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Nuclear energy and sustainable development

Report[1]
Committee on the Environment, Agriculture and Local and Regional Affairs
Rapporteur: Mr Bill ETHERINGTON, United Kingdom

Summary

Nuclear electricity generation has long been very controversial and countries have adopted widely differing policies in their approach to the subject. Nowadays, a number of Council of Europe member states are considering developing or continuing civil nuclear industries, a reaction that was mainly triggered by the energy crisis of January 2009.

Nuclear energy permits a significant reduction in greenhouse gas emissions compared to the burning of fossil fuels and therefore could be of great benefit to the environment because it has an important role to play in mitigating the effects of climate change. However, it cannot be considered "sustainable", since resources of uranium are finite and at best only available in the medium term. Moreover, the nuclear industry still has to solve the problem of the safe, long-term disposal of radioactive waste.

Countries with developed nuclear industries should pool their efforts in order to provide assistance to the countries interested in developing nuclear energy. Any initiative in this direction should have the support of the international community. Therefore, the Assembly calls for the development of an international infrastructure for nuclear energy, based on broader international co-operation and on the active participation of all the countries concerned, for example through the creation of international nuclear fuel recycling centres. It also invites states to review the rules governing the nuclear energy market. It suggests organising parliamentary debates on the future of nuclear energy in order to bring together all the different points of view on the topic, which may vary considerably from one country to another.

1. Reference to committee: Doc. 11198, Reference 3333 of 16 April 2007.

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A. Draft resolution

1. Nuclear electricity generation has long been very controversial and different countries have adopted widely differing policies in their approach to the subject. In this context, the Parliamentary Assembly recalls its Resolution 1435 (2005) on energy systems and the environment and its Resolution 1588 (2007) on radioactive waste and protection of the environment

2. Today, nuclear energy represents 17% of electricity generation worldwide. Countries like Finland, France, Russia, China, India, the Republic of Korea, the USA and Japan have stated their intention to build or are already building new nuclear power plants. For example, by 2030, nuclear energy may become the major source of energy in Japan, supplying over 40% of the country's needs.

3. The Assembly notes that several Council of Europe member states (Poland, in co-operation with the Baltic States, and Turkey, Great Britain, Italy, the Netherlands and Germany), as well as countries in the Asia-Pacific region, are considering developing or continuing civil nuclear industries, possibly by extending the lifespan of the power plants already in existence without construction of new plants.

4. Some European countries hit by the energy crisis triggered in January 2009, when Russia’s gas supply to the rest of Europe was stopped, have decided to review their energy policy with the nuclear industry being given a fresh chance.

5. The Assembly is of the opinion that nuclear energy could help to attain the goals of the United Nations Framework Convention on Climate Change (UNFCCC) and especially the Kyoto Protocol because its use permits a reduction in greenhouse gas emissions compared to the burning of fossil fuels.

6. However, the Assembly stresses that nuclear energy cannot be considered “sustainable”, since resources of uranium are finite and at best only available in the medium term. Paramount efforts are needed to fully develop all forms of renewable energy, which will be needed when fuel sources for fossil and nuclear energy are depleted.

7. The Assembly is convinced that in the short to medium term nuclear power could be of great benefit to the environment because it has an important role to play in mitigating the effects of climate change. However, in the long term, the nuclear industry still has to solve the problem of the safe, long-term disposal of radioactive waste.

8. The Assembly is therefore of the opinion that the international community has to find effective solutions to three interrelated tasks: energy security, economic growth and environmental protection.

9. It underlines, however, that the nuclear industry has a high potential for developing R&D in the field of new technologies and can play an important role in reducing the effects of poverty and ensuring long-term energy sustainability in developing countries. It underlines, however, that the development of the nuclear industry in those countries should also include the development of energy infrastructure and staff training.

10. The Assembly is of the opinion that the nuclear energy should be underpinned by a sound system for ensuring the security and safety of nuclear materials and facilities.

11. It wishes to stress that no country in the world can act absolutely independently. It also notes that the energy market has become more global and more open and that existing practices have become obsolete and outdated.

12. The Assembly is of the opinion that these changes imply drawing up a set of new rules governing the energy market, in order to ensure the security and safety of society.

13. The Assembly stresses that it is very important to create open, transparent and equal conditions for countries to access the market of goods and services offered by the world nuclear energy sphere but to ensure at the same time the safety and the security of nuclear energy.

14. Public opinion is of the utmost importance regarding civil nuclear programmes. Citizens must have access to transparent information in order to fully understand the nuclear electricity generating process and especially the safety measures linked to this process.

15. Large-scale nuclear energy development across the world is closely linked to access by more and more countries to nuclear technologies, materials and equipment. The international community is facing issues related to nuclear non-proliferation and nuclear and environmental safety. Therefore, countries with developed

nuclear industries should pool their efforts in order to provide assistance to the countries interested in developing nuclear energy and any initiative in this direction should have the support of the international community.

16. A major step towards achieving such goals would be the development of an international infrastructure for nuclear energy, based on broader international co-operation and on the active participation of all the countries concerned, for example through the creation of international nuclear fuel recycling centres (uranium enrichment, managing of spent nuclear fuel, and personnel training) under the supervision of the International Atomic Energy Agency (IAEA).

