

Policy responses to NPP ageing

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- Large capital equipment is generally replaced without intervention because new equipment with better environmental & safety performance has much better economics (lower running costs pay for new construction costs)
- If not, regulation required. Single-skin oil tankers phased out from 2005 onwards, old coal-fired plant closed under LCPD
- But new nuclear several times more expensive than old and running costs similar so PLEX attractive
- Old Soviet designs forced to close after Chernobyl but no similar process for other plants

License duration

- USA only country that has fixed license durations, 40 years, based on economic & anti-trust considerations
- Other countries license plants from major maintenance outage to the next one
- Common practice is to carry out Periodic Safety Reviews (PSRs) to review requirements for a further 10 years

Why are nuclear plants closed?

Reaches end of:

- Design life? No
- Accounting life? No
- Regulatory life? Seldom
- Political life (phase-outs)? Sometimes (Germany)
- Physical life (life-limiting component not acceptable)? Sometimes
- Economic life (often involving need for major repair? Most common

Attractions of life-extension

- Cheaper than new capacity
- Less public opposition than new-build
- Upgrades low economic risk than new-build.
- Design a known quantity
- Maintains national nuclear capacity and nuclear skills
- Allow upgrades to improve the plant's profitability
- Delays start of decommissioning & reduces annual provisions for this

Where is life-extension important?

- 2/3 of world's 435 reactors in 7 countries (USA, France, Japan, Russia, Korea, China, India)
- But 2/3 of world's 105 old reactors (>35 years) in USA (52), Japan (12), Russia (7)
- France has 33 reactors aged 30-37 years old
- Therefore focus on USA and France. Other countries operating on a one-off basis

- 18 commercial reactors already retired in USA, 14 for economic (inc repair cost) reasons. None because reached end of license
- 5 retirements announced in 2013: 3 because of need for major repairs, 2 on running costs. Important influence of gas price
- Mark Cooper claims 37 reactors at risk of closure, 11 at serious risk. Of the 11, only two not due to repair/operating costs

License extension in USA

- Oldest operating plant in USA commissioned 1969
- Planning for PLEX goes back to 1982, first application made 1998 when plant only 23 years old
- NRC expecting to receive license extension to 80 years proposals from 2018 onwards
- By 2012 about 70% of US reactors had been given approval to 60 years, 14 awaiting a decision, 14 yet to apply

