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Challenges and Opportunities of Small Uranium Mines in the SMR Development Era

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Abstract

Many countries, in paticular in african region will still facing energy needs and gaps. They mostly use fuel power plant,and will be obliged to proceed to energy mix approaches in regard to fulfil end users needs. So Small and Medium Modular Nuclear Reactors(SMRs) technologies, using small quantitites of uranium fuel, will be a serious option for many least developped countries (LDCs) of Africa which do not yet have a profound knowledge of the whole nuclear power technologies fields and allied technoliges. By the way, a growing interest of small quantities of uranium mining sites will grow and become very strategic activities of cooperation and marketing for both new comers, expanders and providers of nuclear power services.

INTRODUCTION

With a population estimated in 2010 at 1.014 Billions, the african region inhabitants are foreseen to reach 1.318 billions and 1.780 billions respectively for the year 2020 and 2035[1, 2] .

The statistics show that the population will double by 2050 (2.112 billions in 2052[1,2]), and with majority of people living in urban areas meaning, by the way, an increased demand of services like energy and electricity which are high priority needs for all social and economic developments of communuties and countries.

People without decent access to energy are estimated to about 600 millions. The Energy access varies, approximately from 2% in to more than 95 % depending to the country [1-3].

The African reserves of Fuel and oil are estimated at over 130 billion barrels, representing 9.5% of the world's reserves, and more than 80% of these resources are located in the north and west of Africa [1, 4].

The Electricity consumption in many Least Developed countries (LDCS) in Africa is largely provided by fossil fuel with a contribution reaching over 75% ; this contribution of fossil power is followed by hydropower at around 22% ,nuclear and renewable power concurrence is considered at a level of 5% approximately[1-4].

Africa's energy demand is far exceeded energy supply. The electrical energy demand is over 1,465 (GWh) for the year 2010, used only to serve 40% of the population [1]. The electrical demand will grow and pass to 2,401 and 2,717 respectively during the years 2030 and 2035[1, 2].

In regard of the reduction of energy resources, especially the diminution of fossil resources, it's in need to see what options are to be considered by Africa and for Africa sustainable development.

As of today only South Africa uses nuclear energy for power generation and is considered as expander of its nuclear power programme. A number of 21 countries have established politcal decisions to embark on nuclear power and it is foreseen that at least 10 among them will develop and operate their first nuclear power plant for electricity generation within the next 10 to 20 years and to became newcomers NPPs[1-3]. If so, this fact can be a way to encourage and expand nuclear power in more countries to enjoy nuclear power opportunity.

APPROACHES AND ANALYSISES

Nuclear power suppose many components considerations, like scientific and technological prepardess, financial capability and safety and security prepardness, responsibility and commitment in terms of safeguards among the countries and the whole world.

One of these subcomponents is the uranium, the basis of the nuclear fuel, which constitue a basis of cooperation between nuclear operators and countries holding significant ressources of that yellow metal. The results of that kind of cooperation was just financial compensation, after exploitation and exportation of the uranium. So a new approach may be considered in a context of energy ressources dimimution and electrical energy demands rapid growth in LDCs of Africa and in a context of expansion and maturity of the SMRs technologies.

This means that countries with uranium ressources and with small uranium ressources but sufficient for sustaining the commercial activities related to SMRs technology can develop a nuclear power program based on their uranium ressources with nuclear operators in a win-win approach, during the next decades.

Known resources of uranium in 2015 are shared around approximately 16 countries ; Australia, Kazakhstan Russian fedreation concentrate over 52 % of all theses reserves. The african states having uranium reserves are mainly Niger, South africa and Tanzania[1, 3] . The current usage of uranium in the wold is over 63,000 tU/yr , especially used for nuclear applications like power reactor and research reactor.

So significant interest in exploration effort, due partly to increased costs and maybe to geostrategic consideration are noted. During the period from 2004 to the end of 2013 about US$ 16 billions was spent on uranium exploration and deposit delimitationson over 600 projects. in this period over 400 new junior companies were established[3, 4].

The recycled uranium and plutonium is another source of investigation, and allows yearly production of 1700-2000 tU of primary supply, depending on whether just the plutonium or also the uranium is considered. It is forecasting to obtain to 3000-4000 tU/yr by 2020[3, 4].

Energy equivalence of natural uranium depends on the efficiency of uranium utilization,like: the rate of depletion of depleted uranium during the enrichment phase ;plus this rate is weak, the better we take advantage of the U235 component[4].

the rejection choice rate results from a compromise between the cost of uranium and that of the SWU (separation work unit) called also UTS (Unité de Separation),the rate of uranium combustion in a reactor and the possible reusage of the plutonium produced and the processing uranium from a reactor[4]. The values reached in the PWRs are greater than10,000 toe per tonne of natural uranium for a rejection rate of around 0.3% and without recycling processes[3]. So the energy equivalence is about 500 000 toe per tonne of natural uranium and in water reactors with no recycled plutonium, it is possible to have one ton of natural uranium to provide 420,000 GJ, or 10,000 toe, or 14,334 tec[2-4].