17. The Assembly therefore invites Council of Europe member states and non-member states to:

17.1. take into account, in the framework of their policies for diversifying energy sources, nuclear energy, as an option for contributing towards the reduction of greenhouse gas emissions and global warming;

17.2. increase international co-operation by adapting old habits based on secrecy, to the new world realities, especially to globalisation, by promoting openness in the field of the civil nuclear industry;

17.3. strongly support R&D in the field of nuclear technologies, both in the branch of effective energy production and in the management of nuclear waste and effectively implementing the results of that research;

17.4. promote policies of transparency in all the stages of electricity production by the nuclear industry;

17.5. take measures in order to widely inform civil society on all aspects of nuclear energy;

17.6. take speedy and concrete steps towards solving the problems of nuclear waste;

17.7. take all necessary measures to lay the foundations for a global nuclear energy infrastructure, including the establishment of international nuclear fuel recycling centres under the supervision of the International Atomic Energy Agency (IAEA);

17.8. review the rules governing the nuclear energy market.

18. The Assembly also recommends that the existing international organisations concerned, the IAEA and the Nuclear Energy Agency (NEA) of OECD, in particular:

18.1. determine with clarity which technologies can be used for the construction of new power plants;

18.2. ensure strict observance of the safety rules by the countries lacking experience with the nuclear industry;

18.3. contribute to staff training and to monitoring of the entire process of nuclear energy production in these countries, especially in the field of compliance with nuclear safety rules.

19. Finally, the Assembly also decides to organise parliamentary debates on the future of nuclear energy in order to bring together all the different points of view on the topic, which may vary considerably from one country to another.

B. Explanatory memorandum by Mr Bill Etherington, rapporteur

1. Preamble

1. Nuclear electricity generation has long been a very controversial industry and different countries have adopted widely different policies in their approach to the subject. This report is not intended to be for or against nuclear power, but to place it in context within the wider debate involving all generation of power and all use of fuels to provide energy.

2. The Parliamentary Assembly has already agreed that we must aim to increase sustainable energy sources (see, for example, Resolution 1435 (2005) on energy systems and the environment) and more recently has examined the problems of disposing of nuclear waste (see Resolution 1588 (2007) on radioactive waste and protection of the environment). Both of these reports question the oft-quoted belief that nuclear energy is "sustainable". It is not: known resources of uranium are finite and at best only available in the medium term, less in fact than the known resources of coal, but rather more than oil and gas.

3. If the problem of global warming is to be successfully challenged, then certainly in the short to medium term nuclear power could be of great benefit, but there are some difficult problems. If we were to see a large expansion of nuclear power then obviously the medium term availability of uranium would become of shorter duration and the problem of disposal of nuclear waste would become greater.

4. Consideration also has to be given to the advances being made in carbon sequestration from the burning of fossil fuels. If these advances become a total success then fossil fuel burning could become at least as attractive as nuclear power.

5. An often overlooked fact involving nuclear power is the immense amount of resources that has been invested in the research and development of the industry. If but a fraction of this investment had been used to advance the clean burning of fossil fuels and genuine sustainable renewable energy resources, the whole scene would be very different indeed.

6. I would like to pay tribute to my former Russian colleague on the Environment Committee, Mr Grachev, who had almost completed his report on this subject when he sadly retired from his membership of the Council of Europe Parliamentary Assembly and it was decided that your rapporteur would continue to complete and present the report.

7. Mr Grachev was a much firmer advocate of nuclear power than your present rapporteur, but the text of his original thoughts remains unaltered.

8. Undoubtedly nuclear power has an important role to play in mitigating the effects of climate change, but it falls far short of a complete answer and must not be used as a smokescreen to dilute the paramount effort to develop to the full all forms of renewable energies, which will be needed to sustain the human race when all sources of nuclear fuel and fossil fuel are gone, a scenario which is much closer than many realise.

2. Introduction

9. The international community has to find effective solutions to three interrelated tasks – energy security, economic growth and environmental protection. Fair, competitive responses to global energy challenges based on market economy principles will help to prevent potentially destructive effects on production, supplies and transit of energy resources and establish a solid basis for the dynamic and sustainable long-term development of our civilisation.

10. Over the next thirty to fifty years nuclear energy will make a significant contribution to resolving the problem of energy security as a basis for sustainable development.

11. Nuclear energy is the most feasible, technologically proven, environmentally acceptable and competitive alternative to hydrocarbon energy. We believe that developing nuclear energy is a move in the right direction.

12. Nuclear energy is viewed as an attractive option because of certain competitive advantages, such as the least dependency on fuel prices in comparison with other sources of energy, insignificant volume of energy cargo transportation, detailed consideration of nuclear and environmental safety matters, environmental protection and the absence of greenhouse gas emissions or adverse effects on climate.

13. The main prerequisites for widespread development of nuclear energy are enforcing the nuclear non-proliferation regime, ensuring security and safety of nuclear materials and further reducing the different risks posed by its development.

14. Nuclear energy use can become a framework for establishing an energy system ensuring sustainable, environmentally safe, cost-effective and socially acceptable development and improvement in all fields of human activity in the 21st century.

15. Its development will contribute to global energy security, which will be possible only within a solid framework of international co-operation.

16. At the same time, it has to be acknowledged that individual solutions are no longer appropriate. In an increasingly global world, only those who realise this fact will be capable of effective action.

17. To properly respond to the new challenges and exploit new opportunities, the world nuclear energy industry should consolidate its efforts. The different players should be systematically involved in the international nuclear fuel cycle, pooling and making efficient use of competitive advantages.

18. Further internationalisation of the nuclear fuel cycle to ensure stable access to its products and services for the countries concerned, while strictly complying with and strengthening the international nuclear non-proliferation regime, is a strategic thrust for nuclear energy.

19. The tasks facing Russia and the international community are of a truly global nature. That means that sustainable, safeguarded and safe development of nuclear energy can be achieved only through joint bilateral and multilateral efforts.

20. Russia, as one of the world's major suppliers of uranium-related products and services, is fully open to and prepared for such co-operation.

3. Global energy issues and sustainable development

21. In recent years, energy has become highly topical all over the world. Today's world is changing fast in terms of both newly emerging countries with rapidly developing economies and the growing energy consumption of developed countries.

