Nuclear energy supports sustainable development

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ABSTRACT

The article is aimed at acceptability, compatibility and sustainability of nuclear energy as nondispensable part of energy sources with vast innovation potential. The safety of nuclear energy, radioactive vaste deposition, and prevention of risk from misuse of nuclear material have to be very seriously abjudged and solved. Nuclear energy is one of the ways how to decrease the contamination of atmosphere with carbon dioxide and it solves partially also the problem of global increase of temperature and climate changes. Given are the main factors responsible for the renaissance of nuclear energy.

INTRODUCTION

The nuclear industry in US produces about 20 % of electric energy (produces world-wide about 17 % of electric energy) and in 2001 the first time was the production of nuclear energy cheaper than that from fossil fuel. The power plant V1 in Jaslovske Bohunice is the second most cheapest source in our country, producing energy for less than half of the average expences of all our energy sources.

We can be sure that the nuclear energy will be the nondispensable part of energy sources also in future. Nuclear energy owns a vast innovation potential. Further research and development have to react sensitively to the needs of acceptability, compatibility and sustainability of nuclear energy. The safety of nuclear energy, radioactive waste deposition, and prevention of risk from nuclear materials misuse are very seriously abjudged and solved.

Nuclear energy is one of the ways how to decrease the contamination of atmosphere and it solves partially also the problem of global increase of temperature. Nuclear energy prevents of 1.8 billion ton of emissions in the whole world. In Europe it represents 550 mil t of CO_2 emissions yearly. This is equivalent of emissions of 140 mil cars.

AIMS

The main aims of nuclear energy are:

- to continue to keep an important share in energy production in long term perspective,
- to innovate and improve technology and safety of nuclear industry,
- permanently improve its economic, environmental and mental compatibility and acceptability.

WORLD ENERGY SYSTEM – DOMINANCE OF FOSSIL FUELS

World Energy Trading Organizations (WETO) tried to suggest the description of the future world energy system [1]. According to their conclusions, world energy demand is projected to increase at about 1.8%/year in the next three decades. While industrialized countries experience a slowdown in the growth of their energy demand 0.4 %/year in the EU, conversely, the energy demand of developing countries growths rapidly. The world energy system will continue to be dominated by fossil fuels aboutt 80 % of total energy supply in 2030. Coal will remain the main source of energy, followed by gas and oil. Natural gas will represent about 25 % of world energy supply. Oil will decline according to sources

exhaustion and coal demand could grow rapidly as it becomes more competitive than other fuels. The change in the fossil fuel shares impacts considerably on the carbon intensity of the world energy system and on the associated CO_2 emissions.

Due to the continued dominance of fossil fuels, world CO_2 emissions are expected to increase more rapidly than the energy consumption (2.1%/year on average), reaching in 2030 twice the level of 1990.

NUCLEAR POWER DOES NOT KEEP PACE WITH TOTAL ELECTRICITY PRODUCTION

Nuclear energy increases slightly in absolute terms. During the 1990-2000 decade the growth of nuclear was 2.7%/year, but this rate weakens to 0.9%/y over the projection period. In 2030, nuclear will represent about 10 % of the world gross inland consumption (GIC) compared to 18% in 2000.

Globally, energy from renewable sources is expected to cover round 10% of world energy requirements in 2030 essentially due to the continuous decline of traditional biomass consumption in the Third World.

The development of nuclear power does not keep pace with total electricity production: nuclear world market share comes down to 10 % of total electricity production in 2030, from 18 % in 2000.

World electricity production from renewables is expected to rise from 2 % in 2000 to 5-10 % in 2030, mainly because of a rapid increase in the electricity production from wind.

The share of large hydropower electricity production will decline from 19 (2000) to 13 % (2030).The other technologies, based on fossil fuels (gas, oil, coal) will cover the rest.

NEW NUCLEAR POWER PLANTS

Mainly the two type of nuclear power plant can be considered for close future :

- Standard large Light Water Reactor (LWR) - is supposed to exhibit capital costs slightly increasing over time due to increased investment in security measures. In the technology case, the investments as well as O&M costs are assumed to be about 35 % lower as compared to 2030.
- New evolutionary nuclear design. This technology is assumed to be introduced gradually after 2010 and costs about 30 % less to construct than the LWR by to 2030 thanks primarily to its inherent safety characteristics. Probably it gains a substantial share of the total nuclear market (approx. 12 %). For the nuclear technology case this type of plant is assumed to be 35 % cheaper to construct and 35 % to operate.

Two kinds of blocs attract attention of nuclear community nowadays:

- It is EPR, the improved and verified reactor PWR with many original elements of inherent safety, developed in cooperation of France and Germany (Framatom, EdF-CNEN, Siemens KWU) and
- pressurized reactor cooled and moderated with light water advancing CIS row of blocs, VVER-640/V407 with 1800 MWt and 640 MWe (contemporary 290 MWt).

