

Next Steps in the Commercialization of Advanced Nuclear Reactor Technology

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USNRC Commissioner (1998-2007)

**DOE-NRC Workshop on Advanced Non-Light Water Reactors
June 7-8, 2016**

About the USNIC

- Leading business consortium advocate for increased U.S. nuclear energy use and global deployment of U.S. nuclear technologies and services
- Represents over 80 member companies encompassing wide representation of the nuclear energy supply chain and key movers
- Member of the Civil Nuclear Trade Advisory Committee, the U.S. Industry Delegation to the IAEA and the ANS International Committee
- Strongly supports Gen 3+ reactors, small modular reactors and advanced reactors moving in parallel paths

DOE-NRC Workshop

- NIC commends the DOE and NRC for organizing this second workshop
- Both organizations continue to be challenged by Congress to identify ways to enable the development of Advanced Reactor Technologies
- This meeting provides a meaningful and timely forum to share views
- Solid progress has been made on Advanced Reactors since the last workshop in September of 2015
- We look forward to identifying ways to enable the deployment of Advanced Reactor Technologies through a comprehensive, enhanced DOE program and with a timely, risk-informed, performance-based licensing process consistent with NRC safety standards

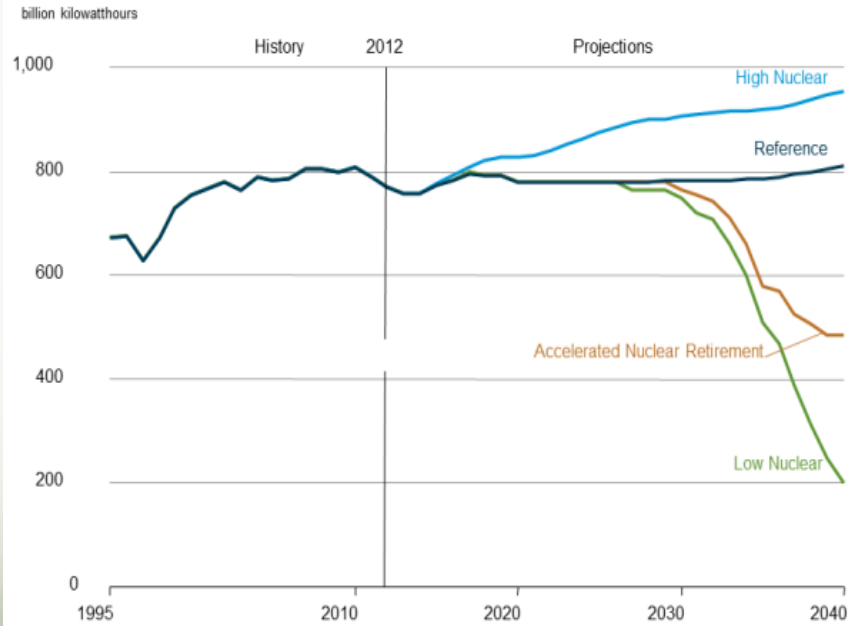
Progress on Advanced Reactors Since 2015 Workshop

- White House Summit on Advanced Reactor Issues
- DOE inauguration of GAIN initiative
- NIC, NIA and NEI all unveil proposals to “move the ball forward” on AR issues
- FOA for two Advanced Reactor Technologies – Southern/Terrapower and X-energy
- Significant progress in legislation in both the U.S. Senate and House of Representatives on licensing reform and modernization
- NRC roll-out of Advanced Reactor Design Criteria

