

Utilities Policy Advisory Committee (UPAC) Wednesday, December 4, 2024 8:00 a.m. – 10:00 a.m.

Blue River Board Room 121 S. Tejon Plaza of the Rockies or Microsoft Teams <u>Click here to join the meeting</u>

| 8:00 a.m. | 1. | Call to Order | |
|------------|----|--|------------|
| 8:05 a.m. | 2. | Approval of November 6, 2024, UPAC Meeting Minutes | Decision |
| 8:10 a.m. | 3. | Bechtel and TerraPower | Discussion |
| 9:00 a.m. | 4. | Colorado Springs Utilities Key Account Manager for Local Military Installations | Discussion |
| 9:45 a.m. | 5. | Selection of UPAC Officers for 2025 | Decision |
| 9:50 a.m. | 6. | Customer Comment Citizens can provide comment in person, by joining the meeting from computer or by phone using the link above. If you would like to speak during the citizen comment period, please sign up to speak through <u>BoardSubmissions@csu.org</u> prior to the meeting. | Discussion |
| 9:55 a.m. | 7. | Committee Member General Discussion | |
| 10:00 a.m. | 8. | Adjournment | |
| | | Next meeting: January 8, 2025 | |
| | | Note: UPAC Bylaws, Rule 6: Customer and Public Comment: (b) At the discretion of the Chair, or the majority of the Committee Members present, customers and members of the public will be allowed to comment or ask questions concerning items discussed at regular meetings or concerning matters discussed at special meetings. Comments or questions by individuals will be | |

limited to five minutes each, and all customer or public comments will not exceed twenty minutes on any agenda item unless time is extended by the Chair

or majority of the Committee Members present.



Minutes Utilities Policy Advisory Committee (UPAC) Wednesday, Nov. 6, 2024 Blue River Boardroom, 5th floor, 121 S. Tejon St., Colorado Springs, CO and Microsoft Teams Virtual Meeting

Committee members present in the Boardroom or via Microsoft Teams:

Chair Larry Barrett, Scott Smith, Gary Burghart, Michael Borden, David Watson, Katherine Danner, Chris Meyer, Tom Carter and Albert Badeau

Committee members excused: None

Staff members present in the Boardroom or via Microsoft Teams: Travas Deal, Kaitlin Haslam, Bethany Schoemer, Amy Lewis, Tristan Gearhart, Al Wells, Christian Nelson, Marcela Espinoza, Heather Tocci, Fadil Lee, Leslie Smith, Gabe Caunt, Kathryn Rozwod, Steve Barry, Kerry Baugh, Matt Dudden, Tyrone Johnson and Jacqueline Nunez

Utilities Board members present in the Boardroom or via Microsoft Teams: None

City of Colorado Springs staff present in the Boardroom or via Microsoft Teams: David Beckett

Residents present in the Boardroom or via Microsoft Teams:

Mason Baker and Michael Squires

1. Call to Order

Chair Larry Barrett called the meeting to order at 8:01 a.m. and called the roll.

2. Approval of Oct. 2, 2024, UPAC Meeting Minutes

Committee Member Chris Meyer made a motion to approve the Oct. 2, 2024, meeting minutes and Committee Member Katherine Danner seconded the motion. The motion passed unanimously.

3. Utah Associated Municipal Power Systems Presentation

Mr. Mason Baker, Utah Associated Municipal Power Systems (UAMPS) Chief Executive Officer, presented experiences their agency has had in the nuclear generation space. UAMPS provides wholesale electric energy services, on a nonprofit basis, to community-owned power systems throughout the Intermountain West. There are currently 50 members from Utah, Arizona, California, Idaho, New Mexico and Wyoming.

UAMPS terminated their Carbon Free Power Project due to construction risk concerns and the inability to reach 80% subscription target. The project

development started in 2012 with NuScale Power technology. This helped secure \$1.4 billion cost-sharing with the Department of Energy. UAMPS engaged with the Shoshone-Bannock tribes starting in 2014 for site considerations. Ultimately the construction cost deterred potential partners, and the interest rate increased 150 basis points, impacting power costs along with supply chain issues and labor availability.

Mr. Baker discussed their resource mix and energy transition needs which includes their current peak load of 1,350 megawatts. The resource mix includes 25% hydro, 15% coal, with an increase in natural gas. Their planning requirement increases to 115% of peak load for resource adequacy. UAMPS is currently studying 1,200 megawatts of new generation options.

4. Customer Comment

There were no customer comments.

5. Committee Member General Discussion

Colorado Springs Utilities CEO Travas Deal discussed the permitting process for the Nixon site. It is estimated that \$15 million would be the initial site permitting cost. This approach could open potential partners with an already-permitted site. Clear Springs Ranch was identified as a potential nuclear site with 1,000+ acres of existing transmission infrastructure.

The power plant transition strategy and timing were discussed. The committee identified a 15 year+ timeline for nuclear power implementation. The committee noted the importance of parallel planning for both short-term needs and long-term nuclear possibilities.

Mr. Barrett noted that his term serving as chair will conclude at the end of the year. He will be continuing as a committee member. Chair and vice chair elections are scheduled for the December meeting. Mr. Barrett will provide recommendations for the new leadership positions. In December, it is anticipated that we will have representatives from Bechtel, TerraPower, and a Springs Utilities military account representative. A presentation on ethics, open meetings, and the Colorado Open Records Act (CORA) will be scheduled for December 2024 or January 2025.

