

## **Connection between Nuclear Energy and Nuclear Weapons can be Broken**

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Having been member of Pugwash for decades I must say with regret that many of leading pugwashites believed that a connection between the use of nuclear energy and nuclear proliferation is so close that it requires abandonment of the peaceful use of nuclear energy. While this unrealistic position did not stop the development of nuclear energy, it reduced Pugwash efforts to influence nuclear energy development in direction of proliferation safety. Now, few decades later option of abandoning peaceful use of nuclear energy is no longer viable due to the problems with climate change.

Future nuclear energy development acceptable to general public, technically and proliferation safe is now not only a necessity, it can be a feasible future, should the lessons of the past twenty years, lost years from the point of developing proliferation safety, as well as from Iranian situation and Fukushima accidents be heeded.

We are now facing a period of about 50 years with rather clear need of nuclear fission energy. In that period we have to reduce carbon emission by 80% or more. Contribution of carbon free energy from nuclear fusion or from carbon capture and storage (CCS) on a significant scale is not likely before about 2065. Optimistic predictions for renewable sources by leading organizations such as European Renewable Energy Council, Global Wind Energy Council, Greenpeace and others are not alone sufficient for a giant task to reduce by 2065 carbon emissions from a "Business as Usual" energy future to one that could keep the global temperature increase below 2 degrees C, such as 2011 IEA World Energy Outlook WEO 450 trajectory (Vladimir Knapp, Dubravko Pevec: Future without Nuclear Energy; is it Feasible, is it Sensible?, Proc. Int. Conf. on Nuclear Option, June 3-6. 2012, Zadar, Croatia). So we now just do not seem to have a choice, we must make nuclear energy proliferation safe and prevent its military and terrorist abuse.

To emphasize the essential here is first a short list of measures which could lead to nuclear energy development that would be technically and proliferation safe. Some details and argumentation follow below. Applying them we would achieve technically and proliferation safe nuclear energy development up to the future scale required for essential contribution to carbon emission reduction:

- Establishment of international Nuclear Fuel Agency and internationalizing all national uranium enrichment installations
- Postponement of fuel reprocessing and plutonium use to at least 2065
- International licensing of nuclear reactors constructions

Obviously a change of present attitudes determined sometimes by shortsighted national interests is required. This may seem impossible at present. Lead role should be with NW countries. After decades of fruitless nuclear disarmament a reconsideration of early ideas of "nuclear fathers" could show the way. We believe the change and the needed political will will be created when the climate change becomes clearly evident to general public. We hope this does not happen to late.

## **Ad a)**

As is known and has been elaborated already in extensive International Fuel Cycle Evaluation study (INFCE, 1978-80), proliferation sensitive nuclear technologies associated with nuclear energy are fuel enrichment and fuel reprocessing. Dominant nuclear technology of light water reactors requires enriched uranium. Although such reactors require low enrichment, up to 5%, any country in possession of enrichment installations can use them to produce high enrichment, respectively, nuclear explosive.

During the era of cold war two nuclear superpowers were able to control proliferation within their respective blocks. That control was over with the break up of Soviet Union. Contrary to (perhaps naive) expectations, serious steps towards nuclear disarmament did not take place with the end of cold war. Nuclear weapons, instead, developed into an important lever in world policy, respectively, into a status symbol. In addition to five original nuclear weapon (NW) countries we now have three declared NW countries more, India, Pakistan, North Korea, and Iran as suspected candidate.

To close this path to nuclear weapons proliferation is simple, in principle at least. It was in fact proposed by nuclear energy fathers wishing to end military abuse of nuclear energy through so called Lilienthal-Baruch plan proposed by US in United Nations in 1946. It was rejected by Soviet Union developing its own nuclear weapons. Plan envisaged supranational International Atomic Development Authority (IADA) in charge of uranium enrichment and fuel supply (details in a great book by Nobel Prize winner Philip Noel-Baker: *The Arms Race*, 1958).

At present time we have a weakened Non Proliferation Treaty (NPT 1970), signed by all but three world countries, to build on. NPT as an accord between NW countries and non-nuclear weapon (NNW) countries acknowledges the right of all countries to the peaceful use of nuclear energy. NW countries promise to help signatories of the Treaty (Article VI) to achieve it. Dominant present reactor technology requires enriched uranium. In absence of supply free of political bias, perceived or real, several NNW countries have constructed such facilities and contributed to the increased proliferation risk. Iranian situation has again stimulated thoughts about creation of international fuel agency, probably as extension of IAEA mandate that would supply enriched uranium without political bias to any country accepting IAEA supervision and inspection of its use. Establishment of Nuclear Fuel Agency (NFA) would require international guaranty by NPT NW countries, in spirit and letter of that treaty, to supply NFA with enriched uranium, whilst NFA should supply any country intending to use nuclear energy with nuclear fuel without any political bias or delays, at correct prices, in return for acceptance of IAEA inspections, including Additional Protocol. Existence of such NFA would remove the need for construction of small and in most cases uneconomic national enrichment installations that impose heavy burden on programs of peaceful use of nuclear energy. A construction of such installations ignoring the NFA would indicate proliferation intentions. Again in the spirit and letter of NPT, NW countries are obliged to serious steps towards nuclear disarmament. In the field on uranium enrichment a minimum first step NW countries should undertake is to abandon further production of highly enriched uranium and sign Nuclear Fuel Cut-off Treaty. To assure the respect and application of this treaty, IAEA supervision and inspections should be applied on equal manner to all enrichment installations, in both NW and NNW groups of countries. This would remove the long standing objections and feeling of unequal treatment of NNW countries and remove some reasons for construction of national installations. To confirm their intention to abandon nuclear weapons NW countries must also sign Comprehensive Test Ban Treaty (CTBT). A final step, in the long run, to remove the proliferation risks associated with uranium

