

Excellence in Nuclear Operations & Radiological Safety

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A Changing Landscape – Our Reality!



- Cheap natural gas / competitive wind and solar
- Tax reform – maintains PTC, nothing for nuclear
- Customers regulated / deregulated sensitive to price
- Competition in our business, developers and their parties
- Nuclear plants announcing closures (risk/economics)
- Mixed political environment and support

A Changing Landscape

- The external context for our business has fundamentally changed.
- An internal transformational change is needed in response.
- We must make the case to our state regulators that the value of nuclear energy exceeds the cost.
- Nuclear provides value to our communities in ways beyond the electricity we generate.
- While we can leverage this value, we have greatest control over the element of cost.

A Changing Landscape

Current industry realities driving change:

- **Flat or declining demand: even while our overall customer base continues to grow, overall sales are flat or declining (less than 1% growth per year).**
- **Heavy regulatory, industry and self-imposed burden over course of many years.**
 - Sustained, low-cost natural gas.
 - Shutdowns of U.S. nuclear plants (12 announced/considered through 2025)
 - Subsidized wind and solar projects
- **Operating cost increases (up 28% for the nuclear industry over the last decade).**
- Flawed electricity markets that do not price-in the full value of nuclear energy.

Our value and our leverage:

- Clean energy – largest source of carbon-free generation
- Supports grid and price stability for customers
- Contributes to fuel and technology portfolio diversity
- Environmentally sound – small footprint, wildlife friendly
- Engaged employees – highly skilled, trained and experienced; most valuable resource
- Unmatched capacity factor and availability
- Operates when needed (fuel on site)
- Economic engine – long-term careers, local/state/federal tax base

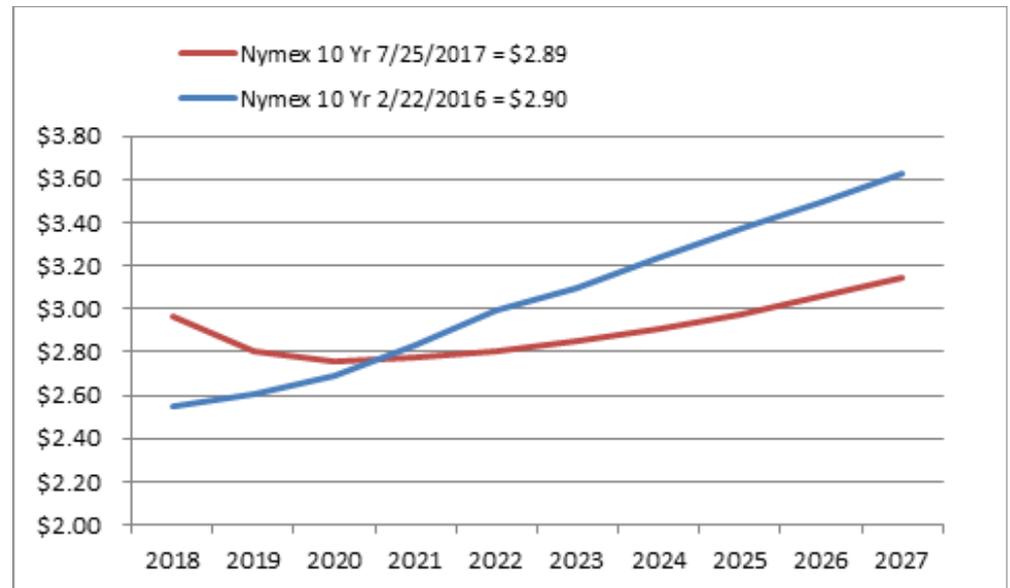
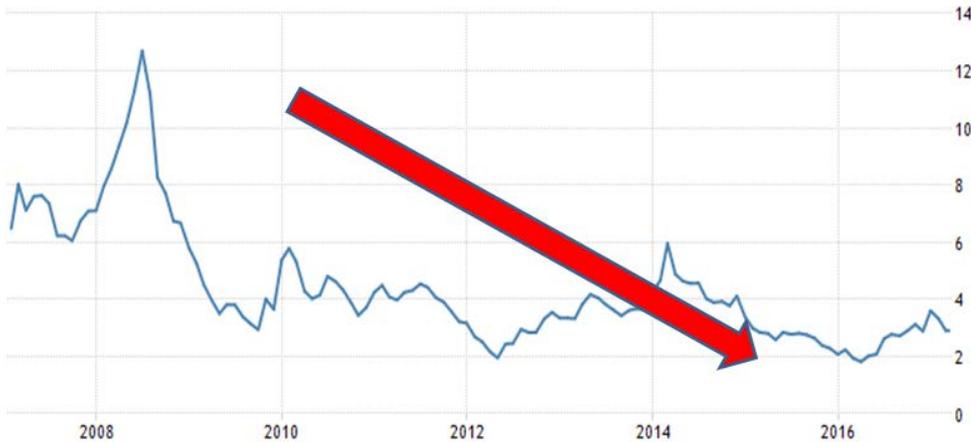
- We must improve our competitive edge
- Sustain operational excellence, and keep our nuclear fleet competitive with alternative energy sources.
- A transformational change with common vision is needed.

