ADDITIONAL REFERENCES AND INFORMATION SOURCES

1.  http://www.sao.ru


ENERGY SUPPLY OF SAO RAS. PROBLEMS AND SOLUTIONS

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Photos: V. Romanenko, O. Popel, L. Director
On covers: The Christ face discovered on a rock near the SAO RAS location

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Moscow – Nizhny Arkhyz
2002
Collaboration of two Russian Academy of Sciences (RAS) research centers: Special Astrophysical Observatory (SAO) and Institute for High Temperatures (IVTAN) – started in the year 2000 in frame of the RAS Program «Improvement of Energy Efficiency of RAS Institutions and Expenditures Reduction for Energy Supply».

The problem of reliable energy supply of SAO facilities, located in mountains of Western Caucasus, in conditions of rapid prices growth for electricity and liquid fuel is extremely topical. On its solution depends success of scientific investigations carried out by unique astrophysical equipment, and what is not less important – life conditions of about 1000 habitants of autonomous residential township.

As a result of energy audit of SAO objects by IVTAN experts a Program of structural reconstruction of SAO energy supply systems was elaborated, which takes in account unique ambient conditions of the Arkhyz region as well as effective utilization of environmentally friendly renewable energy sources.

Realization of the first Program stages is already in progress by joint efforts of SAO, IVTAN and several specialized organizations using the financial support of the Russian Ministry of Industry, Science and Technologies according to a State Contract. Pilot demonstration installations will be assembled at SAO objects quite soon.

Solving of the key energy supply problems will provide for continuous high level astrophysical studies, create comfort working and living conditions for the personnel and inhabitants, dramatically decrease expenditures for energy resources, and finally will secure reliable energy supply of the Observatory.

Accomplishment of the indicated Program requires attraction of financial resources. SAO is the leading Russian research center, where unique astronomical and astrophysical studies are carried out, is a property and pride not only Russian but international science. To maintain its workability and to support researchers and specialists is a must not only for Russia but as well for international scientific community.

Professor Director, Special Astrophysical Observatory
Yuri Balega

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Project Contributors:
Russian Ministry of Industry, Science and Technology
(State Contract 41.003.11.2919)
Russian Academy of Sciences
(the RAS Program «Improvement of Energy Efficiency of RAS Institutions and Expenditures Reduction for Energy Supply»)
Russian Foundation for Basic Research
(Project 01-02-17317)
The Project Investor: JSC «Modern Technologies «Helion»
(Production of Solar Collectors and Solar Water Heaters)

In parallel with solution of the SAO RAS key energy supply problems the project realization will promote perspective environmentally friendly energy conservation and nontraditional renewable energy sources technologies development and utilization. A sound scientific and practical basis will be established for their replication at Caucasus and other regions of Russia.

Local and Foreign Contributors are invited to participate in the Project

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5. Creation of a wind farm to increase reliability of USP objects power supply

Recently power and heat supply of USP objects, which are customers of categories 1 and 2 demanding uninterrupted supply is provided by a blind-alley extremely deficient electrical transmission line of Karachaevo-Cherkessia energy system. There are no back-up units at the site.

Creation of a wind farm will increase reliability of important users and reduce power consumption from the grid.

As a first stage it is planned to install a wind farm with 90 kW capacity consisting of 3 wind-mills of the Pitch Wind type, which will be produced at the Lianozovo electromechanical plant using a Swedish license. Further on it is supposed to increase the wind farm capacity up to 300 kW and even to 1 MW to cover the significant demand for power in only the USP objects, but the SAO demand as a whole.

In the year 2002 in the frame of the State contract with the Ministry for industry, science and technologies a business-plan providing for creation of a SAO RAS wind farm is elaborated (Stock company “Scientific and production center for wind energy “SOWENA”).
BRIEF INFORMATION CONCERNING SAO RAS

SAO RAS:
– Is a world known center making a significant input in solving basic problems of outer space and Earth atmosphere;
– Consists of a highly qualified team of researchers, engineers and technicians counting more than 300 people;
– Enjoys one of the world largest optical telescope with the mirror diameter 6 m located at 2100 m altitude (GT);
– Unique radio-telescope with antenna diameter 600 m (RATAN);
– Autonomous alpine living township for 1000 inhabitants located in a picturesque conservancy area of the West Caucasus (USP).