Nowadays most of reactor units capacity varies from 60 MWe to more than 1600 MWe,. At the same time there have been many hundreds of smaller and medium power reactors under operation, construction or planed [3,5,6]. The International Atomic Energy Agency (IAEA) consider as small, the reactor with power under 300 MWe ; in the meantime, the IAEA consider reactor with about 300- 700 MWe as medium reactor[5].

The IAEA calls today the small and medium reactors by the terms SMRs. Today, due partly to the competitive capital cost and safety the interest in SMRs is growing in somes countries with low income and small and medium size electrical grids[5,6]. A 2009 assessment by the IAEA under its Innovative Nuclear Power Reactors and Fuel Cycle (INPRO) program concluded that there could be 96 small modular reactors (SMRs) in operation around the world by 2030 in its high caseforecasting scenario , and 43 units in the low case[3].

The lack of profitability of the small sites are still changing and the interest of the nuclear operators and industrial may change because of many facts :

- The interest in developping SMRs which use smaller quantities of uranuim ;
- Possibilities for operators to exploit small sites by using the sames infrastrucutres with bordering countries ;

The interest of cooperating with LDCs in african countries expressing political decisions and commitment to embark on nuclear power programme.
In general, and as example, energy accessibility in Sub Saharan Africa is lower than the average level in whole Africa.

For example, the search for uranium, which had a significant evolution in Senegal between 1965 and 1984, was relaunched in 2007 ; in the Eastern Saraya Research License. The graphitic shales of Mako and Dialé can also spark interest in uranium research and reserves found are estimated between 5,000- 10,000 tonnes[7].

Also, in Mali some 5,000 tonnes of uranium mine are located in Faléa, a municipality in a isolated region,close to the borders of Senegal and Guinea[8]. And in November 2012, a feasibility study prouve that Faléa areas contain about 12,000 tons of uranium, four times the production of the Arlit Areva mine in Niger in 2012[8].

In Guinea,the discovery analysises from Murchison's analysis of samples collected, in particular, from the Firawa site in Kissidougou at 600 km in southeast of Conakry give promising results ; many other Uranium Exploration Licenses in Guinea are issued[8, 9].

DISCUSSIONS

Small sites of uranium in african countries and in many LDCs constitute a potential source of cooperation for energy for nuclear power, in a context of decresing of energy ressources in the Africa and especially in the sub saharian region for the coming years (at the horizon 2035). But some requirement and provisions need to be taken to avoid lack of security and safety and to comply fully with safeguards. For successful and sustainable nuclear power programme these international legal instruments and guides have to be transposed at national, sub-regional and regional levels.

The regional initiative under the Pelindaba Treaty under which the African Commission on Nuclear Energy (AFCONE) has been established, as the body responsible for, inter alia, ensuring compliance with states obligations need to be strengthened[10].

The FNRBA(Forum of Nuclear Regulatory Bodies in Africa,)with its 33 Members as of 2015 need to be supported in terms of human and financial resources.

AFRA-NEST(Network for Education for Science and Technology) With support of AIEA and international cooperation and member states is also a way
The African countries have to implement several Emergency Preparedness Review (EPREV) services in a number of Member States, and to fortifiy their cooperation for illicit trafficking of nuclear material.

To limit potential risk of illicit traffic and to increase safety and safeguards levels, the International fuel reserves which are Low Enriched Uranium material (LEU) projects are very important and are serious support for LDCs of Africa in the next decades.

There have been three major initiatives to set up international reserves of enriched fuel, two of them multilateral ones, with fuel to be available under International Atomic Energy Agency (IAEA) auspices despite any political interruptions which might affect countries needing them (Russian LEU reserve and the IAEA LEU bank in kazkstan).The third is under US auspices, and also to meet needs arising from supply disruptions[11] These initiatives have to be supported at highter level, by all IAEA member states.

CONCLUSION

The small uranium sites in africa, present growing interest by nuclear operator. Exploration and research licences are also increasing. In fact, the small uranium sites maybe sustainable when used for serving fuels for SMRs which need small quantities of fuel. SMRs maybe also an option or a mandatory option for somes countries in need of electricity consumption, in the context of diminution and ending of fuel ressources, in the next decades.
But, safetyconsiderations need to be addressed now to avoid nuclear material proliferation, in future nuclear power plan in the region and indirectly during transport, fueling and re-fueling processes and waste processing. Attention need also to be made on site safety because safety of power plan maybe transposed to the safety of small sites mining.

The political statibilities of many countries and zones is a major risks and concerns for proliferations and a fact that can discourage international cooperation of western countries for cooperating in regards to develop nuclear power programs in Africa.

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Country or International Organization

Senegal

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