The basic difference among these two groups of blocs is according to attitude to the largest reactor incident. While VVER 640 concentrates to prevent by all means the melting of central reactor zone improving and suggesting new technologies of cooling, the EPR concept is based on the fact, that when some safety systems will fail and the central zone will be melted, the fused mixture will flow down to the protected position, where it will be partially under control.

About 25 % of reactor blocs are working for aproximately 30 years. The key moment for today's nuclear energy is to receive the permission to operate for further period. Only this can prevent 10 % decrease in nucleus expected for 2010 in US. After deep complex control of blocs, many of them are permitted to operate for further 10, 20 or 30 y.

CARBON DIOXIDE EMISSIONS

The overall effect of nuclear technology case is a worldwide reduction of CO_2 emissions in 2030 of 2.8 % (4.6 % in the OECD). At global scale there is expected considerable increase in nuclear electricity generation. Overall nuclear contribution can increase from 9 % to over 15.5 % (from 16 % to 37 % in the

OECD). Nuclear power can penetrate into the high to medium annual loads displacing coal and gas fired electricity production.

The amount of globaly and yearly produced CO_2 is approximately about 6 500 Mt, in Slovakia about 11 Mt. Additional 17.6 Gt of CO_2 would correspond to the production of. electric energy produced in NPP in years since 1980 to 2002 (cca 42 PWh) if it would be produced using natural gas.

The content of CO_2 in atmosphere today increases about 1 %/y. Since 1860 the highest mean Earth temperatures are measured these years. And to fulfile obligations from Kyoto seems difficult. Japan, to reach the aim (-6 %) ought to construct 20 new 1300 MW/bloc till 2010. In EU (-8 %) the rate of decrease is slower than expected. US (-7 %) refuse to reduce emissions according to Kyoto at all, pointing that it could threaten their further economic development. CIS finaly ratified Kyoto Protocol in March 2005. This commitment push it closer to 50 % border needed for its overall validity.

THE NEED OF ENERGY FOR DEVELOPING COUNTRIES

Not negligible is also the need of energy for developing countries. New reactor blocs construction is shifted to Asia, where the increase of share of nuclear sources will reach aditional 8 % to total 26 %! China intends to construct 30 new nuclear power plants (about 36 GWe till 2020 y), South Korea plans new 10 blocs till 2015 and will increase with them todays production of 40 % (16 NPP of total 112 TWh/y), North Korea intends to built 2 blocs, Taiwan 4 new blocs, India 20 blocs till 2020 y and 5 NPP cooled with liquid Na, Pakistan till 2015 two blocs, Japan about 15 blocs till 2020 y (additionaly to 54 blocs in todays operation), and Iran 4 blocs in close future.

NEW TECHNOLOGIES

According to the last trends in nuclear technologies the **attitude of broad European community** to nuclear energy changes. The majority votes for atomic power plants (e.g. in US 60 %, in South Korea 92 %, France 67 %, Germany 81 % etc.) Convention from Kyoto on reduction of CO_2 emissions supports the case.

More close **communication of operators with inhabitants** is accented to dissolve their negative expectations. The possibilities of effective bloc shut down and its final decommission, as well as the routes for high radioactive waste processing are emerged. It can be demonstrated by projects of decommission of NPP Tokai-1 (250 mil. USD, 15 y), NPP Zion-1, NPP Vandellos-1 (300 mil. USD, 30 y), etc.

An important effects on nucleus may impose also **energy producers** [4] increasing the load factor and nominal output of reactor bloc, and to reach exclusion of nucleus from electricity corporations and unite that into great nuclear conglomerates with more united operation and better support, and more internalise the production of nuclear energy.

RENEWABLES

The main technologies, probably improved in their techno-economic characteristics during the next decades could be:

- Biomass gasification for electricity production in small scale (less than 25 MW) combined cycle plants,
- Photovoltaics,
- Small hydro, assumed to be a mature technology registering insignificant gains over the projection period,
- On-shore wind turbines (over 500 kW capacity), without significant impact to electric market (no proper conditions in Slovakia).

The renewables result now in 3 % reduction in worldwide CO_2 emissions.

The technology cases defined here do not offer definitive solutions for the global CO_2 emission problem. This is largely because the power generation sector represents only a part of the energy market. The

extension of these energy technology cases to other important CO_2 emitting sectors (road transport, the residential and tertiary sector) should be a priority in the future.

THE MAIN FACTORS OF COME BACK FOR NUCLEAR ENERGY

Lastly we try to identify the main factors responsible for the renaissance of nuclear energy:

- Prolongation of the operation period of NPP to 50 or 60 years
- Shortage of licencing procedure of new piles
- Increase of passive and active safety of NPP
- Increase of pressure on CO_2 production decrease
- Permanent increase of costs of fossil fuels
- Small development rate of technologies of renewables

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