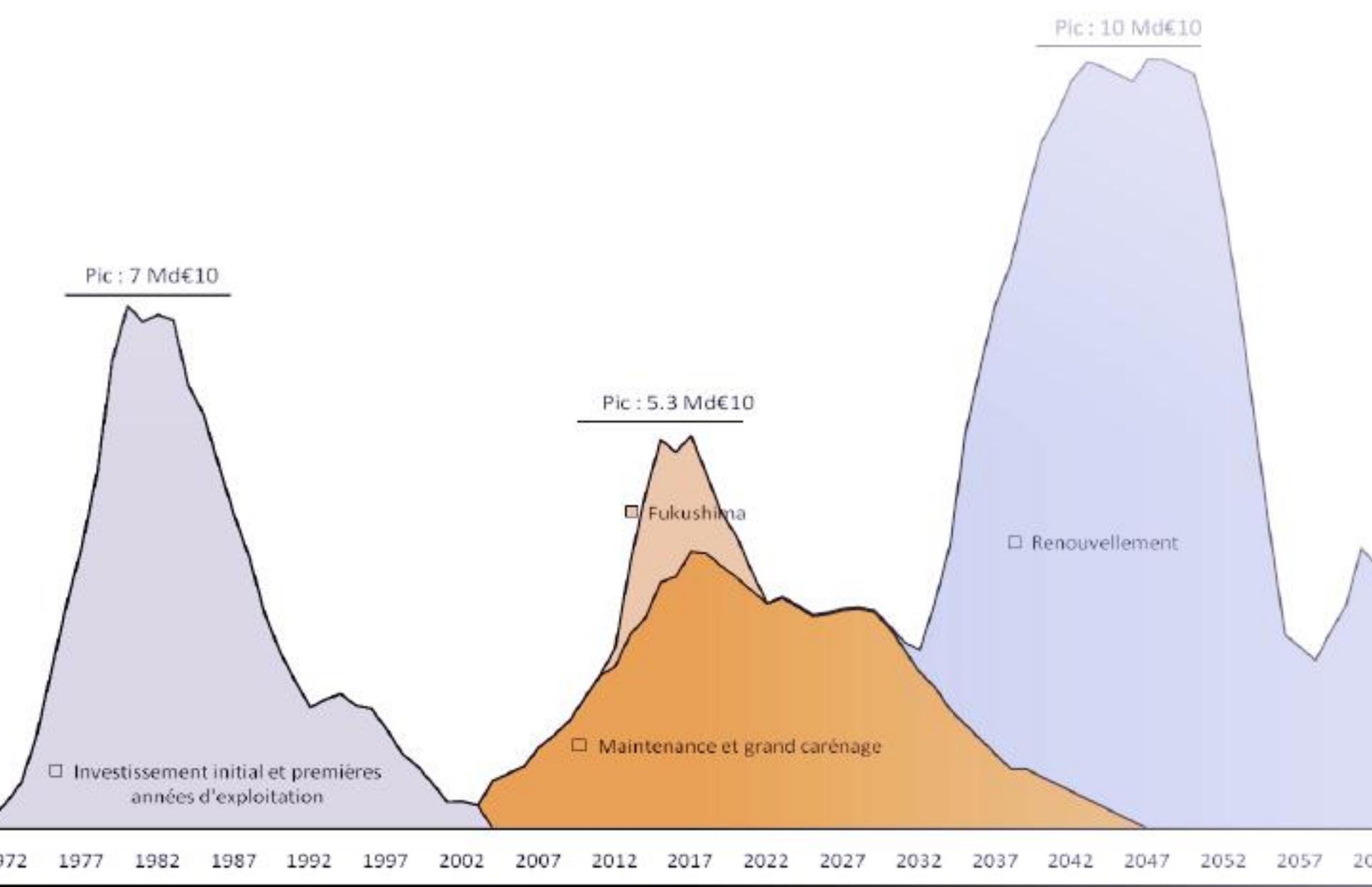
License extension in USA

- Applications up to 2006 (ca 50) all completed within 30 month target
- If application for PLEX made 5 years before 40 years is up, closure not required at 40 years
- Since 2006 several taking much longer. Since 2012, 2 year moratorium on PLEX imposed by NRC because of waste issues (siting HLW facility). No plants at risk of closure for license reasons
- Data on cost of PLEX very sparse. No evidence that any PLEX applications have required major modifications

- The regulator carries out PSR every 10th maintenance outage. Clock restarts when process complete so PSR required less often than 10 years
- Reactors largely standardised so issues dealt with on generic basis. First 900MW reactors cleared to operate to 40 years in 2011
- Fessenheim, oldest plant, previously said to lag behind others in operational discipline cleared to operate by ASN till 2019 but decision by Hollande to close it in 2016
- Issues arising in earlier PSRs: seismic protection (€1.9bn), withstanding low ambient temperatures, pressure vessel integrity

Fukushima & France

- Fukushima modifications taking priority in ASN over PLEX. France appears more rigorous than other countries in its stress test requirements
- EDF estimates €10bn for Fukushima requirements for 63GW- €160m/GW. In UK, €215 for 9GW €24/GW
- Total of €100bn for PLEX plus Fukushima, inc €15bn to replace heavy components, €10bn to boost safety against external events & €10bn for Fukushima
- As much as initial investment cost but a third of cost of replacement (EDF says too expensive)



What standard to upgrade to?

- Is it defensible to give 20 years more life to a design that would have no chance of being licensed if a new build?
- Is it premature to give life extensions 15 years before existing license expires?
- Chevet (President ASN) 'ASN's requirements are very different from how the US nuclear regulator evaluates life extensions, because in the US, life extensions are based on the initial safety standards from when the reactor was built'