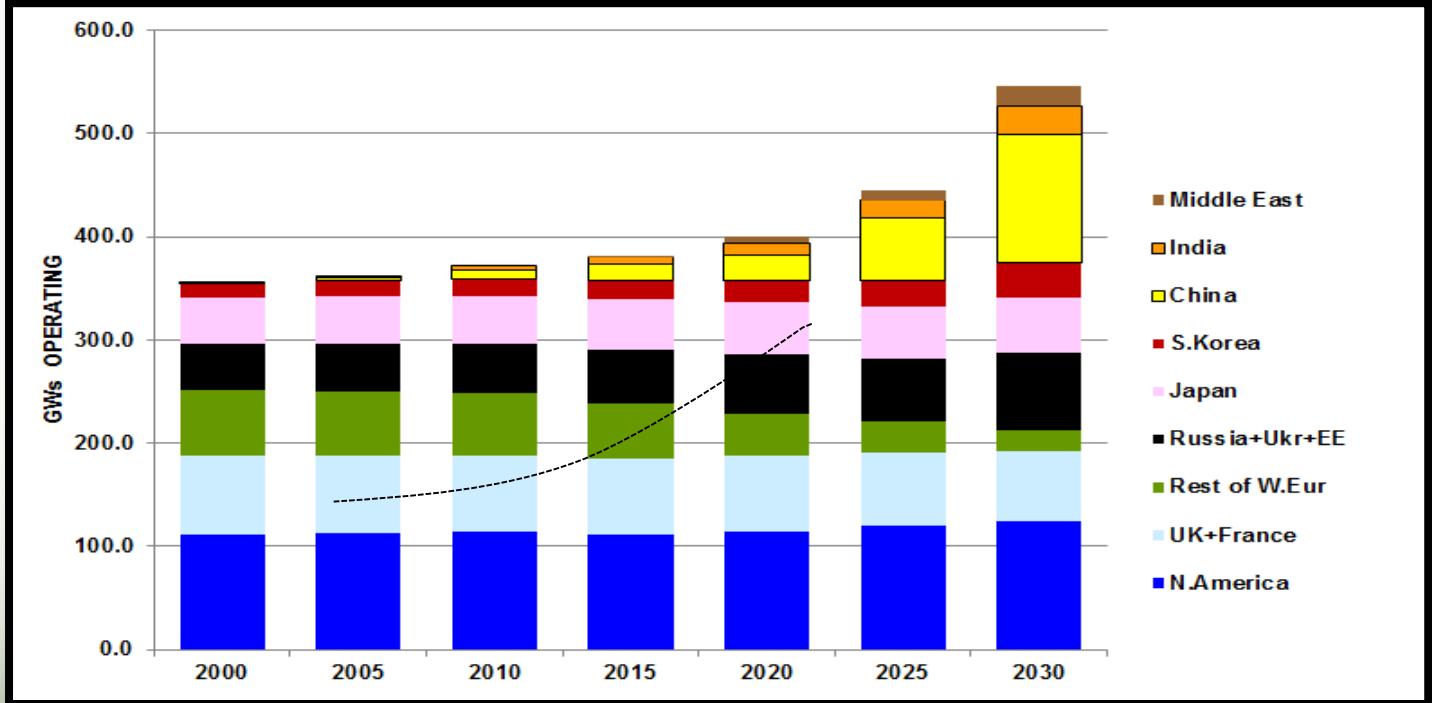
U.S. Nuclear Fleet

Nuclear Plant Life After 60 an X Factor

Figure MT-35. Nuclear electricity generation in four cases, 1995-2040



Booming Global Market Demand



Source: Verdigris Capital, LLC



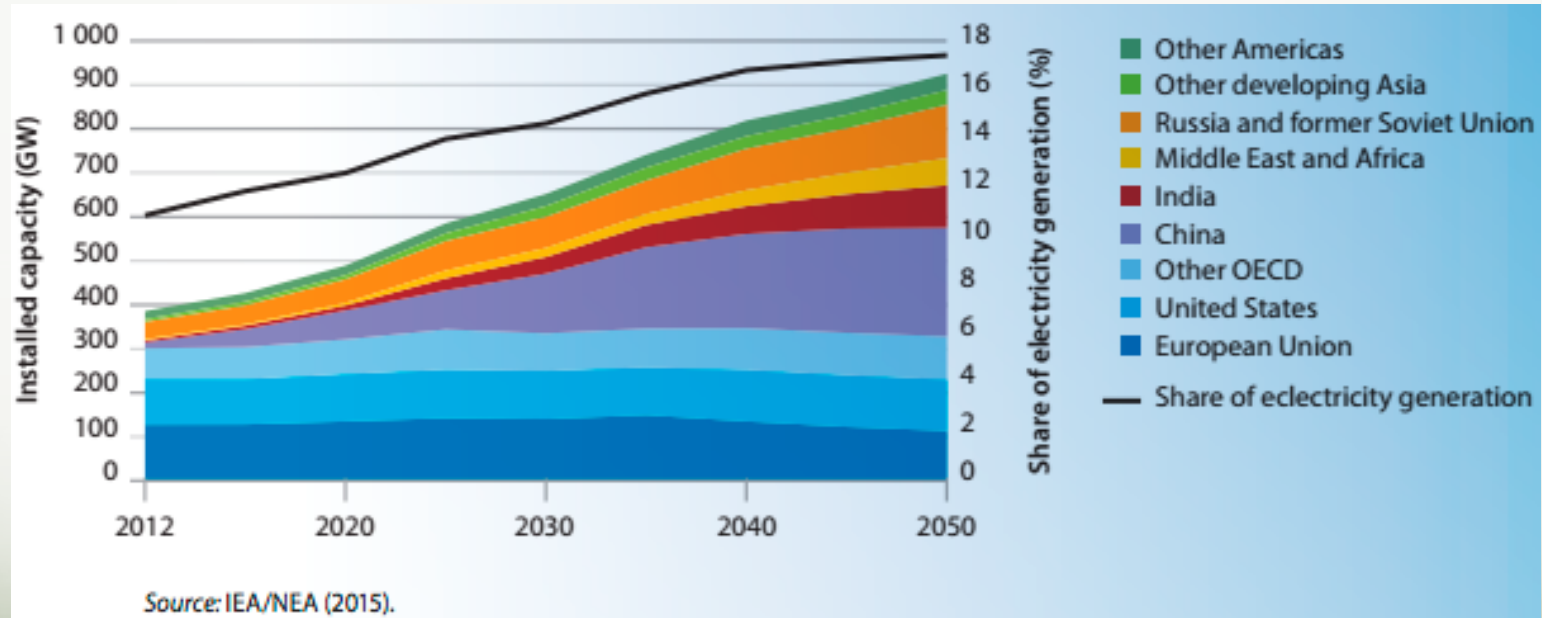
U.S. With Only Five Of 67 New Reactors “Under Construction”

Table 1. Nuclear Reactors “Under Construction” (as of 1 July 2014)³⁶

Country	Units	MWe (net)	Construction Start	Grid Connection
China	28	27,756	2008-2013	2014-2018
Russia	9	7,273	1983-2019	2014-2019
India	6	3,907	2002-2011	2014-2016
South Korea	5	6,320	2008-2013	2014-2018
USA	5	5,633	1972-2013	2015-2019
Belarus	2	2,218	2013-2014	2019-2020
Pakistan	2	630	2011	2016-2017
Slovakia	2	880	1985	2014-2015
UAE	2	2,690	2012-2013	2017-2018
Ukraine	2	1,900	1986-1987	2015-2016
Argentina	1	25	2014	2018
Brazil	1	1,245	2010	2016
Finland	1	1,600	2005	2016
France	1	1,600	2007	2016
Total	67	63,677	1972-2014	2014-2020

Sources : IAEA-PRIS, MSC, 2014

Projected nuclear capacity in the IEA Energy Technology Perspectives 2015 2°C scenario



USNIC Sept. 6, 2011 letter to DOE Secretary Chu

- Admin./DOE must elevate the prioritization of advanced reactors
- Key part of a continuing and growing role for nuclear energy
- Essential to assure reliable, low-carbon, baseload electricity
- Vital for US energy security, economic growth and tech leadership
- Complementary to continued deployment of light water reactors
- Imperative that the DOE provide the leadership and resources needed to champion the development of advanced reactors
- Development costs will not be incurred by private companies without a policy that establishes value of advanced reactors

