

U.S. NUCLEAR REACTOR EXPORTS AND WESTINGHOUSE

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Nuclear Information and Resource Service

U.S. Nuclear Exports

US Export History

- 1959-1976: \$921.9 million to Euratom and nine countries
- 2005: India
 - Stalled since 2012 due to India's liability law
 - 2016: Westinghouse deal for up to six AP1000 reactors

Civil Nuclear Cooperation Agreements (CNCA)

- 23 countries + Euratom (27 countries) and IAEA

Recent Export Deals

- Indonesia – technical assistance grant for SMR development
- Philippines – most recent CNCA (2023 December)
- Poland – nine AP1000s + possible EXIM financing for BWRX-300
- Romania – possible \$4 billion financing from EXIM and IDFC
- Ukraine – nine AP1000s, twenty Holtec SMR-300s, regulatory analysis

U.S. Export Policy

Atomic Energy Act (AEA) Requirements

- AEA = governing statute for U.S. nuclear energy policy
- Section 123: requires Civil Nuclear Cooperation Agreements
 - negotiated with U.S. Department of State
 - assistance and concurrence of Department of Energy and its National Nuclear Security Administration
 - consultation with Nuclear Regulatory Commission
- CNCAs must satisfy 9 non-proliferation criteria
 - 2006: AEA amended to permit CNCAs with countries that have not signed the nuclear Nonproliferation Treaty (e.g., India)
- 2009: U.S.-UAE agreement sets “Gold Standard” for CNCAs
 - Countries agree to forgo enrichment and reprocessing
- Part 810: regulates transfers of technology and nuclear materials under Section 123

U.S. Export Finance Agencies

Export-Import Bank (EXIM)

- Official U.S. export credit agency (ECA)
- Financing Requirements:
 - “reasonable assurance of repayment”
 - Environmental & Social Due Diligence Procedures and Guidelines
 - IAEA safety standards and guidelines
 - Current Civil Nuclear Cooperation Agreement
 - Party to Convention on Supplementary Compensation (CSC)
 - Design approval by U.S. Nuclear Regulatory Commission or equivalent authority

International Development Finance Corporation (DFC)

- Established in 2018
 - U.S. alternative to China’s Belt and Road Initiative
- Authorized to make loans or equity investments
 - Lending cap: \$60 billion
 - Low-income & lower middle-income countries (LICs & LMICs)
 - Criticized for loaning \$3 billion to wealthier countries

Nuclear Export Changes & Proposals

New Programs

- 2022 – Dept. of State: FIRST Program and Project Phoenix (coal-to-SMR “transitions”)
- 2023 – EXIM issues SMR Financing Toolkit (*no policy changes*)
- 2024 – Nuclear Power Project Management and Delivery working group

Proposed Legislation

- International Nuclear Energy Act (H.R. 2938)
 - White House Office on International Nuclear Energy Policy
 - Depts. of State, Energy, & Commerce to create RD&D partnerships
 - U.S. Interagency Cooperation:
 - Nuclear Exports Working Group
 - Civil Nuclear Program Support
 - Advanced Reactor Coordination and Resource Center
 - DFC to establish cooperative financing
- International Nuclear Energy Financing Act (H.R. 806)
 - Advocate for nuclear finance at multilateral financial institutions

Washington's Interests

Global Dominance in Energy

- Largest oil and gas producer
 - Fossil fuels dominate US production, consumption, and exports
- *Not* positioned for renewable energy exports
 - Domestic wind and solar dependent on imports
 - Domestic manufacturing growing ... to meet domestic market

Competition with Russia and China

- “Assure US nuclear leadership”
- US influence in nuclear energy and weapons control policy

Durable Alliances through Dependency

- “Nuclear exports = 100-year relationships”

Nuclear Exports & Foreign Policy

“[T]he initial supply of a reactor typically leads to the supplier’s involvement throughout the hundred-year life of the nuclear program, enabling long-term influence on nuclear safety, security and nonproliferation, as well as the ability to advance energy security and broader foreign policy interests.”