enrichment would be the internationalization of all enrichment installations, in NW and NNW countries, as was proposed by leading scientists from Manhattan project and was a part of US proposal in UN in 1946.

**Ad b)**

With the problem of enrichment installations presently in the foreground we must not overlook the other path to proliferation through building of reprocessing installations, for early introduction of breeder reactors or other ways of plutonium use in energy production. Decisive question is sufficiency of uranium resources for essential nuclear contribution to climate change mitigation without reprocessing and plutonium use. Early introduction of fast breeders would remove the question of uranium resources, but would also introduce reprocessing of spent fuel for extraction of plutonium, as well as proliferation risks associated with material controls in reprocessing plant, in fuel production and in transport. Unwelcome would be the future in which these risks would be added to the proliferation risk from enrichment installations. In view of that we had another look into the question of uranium sufficiency and the need for early introduction of breeder reactors. On the basis of conventional uranium resources as estimated by Uranium Institute (Red Book) for 2008 and assumed consumed by 2065 in conventional proven reactors without fuel reprocessing and plutonium use, we find (V. Knapp, D. Pevec, M. Matijević :The potential of fission nuclear power in resolving global climate change under constraints of nuclear fuel resources and once-through fuel cycle, Energy Policy 38, 2011) that essential contribution to carbon emission reduction is possible in that time period. To be specific, more than one third of the emission reduction required by 2065 can be nuclear, thereby essentially reducing the task for renewable sources of energy and energy saving measures. In this nuclear development concept, in the next about 50 years nuclear energy expansion would rely on proven conventional technology without reprocessing of spent nuclear fuel. This nuclear strategy would allow a serious nuclear contribution to climate change mitigation avoiding introduction of new reactor technologies without sufficient operating experience. Postponement of reprocessing and plutonium use would give time to develop institutions and international organizations to secure safe large scale use of plutonium if needed after about 2065.

**Ad c)**

In view of the effects of Fukushima accident on public acceptance of nuclear energy it is necessary to consider steps that will make sure that technical inadequacies, or unsound practices such as have been revealed in Fukushima (neglect of larger tsunami predictions, location of diesel generators for emergence core cooling, multiple structures, location of spent fuel pool, etc) will not occur again. It must be made sure that attempts to reduce high investment costs will not compromise plant safety. Some general principles for future development of nuclear energy making it more acceptable and compatible with public opinion can be recognized and incorporated in obligatory licensing rules. With potential of nuclear accidents to cause effects beyond national borders nuclear safety cannot be exclusively national jurisdiction. It should become a matter for international law. This is becoming increasingly clear with the accidents in Chernobyl and Fukushima. With future nuclear constructions in technically less developed countries of Asia or Africa compromises on highest safety criteria cannot be excluded as long as IAEA has only advisory role on nuclear safety. A clear lesson of Fukushima and even more of Chernobyl is that internationally developed and agreed licensing and safety criteria for nuclear plants, administered through IAEA, should become obligatory. No country can have right to impose a risk of unsound construction on its neighbors. That should finally mean that an

international construction permit would be required for a nuclear plant in any country. Implementation would, of course, have to be based on international agreement, with UN Security council as a body with power to act in case of non-compliance and with IAEA in charge of technical assessments, supervision and inspections.

**Background Papers:**

1. Man-Sung Yim: Nuclear nonproliferation and the future expansion of nuclear power, Progress in Nuclear Energy 48, 2006 (A good information but now somewhat outdated)
2. Knapp, D. Pevec, M. Matijević: The potential of fission nuclear power in resolving global climate change under constraints of nuclear fuel resources and once-through fuel cycle, Energy Policy 38, 2011)
3. Knapp, D. Pevec: Future without Nuclear Energy; is it Feasible, is it Sensible?, Proc. Int. Conf. on Nuclear Option, June 3-6. 2012, Zadar, Croatia
4. Dubravko Pevec, Vladimir Knapp and Krešimir Trontl: Long Term Sustainability of Nuclear Fuel Resources, Chapter in the book, Advances in Nuclear Fuel, InTech, Rijeka 2012.