This message is as valid today as it was five years ago...

Advanced Reactors Technical “Summit” Findings (2014-16)

USNIC/Argonne, USNIC/UMass-Lowell, USNIC Oak Ridge

- Advanced Reactors must be a national priority for DOE and requires funding commensurate at a minimum with the NP2010 and SMR FOA programs
- Advanced Reactors offer significant economic advantages and can also be used to make global environmental progress
- The current USNRC-LWR licensing paradigm is not workable for advanced reactors
- Developing a “staged” approach to licensing is critical to securing private funding for advanced reactor development
- U.S. high flux test reactor facility coupled with prototypes is needed to enable advanced reactor development of designs, fuels and materials

Highlights of February 2016 NIC White Paper on Advanced Reactors

- **Appropriate Congressional oversight** of the NRC's Advanced Reactor licensing process
- **Sufficient resources** for the Advanced Reactor licensing program at the NRC
- **Sets target for AR licensing reviews** no longer than thirty six months
- **Dedicated general revenue funds** - \$5 million in FY 2017 and growing to \$15 million - for regulatory infrastructure and staffing to review Advanced Reactor designs
- **Congressional requirement for the NRC to establish a phased design review** and licensing process to provide early milestones and determine licensability of designs
- **Resolution of key NRC policy issues for Advanced Reactors** based on Source Term analysis and develop risk informed performance based Advanced Reactor licensing process