The scientific platforms and the living township of the SAO RAS are located far away from powerful centralized transmission lines. The existing electricity and heat supply systems of the SAO RAS are not adequate. The tariffs for energy sources are fast growing. All these conditions create serious problems concerning reliable life sustenance of SAO, adversely influence living conditions of the personnel and hamper carrying out the scientific programs. SAO expenses for energy supply during last years increased more than five-fold and exceeded 7 mln. rubles per annum, whereas the quality of services dramatically decreased.

Structure of energy sources consumption in SAO RAS

The project is elaborated by IVTAN and “UNIFRESH” company with participation of SAO RAS.
3. Equipment of USP, RATAN and some socially significant objects of LSP with solar heating installations

Climatic conditions of the SAO site are highly favorable for solar energy use. A number of SAO objects have electrical systems for hot water supply and space heating. Bearing this in mind it appears expedient to install solar heating units to decrease power consumption and enhance reliability of solar energy supply to socially significant objects. Namely, solar installations are developed for hot water supply in the hotel at the USP, kinder garden, hotel and swimming pool at the living township, also it is planned to equip reflectors and some small distributed objects of the RATAN.

It is planned to use advanced solar collectors fabricated of heat resistant plastics using rotational molding technique. This equipment is developed jointly by IVTAN and “ANION” company. Start of pilot production of those installations is scheduled for early 2003.

Solar water heating installations will be implemented in the period when space heating is not necessary.

Along with solar water heaters, a number of SAO objects will be equipped with solar space heating units using solar air heating collectors, see Fig. 3.

The fore-most objects for solar energy use will be cabins of the RATAN circular reflectors, where valuable electronic devices are located, which need for their operation positive temperatures.

Operation principle and results of simulation of the solar air heating installation for space heating of RATAN circular reflector cabins operation. The simulation demonstrates the possibility of effective use of solar energy for space heating during the most cold period of the year.
The DKV and DE boilers installed in the boiler house produce steam with 1.4 MPa pressure, whereas in the steam plenum the steam pressure does not exceed 0.2 MPa. The pressure excess is useless decreased in a reduction device (RD). If in parallel with the reduction device a back-pressure turbine (BPT) is installed the boiler house becomes a mini cogeneration plant. It is possible and technically feasible to produce up to 300 kW power and use it for the needs of the plant and for some technological processes. This approach will be realized along with automation of the plant and will provide for multifold increase of heat supply of the living township reliability and simultaneously will decrease the expenses for thermal energy production.

1. Repowering of the living township boiler house

The DKV and DE boilers installed in the boiler house produce steam with 1.4 MPa pressure, whereas in the steam plenum the steam pressure does not exceed 0.2 MPa. The pressure excess is useless decreased in a reduction device (RD). If in parallel with the reduction device a back-pressure turbine (BPT) is installed the boiler house becomes a mini cogeneration plant. It is possible and technically feasible to produce up to 300 kW power and use it for the needs of the plant and for some technological processes. This approach will be realized along with automation of the plant and will provide for multifold increase of heat supply of the living township reliability and simultaneously will decrease the expenses for thermal energy production.

To substitute the electrical heating of objects located at the RATAN site with space heating and hot water supply from a gas fired boiler house it is expedient to use a mini boiler house equipped with two water heating boilers with total capacity 0.6-1.0 Gcal/h.

The block boiler house: represents an all-metal thermally insulated module, with the following technological equipment inside:

- water heating automated boilers and a unit for hot water supply;
- pumps securing water circulation in the heating network;
- a water make-up rig;
- natural gas supply equipment with an metering instrument;
- Electrical equipment, control and automation equipment, chemical water treatment unit (water softening)

The automation scheme provides for following up process disturbances, secures cut-off of natural gas flow and produces an acoustical signal at:

- divergence of heat carrier temperature at the boilers exit;
- divergence of natural gas pressure in front of the boilers;
- excessive noxious gas content in the boiler house premises;
- insufficient draft in the stack-gases duct;
- increase of heat carrier pressure;
- disconnection of electricity supply.