22. Growing tension on the energy markets in recent years is not a temporary phenomenon. The world's developed and developing countries have aligned themselves in terms of per capita energy consumption.

23. At the same time the economy cannot survive without an adequate energy supply, regardless of the country's political system or its level of development, and this applies equally to centrally planned and market economies and to developed and developing countries.

24. Energy supply has come to the fore. Energy resources are critical for improving living standards and expanding opportunities for people in both developed and developing countries of the world.

25. Assuming that the existing consumption level in developed countries will attain a balance, total energy production has to increase at least threefold, and that is without taking world population growth into consideration.

26. Thus, ensuring efficient, solid and environmentally safe energy supplies at prices corresponding to the fundamental principles of the market economy is a major challenge for humankind.

4. Principles of ensuring global energy security

27. The tasks and principles of global energy security include the following:

– openness, transparency, stability, efficiency and competitiveness of markets with regard to production and supplies as a key to ensuring global energy security;

– establishing transparent, fair, stable and efficient legal frameworks and legislative and regulatory systems;

– encouraging investment in the energy sector;

– improving energy efficiency and energy saving through national and international initiatives;

– diversification of energy, geographical and industry markets;

– ensuring security of energy infrastructure;

– developing and introducing innovative energy-efficient technologies;

– environmental responsibility in development and use of energy resources, introduction and exchange of environmentally safe technologies contributing to resolving the issue of climate change and sustainable development;

– joint actions to mitigate the consequences of energy emergencies;

– resolving energy problems of the poorest population groups in developing countries.

28. Many of these tasks which must be solved if global energy security is to be ensured and strengthened were touched upon by the G8 leaders in their St Petersburg summit declaration in 2006.

4.1. Improving transparency, predictability and stability of global energy markets

29. The presence of free, competitive and open markets is vital to an efficient global energy system as a key prerequisite for sustainable development.

30. Transparency and predictability of energy policy and regulatory regimes in each state contribute greatly to shaping efficient energy markets.

31. Expanding dialogue between energy-producing and energy-consuming countries can promote transparency, predictability and stability of global energy markets.

32. The smooth functioning of world energy markets also requires regular and timely exchange of accurate and credible information.

4.2. Improving the investment climate in the energy sector

33. To ensure adequate energy supplies on a global scale, several trillion US dollars should be invested in the energy sector by 2030, with a considerable part of that amount allocated to satisfy the needs of developing countries.

34. Conditions should be created and maintained to attract investment in the energy sector by establishing competitive, open, fair and transparent markets.

35. When making decisions on investment, great importance is attached to the energy and environmental policy of a given state, and predictable regulatory regimes in energy-producing, energy-consuming and energy-transiting countries should therefore be promoted. This should include the adoption of stable legislation based on the principles of the market economy, investment governance and forecasting of medium- and long-term demand for energy resources, the establishment of clear and consistent taxation systems and the removal of excessive administrative barriers.

36. Attracting investments in all stages of the energy cycle can make it easier to:

– introduce innovative energy-efficient technologies;

– encourage wider use of renewable and alternative sources of energy, primarily nuclear energy;

– introduce and expand use of more environment-friendly and efficient technologies and methods, including in nuclear energy;

– develop efficient generation capacities in the field of electric power production, including the development of nuclear energy as one of the priorities;

– expand and improve efficiency, security and safety of power networks, as well as possibly linking them up with energy systems of other states, including developing countries.

37. Capital flow to energy production should be facilitated, including for building new, more efficient installations and upgrading the existing power plants (including nuclear power plants), to ensure wider use of renewable energy sources.

38. Supplying properly qualified human resources for the energy sector in the long term is critical to ensure energy security.

39. Adequate measures are required, therefore, to ensure proper training of energy sector employees, including in the field of new and innovative energy sources and technologies necessary to ensure long-term energy security. The training of highly qualified personnel for nuclear energy is especially important.

4.3. Improving energy efficiency and energy saving

40. Saving energy resources plays an important role in strengthening energy security. It is often a more cost-efficient and environmentally responsible means of meeting the growing demand for energy.

41. Energy efficiency and energy saving are among the most efficient solutions to the problem of reducing greenhouse gas emissions.

42. In all development scenarios, energy saving, that is, making energy consumption more efficient, is a priority activity achieving maximum impact in the shortest time in resolving the climate change issue. Expanding the use of nuclear energy can make a decisive contribution here.

4.4. Energy diversification

43. Energy diversification is one of the most effective instruments for reducing risks in the field of global energy security.

44. Developing low-carbon and alternative energy, making wider use of renewable energy resources and introducing innovative technologies in all energy sector industries can help reduce risks in global energy security.

45. Nuclear energy has a special role to play in diversifying energy sources, being the most feasible, technically proven, environmentally acceptable and competitive alternative to carbon energy.

46. Nuclear energy is viewed as an attractive option because of such competitive advantages as the least dependency on fuel prices in comparison with other sources of energy, insignificant volume of energy cargo transportation, detailed consideration of nuclear and environmental safety matters and environmental protection.

4.5. Innovative energy technologies

47. At the G8 summit held in 2007 in Heiligendamm, the G8 leaders noted that: “Innovation is one of the crucial drivers of economic growth in our countries. We therefore agreed to take action to promote innovation as well as research and development.”

48. The arrival of innovative technologies on the market will contribute to improving energy sector efficiency and strengthening global energy security. These new initiatives include developing potentially valuable technologies, including those linked to the construction of improved power circuits, superconductivity and nanotechnologies (including biological nanotechnologies); conducting research and development in the field of fusion energy within the International Thermonuclear Experimental Reactor (ITER) project; and implementation of the IAEA International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO).