6. Adjournment

Committee Chair Larry Barrett adjourned the meeting at 10:30 a.m.

Next meeting: Dec. 4, 2024, at 8:00 a.m. in the Blue River Board Room

TerraPower Introduction

December 2024

Christian Blessing Director of Strategic Development





2012

• TerraPower laboratory is established.

TerraPower identifies

molten salt reactors as

a research technology.



2022-2024

- TerraPower works to finalize Natrium design.
- TerraPower secured a total of **\$830 million** in the largest private fundraise among advanced nuclear companies.

2006

Bill Gates and like-minded visionaries determine the private sector must act to develop clean energy resources to halt climate change and to raise global living standards.



2020-2021

.

- The DOE awards TerraPower **\$2 billion** to demonstrate the Natrium[™] reactor and integrated energy system.
- TerraPower and PacifiCorp announce efforts to advance the Natrium^{™1} reactor demonstration project near a retiring coal plant in Wyoming.





TerraPower - Energy & Radiopharmaceuticals



With over 15 years of innovation, TerraPower continues to grow and diversify its portfolio. Its multidisciplinary team has made progress on advanced reactor designs, reactor licensing, design software and isotope production

The Natrium reactor program and TerraPower Isotopes (TPI) are now ready for commercial deployment, while the Molten Chloride Fast Reactor (MCFR) remains in the research and development stage.



TerraPowe

Carbon-Free Power for the Clean Natrium Energy Transition

- Natrium provides scalable, dispatchable power, • supporting decarbonization efforts and stabilizing grids with high renewable penetration.
- The integrated energy storage capability allows ٠ Natrium to function as a peaker plant, supplying critical power when intermittent sources like solar and wind are unavailable.
- A key innovation is Natrium's novel architecture, ٠ which simplifies and separates major components, allowing the power block to be constructed and operated without nuclear-grade equipment.
- Natrium is particularly well-suited for converting ٠ retired coal plants into nuclear facilities, offering a pathway to repurpose existing infrastructure.
 - Ready for Commercial Deployment

Copyright © 2024 TerraPower, LLC. All Rights Reserved

Transforming the Fight Against toi ISOTOPES Cancer

- TerraPower Isotopes (TPI) is at the forefront of developing the next generation of medical isotopes, with a focus on revolutionizing oncology treatment.
- TPI is one of the few companies capable of delivering Actinium-225, a rare isotope with significant potential in cancer therapies.
- In January 2024, TerraPower delivered its first samples of Actinium-225 to customers, marking a groundbreaking step in expanding the availability of this critical isotope and moving closer to commercial sales.

Ready for Commercial Deployment

Nuclear Technology R&D with MCFR **Potential for Multiple Use Cases**

- The Molten Chloride Fast Reactor (MCFR) has the potential to provide a low-cost, versatile solution for industrial process heating, chemical production, waste reduction, and maritime propulsion.
- MCFR's development program addresses a broad array of use cases across large end markets.
- TerraPower's strong partnerships, including a ٠ collaborative development effort with Southern Company, bring expertise and funding to the program.
- The project received the 2020 ARDP Risk Reduction ٠ Award, with an 80/20 cost-sharing arrangement between the U.S. Government and TerraPower.

In R&D Stage

Natrium Reactor Plant

ENERGY ISLAND

Ę

- No Nuclear QA Work
- Operations support energy dispatch, demand following, arbitrage
- No immediate impact on reactor

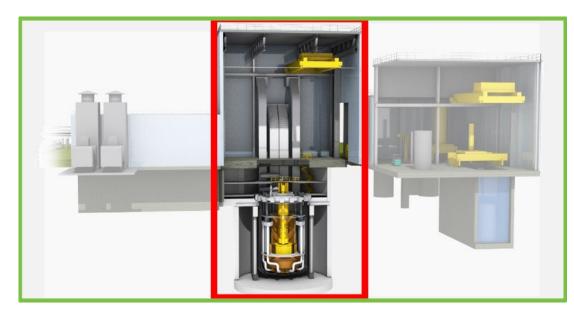


NUCLEAR ISLAND

- Graded Nuclear QA
 Work
- Operations focused on constant reactor power
- No immediate impact from energy storage or turbine



The Natrium Technology



Advanced nuclear reactor

- Sodium-cooled fast reactor
- 345 MWe clean energy
- 4x more fuel efficient

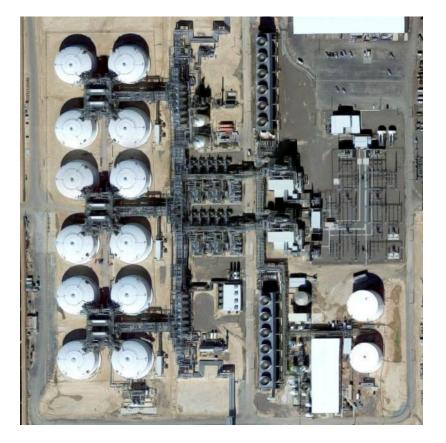


Integrated energy storage system

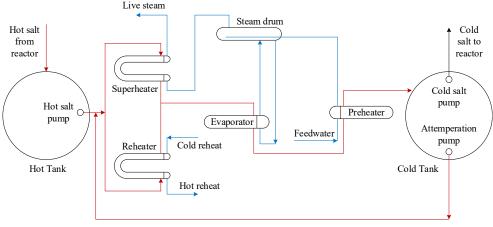
- Molten salt energy tanks
- Allows ramp up to 500 MWe for 5+ hours
- Larger than any commercial battery available today



