

# Reactor options for the Czech Republic

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# Criteria

- Vendor credibility
- Price
- Availability of finance
- Construction experience
- Operating experience
- Ability to satisfy European safety requirements
- Size, must be a PWR

# Reactor options for Czech Rep

- Rosatom AES-2006
- Areva EPR
- Areva/Mitsubishi Heavy Industries Atmea One
- Westinghouse AP1000
- China General Nuclear Hualong One
- Korean Electric Power APR1400

# AP1000

- Westinghouse was given Chapter 11 bankruptcy protection in March 2017. Its parent, Toshiba, is on the verge of bankruptcy & trying to sell Westinghouse but no likely buyer
- 8 AP1000s under construction, 4 China, 4 USA, none in operation. All at least 4 years late & far over budget. If no buyer for Westinghouse, 4 US units may be abandoned
- Recent costs estimates prior to construction ca \$6,000-7,000/kW. Latest cost estimate for Vogtle project (US) ca \$11,000/kW
- South Carolina (Summer): 'Our experience with Westinghouse [is] a trend of continuous deceit & non-transparency', and [we are] a victim of financial malfeasance'.
- Little prospect of government loan guarantees
- Design approved by US (2011) & UK (2017) authorities. About 1100MW net so OK

# EPR

- Areva NP collapsed March 2015. Support by French government & plan for EDF to take majority stake but conditions cannot be fulfilled till end 2018
- 4 EPRs under construction, 2 China, 1 Finland, 1 France, none in operation. All at least 4 years late & far over budget
- Reactor vessels for China & France sub-standard. Lids may have to be replaced in 2024. Resulting investigation revealed QC falsification by Areva NP going back up to 50 years
- Recent costs estimates (Hinkley) prior to construction ca \$7,000/kW. Latest cost estimate for Flamanville (France) ca \$7,000/kW
- Little prospect of French government loan guarantees
- Design approved by UK (2012), under review by France & Finland. 1600MW so too big?

# Atmea One

- 50/50 joint venture with Areva & MHI. Will Areva survive?
- No orders. Possible orders for Jordan, Turkey, Argentina now seem unlikely
- No credible cost estimates
- Little prospect of French loan guarantees, possible Japanese loan guarantees
- Detailed design review not carried out. 1100 MW so OK

# AES-2006

- Rosatom strongly backed by Russian government
- 1 AES-2006 in operation since Feb 2017. Initial operation unreliable. 5 under construction, 3 Russia, 2 Belarus. Russian plants 4 years or more late, unquantified delays in Belarus
- Accidents during construction at Leningrad & Belarus, allegations of corruption & poor quality materials, concern about shortage of skills & inadequate supply chain
- Cost estimates for Finland, Hungary, Egypt etc about \$6000/kW
- Russia offers loans but does it have the capability to meet the 35 export orders it already has requiring loans?
- Design under review in Finland. About 1150MW so OK

# APR1400

- KEPCO state controlled. 1 APR1400 in operation in Korea since Dec 2016. 3 under construction in Korea & 4 in UAE
- 2 APR1400s delayed by 3-4 years because QC documentation falsified & equipment had to be replaced. A number of operating plants closed for 2 years to replace equipment
- KEPCO admits version built in Korea & UAE would not meet European standards (no core catcher or aircraft protection)
- UAE prices very low (\$3600/kW) but suspicions order was under-priced. How much would additional safety add?
- All 5 candidates (May 2017) for Korean President promised to phase out nuclear in Korea so government support for loan guarantees unlikely
- Updated version under review in USA but little progress yet. 1450MW so maybe too big



# Hualong One

- CGN state-owned and backed by Chinese government in export markets
- 2 versions of Hualong One, CNNC & CGN. 2 of each version under construction in China, CGN version for less than 2 years. No useful information on progress
- Concerns within China & from French safety regulator about quality & safety culture in China
- No information on prices offered. China said it will offer loans but not tested yet
- UK review of CGN Hualong One started in Jan 2017 so little progress & no information yet

# Strengths and weaknesses of candidate designs

	EPR	AP1000	Atmea One
Vendor credibility	QC falsification up to 50 years. Areva bust	Westinghouse bankrupt	MHI no experience in exports
Price	High (~\$7000/kW)	High (~\$7000/kW)	Unknown
Availability of finance	No	No	No
Construction experience	Very poor (4 reactors)	Very poor (8 reactors)	None
Operating experience	None	None	None
Satisfy European regulator?	Yes	Probably	Unknown
Size	1650MW – too big?	1200MW - OK	1200MW - OK

# Strengths and weaknesses of candidate designs

	<b>AES-2006</b>	<b>Hualong One</b>	<b>APR1400</b>
Vendor credibility	Lack of experience in open markets	No experience in open markets	Only export to UAE
Price	High (\$6000/kW)	Unknown	Old design low
Availability of finance	Offered, but lack of capability?	Probably offered	Unknown
Construction experience	Poor (6 reactors)	Little experience (4 reactors)	Some delays due to QC issues (6 reactors)
Operating experience	Minimal & poor so far	None	Minimal
Satisfy European regulator?	Being tested in Finland	Review just started in UK	Major upgrades needed
Size	1200MW - OK	1200MW - OK	1400MW – too big?

# UK Experience: Hinkley Point C

- Hinkley, 2 EPRs (3.2GW), first of 5 projects to add 16GW of nuclear in UK by 2030
- Uses EPR technology, unproven in operation & suffering appalling problems of cost & time overruns in the 3 projects using it. Supplied by Areva NP, in financial collapse & might not be saveable & has been falsifying quality control records for safety critical items of equipment for up to 50 years.
- In 2008, construction start 2012, expected completion 2017 at cost of £4bn (€4.4bn), latest estimate construction start 2019-21, completion 2025-27, cost £19.6-20.3bn plus finance costs (+30%)
- Power bought on 35-year take-or-pay inflation-indexed contract for >£100/MWh. Off-shore wind £57.50/MWh
- Likely to require UK taxpayer guarantees worth about £14bn. If Flamanville not in service by end 2020, offer of guarantees expires
- Uncertainties: Can Areva NP be rescued? Can EDF raise the cash? Will the appeal against the Commission state-aid approval be successful?
- Other 4 projects equally problematic

# Is there an alternative to nuclear?

- Wrong question. Is nuclear an option? Experience from USA, UK, Russia, France, China suggests nuclear will at best be a very expensive option providing much less than forecast and at worst will fail completely
- Over its 60 year history, nuclear has consistently failed to meet expectations, renewables have consistently exceeded expectations
- Czech plans risk locking Czech Rep into a very risky policy for the next 20 years at the expense of proven, cheaper, more flexible options
- Czech Rep can profit on the vast experience with low-carbon technologies generated in countries such as Germany, China, Denmark