49. Of all innovative energy technologies, nuclear energy is the most feasible option, which, thanks to scientific and technical advances in the field and the developed infrastructure, can take the lead in energy production in the 21st century and ensure sustainable human development.

4.6. Resolving the issues of climate change and sustainable development

50. Sustainable development implies an environmentally responsible approach to development and use of energy resources.

51. The entire international community has acknowledged that the climate change issue must be resolved.

52. The Kyoto Protocol, the first international instrument applying market principles to environmental protection, is an effective mechanism promoting the reduction of greenhouse gas emissions and efficiently resolving the issue of climate change.

53. Nuclear energy has a highly significant role in attaining the goals of the Kyoto Protocol and the United Nations Framework Convention on Climate Change (UNFCCC). The advantage of nuclear energy is that it contributes the least to the “greenhouse effect”. It is estimated that a nuclear power plant produces the lowest volume of greenhouse gases per unit of energy compared with all types of energy used at present or to be

used in the future. Energy production in nuclear power plants can enable humankind to cut greenhouse gas emissions and significantly reduce their impact on the atmosphere, while large-scale introduction of nuclear energy or the even more efficient new generation of energy based on using energy of the deep structure of matter will enable us to resolve the issue of climate change resulting from human activity.

4.7. Reducing energy poverty

54. It is impossible to drastically reduce poverty in general without resolving the issue of energy poverty. If energy poverty remains it is also not possible to support health care services, supply people with safe drinking water, improve sanitation, make agriculture more efficient, increase food production or create employment by attracting investment in the enterprises of developing countries.

55. There appears to be a need for expanding access to energy resources for the poorest population groups and improving energy efficiency in developing countries.

56. Programmes of assistance to the developing countries should be aimed at improving their policies and regulation systems in order to attract private capital. International financial institutions should help resolve these problems.

57. Nuclear energy can play an important role in reducing poverty and ensuring long-term energy sustainability in developing countries. At the same time, the development and use of nuclear energy should include the development of energy infrastructure and personnel training.

5. Factors contributing to reducing the role of conventional energy

58. A number of countries (for example, Germany, the United States, France and Japan) have chosen to ensure energy security by reducing dependency on non-renewable sources of energy – imported oil and natural gas – through developing alternative electrical energy sources, primarily nuclear energy.

59. This is not an arbitrary choice. Several years ago most experts believed that oil would remain the main source of energy indefinitely but they have now changed their minds. According to some estimates, oil will remain the dominant source of energy for thirty years at the most, for several reasons.

60. Firstly, oil prices are high and fluctuate. In 2005 world oil prices rose by 42% as compared to 2004, while the average European imported natural gas price increased by 48%. At the same time, the share of fuel in the structure of goods has become highly significant.

61. However, from a strategic point of view, prices are not the main reason. A more important factor is that, as the number of energy consumers grows, especially in countries like India and China, a shortage of oil will become inevitable.

62. It is not possible to constantly step up extraction either. The oil reserves available are limited, and not only because the volume of the subsoil is limited but also for a number of other reasons. There is also an energy limitation, because the extraction of oil which is difficult to access may require more energy than it will generate. In this case cost becomes a secondary parameter.

63. Another source of energy is natural gas, which is also a valuable raw material for many other industries. Dmitry Mendeleyev said that burning natural gas is almost the same as using banknotes as fuel. Nevertheless, we still do it.

64. The third important source of energy is coal. In Russia, for example, coal is the source of about 18% of all the energy produced. There is enough coal for another three hundred years, but the use of coal is restricted by environmental regulations.

65. There is growing concern over atmospheric pollution which calls for urgent solutions.

66. In addition, there are problems relating to transportation infrastructure, which may prove inadequate to transport the growing volumes of conventional energy as energy consumption increases.

67. All this means that ensuring efficient, stable and environmentally safe energy at prices reflecting the fundamental principles of the market economy is a challenge for our countries and humankind in general, requiring solutions to a number of serious interrelated issues, such as:

– growing demand for energy resources (it is estimated that by 2030 demand will increase by more than half, with 80% of it met by fossil fuels, reserves of which are limited);

– growing dependency of many countries on imported fuel;

– the need for enormous investment in all stages of the energy production cycle;

– the need to protect the environment and resolve the issue of climate change;

– political instability, natural disasters and other threats.

68. As all these issues are of a global nature, partnership should be forged between all the parties concerned in order to strengthen global energy security.

6. The role of nuclear energy in sustainable development

69. Nuclear energy plays a special part in solving the problems of energy resources, ensuring sustainable development and energy security. This has already been recognised by Russia and many other countries in the world.

70. Nuclear energy should be environmentally safe, cost-effective, stable in terms of non-proliferation and should be underpinned by a reliable system ensuring security and safety of nuclear materials and facilities.

71. It will be impossible to reach a sustainable fuel and energy balance within the next thirty to fifty years without large-scale development of nuclear energy.

72. Today, nuclear energy is the only feasible and available source of energy valuable in terms of preserving the balance between world energy production and the growing demand for electric power. Nuclear energy is also attractive in terms of reducing atmospheric pollution and, consequently, resolving the problem of climate change.

73. One key point is that thirty to forty years ago, when the nuclear energy industry was in its infancy, it was merely an aspect of military nuclear programmes. Large-scale civilian nuclear programmes were implemented mostly in countries where major military nuclear programmes existed.

74. Today, given increasing prices for hydrocarbons and the boom in energy consumption, nuclear energy has gained its own value.

6.1. Prerequisites for nuclear energy development

75. The situation in the world is very different now and characterised by two important features:

– Nuclear energy development has become global. Whereas in the past only certain countries developed nuclear technologies, today the process has become truly global. More and more countries find it right and reasonable to have access to cheap and efficient nuclear energy.