Energy Island Thermal Storage







Thermal Storage

- ld
 - Number of tanks based on customer's energy need
 - Steam generator trains based on size of turbines
 - Turbine size based on customer's power



Benefits of Energy Storage

- Dispatchable & CO2 free
- Step change in nuclear power flexibility
- Competitive with heavy duty combined cycle
- Unmatched GWe scale energy storage
- Nuclear island unaffected by turbine load following

| | Ramp Rate (P _{nom} /min) | Turndown (P _{nom} minimum) |
|-------------------------------------|--------------------------------------|--|
| AP1000 ¹ | 0.4% | 15% |
| NuScale ² | 0.8% | 20% |
| Hard Coal ³ | 6% | 10-20% |
| NATRÍUM ⁴ | 10% | 20% |
| CCCT 1x1, GE 7F.05 ⁵ | 10.4% | 43% |
| CCCT 1x1, GE 7HA.03 ⁵ | 11.7% | 33% |

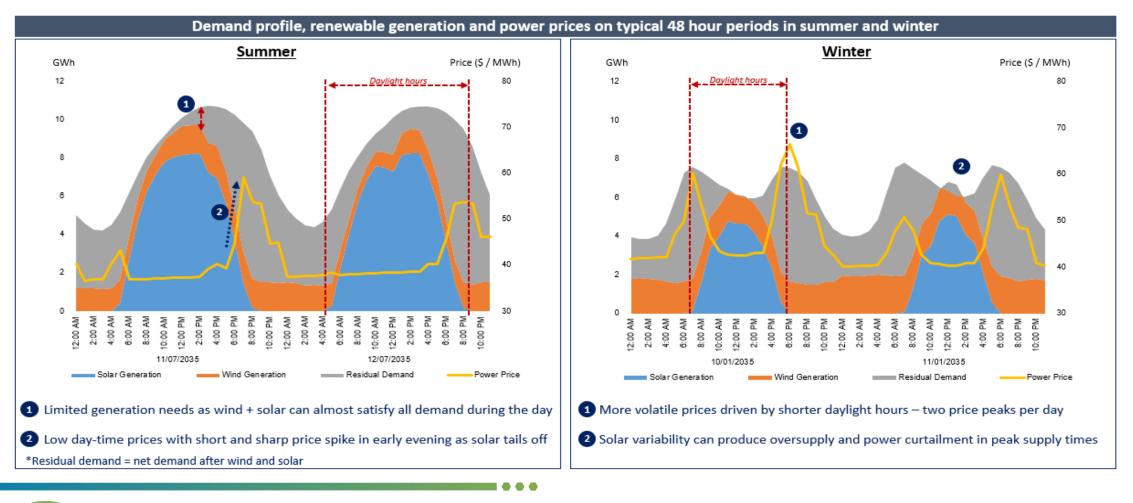
Notes

- Load following capability per AP1000 Design Control Document Tier 2 sections 3.9.1.1.1 r19 & 7.7.1.1 r16. 2%/min for <10%P_{nom} is available for frequency response.
- 2. <u>https://www.nuscalepower.com/environment/renewables/solutions-to-the-duck-</u> <u>curve</u>
- 3. IRENA (2019), Innovation Landscape Brief: Flexibility In Conventional Power Plants
- 4. Further design expected to reveal higher ramp rate & lower turndown
- 5. GEA32930A (05/2020), GEA34163 (09/2019)



Energy Storage & Ramping Balance a Renewables-Based Grid

Significant price volatility from solar daily / seasonal variability - WECC Region





Basic Operation

Ę

Charging: Low Price $\dot{W}_T < \eta_T \dot{Q}_{R_T}$

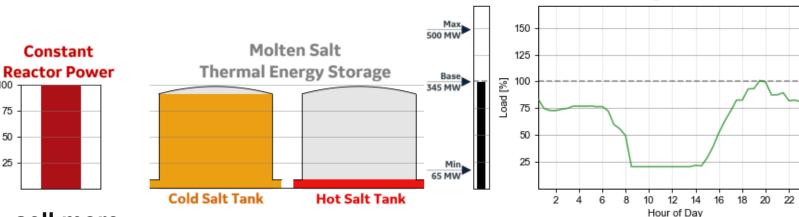
- Hot salt tank level increases •
- Cold salt tank level decreases ٠

Discharging: High Price $\dot{W}_T > \eta_T \dot{Q}_{R_X}$

- Hot tank salt level decreases ٠
- Cold tank salt level increases ٠

```
Even: \dot{W_T} = \eta_T \dot{Q}_{R_T}
```

- Steady hot tank salt level
- Steady cold tank salt level ۰



Low price - sell less, high price – sell more

Store when renewables are producing power (lower prices) and discharge when they are not (higher prices) ٠

100

75

50

25

Power [%]

