Journal of Zhejiang University-SCIENCE A (Applied Physics & Engineering)

Generation III pressurized water reactors and China's nuclear power

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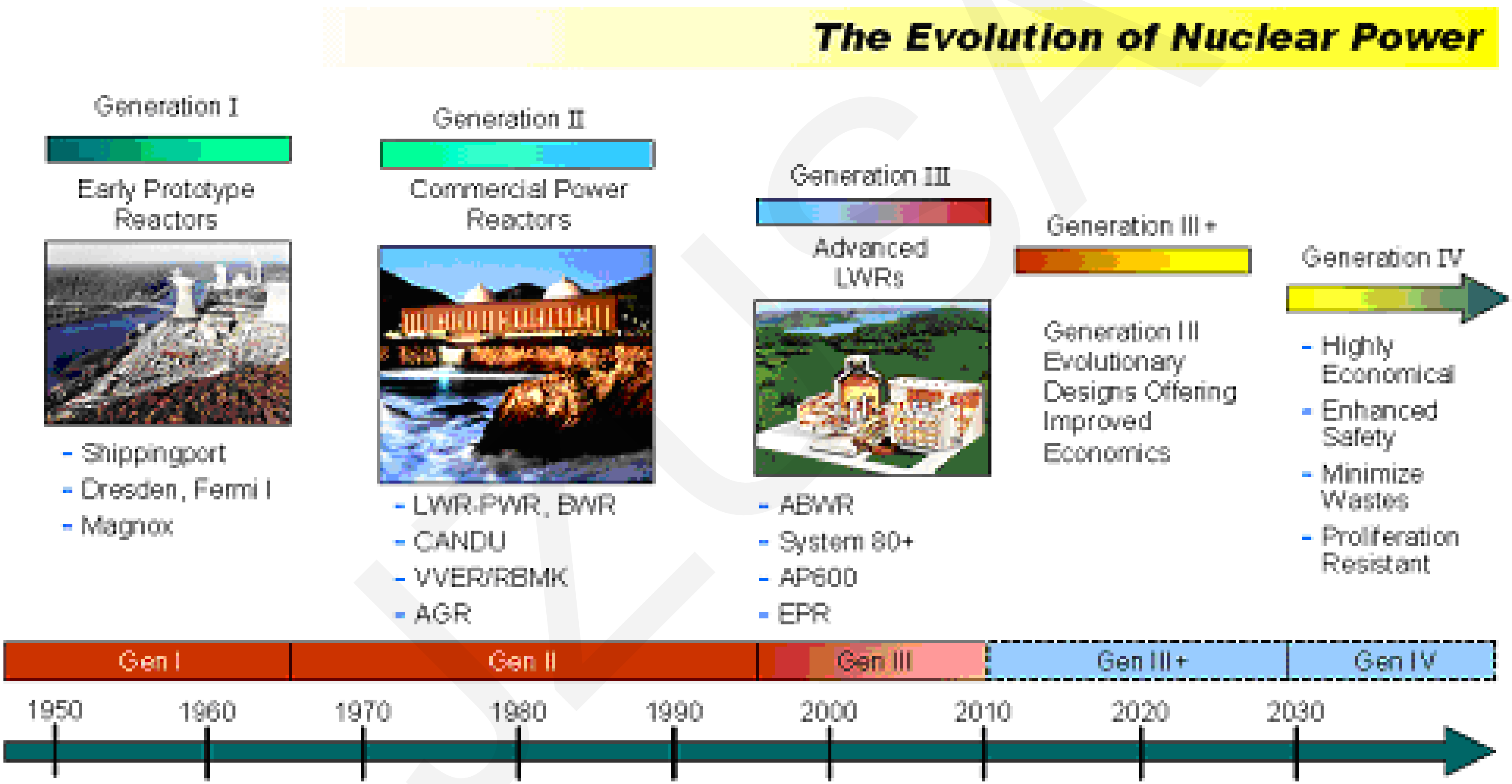
Cite this as: Yong WANG, Ji-en MA, You-tong FANG, 2016. Generation III pressurized water reactors and China's nuclear power. *Journal of Zhejiang University-SCIENCE A (Applied Physics & Engineering)*, 17(11):911-922.