Gaps and Needs – DOE - (September 2015)

Gaps

- Insufficient funding for DOE Advanced Reactor effort causes selection of “winners and losers”
- Woefully insufficient R&D funding to develop new reactors, fuels and materials
- Requiring broad IP waivers to receive funding is disincentive to innovative developers

Needs

- Enhanced funding of Advanced Reactor initiatives to allow broader tech development (Recent DOE FOA Positive – but Only 2 “Winners”)
- Systemic sustainable funding comparable to NP2010 with lower cost-share (Still needed)
- Eliminate or reduce IP requirements (Still needed)

Gaps and Needs – DOE - (September 2015)

Gaps

- Infrastructure for Advanced Reactor technology developers
- Nuclear industry is treated as one “stakeholder group”

Needs

- Advanced Test Reactor (Congressional action needed)
- Small Scale Prototype Incubators (GAIN initiative is a start)
- Easier access to DOE facilities (GAIN initiative is a start)
- The needs of utilities and reactor vendor developers are different and need to be recognized by the USG (Jury is out)

Gaps and Needs - NRC- (September 2015)

Gaps

- Non traditional vendors don't know how best to engage with the NRC staff in initial technology discussions
- Significant early cost of NRC licensing fees
- Developers seeking phases of investor funding can't wait years to find out if technology "viable"
- Lack of clear milestones and timelines for licensing Advanced Reactors

Needs

- Identify "key questions" the NRC would like developers to address in introductory discussions (**RIS-15-07 is useful but direct engagement by Agency staff needed**)
- Fee waivers through use of general revenues or DOE funding pass-through (**Congressional action needed**)
- Creation of phased licensing approach – "is it licensable" - to increase investor confidence (**To be determined**)
- Commission must set targeted timeline for license review and hold the staff and itself accountable (**Still needed**)

Gaps and Needs – NRC - (September 2015)

Gaps

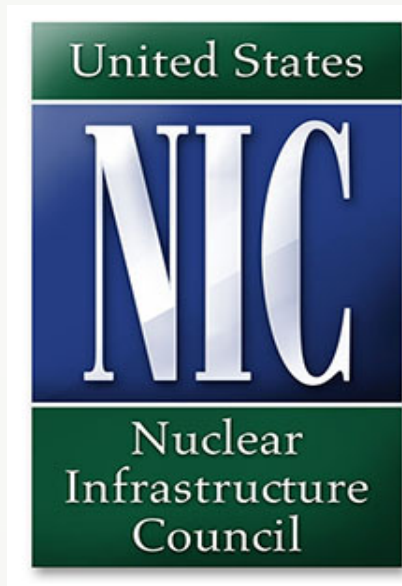
- Policy issues remaining to be resolved – security/control room staffing, insurance. – cause uncertainty for developers
- Lack of understanding of what resources are needed for NRC to license Advanced Reactors
- Prescriptive regulatory framework developed for light water technology does not meet Advanced Reactor needs and could require major revisions to requirements or significant exemptions

Needs

- Similar to recent EPZ and fee papers – staff should actively elevate generic Advanced Reactor issues to Commission (**Action still needed**)
- Congress should understand what is needed for NRC to enable Advanced Reactor review (**Short term ok – longer term needs action**)
- The NRC needs to develop a risk informed framework that recognizes the significantly reduced source term risk from Advanced Reactors (**Uncomplete**)

Summary

- NIC appreciates the opportunity to participate
- We look forward to a continuing series of meetings
- Advanced Reactor progress is pivotal both domestically and globally
- U.S. needs to continue to be a global trailblazer in safe nuclear energy
- Window of opportunity is finite – these technologies can and will go abroad
- Ramped-up programmatic, funding and regulatory commitment is vital to promote innovation along with investment in infrastructure



The United States Nuclear Infrastructure Council (NIC) is the leading U.S. business consortium advocate for new nuclear and engagement of the American supply chain globally. Composed of over eighty companies NIC represents the "Who's Who" of the nuclear supply chain community. For more information visit www.usnic.org

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