“FROM SEA TO SHINING SEA.....”



What is challenging nuclear viability?

Natural gas prices – 2006-2017 (\$/MMBTU)



What is challenging nuclear viability?

Natural gas prices – 2006-2016 (\$/MMBTU)



SOURCE: WWW.TRADINGECONOMICS.COM | OTC

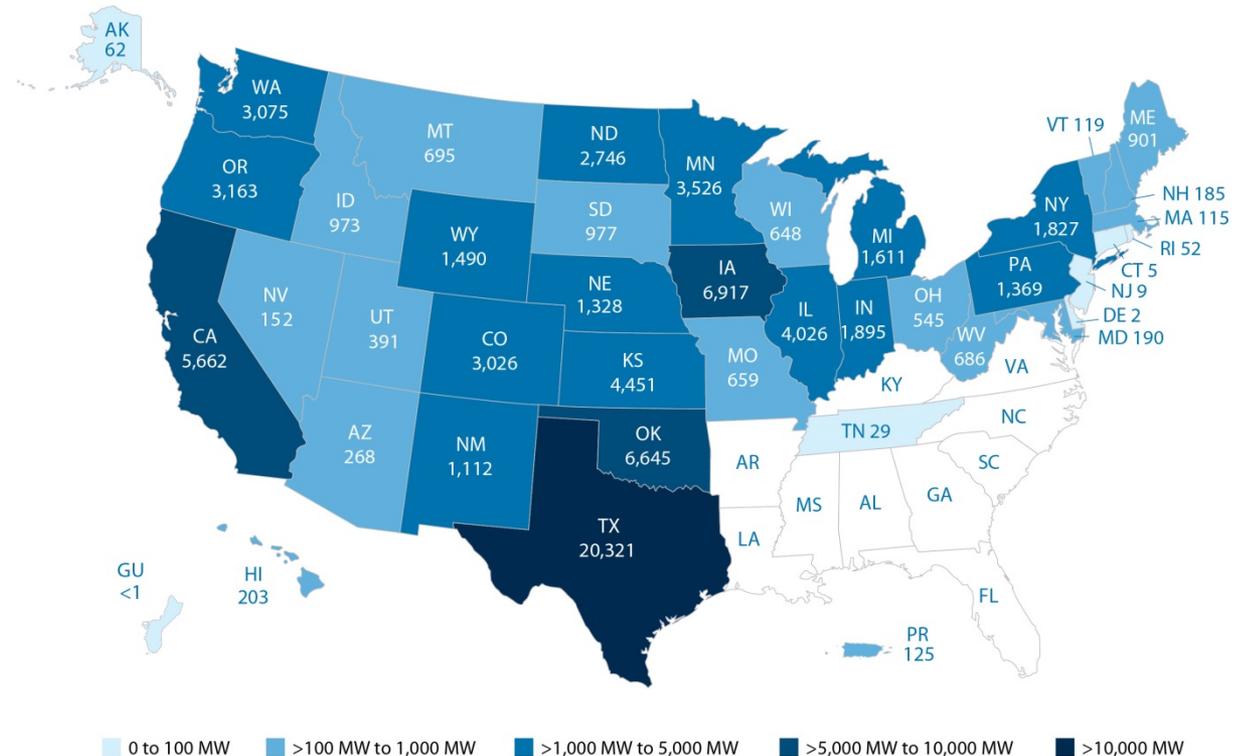
U.S. Nuclear Plant Costs (2015 \$):