– Taking into consideration that in the area of nuclear energy almost no country in the world can act absolutely independently, the nuclear energy market is one where everyone depends on everybody else.

76. Such mutual dependence and the global nature of the market call for a serious joint review of the rules governing this market. Given its tight links with military programmes, the market remained closed and isolated for quite a long time. Today, it has become global and more open, but a number of outdated and obsolete rules were retained.

77. In terms of ensuring the safety and security of nuclear energy, the most important factor is creating open, transparent and equal conditions for countries to access the market of goods and services offered by the world nuclear energy sphere.

78. At the same time, it should be understood that improving public opinion regarding civilian nuclear programmes and relevant decisions by the leaders of states is a necessary condition but not the only one.

79. With no facilities and no proper set-up for the nuclear fuel cycle, there will be no nuclear renaissance. And there are still a number of tasks to be resolved in this area.

80. If new nuclear power plants are commissioned throughout the world, there will be enormous pressure on the first stage of the nuclear fuel cycle, whose major phases include the extraction of natural uranium, its enrichment and fuel production. Production will have to be expanded. Only if this development goes hand in hand with the development of generating facilities can we expect peaceful nuclear programmes to play the leading role in supplying humankind with energy.

81. A further important task to be resolved is the management of spent nuclear fuel and radioactive waste.

6.2. Nuclear renaissance

82. Today, nuclear energy is an efficient and stable source of about 17% of electric power produced worldwide. At the same time, rapid economic growth in certain regions and countries has already made it necessary to plan ahead for new energy capabilities and development of the relevant production and energy infrastructure. According to IAEA estimates, between 30% and 80% of increased energy capacity in Asia, for example, can be achieved by building nuclear power plants.

83. With this in mind, the fact that nuclear energy development has been actively discussed worldwide, which is a true nuclear renaissance, seems reasonable and logical. Besides this, a nuclear renaissance is becoming increasingly feasible.

84. Considering that the experience of running nuclear power plants in recent years has shown that this kind of energy is efficient and safe, it is only logical that many countries have already adopted programmes for more widespread nuclear power plant construction.

85. Countries like Russia, China, India, the Republic of Korea, the United States and Japan have clearly stated their intentions as to nuclear power plant construction. For example, by 2030 nuclear energy may become the major source of energy in Japan, supplying over 40% of the country's energy.

86. Decisions to develop civilian nuclear power programmes have been taken in countries which have never developed and do not intend to develop the military component of nuclear programmes. Turkey has decided to build a nuclear power plant on the Black Sea coast. Construction is to begin in 2007 and three power plants will have been completed by 2015. The Australian Prime Minister has supported nuclear energy development in his country, and experts believe that nuclear electric power may already be generated in Australia in ten years' time. Construction of a nuclear power plant in Poland is under consideration. Asia-Pacific countries also plan to develop nuclear energy.

87. In a number of other countries, such as Great Britain, Italy and even Germany, well-known for its anti-nuclear policy, there is growing discussion of the future role of civilian nuclear energy as a key component of the energy balance.

88. When evaluating the quantitative indices of nuclear renaissance American experts concluded that aggregate world nuclear power plant capacity will increase from 371 GWt in 2005 to 438 GWt in 2030, which is a very significant increase, especially since the commissioning of new nuclear power facilities has been a fairly rare occurrence in the last twenty years.

6.3. Nuclear energy development in Russia

89. Russia is one of the many countries sharing this opinion.

90. In that country opting for national nuclear energy is not only a political decision imposed by circumstances but it is backed by a specific programme of action aimed at creating the full spectrum of necessary conditions. Nuclear energy is developed on the basis of the necessary legal, financial and administrative framework.

91. The federal targeted programme entitled “Development of Russia's Nuclear Energy Production Complex in 2007-2010 and subsequently up to 2015” is a public-private partnership for building new nuclear energy facilities. Government support at this stage does not imply that Russian nuclear power plants are not competitive in comparison to other types of energy but acts as a compensation mechanism until market relations are developed. The Russian Government has decided that market relations should be introduced into the electric power sector after 2011.

92. In July 2007 the Russian Federation Government approved the federal targeted programme “Ensuring Nuclear and Radiation Security for 2008 and up to 2015”, which provides for state funding for management of spent nuclear fuel and radioactive waste and decommissioning, problems that remained unsolved in the previous stages of nuclear energy development.

93. A federal law has been adopted, providing for restructuring of the industry and a transition to market relations in its civilian sector. For the first time, legal entities have been granted the right to own nuclear materials and facilities, while state-owned enterprises in this sphere are to be transformed into joint stock companies.

94. This summer saw the founding of AtomEnergoProm, a holding comprising major civilian nuclear energy enterprises. This open joint stock company is a nuclear energy production complex which aims to concentrate the resources needed for the tasks ahead.

95. Today our minimum target is to ensure that at least 16% of energy is produced by nuclear power plants and the weighted average target is the index set by the energy strategy (22%), while a 25-30% share is called for in real terms, this being the average index of the developed countries.

96. Long-term technology policy envisages the development of a model design “Nuclear Power Plant 2006” based on a WWER reactor and the gradual introduction by 2030 of new fourth-generation fast neutron reactor nuclear energy technology, a complete nuclear fuel cycle and uranium-plutonium fuel, which should remove limitations with regard to raw materials of fuel for the foreseeable future.

6.4. Complying with the nuclear non-proliferation regime

97. Large-scale nuclear energy development across the world is closely linked with the access of more and more states to nuclear technologies, materials and equipment. This means that the international community faces issues related to nuclear non-proliferation and nuclear and environmental safety, as well as ensuring the security and safety of nuclear materials, the economic competitiveness of nuclear energy and a reduction of related risks.