- The Natrium design is different from LWRs because the outlet temperature is high enough to support storage. ٠
- Reactor output is steady ... minimize cycling of reactor ٠
- Price following above and below 100% reactor power ٠

 $\frac{\left(\rho V_{working}\right)_{hot} \left(C_{hot} T_{hot} - C_{cold} T_{cold}\right)}{\frac{\dot{Q}_T}{\eta_T} - \dot{Q}_{Rx}}$ Full Power Turbine Hours =

Electric Energy Prices: JEPX 2019/2020

Optimized Load-Following With Boosted Capacity

Fal

Summer

Spring



140

120

80

60

40

20

24

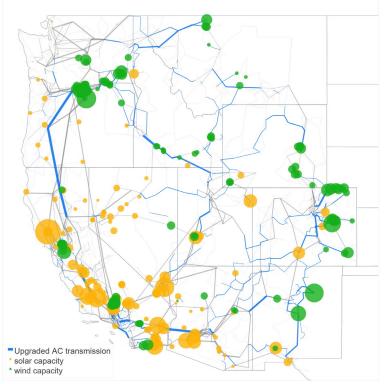
100 툴

Price [\$/|

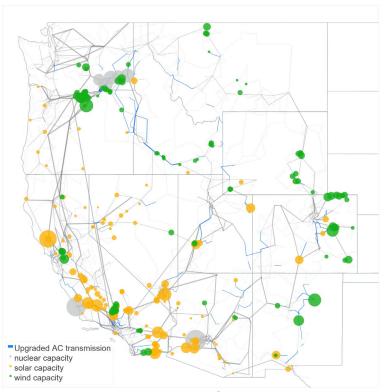
Energy

Total System Cost Reduction with Energy Storage

Breakthrough Energy Grid Model (<u>https://science.breakthroughenergy.org/</u>) of generation and transmission for the Western Interconnect with 90% carbon free energy



New renewables only: over 12,000 GW-miles of new transmission capacity needed in lowest-cost scenario



Renewables + flexible nuclear: 83% reduction in new transmission capacity



Natrium Cost Advantage



400m Environmental Protection Zone

- Natrium maintains its key advantages relative to other designs:
 - Reduced nuclear quantities and construction labor
 - Shorter construction duration
 - Added value from energy storage
 - Smaller Emergency Planning Zone (EPZ)
- Total cost of energy for the current Natrium design is lower than competitors
- We are realizing cost reductions on the base Natrium design and will continue to do so
- We are also pursuing technologies that can reduce costs on future commercial units



Natrium in Wyoming





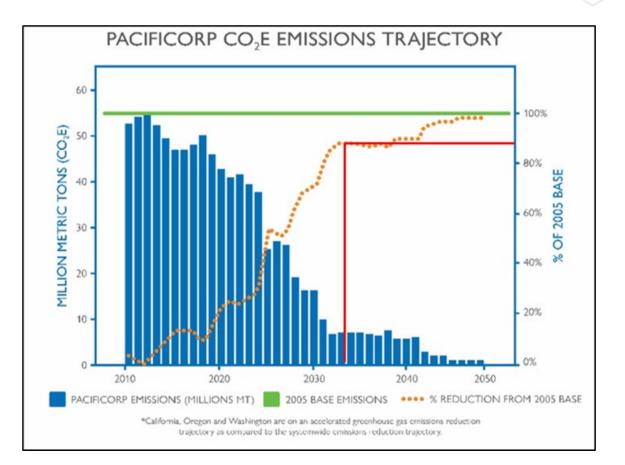


- Developing the first Natrium plant near a retiring coal plant in Wyoming with utility PacifiCorp
- Announced final site choice in Kemmerer, Wyoming, November 2021
- 1,600 construction jobs at peak; 200-250 full time jobs when the plant is operational
- Non-nuclear construction began in June 2024 and plant operational is planned ca. 2030



Natrium Reactor's Strategic Advantage

- Natrium reactor delivers
 - Low Cost
 - Clean Electricity
 - Dispatchable Power
 - Clean Heat
 - Resilience changing markets
- Natrium reactor's target market
 - 80% decarbonization
 - Diminishing returns
- Scarcity
 - Strong market need
 - Challenging production





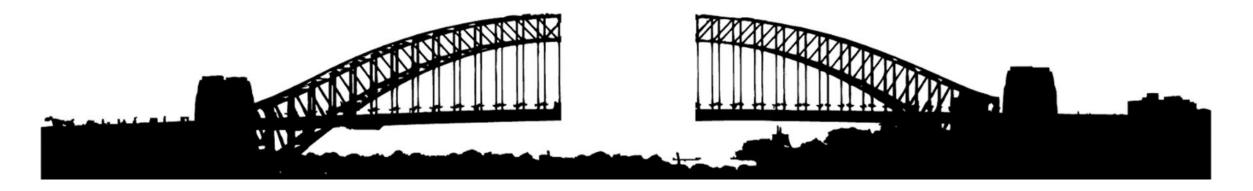
Mitigating Megaproject Challenges

Nuclear Vendor – Challenges

- Incomplete Design & License
- Inexperienced Supply Chain & Workforce
- Inequitable Contract Structure

Client Requires Certainty

- Cost
- Schedule
- Plant Performance





Natrium Reactor Development Roadmap

• First-of-a-kind (FOAK)

