo NPP is switched-off from a network//by URL: <http://balakovolife.ru/predpriyatiya/item/2732-energoblok-2-balakovskoj-aes-otklyuchen-ot-seti.html> (Date of the address: 04.04.15)

66. VNIIAES - 35 years of work on safety of nuclear power plants//URL: <http://www.vniiaes.ru/AboutYears.aspx> (Date of the address: 04.04.15)

67. International scale of nuclear events (INES)//URL: <http://www.rosatom.ru/aboutcorporation/activity/safety/ines/> (Date of the address: 04.04.15)

68. GENERAL PROVISIONS of SAFETY of NUCLEAR POWER PLANTS//URL: <http://files.stroyinf.ru/Data1/8/8253/>(Date of the address: 04.04.15)

69. Accident//URL: <http://slovari-online.ru/word/бизнес-словарь/авария.htm> (Date of the address: 04.04.15)

70. Horizons of Atom 31.08.2013//URL: <http://www.youtube.com/watch?v=B88ipN0QHS0> (Date of the address: 04.04.15)

71. This bitter word - Chernobyl//URL: <http://stpr34.ru/news/ob-yetom-govorjat/yeto-gorkoe-slovo-chernobyl.html> (Date of the address: 04.04.15)

**More  
Books!** 



**yes**  
**I want morebooks!**

Buy your books fast and straightforward online - at one of the world's fastest growing online book stores! Environmentally sound due to Print-on-Demand technologies.

Buy your books online at  
**[www.get-morebooks.com](http://www.get-morebooks.com)**

---

Kaufen Sie Ihre Bücher schnell und unkompliziert online – auf einer der am schnellsten wachsenden Buchhandelsplattformen weltweit!  
Dank Print-On-Demand umwelt- und ressourcenschonend produziert.

Bücher schneller online kaufen  
**[www.morebooks.de](http://www.morebooks.de)**

OmniScriptum Marketing DEU GmbH  
Heinrich-Böcking-Str. 6-8  
D - 66121 Saarbrücken  
Telefax: +49 681 93 81 567-9

[info@omniscrptum.com](mailto:info@omniscrptum.com)  
[www.omniscrptum.com](http://www.omniscrptum.com)

OMNI Scriptum 