98. In these circumstances, the states with developed nuclear industries should pool their efforts in order to provide assistance to states interested in developing nuclear energy.

99. In the current situation, given the new challenges and threats facing the world community, the balance between developing world nuclear energy and complying with the nuclear non-proliferation regime should be ensured.

100. Maintaining that balance is not an easy task. As already pointed out, more and more countries are opting for nuclear energy development, which will inevitably entail uranium enrichment and the need to process spent nuclear fuel. Building the nuclear fuel cycle facilities required is expensive. Another important task is IAEA control. Furthermore, there is always a risk that civilian technologies might be used for military purposes.

101. In this context, a problem arises of how, on the one hand, to guarantee access to nuclear fuel and services relating to spent nuclear fuel management for the countries concerned and, on the other hand, to restrict the spread of nuclear technologies and the construction of new nuclear facilities in different parts of the world and to avoid new risks for the nuclear non-proliferation regime.

102. It is not possible for technical, political and ethical reasons to prohibit access to cheap and efficient nuclear energy for those countries.

103. This is impossible when access to cheap and efficient energy resources is a key prerequisite for development.

104. The task facing the world community is to develop new systems that would guarantee the right of any country in the world to use nuclear energy for civilian purposes while ensuring strict compliance with the nuclear non-proliferation regime.

7. Nuclear fuel cycle initiatives

105. We recognise that this is an extremely complex matter and international co-operation is therefore especially important in seeking solutions to the aforementioned problems.

106. In recent years, a number of initiatives have been launched with regard to the nuclear fuel cycle, including the following:

– the initiative of Vladimir Putin, President of the Russian Federation, on energy support for sustainable human development, resolving the issues of non-proliferation of nuclear weapons and improving the environmental situation on the planet, announced during the Millennium Summit in 2000, and that of the United States (IAEA INPRO project);

– the International Forum Generation-IV project;

– IAEA activities geared to identifying a mechanism guaranteeing fuel supply for nuclear power plants in the countries developing nuclear energy;

– bilateral Russian-American co-operation in civilian nuclear energy;

– initiative of the President of the Russian Federation of 25 January 2006 on developing a global nuclear energy infrastructure (International Uranium Enrichment Centre – IUEC);

– the US Initiative for Global Nuclear Energy Partnership (GNEP);

– Joint Statement by the presidents of the United States and Russia on nuclear energy and non-proliferation joint actions, of 3 July 2007.

107. These and other initiatives are all important, each having its own advantages and limitations.

108. The initiative of the Russian Federation President of 25 January 2006 on developing a global nuclear energy infrastructure is one of the mechanisms aimed at allowing equal access to nuclear energy for all the countries concerned while ensuring compliance with the requirements of the nuclear non-proliferation regime.

109. The initiative is aimed at further developing nuclear energy as a basic component for ensuring global energy security. The Russian initiative could provide a feasible opportunity to develop nuclear energy across the world swiftly and safely taking due account of the need to ensure non-proliferation of the most sensitive nuclear technologies for uranium enrichment and spent nuclear fuel processing.

110. As with its national nuclear energy development programme, Russia's approach to these issues involves gradual, phased supply of resources and specific progress – not promises and attractive but unworkable models, but specific yet small-scale actions proven in practice.

111. Uranium enrichment technology is the most sensitive part of the first stage of the nuclear fuel cycle in terms of proliferation. Therefore, a solution is required that would curb the tendency of countries striving to develop nuclear energy to independently develop enrichment technologies. This solution should meet at least three requirements: it should guarantee a reliable supply of nuclear fuel, be commercially attractive and ensure compliance with the nuclear non-proliferation regime.

112. Since uranium enrichment is a necessary technological process in producing nuclear fuel for power plants, and at the same time the most sensitive part of the nuclear fuel cycle in terms of proliferation, the first IUEC has been set up in Angarsk, in the Russian Federation.

113. In practice, the centre guarantees states access to uranium enrichment capabilities to meet nuclear fuel needs without creating their own nuclear fuel cycle, which consumes a great deal of time and resources.

114. The sponsors of the centre, under an inter-governmental agreement of 10 May 2007, are the Russian Federation and the Republic of Kazakhstan. The centre's main task is to provide guaranteed access to the uranium enrichment capacities of the Angarsk Electrochemical Plant Federal State Unitary Enterprise with a view to providing uranium enrichment services so that fuel for nuclear energy may be produced.

115. To ensure that the centre is run on market principles, it was set up under Russian Federation laws as an open joint stock company, making the initiative more financially attractive, since participating organisations will not only have access to uranium enrichment services to satisfy their needs but also receive dividends from the centre's activities.

116. Third party states may join the centre at any time, with no political conditions attached.

117. Russia has been working constructively with the IAEA to identify specific parameters for the participation of the agency in the centre's activities.

118. Since the materials of the centre should be covered by IAEA safeguards, an unprecedented step has been taken to enable the agency to monitor activities at the Angarsk Electrochemical Plant. This is the underlying basis for the centre and the plant has been excluded from the list of especially sensitive facilities of the Russian Federation and included in the list of nuclear fuel cycle facilities covered by IAEA safeguards. The necessary procedures to include the centre in this list are currently being completed.

119. The centre could very well become involved in the IAEA project on guaranteed supplies. The centre can guarantee uranium enrichment services with the use of time-tested, technology-intensive and competitive technology of isotope enrichment, as well as contribute to establishing the system of guaranteed supplies of nuclear fuel to satisfy nuclear energy needs.