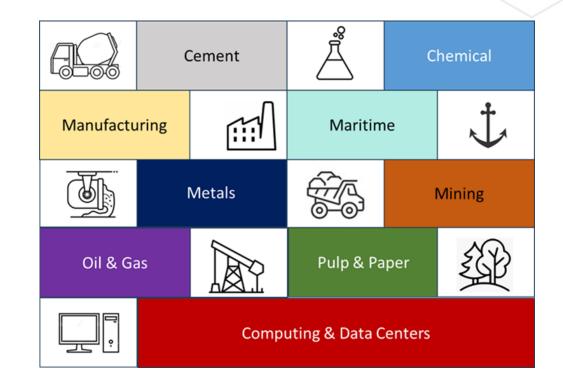
- Demonstration Reactor Kemmerer, Wyoming, completed circa 2030.
- Mature Design & License
- Next-of-a-kind (NxOAK)
 - Mature the Natrium Reactor technology beyond FOAK.
 - Supply Chain and Workforce Mature & Expanding
- Nth-of-a-kind (NOAK)
 - Standardized design
 - $\circ\,$ Experienced supply chain and workforce,
 - Fair contract structure





Targeted Clients

- Attractive Industries
 - Large Energy Consumers
 - \circ Converting to Clean Energy
 - $\circ~$ Perceive utilities as slow moving
- Commodity Producers
 - Energy cost sensitive
 - Require Mature Technology
 - Disruption to Organization
- Ranking the Commodity Producers
 - o Best Company can influence or control global price
 - $\circ~$ Good primary form of energy is heat
 - $\circ~$ Poor primary form of energy is electricity