Year	Fuel	Capital	Operating	Total
2002	5.73	3.92	18.61	28.27
2003	5.60	4.94	18.87	29.40
2004	5.29	5.66	18.56	29.50
2005	5.02	5.81	18.97	29.80
2006	5.05	5.56	19.23	29.85
2007	5.13	6.12	19.09	30.35
2008	5.36	6.77	19.53	31.66
2009	5.94	7.17	20.52	35.38
2010	6.77	7.17	20.66	36.59
2011	7.10	10.07	21.91	39.08
2012	7.47	10.77	21.50	39.75
2013	7.74	8.21	20.95	36.91
2014	7.22	8.19	20.95	36.35
2015	6.91	7.97	20.62	35.50
2002-2015 Increase	21%	103%	11%	26%
2010-2015 Increase	2%	-13%	0%	-3%

- Markets flooded with natural gas at historically low prices
- Customers are choosing self-generation, solar providers
- Electric sales flat or declining
- Subsidized wind and solar have competitive advantage
 - Cost of wind power \$20-25/MWh
- **US Wind:** 95K MW installed/in-prog
- **US Nuclear:** 99K MW installed
- Generating costs at U.S. nuclear plants increased 28% in last decade
- Labor is largest cost element of budget & recent cost increases
- US power plants' cost of production from natural gas plunged 71% between 2008 and 2016

What does the landscape look like today?

- **82,143 MW** of installed wind in US YE 2016 (2,539 MW YE 2000)
- 14,004 MW under construction and 11,815 MW in advanced development (a total of 25,819 MW of wind capacity in near term deployment)
- Cost of wind power \$18-21/MW-H subsidized
- Avg Nuclear cost of generation =
?????



U.S. Nuclear Plant Premature Closures

Not Cost Competitive

Lacks State Support

Prohibitive Repairs

Vermont Yankee



Kewaunee



Beaver Valley



Indian Point



San Onofre



Crystal River



Fort Calhoun



Pilgrim



Davis Besse



Diablo Canyon



Palisades



Oyster Creek



Perry



Others?
TMI
Millstone
VC Summer

Spared by State Action
(10 years only)

Illinois

Clinton

Quad Cities

New York

Nine Mile

Ginna

Fitzpatrick

-  Closed
-  Closure Date Set
-  Closure Threatened

↑
First Energy exiting competitive markets,
seeking state support in OH, PA

THE LATEST IMPACT: VC Summer



*"The two utilities that had been building twin Westinghouse 1150 MW AP1000 nuclear reactors at the V C Summer site in South Carolina have pulled the plug on the project"
August 2017*

*"Nearly 5,000 construction workers will lose their jobs with the closing of the V.C. Summer Plant"
August 2017*

*"Westinghouse Files for Bankruptcy, in Blow to Nuclear Power"
March 2017*



<http://www.thestate.com/news/local/article164740177.html>

IS THIS OUR FUTURE?



What is “Delivering the Nuclear Promise”

1. Advancing Safety, Reliability and Economic Performance.
2. Assuring future viability through efficiency improvements.
3. The industry has set a goal to achieve **30 percent reduction** in costs.

Nuclear must transform

Clear goal:

Survival:
Keep Nuclear
in the National
Energy Portfolio

Clear strategy:

Improve nuclear value
by 2018 through
Delivering the Nuclear
Promise

To Compete!