120. In response to the initiative of Mohamed ElBaradei, IAEA Director-General, on a nuclear material bank under the auspices of the IAEA, the Russian Federation intends to create an enriched uranium reserve whose storage is to be entrusted to the centre. Materials from this reserve will be supplied upon IAEA request in *force*

majeure circumstances (when both enricher and the market deny uranium supplies for political reasons) to any state developing a civilian nuclear energy programme on condition that it complies with its non-proliferation commitments.

121. It is believed that the Russian proposal to create an enriched uranium reserve at the centre as a branch of the IAEA nuclear fuel bank will enable the implementation in practice of the new mechanism provided for by the guaranteed supplies concept and will be a step towards creating a world infrastructure for nuclear energy of the future.

122. President Putin's initiative is based on the understanding that there should be numerous international centres around the world. Russia is not striving for a monopoly; it is just trying to provide an example by setting the centre up on its territory.

123. On 3 July 2007 the presidents of Russia and the United States adopted a Joint Russian-American Declaration on “nuclear energy and non-proliferation joint actions”.

124. This declaration reflects our common approach regarding a new form of joint action to support the expanded use of nuclear energy and implementation of earlier initiatives in the field of multilateral approaches to the nuclear fuel cycle.

125. To attain the goals set out in the declaration, activities are proposed in fields such as supporting the supply of modern nuclear reactors, promoting the development of infrastructure necessary for nuclear energy and supporting access to financial resources for the construction of nuclear power plants, including loans from international credit organisations, supporting guaranteed supplies of nuclear fuel and providing assistance in managing spent nuclear fuel.

126. It should be stressed once again that the task is to give all states intending to use and develop nuclear energy an opportunity to freely choose their nuclear fuel cycle strategy, including the opportunity to benefit from nuclear energy without creating their own nuclear fuel cycle elements which would be costly and unsafe in terms of nuclear safety and nuclear non-proliferation.

127. Furthermore, Russia supports other nuclear fuel cycle-related initiatives, including the initiative by the US President on the GNEP and the proposals made by the group of major suppliers of enriched uranium within the guaranteed supplies scheme.

8. Innovations in nuclear energy

128. Of all innovative energy technologies, nuclear energy is the most feasible option and, thanks to scientific and technical advances in the field and developed infrastructure, can take the lead in energy production in the 21st century and ensure sustainable human development.

129. At present, many nuclear energy countries are implementing programmes aimed at creating an image of nuclear energy acceptable for both producers and consumers, drawing up principles, requirements and criteria for its creation and functioning in the future, and specifying and launching the necessary research and development.

130. Innovative nuclear energy will be based on principles differing from those typical for modern nuclear energy, which is based on fuel supply, electricity generation and spent nuclear fuel management technologies, each run as a separate and independent operation.

131. Innovative nuclear energy will bring together all these operations within one technologically closed-loop fuel cycle, solving two major problems: where fuel comes from and where nuclear waste goes.

132. What is the most feasible option for supplying energy for the sustainable development of civilisation today?

133. The most energy-rich raw material known today is natural uranium. The aggregate capacity of the world uranium reserve is ten times greater than that of world reserves of hydrocarbons – coal, oil, and natural gas together. However, modern nuclear energy technologies involving thermal reactors make it possible to use only one uranium isotope – U-235. Its natural uranium content, consisting of a number of different isotopes, is as low as 0.7%. The content of another component of this mix – U-238 – is 140 times higher, while almost 90% of it goes into enrichment facility refuse and another 10% into spent nuclear fuel, which is often inaccurately referred to as nuclear waste. In general, the thermal reactor-based system can extract energy from only about 0.5% of all nuclei of natural uranium. If this type of nuclear energy is intensively developed, the world will run out of uranium very soon, in another fifty years.

134. One of the major advantages of nuclear energy raw material is its renewability, thanks to the possibility of generating energy and regenerated fuel using fast neutron reactors.

135. This technology is now ready for large-scale introduction, and Russia is leading the field in this respect.

136. This is confirmed, in particular, by the successful functioning of fast neutron sodium reactors BR-10, BOR-60, BN-350 and BN-600. The latter has been operated for over twenty-five years at the Beloyarskaya Nuclear Power Plant in the Urals, and it is the only commercial fast reactor in the world. Another, more powerful reactor, BN-800, is now being constructed there.

137. In fast reactors, both wholly natural uranium and accumulated refuse of enrichment enterprises and nuclear waste of thermal reactors will become fuel.

138. There are various development options: a fast reactor can be constructed with a core that generates the same amount of fuel which is subsequently burnt.

139. The system can also be geared to expanded fuel generation in a special blanket around the core, which will produce more plutonium than will be burnt. This excess plutonium can be used to launch new fast reactors.

140. In addition, there is natural thorium, the world reserve of which is several times greater than the world uranium reserve. Using fast reactors this resource can also be easily integrated in innovative nuclear energy.

141. Achieving these ambitious tasks will depend on numerous interrelated factors. In addition to creating and developing basic elements of a new technological platform for innovative nuclear energy, many new industrial facilities should be constructed and new specialists should be trained for them. A brand new nuclear energy system should be deployed, involving a closed-loop fuel cycle that is safe, low-waste, environment-friendly and sustainable in terms of nuclear weapon proliferation.

142. All this requires time and considerable investment. Investing incomes from oil and gas could boost the development of this energy resource. As a result, in thirty to fifty years' time the world could have a virtually inexhaustible source of energy for a historical period of several thousand years.

8.1. IAEA International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO)

143. International co-operation has been launched and developed to devise principles, requirements and criteria for the future creation and functioning of innovative nuclear energy.

144. At the Millennium Summit (6 September 2000, US) the President of the Russian Federation, Vladimir Putin, proposed an initiative on the sustainable development of humankind and radical means of addressing the issues of non-proliferation of nuclear weapons and the environmental protection of planet Earth.

