

Overview of the Status and Forecast of Nuclear Power Industries in the World

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Abstract

Nuclear energy is being contributed continuously and significantly to the industry, science, medicine, food, environmental protection and agriculture, as well as power generation since the commercial nuclear power stations started operation in the 1950s over 60 years and now provides about 11% of the world's electricity from about 454 power reactors and the second largest source of low-carbon power over 31 countries worldwide.

However, after 11 March 2011, the Fukushima Daiichi NPP accident, there have been public concerns about the nuclear safety around the world. This prompted a re-examination of nuclear safety and nuclear energy policy in many countries and raised questions over the future of the nuclear industries. Also, many countries have expressed its willingness to gradually reduce the share of nuclear power energy and expand renewable energy to secure diversity of energy resources.

I investigate the history and current status of the nuclear industry including nuclear power plants that is being constructed, operated or dismantled over the world and also research the direction of nuclear policy by continent and each country considering energy characteristics and circumstances over the world. And then, I would like to predict the future of the nuclear industry in the world through looking at what field we need to focus on in the future to restore the public reliability and to innovate the nuclear industry.

The current status of the nuclear power industry

Nuclear power plants are mostly operating in Europe, North America, East Asia and South Asia. The United States is the largest producer of nuclear power, while France has the largest share of electricity generated by nuclear power. China has the fastest growing nuclear power program with 29 new reactors under construction, and a considerable number of new reactors are also being built in India, Russia and South Korea.

Currently, 31 countries have operating nuclear-power reactors, and 5 countries plan to build nuclear-power reactors. In addition, 30 countries are considering, planning or starting nuclear power programs, and a further 20 or so countries have expressed an interest. For a safe, secure and sustainable nuclear power programs, new comer countries are following the regulation and safety guard. The emerging nuclear energy countries are now following the developed designs of the UK, USA, France, Russia, South Korea and China as these countries have the reactor design license. The classification of new coming countries according to different stages of planning for nuclear power is as Table 1.

Table 1: The classification of new coming countries according to different stages of planning for Nuclear Power.

Different stages of planning for NPP Names of the countries

Power reactors under construction UAE, Belarus, Bangladesh

Contracts signed, legal and regulatory

infrastructure well developed or developing Turkey, Lithuania, Vietnam (but deferred)

Committed plans, legal and regulatory

infrastructure developing Jordan, Poland, Egypt.

In 2018, several very important milestones have been achieved—first EPR and AP-1000 NPPs have been put into operation in China. In 2019, it is expected that China will put into operation first in the world nuclear-power helium-cooled pebble-bed reactor. Also, in 2016, second SFR-BN-800 was put into operation in Russia. Lithuania, Kazakhstan and Armenia planning to reintroduce nuclear power in the future. At the same time, at least 100 older and smaller reactors will most probably be closed over the next 15 years.

The policy directions of the nuclear power industry

The Fukushima Daiichi nuclear accident sparked controversy about the importance of the accident and its effect on the nuclear future. The crisis prompted countries with nuclear power to review the safety of their reactor fleet and reconsider the speed and scale of planned nuclear expansions.

Over the world, country policy on nuclear development varies widely with phasing out nuclear, while planning to increase their nuclear capacity. Several countries are planning a nuclear power phase-out. These are Belgium, Germany, Spain, South Korea and Switzerland. Other countries, like Taiwan, Netherlands and Sweden are also considering a phase-out. Some country, Italy closed all of its nuclear stations by 1990 and nuclear power has since been discontinued.

The United Kingdom has a significant new build program to replace retiring plant. France, the government announced that they remain committed to diversifying the electricity mix by developing renewable energies. For many countries in the world, the main focus for nuclear development will be on long-term operation and the eventual replacement of ageing fleets. Approximately half of the reactor operating today are more than 30 years old, and many utilities are planning and investing in long-term operation as well as power uprates while regulators are assessing on a case-by-case basis whether these reactors can operate for another 10 years or more. Many reactors will be shut down and decommissioned in the next decades, probably at a higher rate than new build construction, and nuclear could see its share of total generation decline. These base-load capacity will be partially offset by renewable power, but also by increased gas and coal power generation, which would lead to higher CO₂ emissions from the power sector.

The future forecasts of the nuclear power industry

The current statistics on nuclear-power reactors of the world shows that we might face a very significant drop in a number of operating nuclear-power reactors somewhere between 2030–2040 if we assume that current operating term of reactors is on average 45 years, and the rate of building and putting into operation new reactors is 21 reactors per 5 years. The future of nuclear power varies greatly between countries, depending on government policies. The drivers and challengers for the development of nuclear power will vary depending on a number of factors including a country's energy and environmental policy, outlook for electricity demand, availability of energy resources, the regulatory environment and the power market structure.

The key actions for the next 10 years are offer same level playing field to all low carbon technologies, industry to build on time and to budget, enhance standardization, continue to share information & experience among regulators and among operators to improve safety, fact-based information, develop long-term strategy for rad-waste management. The future of nuclear power industry over the world would be focused on the timely management of high-level nuclear waste, continuing activities on safety and competitiveness of large water-cooled reactors, engaging research on small and medium reactors(SMR), the associated research on the closed fuel cycle, nuclear decommissioning project and continue to support International Thermonuclear Experimental Reactor (ITER) project which has the potential to be safer and generate less radioactive waste than fission.

Also, to restore public reliability and to advance continuously the nuclear industry in the future, the requirements and internal challenges for any new nuclear concepts, design and technology are always should be safer than the current generation NPP, low financial risk exposure and capital cost, ease and speed of build, readily licensable, simple to operate and secure, assured fuel supply and sustainability, providing social value and acceptance, and, of course be competitive with respect to lowest costs generation.

Keywords: *Fukushima nuclear accident, nuclear power industry, CO₂ emission, alternative energy, long-term operation, nuclear policy, decommissioning, waste management, and renewable energy, shut down, public reliability, low carbon power, sustainability*

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Biography

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