American Security Project – 2019 letter to Congress

quoted in H.R. 806 and in House Subcommittee memo & hearing

Obstacles to U.S. Nuclear Exports

Shortage of Commercially Available Reactor Designs

- AP1000 is the only US reactor built globally since 2006
- No SMR or non-LWR designs approved

U.S. Projects Depend on Subsidies and Buyer Self-Finance

- Nuclear firms lack capitalization and cash flow
- Domestic reactor construction 100% dependent on government finance
 - Utility customer payments during construction (CWIP)
 - Federal government loan guarantees
 - Direct subsidies and cost-sharing grants
 - Production and Investment Tax Credits

Insufficient Manufacturing and Supply Chains

- No industrial capacity for major nuclear components
- Firms focused on fuel and services for existing reactors

The U.S.'s Nuclear “Renaissance”

2005 Energy Legislation

- Nuclear Loan Guarantees: \$18.5 billion
- Production Tax Credits: \$6 billion
- Next-Gen Nuclear Plant: \$1.25 billion
- Licensing Delay Insurance: \$2 billion

30 Reactors Proposed (2006-2008)

- 14 licenses issued
 - 16 license applications withdrawn or suspended
- 4 began construction: Vogtle 3&4 and Summer 2&3
 - Summer 2&3 canceled (2017)
- 2 reactors completed (2024)
 - Vogtle 3&4: 7 years late + \$36 billion final cost
 - 275% schedule increase
 - 260% cost increase
- **93% cancellation rate**

Westinghouse: History

Early Leader in Manufacturing Electricity Infrastructure

- Founded in 1886
- Major producer: turbines, generators, transformers, motors, switch gear

Nuclear Research and Technology

- Uranium metal production
 - Sole supplier of uranium metal for Manhattan Project reactors
- Cyclotron development and atomic physics research
 - Westinghouse “Atom Smasher” (1937)
 - First identified the neutron (1939)
- Manhattan Project recruited Westinghouse scientists
 - Production of enriched uranium and plutonium

Commercial Nuclear Power

- Hired to develop a reactor to power nuclear submarines
- Design became the Pressurized Water Reactor (PWR)

Westinghouse: History (cont.)

Atoms for Peace Program

- U.S. policy to promote “peaceful uses of atomic energy”
- R&D and nuclear power plant construction
 - Price-Anderson Act: limits liability for nuclear accidents
- Licensing U.S. technology to other countries

Westinghouse: Early Lead in Nuclear Power

- Head-start on PWR design through submarine reactors
- Existing customer base among utilities
 - Reactors packaged with turbines, generators, etc.

Focus on Selling Reactors – *Not on Building Them*

- Sold first five reactors as “turnkey” projects
 - Fixed-cost to utility, grants from U.S. government
- After 1963: sold *only* designs and turbines
 - Reactors built mostly by utilities with teams of contractors
 - Westinghouse not liable for cost overruns and delays

U.S. Reactor Construction (1952-1996)

277 reactors proposed

- 1970: President Nixon predicted 1,000 reactors by 2000
- 1977: last reactor placed on order until 2008

134 reactors completed

- **52% cancellation rate**
- 42 reactors now retired
 - 17 early reactors closed (1963-1989)
 - 12 reactors closed (1987-1998)
 - 13 reactors closed (2013-2022)

Endemic Cost Overruns and Delays

- Average construction times ballooned to 14+ years
- Cost overruns averaged 207% of original estimates
 - Some exceeded 1000%
 - Cost of reactors completed in 1980s averaged 250%

A History of Mismanagement

“The failure of the U.S. nuclear power program ranks as the largest managerial disaster in business history, a disaster on a monumental scale. The utility industry has already invested \$125 billion in nuclear power ... only the blind, or the biased, can now think that most of the money has been well spent.”

Forbes Magazine - "Nuclear Follies"

February 11, 1985

Westinghouse: Ownership Changes

1990s: Repositioning and Reorganization

- \$6 billion failure of Westinghouse Credit division (1991)
 - Divestment of several manufacturing businesses
- Acquisition of CBS, move into telecomm (1994)
 - Renamed CBS Corp. (1997)
- Sold Power Generation Business to Siemens (1997)

Nuclear Business Divestitures

- **1999:** Westinghouse Electric Co. sold to British Nuclear Fuels, Ltd.
- **2006:** BNFL sold WEC to Toshiba
 - Toshiba acquires Stone & Webster to bail out CB&I (2016)
 - WEC declares bankruptcy due to U.S. AP1000 projects (2017)
- **2018:** Toshiba sold WEC to Brookfield Business Partners
- **2023:** Brookfield BP sold WEC to Brookfield Renewables and Cameco

Post-Bankruptcy

Ended nuclear construction management

- Reverted to original role
 - Reactor design and marketing
 - Engineering and licensing support

Stone & Webster

- **1960-1990:** 2nd-largest builder in U.S. (17 reactors)
- **2000:** filed for bankruptcy
 - Acquired by Shaw Group for \$38 million + stock
 - *“no one left on the payroll who knew how to build nuclear reactors”*
- **2013:** sold to CB&I for \$3 billion
- **2015:** sold to Westinghouse (Toshiba) for \$239 million
- **2017:** Westinghouse declares bankruptcy
- Today:
 - No nuclear construction projects
 - Services hydro and fossil fuel power plants

