Nuclear Power Status and Considerations

Paul Meier, Director
UW Energy Institute

Presentation to:
Governor's Task Force on Global Warming
May 1, 2008

Nuclear Power Status and Considerations

Objective:

Summarize nuclear power issues relevant to future consideration in Wisconsin.

Issues for new Nuclear Power:

1. construction cost
2. financing
3. fuel supply reliability
4. safety & public acceptance
5. waste management
6. CO2 reduction potential

Clarifications:

Consideration not Construction

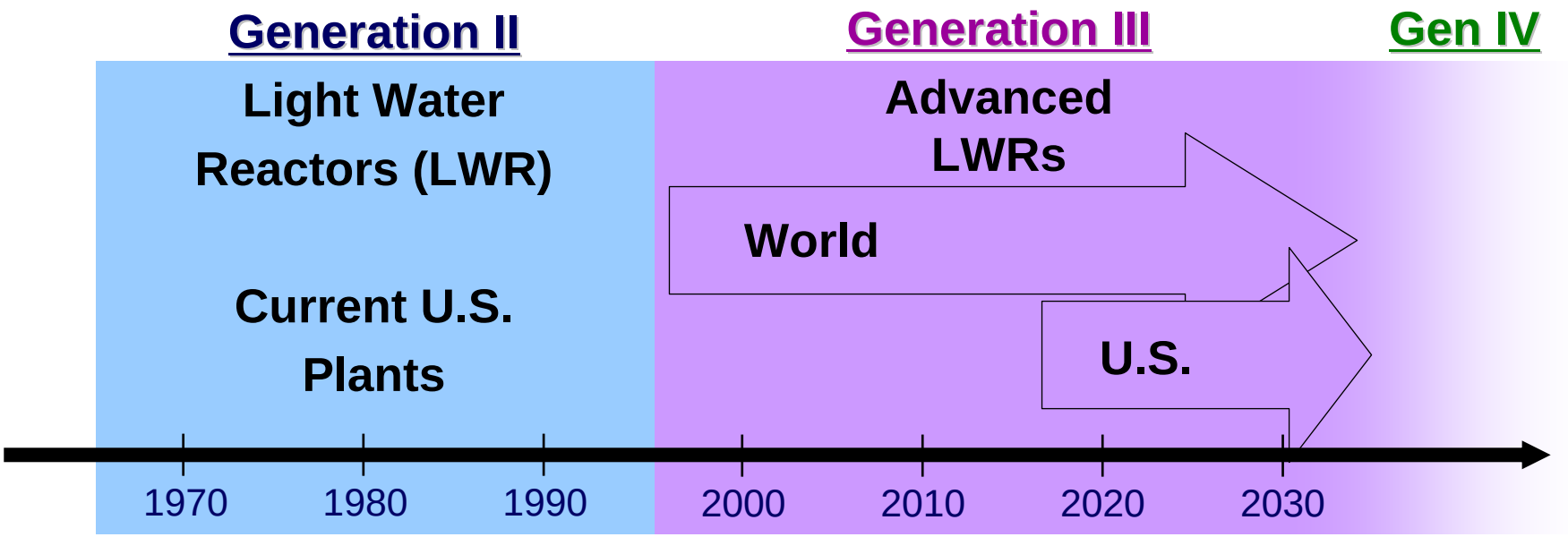
Generation III Nuclear Power Plants (timeline presented)

Issues not necessarily equally relevant to Wisconsin moratorium

Timeline for Nuclear Power

All currently operating U.S reactors are Generation II

Generation III - Design changes for passive safety and lower cost
US: 20+ proposed, 9 planned [1]
World: 70 planned, 30 under construction [2]



[1] NRC: Expected New Nuclear Power Plant Applications, 4/23/08. 9 COL applications received
[2] World Nuclear Association

1. Construction Cost

Construction Cost is Uncertain

- -No construction of Generation III reactors in US or Western Europe*
- -Reported Range of Estimates: 2000 – 10000 $/kW [1]
- - 9 Asian Plants between 1993 – 2005: 3,257 $/kW (2007$) [1]

Construction Cost Projections Have Increased

- -Material costs, supply chain bottlenecks
- -Also true for alternatives (e.g., wind, coal)

A reasonable range of new nuclear power production cost overlaps with projections for wind power or coal with carbon capture and storage.

