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Reflections — what has been heard?

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Nuclear Waste —Burden or benefit?
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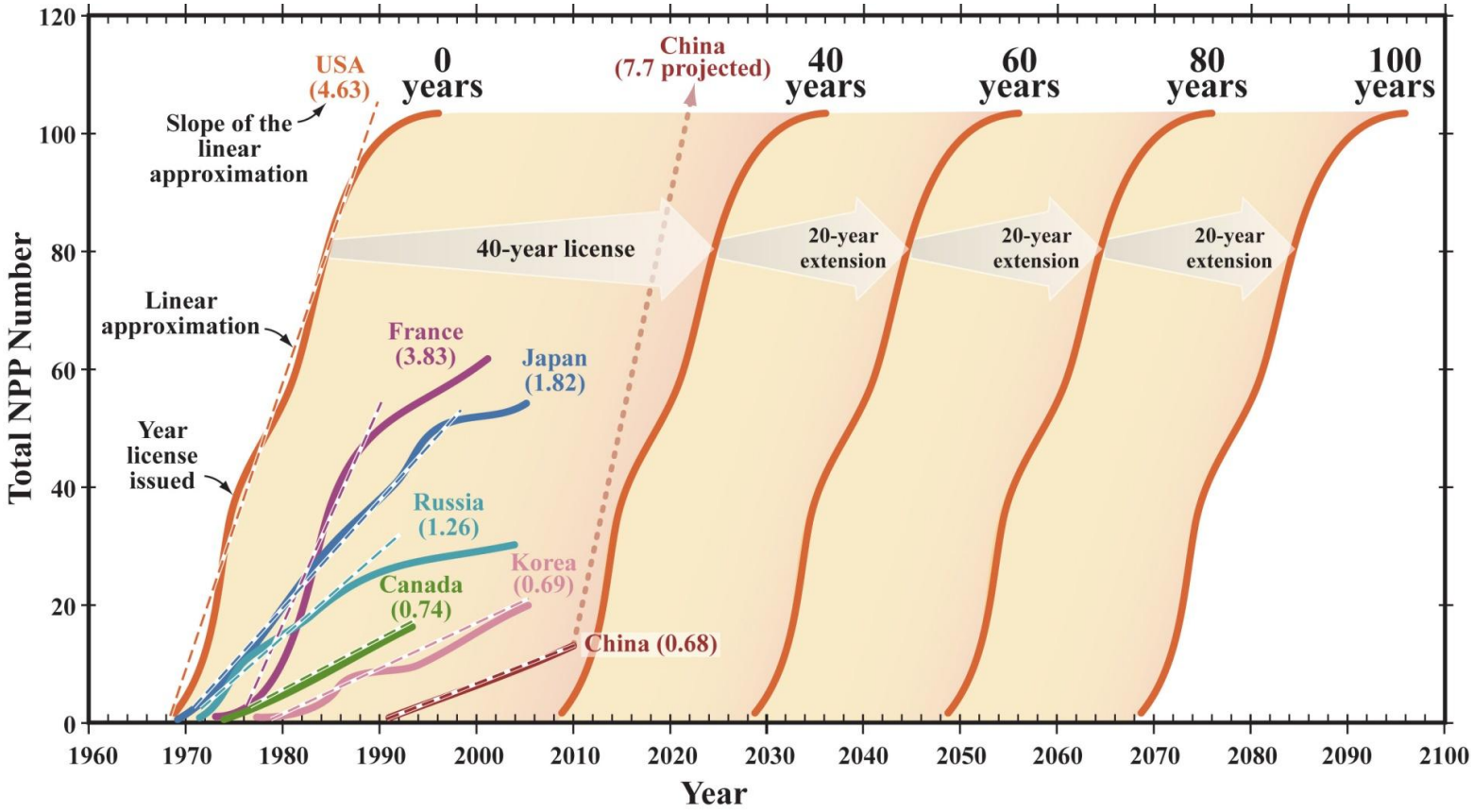
CONSTRUCTION AND PLANNED OPERATION OF PRESENT NUCLEAR POWER PLANTS

Total number of NPPs vs. time for national reactor programs. A linear approximation for the first period of growth of USA is shown. Superimposed are the progressive licensing periods for the US.