Westinghouse: Now

Primary Business Divisions

- Fuel Production
 - most profitable business unit
 - increasing supplier for VVER-440 and VVER-1000 reactors
- Services and Parts for Operating Reactors
- Spent Fuel Management and Decommissioning
- R&D and Engineering
 - New Reactor Design and Development
 - No reactors under construction
 - AP1000 – sole design with NRC approval
 - AP300 and eVinci applications not submitted

Nuclear Export Agreements

- Recent Deals: Bulgaria, Poland, Ukraine

Role in Reactor Export Projects

Reactor Design and Engineering

- Only one design with NRC approval: AP1000

Fuel Supply and Operations Support

Identify Local Suppliers and Contractors

- **Ukraine:** Energoatom to manage construction
 - Westinghouse to sell Summer 2&3 components/modules
- **Poland:** Bechtel as construction manager
 - Westinghouse MOU with 22 Polish suppliers/contractors
- **Bulgaria:** considering Hyundai for construction manager
 - Westinghouse MOU with 17 Bulgarian suppliers/contractors
- **Czech Republic:** cooperation deal with Czech Power Industry Alliance
 - Includes Bechtel as construction manager

Westinghouse *NOT INVOLVED* in Construction

Risk-Averse to Reactor Construction

“Westinghouse said it learned from its U.S. experience during the 2010s and no longer takes on reactor construction. ... In Ukraine, Westinghouse said Energoatom will be responsible for construction of the new reactors and it will be up to Ukraine to determine when work should begin. Financing discussions are ongoing with [EXIM and DFC], the company said.”

Wall Street Journal – “The American Company Trying to Keep Ukraine’s Nuclear Reactors Online”

June 7, 2024

Questions and Uncertainties

Cost and Schedule Controls

- How to control costs with first-time manufacturing and construction?
- How to achieve “modularity” and economies of scale with country-by-country supply chains and construction partners?

Risk to domestic manufacturers and industrial capacity

- How to reduce financial risk and prevent harm to domestic industries?
- Nuclear projects and AP1000 resulted in serial bankruptcies and divestitures of US manufacturers.
 - Stone & Webster (2000) → Shaw Group (2013) → CB&I (2015) → Westinghouse (2017) → McDermott (2020)

Liability and Accountability for Cost and Schedule Overruns

- Who will be responsible for increased costs and delays?
- How will damages be shared/allocated?
- Will there be off-ramps and safeguards?
- How to prevent fraud, and ensure timely reporting and transparency?

KHNP-Westinghouse Dispute

Westinghouse Sued KHNP in 2022

- Action to enforce CNCA between U.S. and S. Korea (RoK)
- Claims KHNP's APR-1400/1000 reactors are based on Westinghouse technology
 - CNCA requires RoK to receive approval from U.S. for sharing U.S. nuclear tech
- KHNP claims its reactors are no longer based on U.S. tech

U.S. Dept. of Energy Denied KHNP Part 810 Report for CZ Bid (2023)

- DoE's decision stated the notice must be made by a U.S. entity
- If Westinghouse does not do so, a KHNP bid to CZ risks dispute with U.S.
- Part 810 violations entail penalties – up to \$124,732/day

Westinghouse Suit Rejected in Sept. 2023

- District Court ruled Westinghouse has no authority to enforce CNCA
 - Court said only the U.S. government can enforce the CNCA and Atomic Energy Act
- Westinghouse appealed the ruling in November 2023

KHNP and Westinghouse Arbitration in RoK

- Case before Korean Commercial Arbitration Board
- Decision not likely until late 2025

KHNP Dispute Context

U.S. Permitted KHNP Export to U.A.E. in 2009

- Westinghouse was included in KHNP's consortium for U.A.E. bid

Westinghouse Now Owned by Private Equity Firm

- KHNP claims Brookfield wants to eliminate competition for Westinghouse
 - → inflate Westinghouse's value, sale price
- Brookfield still controls 51% of W'house after sale to BRP-Cameco consortium

U.S. Gov't Seeking to Reclaim Dominance in Nuclear Exports

- AP1000 is the only U.S. reactor design feasible for export
 - No SMR/nLWR designs approved by NRC
 - No GE-Hitachi ABWRs built since 2006

Broader U.S.-RoK Trade Concerns

- Negotiating over a number of energy sector and industrial trade arrangements
 - APR-1400/1000 export dispute unlikely to be resolved in isolation
- DOE rejection of KHNP export notice remains an obstacle
 - The same cloud hangs over Poland-RoK nuclear bid

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