- - cannot presume nuclear is more expensive than alternatives without case specific analysis

*Under construction in Finland and France.

[1] Jim Harding, Harding Consulting

2. Financing Obstacles

Total project size (>$3B) creates a financing obstacle
- project comprises a substantial fraction of company's market capitalization (net worth)
- cost to borrow money (i.e., interest rate) is higher

Licensing process
- Previous process: opportunities for delay during construction.
- New process: all regulatory reviews before major investment [1]
- U.S. licensing process still not fully tested

EPACT2005 provides:
- loan guarantees and production tax credit to next 6000 MW
- insurance against construction/licensing delays and accident liability

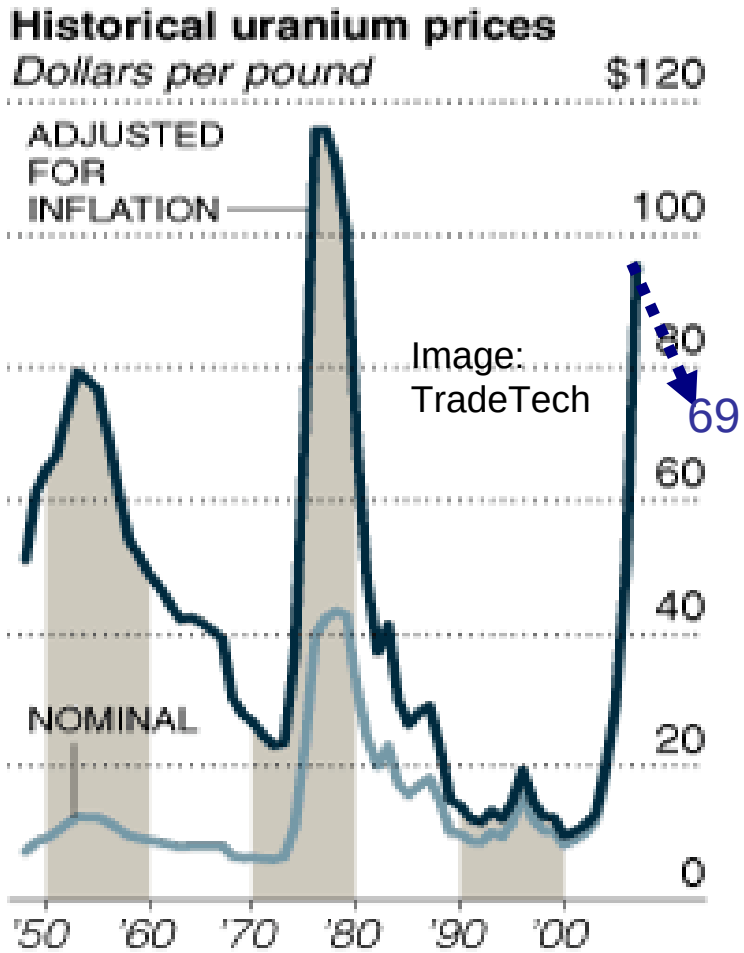
Planned construction will reduce uncertainty in construction cost and licensing process

[1] Eugene S. Grecheck, Vice President Nuclear Development, Dominion

3. Fuel Supply Reliability

71 years of Uranium resources at current consumption & no fuel-recycling [1]
- 10,000 years with fuel re-cycle (GENIV) [1]

Spot prices are increasing due to increase in demand and decrease in supply [2]
- including plateau of Megatons to Megawatts program
- Global market: Largest reserves in Australia, Canada, Kazakhstan [3]
- Spot price (currently 69$/lb) not necessarily indicative of cost to utility