Advantages of block boiler houses as compared with conventional heating systems:

+ Fast start-up.

Dimensions and weight of each module allows for transportation with trucks or railway. At the site the modules are integrated and connected to existing outer engineering networks.

+ Operation in a semi-automotive regime.

Control and automation systems provide operation of the boiler house without permanent supervision, and with only temporarily inspections by personnel.

+ High economy.
BRIEF DESCRIPTION OF PRIORITY TECHNICAL ARRANGEMENTS

1. Repowering of the living township boiler house

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Principle scheme of a mini cogeneration plant

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+ High economy.
PRIORITIES OF ENERGY CONSERVATION AND PERFECTION OF SAO RAS ENERGY SUPPLY SYSTEMS

1. Repowering of the boiler house of the living township of LSP, substitution for natural gas combustion, creation of a water heating boiler house at the RATAN site.

2. Utilization of renewable energy sources for energy supply of SAO objects aimed to decrease consumption of expensive electrical energy for space heating and hot water supply.

PROGRAM OF FOREMOST ARRANGEMENTS FOR ENHANCEMENT OF ENERGY SUPPLY RELIABILITY AND DECREASE OF EXPENSES FOR SAO RAS ENERGY PROVISION

<table>
<thead>
<tr>
<th>ARRANGEMENTS</th>
<th>Cost, thousand rubles</th>
<th>Expected savings, thousand Rublannum</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Repowering of the boiler house including its automation, installation of a steam turbine for power provision for the boiler house needs (about 300 kW)</td>
<td>2000-3000</td>
<td>600</td>
</tr>
<tr>
<td>2. Creation of a water heating boiler house at the RATAN site (capacity 1 Gcal/h)</td>
<td>2000</td>
<td>1000</td>
</tr>
<tr>
<td>3. Equipment of USP, RATAN and some LSP social important objects with solar water heaters (total thermal power 400 kW)</td>
<td>1500</td>
<td>300</td>
</tr>
<tr>
<td>4. Creation of a heat pump facility for GT building space heating</td>
<td>300</td>
<td>100</td>
</tr>
<tr>
<td>5. Installation of a pilot wind farm (total capacity of the first stage 90 kW) to enhance reliability of USP objects power supply.</td>
<td>Showings to be itemized</td>
<td></td>
</tr>
<tr>
<td><strong>Total for the program</strong></td>
<td>5800-6800</td>
<td>2000</td>
</tr>
</tbody>
</table>

completion of lay on of the gas pipe is scheduled for the year 2003

*) the results of energy audit carried out in the frame of the RAS Program “Improvement of Energy Efficiency of RAS Institutions and Expenditures Reduction for Energy Supply” and studies performed in the frame of the State contract 1 41.003.11.2919 with Ministry of Industry, science and technologies of Russian Federation devoted to usage of renewable energy sources.
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### Brief Description of Adopted Technical Arrangements (Continuation)

4. Creation of a heat pump facility for heat supply of the GT building at the USP

Nowadays provision for hot water and space heating of the optical telescope building is carried out by electrical heaters. At the same time the building incorporates a powerful lubrication system used for suspension and control of the telescope resting at gyrostatic supports. Operation of this system is accompanied by emission of a significant amount of low potential heat. The proposed technical arrangement gives way to decline by a great deal the use of electrical heaters and provide for hot water supply and space heating of a part of the building using the waste heat of the lubrication system and a heat pump installation. The discrepancy between waste heat appearance (night) and heat use (predominantly day-time) will be solved by installation of a low-potential heat storage tank.

**Creation of the heat pump facility will provide for:**

– saving annually up to 50 MWh of electricity,
– enhance reliability of heat supply and provide for adequate conditions for employees
– decrease the adverse influence of the heat emission of the lubrication system upon the quality of astronomic observations.

Pay-back of the proposed installation without taking into account the future tariffs growth and listed above positive effects will be less than 3 years.

Significance of this project realization in SAO RAS will be also as a demonstration of an one of the first energy saving object.

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View from the GT building window at the future 90 kW wind farm
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MINISTRY OF INDUSTRY, SCIENCE AND TECHNOLOGIES
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