Perspectives on Uranium for Nuclear Power: Uranium Exploration & In-Situ Recovery Projects in Texas

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Session 3 and Full Program

AAPG Workshop on Subsurface Energy to Power

Accelerating Electricity Capacity with Natural Gas, Uranium, & Geothermal, Hydrogen & Lithium

Norris Conference Center – CityCentre, Houston, TX
January 7 & 8, 2026

Introductions

Sponsorships

1. Recognition of students from University of Houston and from Rice University and other students who are attending this AAPG workshop. Their registration was funded through the Scholarship Awards program of the Texas Section of the AIPG.

2. Their presence reflect their interest and dedication to advancing their professional development within the fields of geoscience and energy, providing them with valuable opportunities to engage with industry leaders, broaden their professional perspectives, and to deepen their understanding of the challenges and innovations shaping the geoscience profession today.

3. Mr. Henry M. Wise, President of the Texas Section of the AIPG. Mr. Wise is also Vice President of Operations for the I2M Corporation. On behalf of the Institute, we extend our appreciation to the AAPG for producing this workshop and for offering Sponsorships to encourage ongoing collaboration between the industrial geoscience and academic geoscience communities. MDC also has the honor of serving as Vice President of the Texas Section of the American Institute of Professional Geologists (AIPG).

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Experience in Uranium Exploration & Production

1. In supporting AAPG over the years (2004-2021), Mr. Campbell served as Chairman of the AAPG Energy Minerals Division's Uranium & REE Committee for 17 years, while Mr. Wise also Served as Vice-Chair - Industry.

2. Experience in the Uranium Industry:

A. MDC (see CV) began in the late 1960s until the late 1970s and began again as the U prices began to rise in the early 2000s to present.

B. HMW (see CV) began in the 1970s until the mid-1980s and began again as the U prices began to rise in the early 2000s to present.

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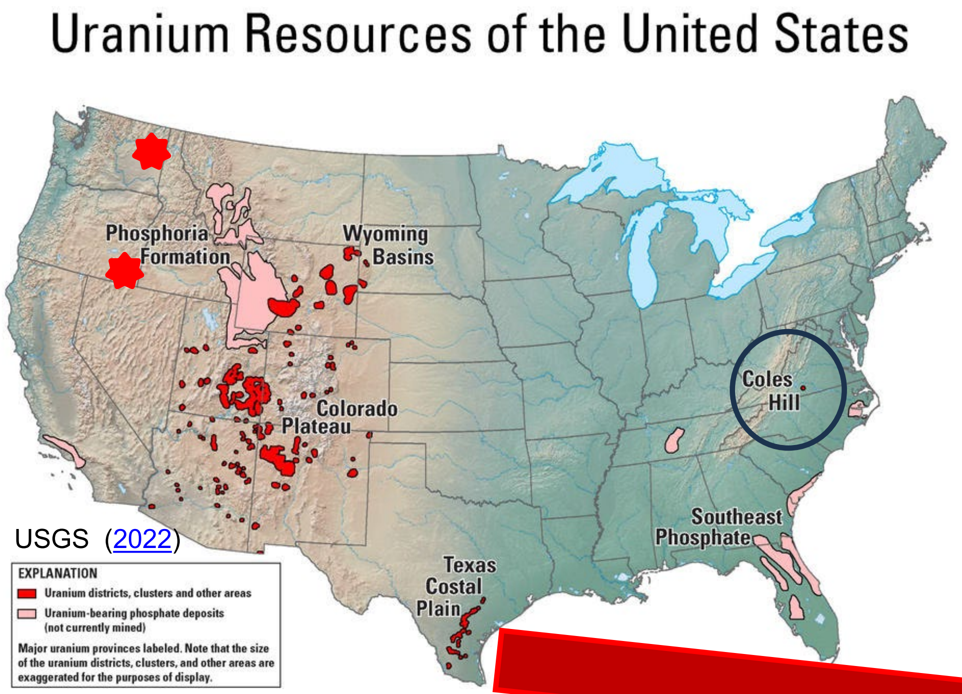
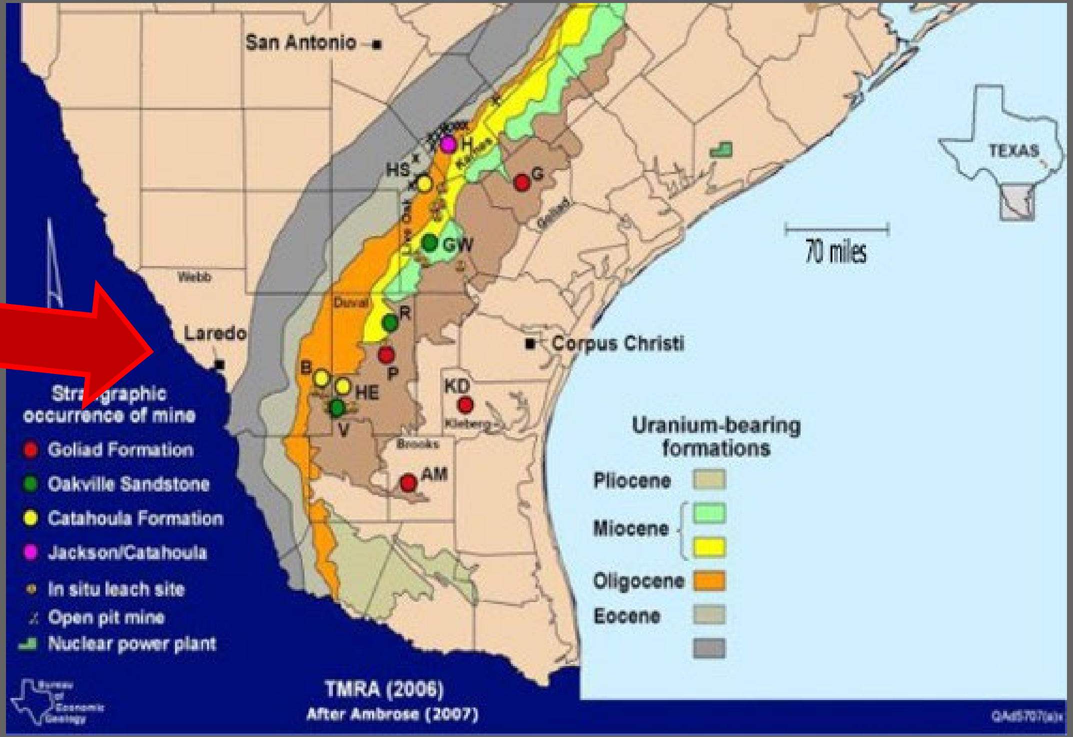
Where Do Uranium Deposits Occur in the U.S.?