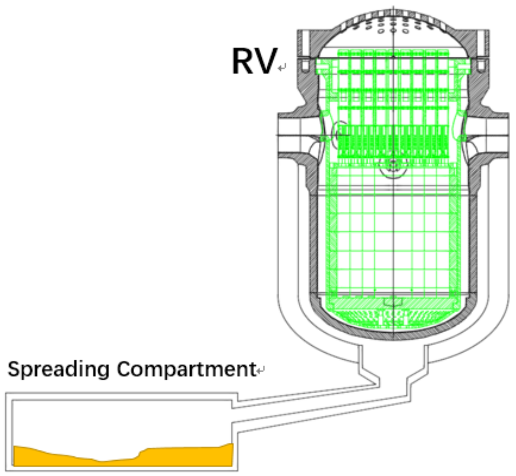
http://dx.doi.org/10.1631/jzus.A1600035

The Evolution of Nuclear Power



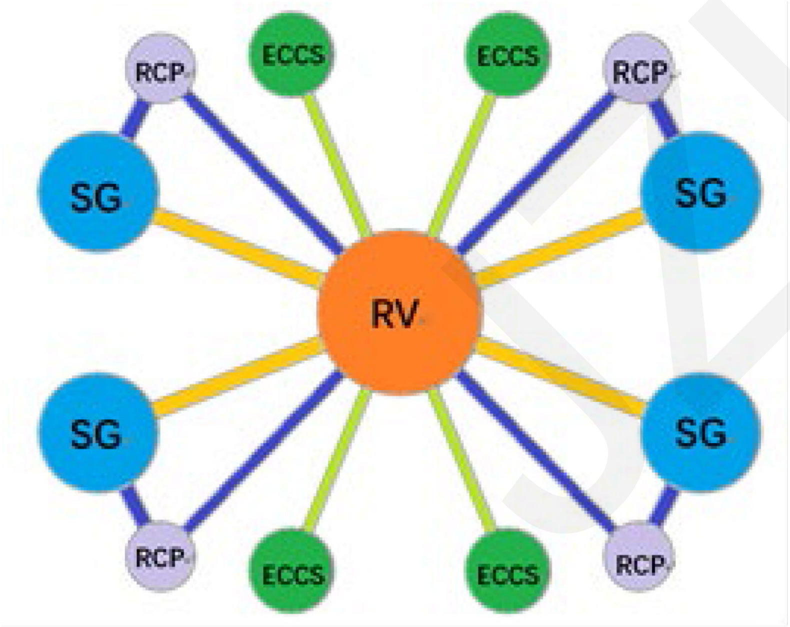
EPR Design Features

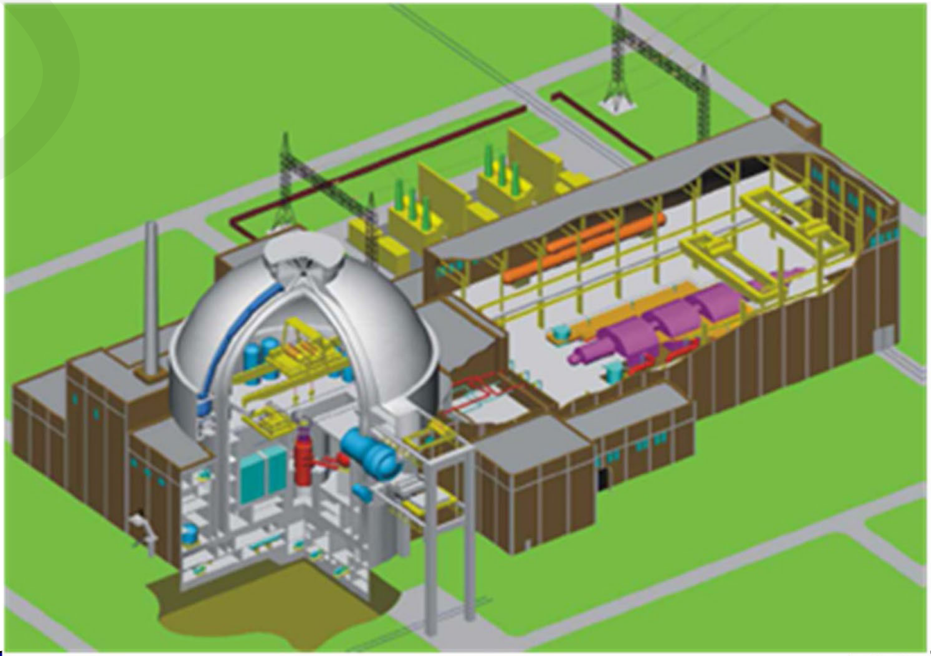
- 4-Train Safety Systems
- Double Containment to protect against commercial aircraft crash
- Core Catcher for severe accident mitigation
- Can run on a full MOX Core
- Higher Plant Efficiency (37%)
- Digital I&C (Siemens TELEPERM-XS)
- 10-15% less uranium consumption
- 15 days outages
- Above 90% life time capacity factor
- Robust design with small technology leap