THANK YOU

To learn more, visit www.terrapower.com



Copyright © 2024 TerraPower, LLC. All Rights Reserved



Bechtel Presentation to Colorado Springs Utilities Policy Advisory Committee

4 December 2024









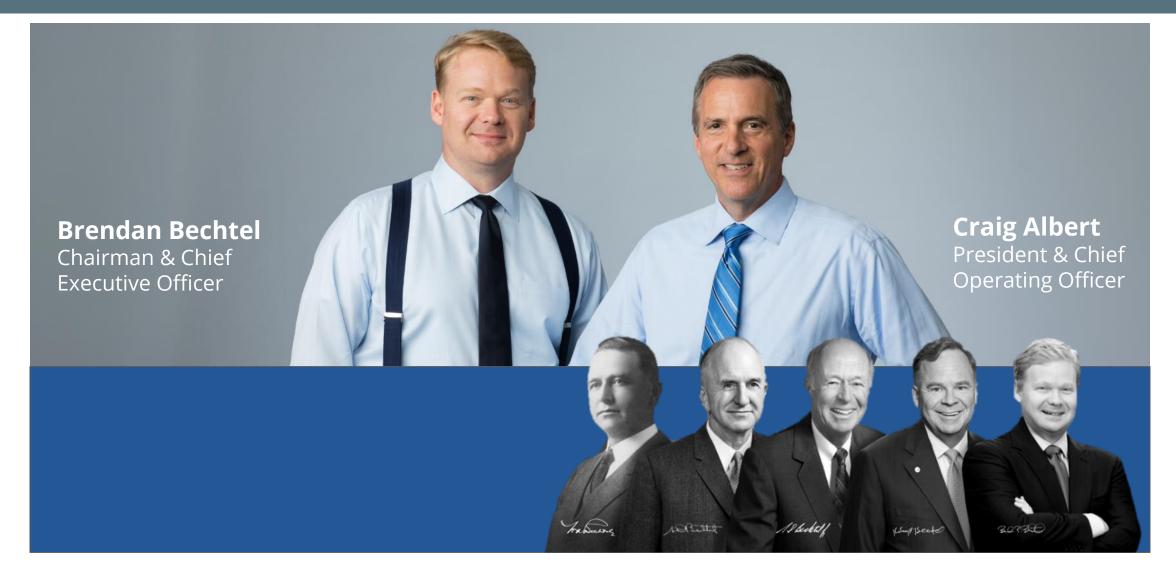
Watts Bar Unit 2







Bechtel – A Trusted Partner Since 1898



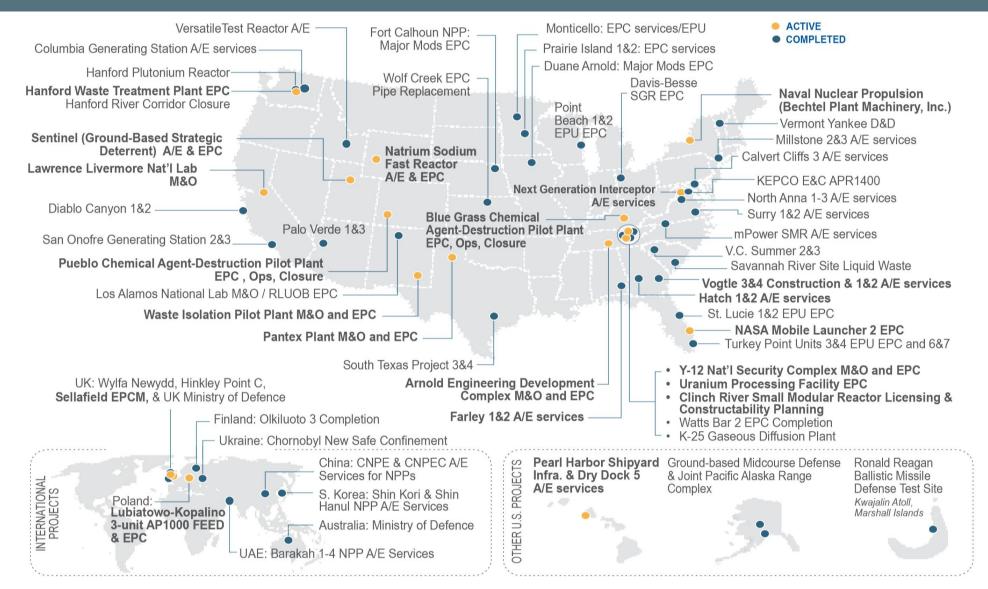


Global Corporation Delivering Mega-Project EPC





Mission Critical Nuclear Experience





Next Generation Nuclear Engagement, **Building on Long History of Success**

- Since 1948, Bechtel has led each generation of nuclear deployments - delivered 76 GW of nuclear generation to grid
- Leader in integrated EPC delivery in the nuclear industry & committed to develop next generation of nuclear power
- Leader in innovation and digital delivery virtual design & construction, advanced work packaging, welding & applied technology
- Active/recent Gigawatt Reactor & SMR/Advanced Reactor new build expertise in project development/FEED, licensing, full EPC and commissioning; major projects include:
 - Natrium Demonstration Project (licensing, EPC)
 - Lubiatowo-Kopalino 1-3 (Poland AP1000 FEED & EPC) —
 - Vogtle Units 3&4 (licensing, construction completion)
 - Wylfa Newydd ABWR (project development, engineering)
 - Hinkley Point C (construction management, project controls)
 - Watts Bar Unit 2 (EPC)
 - Versatile Test Reactor (engineering)

© 2024 Level 3 - Bechtel General, Non-confidential business information | 5

Proven Nuclear Experience









Current EPC on 2 nuclear power mega-projects; provided services plants worldwide - A/E on 71 on 80% of U.S. nuclear plants

Worked on 150 nuclear & Constructor of 44

Manage 4 U.S. Government nuclear labs/sites & EPC on 2 major new nuclear facilities

MORE THAN 76,000 MW OF COMPLETED NUCLEAR POWER DESIGN & CONSTRUCTION

AND LEADER IN GOVERNMENT NUCLEAR EPC

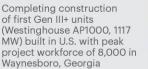
Operating plants - 7 Power Uprates & 36 Steam Generator Replacements

KEY CURRENT AND RECENT NUCLEAR DESIGN & CONSTRUCTION EXPERIENCE



Natrium Sodium Fast Reactor Full EPC and licensing to design and build the first Gen IV reactor (TerraPower's 345MW SFR) in the U.S. DOE's Advanced Reactor Program a Kemmerer site in Wyoming

Vogtle Units 3&4



Uranium Processing Facility

Full EPC of the key operations center and production facility for U.S. strategic deterrent with workforce of 2,000 at DOE's Y-12 site in Oak Ridge ennessee



Lubiatowo-Kopalino Units 1-3 EPC of 3 Westinghouse AP1000 units (Gen III+, 1117 MW each) in Poland, the first nuclear power project in Poland at site on Baltic coast

Watts Bar Unit 2



Full EPC of first new nuclear power plant in the U.S. (4-loop Westinghouse PWR, 1165 MW) to begin operation in 25 years with workforce of 3,200 in Spring City, Tennessee

Waste Treatment Plant



Full EPC of first-of-a-kind facility to treat and process 56 million gallons of WWII and Cold War era nuclear waste for DOE at Hanford site in Washington state



Nuclear Power – Current/Recent Projects (SMR/AR)

Natrium Demonstration Project – Kemmerer, WY



- Since 2020, Bechtel is EPC partner to TerraPower for initial Natrium technology deployment, part of DOE's Advanced Reactor Demonstration Program (ARDP)
- 345MW, sodium cooled reactor with molten salt energy storage increasing power output to 500MW
- CPA submitted to NRC in March 2024
- Site groundbreaking/mobilization in June 2024
- Implementing Bechtel's innovative Digital Delivery approach

Clinch River Small Modular Reactor Licensing & Construction Planning



- Bechtel supporting TVA for its planned deployment of SMR at Clinch River site
- From 2011, performed initial ESP Application and NRC RAI support bounding multiple technologies (NRC approved ESP in 2019)
- From 2023, supporting TVA in ESP updates for GEH's BWRX-300
- From 2023, supporting TVA in construction planning & constructability for BWRX-300 deployment



Other Relevant Nuclear Projects



Vogtle 3&4

- Bechtel trusted to take over construction in 2017
- First new reactors in over 30 years
- One of the largest construction projects in the U.S.at the time, with a labor force of over 9,000 at peak



Lubiatowo-Kopalino 1-3

- Bechtel & Westinghouse delivering 3 AP1000 units for PEJ in Poland
- Focus on localization and nuclear supply chain / workforce training
- Current scope: conceptual design, permitting, construction planning, and supply chain engagement



Watts Bar Unit 2

- Bechtel was prime contractor for EPC services to Tennessee Valley Authority
- First new nuclear project since 1996Completed in 2016, meeting targets