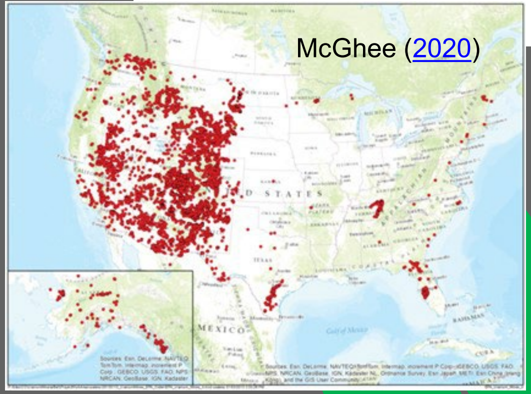


USGS (2022)

- **In Igneous, Metamorphic, & Volcanic Rocks:** Alaska, Colorado, Washington, Oregon & Virginia
- **In Sedimentary Rocks:** Alaska, Wyoming, Colorado, South Dakota, New Mexico, Arizona & Texas.



Abandoned Uranium "Mines"

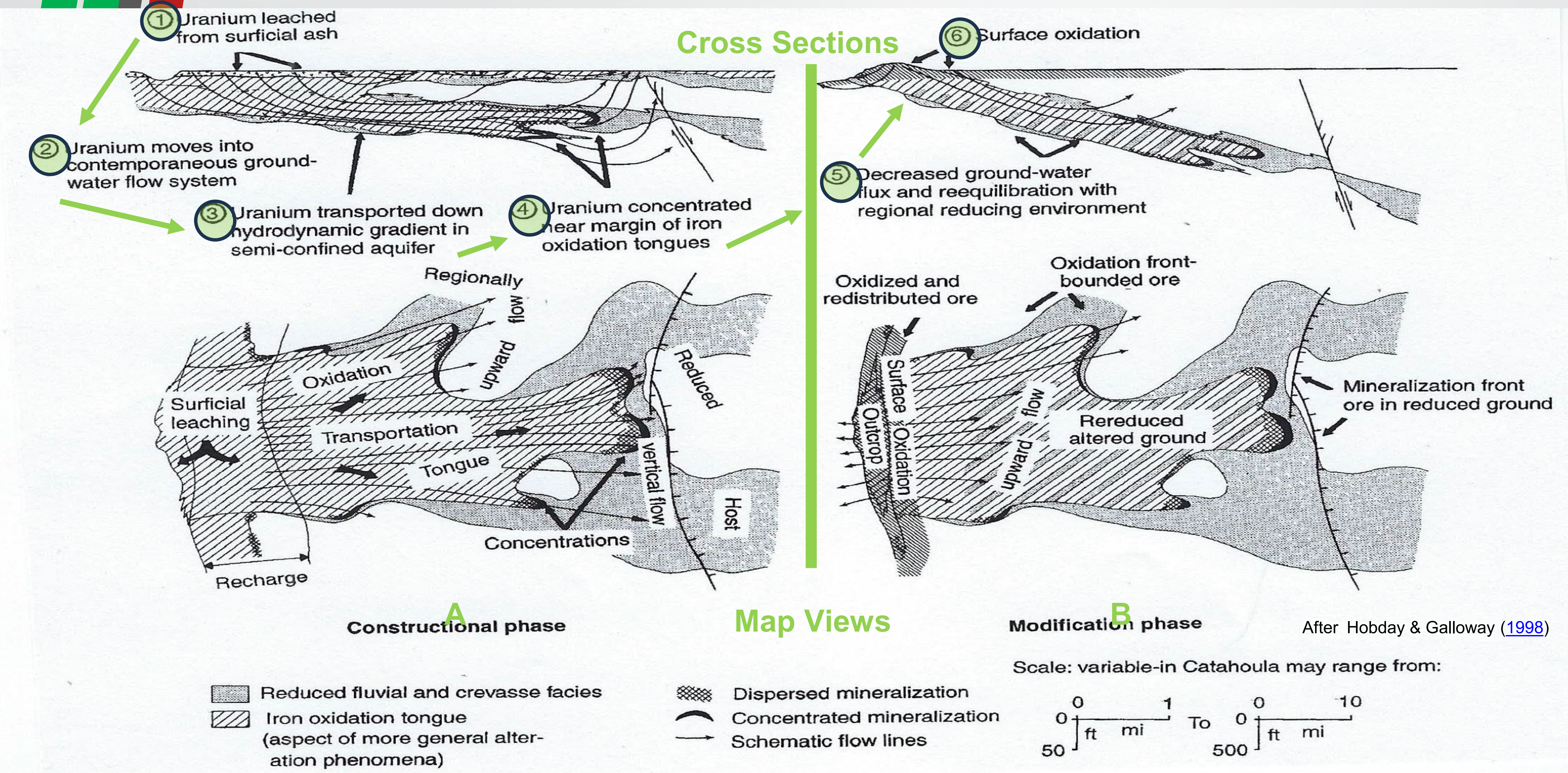


In Texas: Where was uranium production and where is it now?

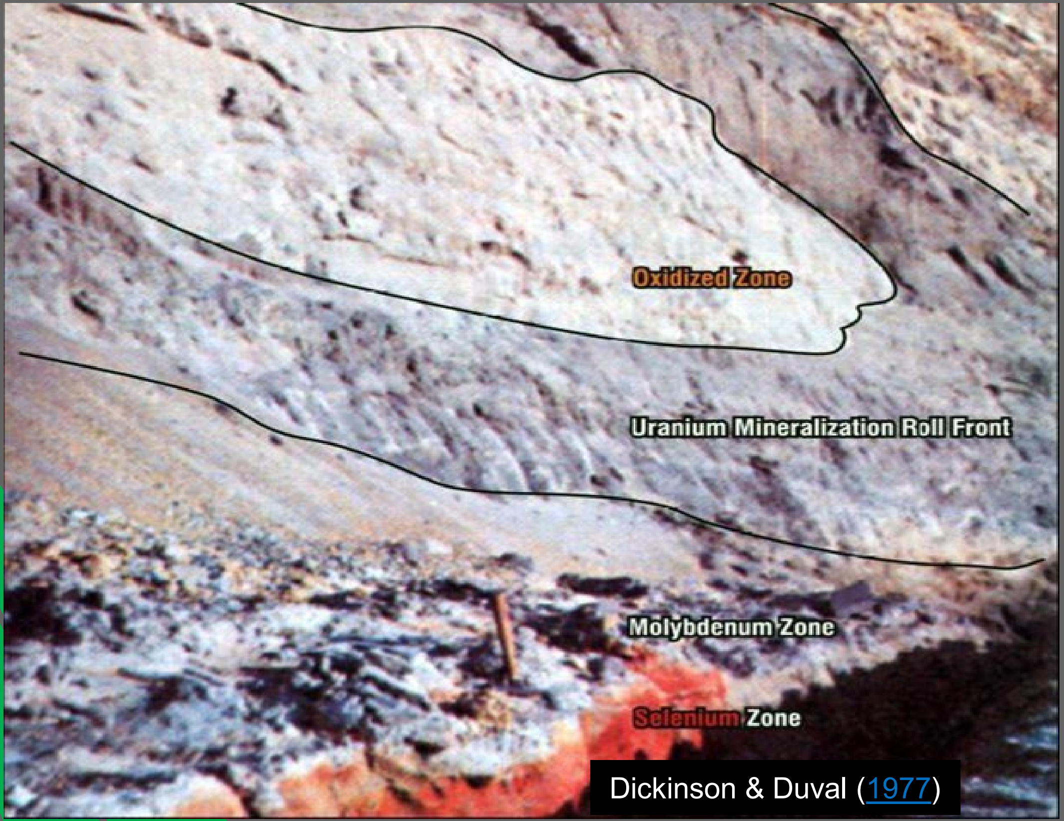
In Past: Surface Mines
Now: In-Situ Uranium Recovery