145. The Russian initiative has been implemented through the IAEA INPRO project which at present brings together 28 countries including the leaders in world nuclear energy – the US, France, Japan and the European Commission. Dynamically developing countries such as China and India have played an active part in the project almost since it was launched.

146. INPRO is aimed at developing innovative nuclear energy systems and nuclear fuel cycles excluding the use of plutonium and highly enriched uranium, as well as enrichment and processing technologies sensitive in terms of proliferation of nuclear weapons.

147. The project has been widely supported worldwide, which is reflected in the relevant IAEA General Conference and United Nations General Assembly resolutions and the documents of the St Petersburg G8 summit.

148. INPRO will enable nuclear energy to make an adequate contribution to satisfying the growing demand for energy in the 21st century.

149. INPRO will also serve as the scientific and technical basis needed to fulfil the tasks set out in the Russian President's initiative on developing global infrastructure for nuclear energy (2006), alongside the principles of the GNEP.

150. This international project will provide an opportunity to unite all the participating countries concerned, including both nuclear technology countries and nuclear technology users, in jointly reviewing means of satisfying energy demand. It will also facilitate implementation of international initiatives aimed at developing and expanding the use of nuclear energy for civilian purposes in strict compliance with the nuclear non-proliferation regime.

151. INPRO is seen to be a platform for joint identification of the international and national measures required for devising and deploying innovative nuclear energy systems and for the use of advanced and economically competitive technologies, characterised by enhanced safety and minimum risk of proliferation and negative effect on the environment, in the innovative process.

152. Expanding the use of nuclear energy as a reliable source to satisfy the growing energy demand in developing countries calls for solutions for a number of tasks:

– devising common user requirements for nuclear technology and requirements for infrastructure in the consuming country;

– supporting international co-operation in identifying and implementing innovative solutions meeting the new requirements for nuclear technology;

– promoting infrastructure development and personnel training;

– supporting regional approaches;

– control over and participation in creating international nuclear fuel cycle centres;

– ensuring guaranteed supplies.

153. Innovations in nuclear energy at this stage of the development and expansion of its use call for a responsible and structured approach.

154. Methodology could be developed to attain this goal, a kind of international standard for systematic evaluation of nuclear energy solutions and scenarios at the national, regional and global level, taking into consideration all critical aspects of nuclear energy development (safety, environmental friendliness, cost-effectiveness, resistance to proliferation, etc.), as well as current achievements and potentially valuable technological solutions.

155. Using methodology like this could make it easier, for example, to forecast national and regional development of nuclear energy, identify optimum options and potential difficulties and provide countries with up-to-date recommendations on risk evaluation and prevention.

8.2. International Thermonuclear Experimental Reactor (ITER) project

156. Special attention should be focused on one innovative nuclear system in particular, the International Thermonuclear Experimental Reactor (ITER) project.

157. The significance of the ITER project can hardly be overestimated: it is deservedly viewed as a real means of harnessing a new source of energy for the benefit of all humankind:

– Thermonuclear energy is attractive because of the virtual inexhaustibility of fuel resources and its environmental friendliness. Thermonuclear reactor fuel (hydrogen isotopes) can be found in limitless quantities.

– Thermonuclear energy is safer than nuclear energy. It does not pose a threat of Chernobyl-type accidents and leakages of radioactive substances, as it is based on synthesis and not fission and therefore cannot result in a chain reaction.

– The initial designs for a system involving magnetic plasma confinement called Tokamak, which served as a basis for the ITER project, were developed by Russian scientists. Tokamak (stands for Toroidal-Shaped Envelope with Magnetic Coils) has been the only survivor of the 114 thermonuclear reactor concepts proposed by physicists around the world.

– The Tokamak concept was tested by the Kurchatov Institute experts and was proclaimed a success. The achievements of Russian scientists in the field of superconductors and original methods of fine electron plasma heating also played a significant role in the ITER project.

158. However, the design and technologies of thermonuclear power plants are extremely complex. ITER will go down in history as an ambitious global project implemented through the consolidated efforts of the whole of civilisation. Its intellectual and financial scale is even greater than that of the International Space Station. A constant temperature of 150 million °C has to be maintained inside a thermonuclear reactor (whereas the temperature inside the Sun is only 20 million °C). It is under this plasma temperature that the hydrogen isotopes burn, leaving no radioactive refuse. At the same time, the amount of energy produced with a unit of thermonuclear fuel is 10 million times greater than those produced through uranium nuclei fission in nuclear power plants' reactors.

159. ITER is designed to overcome the final obstacle on the way to creating the first thermonuclear power plant, which will resolve the energy problems facing humankind.

160. Implementing innovative projects like INPRO and ITER could provide the solutions needed to ensure global energy security and sustainable human development.

9. Conclusions

161. Today, there is growing interest in nuclear energy as a means of ensuring energy supplies for the world's sustainable development. Developing nuclear energy will enable humankind to resolve one of the most pressing global issues, the issue of climate change. Innovative development of nuclear energy will allow it to be regarded as a renewable energy source that can meet the growing demands of humankind. At the same time, large-scale use of nuclear energy in the 21st century will face not only system and technology obstacles characteristic of modern nuclear energy, but also political, infrastructure and economic restrictions.

162. Overcoming those obstacles and resolving the task of comprehensive energy support for sustainable development is closely linked to the construction of a world infrastructure for nuclear energy based on a new innovative technological platform, including the establishment of international centres providing nuclear fuel cycle services under IAEA safeguards (uranium enrichment, managing spent nuclear fuel, and personnel training).

163. Foundations for a global nuclear energy infrastructure cannot be laid without broader international co-operation and active participation of all the countries concerned.

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