Wylfa Newydd

- Bechtel in JV with Hitachi-GE and JGC for two-unit ABWR in Wales
- Project development, licensing, engineering, supply chain, construction planning, cost/schedule

mPower SMR Development

- From 2000-2017, Bechtel and BWXT alliance to design, license, and deploy a 380 MWe mPower SMR
- Extensive system optimizations and innovations, modularization
- FirstEnergy SMR Study analyzed former coal plant sits
- bEnergy Platform Bechtel IP



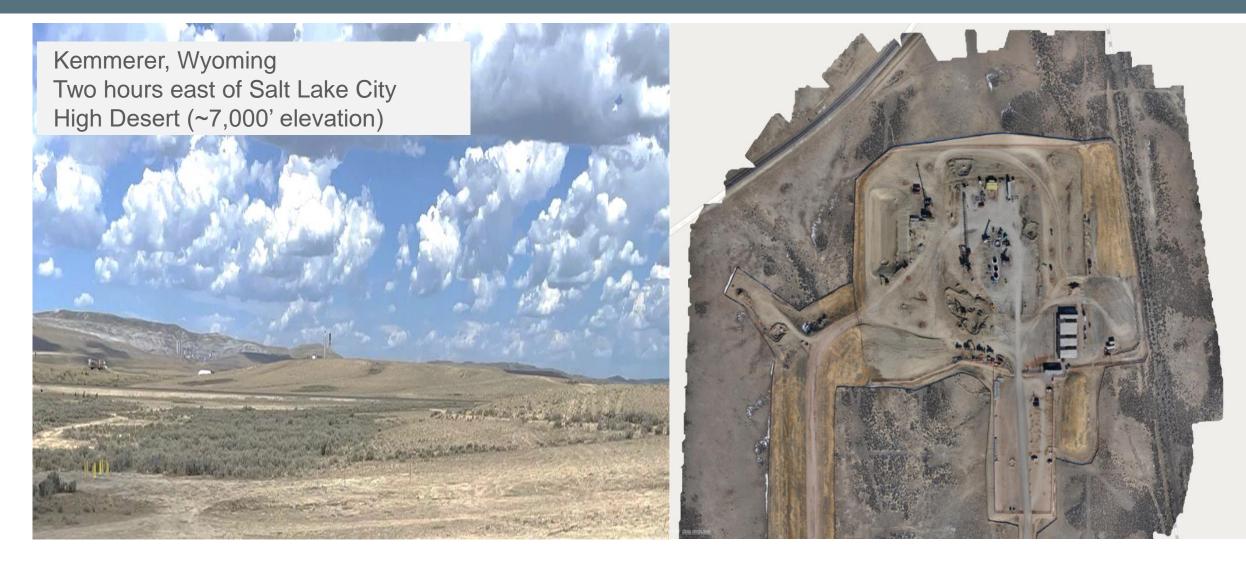
for safety, quality, cost, and schedule Versatile Test Reactor Phase 1 From 2018-2020, R&D collaboration

- with GEH and TerraPower
- Non-power producing sodium fast reactor for deployment at INL
- Plant layout and conceptual design, supply chain, BIM, constructability, and cost/schedule





Natrium[™] Plant (Kemmerer Unit 1): Kemmerer, WY





 Bechtel will be responsible for overall integration of the works, program and priority management. Common management systems will be employed across the project for ES&H, quality, cost, and program monitoring.



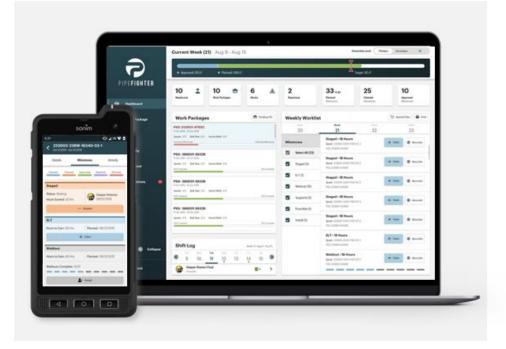




Digital Delivery and Lean Construction

- Maximize time on tools
- Paperless environment







Schedule discussion





UPAC Nuclear Generation Project Military Perspective

Steve Carr – Principal Account Manager, Colorado Springs Utilities December 4, 2024

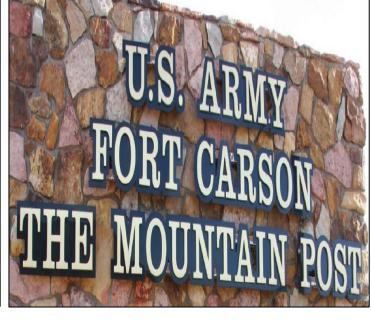
Agenda

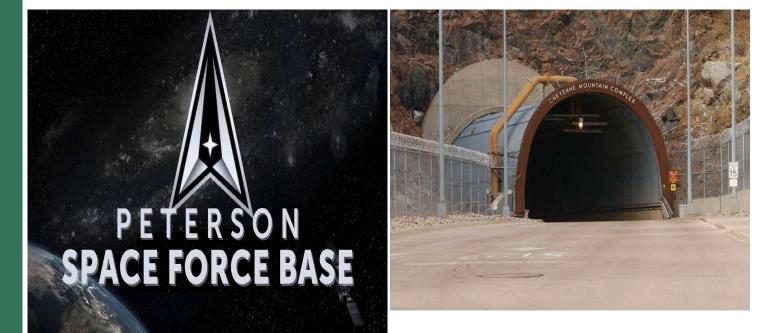
- 1. Military Installations served by Utilities
- 2. Military Energy Focus
- 3. Military Perspective on Nuclear
- 4. Military Approach