[1] Paul Wilson, Associate Professor, Engineering Physics, UW-Madison. Based on reasonably assured, plus inferred resources.
[2] NY Times 3/28/07
[3] EIA-2004

4. Safety & Public Acceptance

Generation III design includes substantial increase in passive safety, fewer maintenance requirements, and improved instrumentation

- Improved safety relative to Gen II plants
  Two advocates cite 10X [1] & 100X [2]

- An Opponent View Point: 5 - 8 different designs proposed
  i.e., design not sufficiently standardized [3]

Waste transportation discussed as part of Waste Management

[1] Professor Mike Corradini, Chair, Engineering Physics, UW-Madison
[2] Eugene S. Grecheck, Vice President Nuclear Development, Dominion
[3] David Lochbaum, Director, Nuclear Safety Project, Union of Concerned Scientists.

4. Safety & Public Acceptance (cont.)

Public opinion research sponsored by Nuclear Energy Institute [1]:

- 85% of Plant Neighbors Rate Their Nearby Nuclear Power Plant Safe

- 85% agree: We should take advantage of all low-carbon energy sources, including nuclear, hydro, and renewable energy, to produce the electricity we need while limiting greenhouse gas emissions

- 71% of Plant Neighbors said Adding a New Reactor at Nearby Nuclear Power Plant is Acceptable

[1] Bisconti Research with GfK.
Latest October 2007; National random samples of 1,000 U.S. adults age 18+;
Interviewed by telephone; Margin of error plus or minus three percentage points.

5. Waste Management

Wisconsin Moratorium: may not authorize unless a facility will be available for disposal of high level waste.

- ~95% of HLW is spent fuel
- Spent Fuel Storage is needed for Generation III reactors
- Yucca Mountain will be utilized for existing (Gen II) waste (2021?)
- On-site storage for spent fuel is initially proposed for Gen III

Will a second repository be needed for Generation III?

- Current fuel-cycle and 20% nuclear: 5 – 9 repositories by 2100 [1]
- Full recycle fuel cycle: 1 repository through 2100 [1]
- Single repository would require extended temporary storage/staging

[1] Paul Wilson, Associate Professor, Engineering Physics, UW-Madison.; [2] DOE Office of Civilian Radioactive Waste Management (2001); [3] General Accounting Office (2001) d02191.pdf

5. Waste Management (cont.)

Long-term retrievable storage cost

- Utilities pay 0.1cent/kWh, ~$30B as of 2007 [1]
- $9B spent, projected cost of ~$60B through 2119 [2],[3]

Spent Fuel Transportation [4]

- Since 1962, no radioactive releases from transportation accidents
- Shipments to repository in 1st year will exceed total of last 30 years
- Many uncertainties surrounding transportation

Prospect of long-term CO2 storage creates an important comparison for the storage of spent nuclear fuel

[1] Paul Wilson, Associate Professor, Engineering Physics, UW-Madison.
[2] DOE Office of Civilian Radioactive Waste Management (2001)
[3] General Accounting Office (2001) d02191.pdf
[4] State of Nevada, Nuclear Waste Project Office

6. CO2 reduction potential

Non-emitting base-load power substantially reduces CO2 emission
- 80% reduction by 2050 increasingly proposed
- Nuclear life-cycle emissions (i.e., “upstream” fossil fuel) not significant

In Wisconsin
- Heavily reliant on coal
- Retirement of existing nuclear reactors anticipated 2030-2035

Alternatives: use less energy, switch fuels, capture emissions

Electricity alternatives are not without obstacles, limitations & uncertainty
- Conservation & efficiency
- Large-scale wind
- Hydro
- Natural gas
- Carbon capture and storage

Additional Information

Streaming Media Presentations
www.energy.wisc.edu/presentations/

Paul Meier
pmeier@wisc.edu
608.262.4515