Generalization of Processes Involved in:

A - Shallow Initial Uranium Mineralization Phase B - Redistributed Phase



How Does Uranium Form in Sediments in Economic Concentrations?



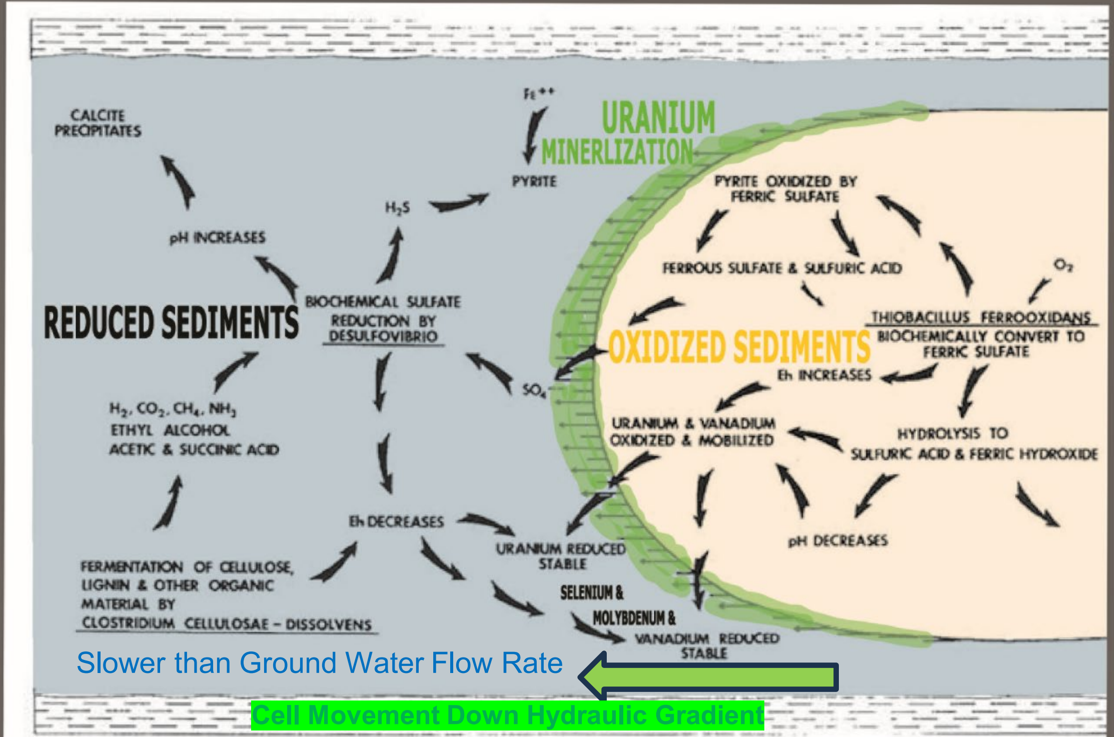
Dickinson & Duval (1977)

Roll-Front Deposit in Open-Pit Wall

- Oxidized Core of Roll-Front,
- Uranium Mineralized Roll-Front (Gray)
- Molybdenum Roll-Front in Some Deposits (Blue)
- Selenium Roll-Front in Some Deposits (Red)
- Vanadium Roll-Ront in Some Deposits (Brown)

- **In Older Sedimentary Rocks** in Utah and Colorado in Tabular Deposits (underground mining)

- **In Younger Sediments** in Wyoming, South Dakota, and Texas in Roll-Front Deposits.