AES2006 Design Features

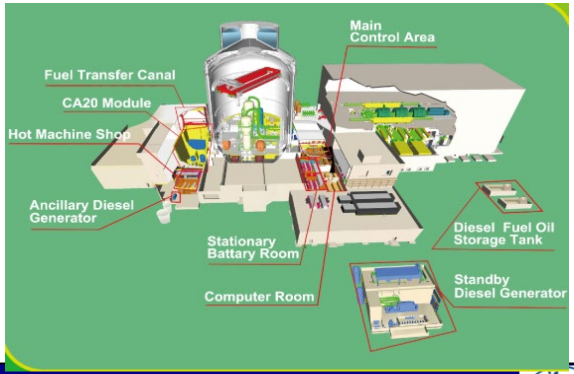
- VVER1000 stretched to 1200 MW
- 60 years service life
- Higher thermal efficiency (35.7%)
- 4-loop design /horizontal SGs





AP1000 and CAP1400 Design Features

- Passive Safety Systems – use forces of nature (gravity, convection, natural circulation to improve safety and simplify systems)
- Passive systems for core cooling, containment isolation, residual heat removal and containment cooling
- No outside electricity needed for 72 hrs
- Number of pumps and safety class valves reduced by about 50%
- In-vessel retention of core melt
- Passive Containment Cooling system
- Proven PWR components



Discussion (1/2)

Item	EPR(AREVA)	AES2006(ROSATOM)	CAP1400(SNERDI)
Design life (years)	60	60	60
Availability（%）	>92%	>90%	>93%
Construction duration (From FCD o connecting to grid）(months)	<54	<54	<56（to be less for fleet construction）
Gross electrical output (MWe)	1770	1197	1500
Average discharge burnup of fuel (MWD/tU)	>50000	>60000	>53000
Fuel cycle length (months)	24	12, capable of 18-24-month refuel cycle	18, capable of 24-month refuel cycle
MOX fuel loading capability	Available	Available	Available
Engineering safety features	Active	Active + passive	Passive
Operation action time (hour)	<0.5	<6	<72

Discussion (2/2)

Item	EPR(AREVA)	AES2006(ROSATOM)	CAP1400(SNERDI)
Severe accident mitigation	Dedicated severe accident depressurization valves, core catcher, containment spray system, passive hydrogen recombiner	Pilot-operated relief valves, passive heat removal system via steam generator, passive heat removal system from containment, core catcher, passive hydrogen recombiner	Passive depressurization squib valve, passive containment cooling system, in-vessel retention, passive hydrogen recombiner
Containment	Double-envelope: external, reinforced concrete; internal, pre-stressed concrete	Double-envelope: external, ordinary concrete; internal, pre-stressed reinforced concrete	Double-envelope: external, reinforced concrete; internal, steel
Capability of withstanding large commercial aircraft crashes	Available	Available	Available
Core damage frequency (CDF) (1/ry)	$<1.24\times10^{-6}$	$<5.94\times10^{-7}$	$<4\times10^{-7}$
Large release frequency (LRF） (1/ry)	$<9.6\times10^{-8}$	$<3.7\times10^{-9}$	$<5.07\times10^{-8}$

Conclusions

- Standardised design to expedite licensing, reduce capital cost and reduce construction time
- Simpler and more rugged design, making them easier to operate and less vulnerable to operational faults
- Higher availability and longer operating life - typically 60 years
- Further reduced possibility of core melt accidents
- 72-hour grace period, so that following shutdown the plant requires no active intervention for 72 hours
- Resistance to serious damage that would allow radiological release from an aircraft impact
- Higher burn-up to reduce fuel use and the amount of waste
- Greater use of burnable absorbers ("poisons") to extend fuel life.