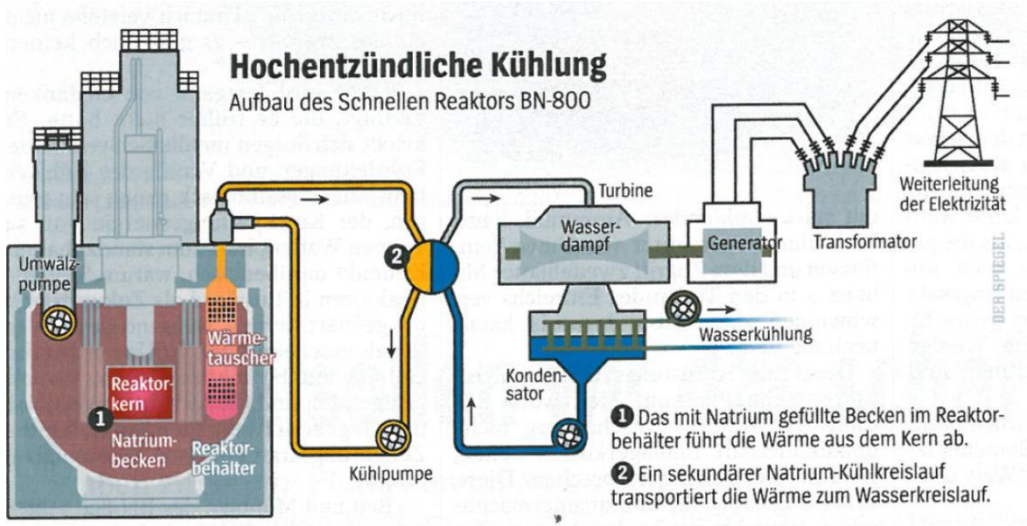


After R. W. Staehle

CONSTRUCTION AND PLANNED OPERATION OF PRESENT NUCLEAR POWER PLANTS

- Plant life extension will result in extended use of exisiting reactors in USA and Europe.
- The economic lives of the first commercial power reactors range from 40 to 60 years, although this can be extended further. However, a large number of plants will be shut down after 2020.
- Replacing old plants either with conventional, fossil-fired power plants, as is being done in Germany, or with new advanced Gen-III nuclear power plants, which would, as a CO_2-free energy form, be enormously beneficial to the environment, represents an huge challenge.
- Major part of the new nuclear power is built now in China (26 plants under construction) and in India.
- Production of spent nuclear fuel will continue for a long time (50…100 years) in the future.

BN-800 FAST BREEDER REACTOR FOR BURNING BOMB-GRADE PLUTONIUM IN RUSSIA



BN-800 FAST REACTOR FOR BURNING BOMB-GRADE PLUTONIUM IN RUSSIA

- Pu of 8500 nuclear weapons (34 tn) will be burnt – Plutonium Management and Disposition Agreement between USA and Russia.
- BN-800 Na-cooled (outlet temperature 550ºC) fast reactor does not have the breeding mantel and it uses 20% Pu MOX fuel.
- BN-800 is planned to start in the end of 2013 – first fuel and Na will be delivered in 2012.
- On the same site a 600 MW fast breeder reactor has been in operation for 32 years.
- In USA the 34 tn plutonium will be burnt in traditional nuclear power plants.
- In 1993 according to the agreement ”Megatons to Megawatts” USA agreed to buy from Russia 500 tn weapon grade U to be used for MOX fuel of nuclear power plants.

NUCLEAR WASTE IN THE LIGHT OF NEW REACTOR TECHNOLOGY

- Spent nuclear fuel will be waste or valuable fuel resource depending on the country - it is waste in small countries and in large countries spent nuclear fuel is reprocessed.
- LWR's consume about 1% of the energy value of uranium, MOX fuel allows saving of 17% (France) of the uranium resource, and the rest about 96% of the spent nuclear fuel may be recyclable to utilize almost all of the energy of natural uranium in Gen-IV fast reactors.
- Reprocessed MOX-fuel can be used for one more cycle.
- Gen-IV fast reactors and emerging nuclear fuel cycle technologies are able to use effeciently the spent fuel. They may be commercially available 30...50 years from now. Test reactors (ASTRID, BREST-300, SVBR-100, MYRRHA) will be available in 2020's.
- Permanent geological repository of spent nuclear fuel/waste is always needed – either in once-through system but also for nuclear waste from reprocessing.

NUCLEAR WASTE IN THE LIGHT OF NEW REACTOR TECHNOLOGY

- Uranium is a finite resource (about 200 years).
- Impact of technology on enhanced LWR performance and on waste management: high performance fuel, higher burn-up, increased MOX loading decrease the amount of spent fuel.
- Closed fuel cycle is, however, preferable, because of reduced mining and cost as well as higher resource base, sustainability, ethics, moral responsibility, but also with higher risks.
- Gen-IV fast reactors will increase resources of nuclear fuel, reduce inventory of long-lived high-level waste, the storage time and the the capacity of the geological repository is increased.
- Fuel cycle transition will require a long time – a half century or more.

NUCLEAR WASTE IN THE LIGHT OF NEW REACTOR TECHNOLOGY

- Any nuclear waste management has to be built on three principals:
  - Reduction of waste generation
  - Waste treatment and recycling of valuable material
  - Disposal and conditioning of non-recyclable residua
- Challenges for the near future are:
  - Building of safe geological repository (Sweden, Finland...)
  - Safe recycling in large scale
  - Fukushima cleaning and aftercare
  - Public confidence and acceptance
  - Political will and national policy
  - Knowledge transfer
  - Extensive R&D and demonstration of Gen-IV prototype reactors
  - Ecological, social, nonproliferation and economical impacts of advanced fuel cycles