Military Installations Served

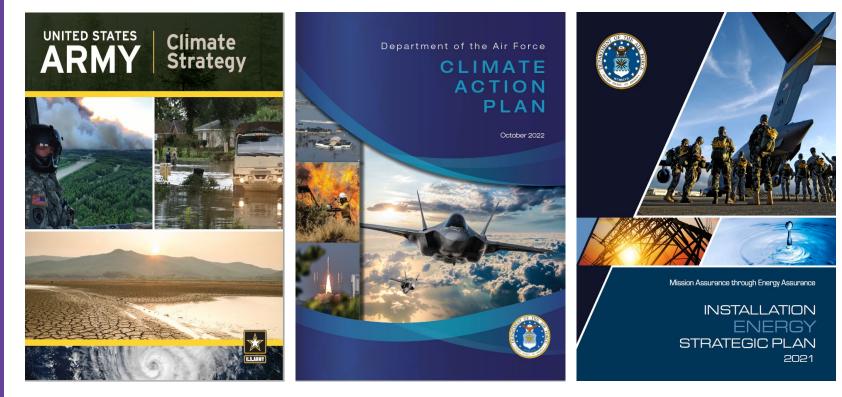
- United States Air Force Academy
- Fort Carson
- Peterson Space Force Base
- Cheyenne Mountain Space Force Station







Military Energy Focus



"Energy Security is National Security."

"The Homeland is no longer a sanctuary."

"Installations are no longer a sanctuary."

"Every installation must be islandable."

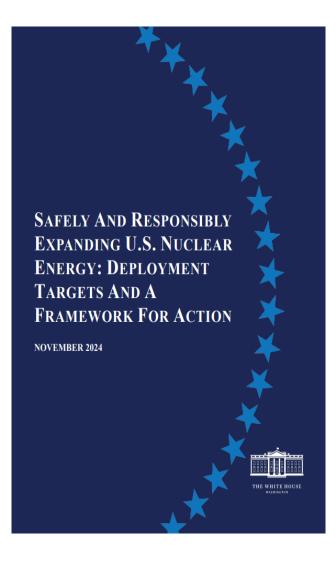
- Mission Assurance Ability to execute mission at all times.
- Resiliency Ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions.

Military Perspective on Nuclear

- Based on:
 - Policy documents (Nov 2024)
 - Association of Defense Communities (ADC) Installation Innovation Forum (Oct 2024)
 - Recent meetings with installations (Sep 2024 Nov 2024)

Military Perspective (Policy)

- Safely and Responsibly Expanding U.S. Nuclear Energy: Deployment Targets and a Framework for Action
 - Subject to change (this is Biden/Harris position) but nuclear energy has strong bipartisan support
 - "Nuclear reactors, including SMRs and microreactors, have the potential to provide defense installations with resilient (24/7) energy for several years, even in the face of physical or cyberattacks, extreme weather, pandemics, biothreats, and other emerging challenges that could disrupt commercial energy networks."
 - Efforts by Department of Navy, Army, Air Force



Military Perspective (ADC Forum)

- "Nuclear energy will be the wave of the future."
 - "Installations need 24x7 power under all conditions."
 - "The Army expects to have nuclear energy on some installations by the early 2030's."
- "Partnerships are needed for energy solutions."
- "Events don't care about installation boundaries."
- "Approximately 60-70% of military personnel live off the installation."
- "Resilient installations keep missions and bring in new missions. Lack of resiliency is a risk to installations growing."
- Navy hosted session on nuclear energy.



Military Perspective (Recent Meetings)

- Meetings with Senior Leaders Army/Fort Carson, Space Base Delta 1 (PSFB, CMSFS)
 - General discussions about nuclear energy
 - All discussions pro-nuclear
 - Potential for future partnerships
 - Services are exploring nuclear energy solutions (RFIs, Studies)

Military Approach

- Partnerships
 - Look to Colorado Springs Utilities / others for solutions
 - Have land Allow use in exchange for military benefit
 - Likely would not want to own/operate generation on installations





UPAC Officer Eligibility and Selection



According to UPAC Bylaws, the Committee shall elect the Chair and Vice-Chair for the next calendar year at the Committee's December meeting.



The Chair shall be elected by a majority vote of the Committee members following nomination(s) by a member or members of the Committee, which nomination(s) must be seconded. The Vice-Chair shall be elected in the same manner as the Chair. If a nominee fails to get elected, nominations shall be reopened.



The Chair and Vice-Chair shall have a voice and shall vote in the selection of the officers of the Committee.



Committee members shall not serve more than two consecutive years as Chair and not more than two consecutive years as Vice-Chair.

UPAC Officer Eligibility

UPAC Chair

Michael Borden Gary Burghart Kate Danner Scott Smith David Watson Chris Meyer

UPAC Vice Chair

Michael Borden Gary Burghart Kate Danner Scott Smith **David Watson** Chris Meyer Larry Barrett