The Challenging context:

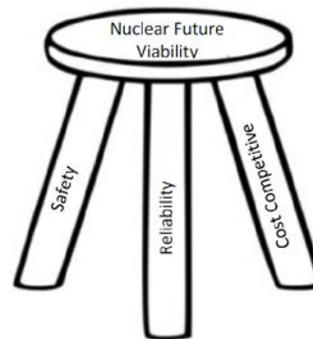
• **\$40/MW-H**  **\$ ≤ \$28/MW-H**



Today average all in Industry = \$36MW-H

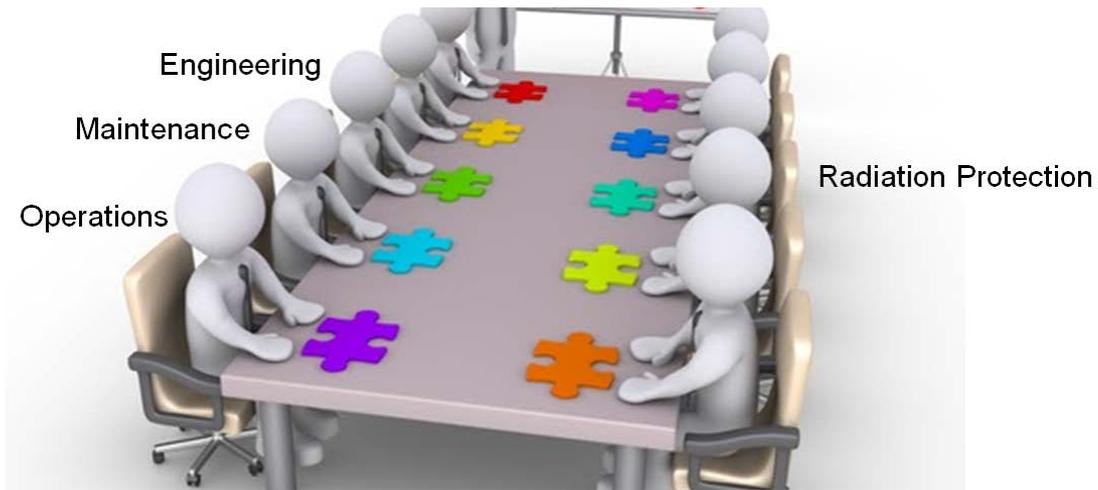
Excellence in Nuclear Operations and Radiological Safety

- In Nuclear it means improving safety, reliability and cost-competitiveness simultaneously – or equally, not trading one for the other.



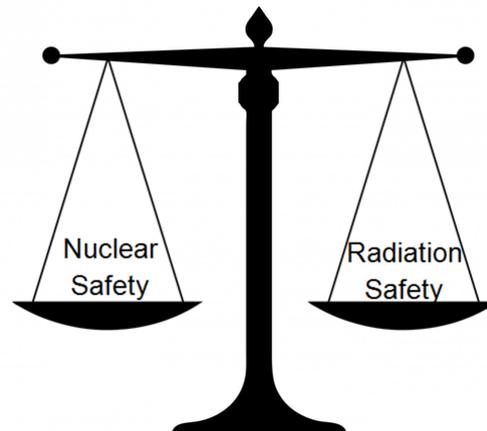
- This is accomplished by implementing industry best practices, using the right processes and tools to enable operational excellence, and pushing for continuous improvement and sustainable costs.

Getting A Seat At The Table



Using the seat

- Prairie Island 2R30
 - Expected larger crud burst due to 2nd cycle after SGR
 - Predetermined possible dose consequences for different crud burst scenarios – SAC approved
 - Use of tiered decision making prior to moving forward to balance dose consequence with minimizing time at lowered inventory



Decision Making

- Prairie Island 2R30
 - 2R30 Crud Burst Peak 3.62 uCi/mL
 - Cleanup curve created based on scheduled plant activities, maximizing purification flow rates and minimizing time without purification.
 - Typically prior to flooding the reactor cavity, RCS hard gamma activity levels are reduced to <0.05 uCi/cc per the EPRI and Westinghouse guidelines.
 - SAC approved decision to permit flooding at 0.0747 uCi/cc
- Results
 - Collective Radiation Exposure 31.346 on a goal of 34 Person-REM
 - Shortened lowered inventory duration by 8 hours

Closing Statement

- Nuclear energy has a lot to offer our customers and our communities. We need to give them the confidence to invest in us. That confidence will come from the results we produce this year and next – in terms of improved safety, reliability and cost-competitiveness.

