NUCLEAR COGENERATION POWER PLANTS IN SOLUTION OF ENERGY, ECOLOGICAL AND SOCIAL PROBLEMS IN RUSSIA’S REGIONS

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SCALE OF REGIONAL COGENERATION SECTOR

N(e)=68.4 GW
Q=322 GWh
или 23%

electricity PP

N(e)=85.5 GW
Q=385 GWh
или 27%
electricity HPP
heat HPP

Q=699.5 GWh
или 50%
— largest and highly socially and environmentally significant growing sector of Russian Unified Power System (UPS);

— formed by cogeneration units (HPP) of up to 250 MWe;

— pressing problem – the HPP operating life expired down to 75-87%;

— further evolution requires an innovative approach based on high-efficiency and environmentally friendly non-carbon technologies, including nuclear cogeneration units (NCGP) (Presidium of the State Council, ES-2035);

— global desalination market.
PRECONDITIONS FOR THE USE OF NHPP

- Substitution of decommissioned fossil fuel HPP;
- Reduced consumption of fossil fuel;
- Greatly improved urban ecology;
- Reliable long-term supply of heat and electricity to consumers;
- Stabilization of heat and electricity rates;
- Increased share of nuclear plants in the base load schedule.
BASE NHPP

- Developed to the industry order (involving over 30 organizations of Rosatom, power industry and the Russian Academy of Sciences) for large-scale use in the regional cogeneration power sector of Russia’s unified energy system;

- For the required safety, cost effectiveness and competitiveness, the base NHPP with the VK-300 reactor facility relies on highly simple and fully passive operation and safety and use of proven NPP components;

- Developed:
  - detailed design of the VK-300 reactor facility;
  - NHPP design for Siberian Chemical Combine;
  - fundamentals of the NHPP standard design;
  - comprehensive feasibility study “NHPPs in Regional Power”;
  - investment feasibility study for the Arkhangelsk NHPP (for a more specific conditions)
BASE NHPP

**Performance:**
- number of units – 2
- rated power – 2x250 MWe
- rated heat generation – 2x400 GCal/h
- expected annual output
  - electricity - 3000 mln kWh/year
  - heat - 3800 thous. Gcal/year

**Economics:**
- payback period from the start of operation, years - 8 (NPP-20)
- internal rate of return, % -11.6 (NPP-4.3)

**Competitiveness** (center, 2020-2030, 5% discount):
- more effective than HPP SGTP – rate of return 1.6 times as high;
- as compared to separated generation (NPP+boiler), the total revenue (including discount) is 2 to 3.7 times as high.
Increased safety through:
- passive initiation and operation of safety systems;
- no need for operator actions and offsite electricity and water supplies;
- two containments.

Safety parameters:
- total probability of a severe core damage 3 orders of magnitude as low as the standard level;
- all accident consequences confined within the NHPP site boundaries.
Feasibility study for the Arkhangelsk NHPP (for a more specific content) conclusions:

- base factor – substitution of HPPs having a significant adverse effect on urban ecology;
- minor radiological impacts on population, ecosystems, and surface and subsurface water;
- chemical and physical impacts on the environment are acceptable even within the NHPP buffer area;
- practically no damage to land and water ecosystems;
- people support – more then 50%.
Ivanovo (2), Ulyanovsk (3), Yaroslavl (3), Kurgan (2), Arkhangelsk (4), Vyatka (2), Komsomolsk-on-Amur (3), Murmansk (2), Tver (2), Kazan (3), Ufa (4), Izhevsk (2), Khabarovsk (4); Perm (2)

**Finding**

The capacity of the reviewed market is enough for 38 base nuclear cogeneration units \( (N_e \sim 10 \text{ GW(e)}) \).
CONCLUSION

- Large-scale introduction of NHPs in the Russia’s unified power system:
  - is a great politically and socially important infrastructure innovation project;
  - will contribute to a dramatically extended application of nuclear power plants and their greatly increased economic and commercial effectiveness;
  - will provide for reliable heat and electricity supply, an improved urban ecology, and large-scale substitution of fossil fuel.

- The required initial step is to develop a branch program and implement a pilot NCHPP.

A support from Rosatom State Corporation’s Public Council will be helpful.
AHEAD OF NHPP