Probable Reactions in an Advancing BioGeoChemical Cell ......From Rackley (1975)

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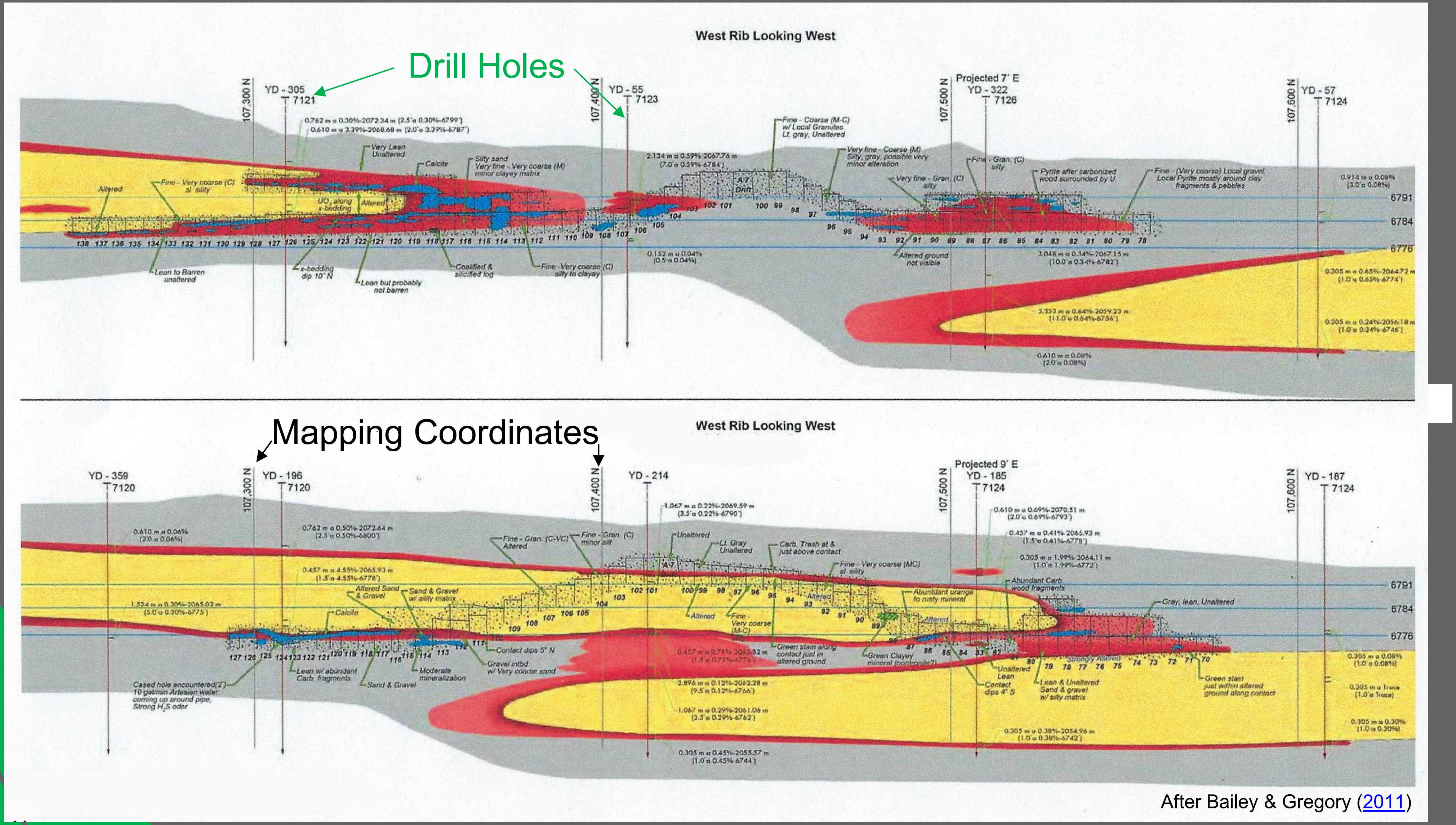
Complicated Structures in Uranium Roll-Front Ore Bodies in Shallow Underground Mine



Designated Ore Zones (in Red) Oxidized Zone (Yellow) Calcite (Blue)

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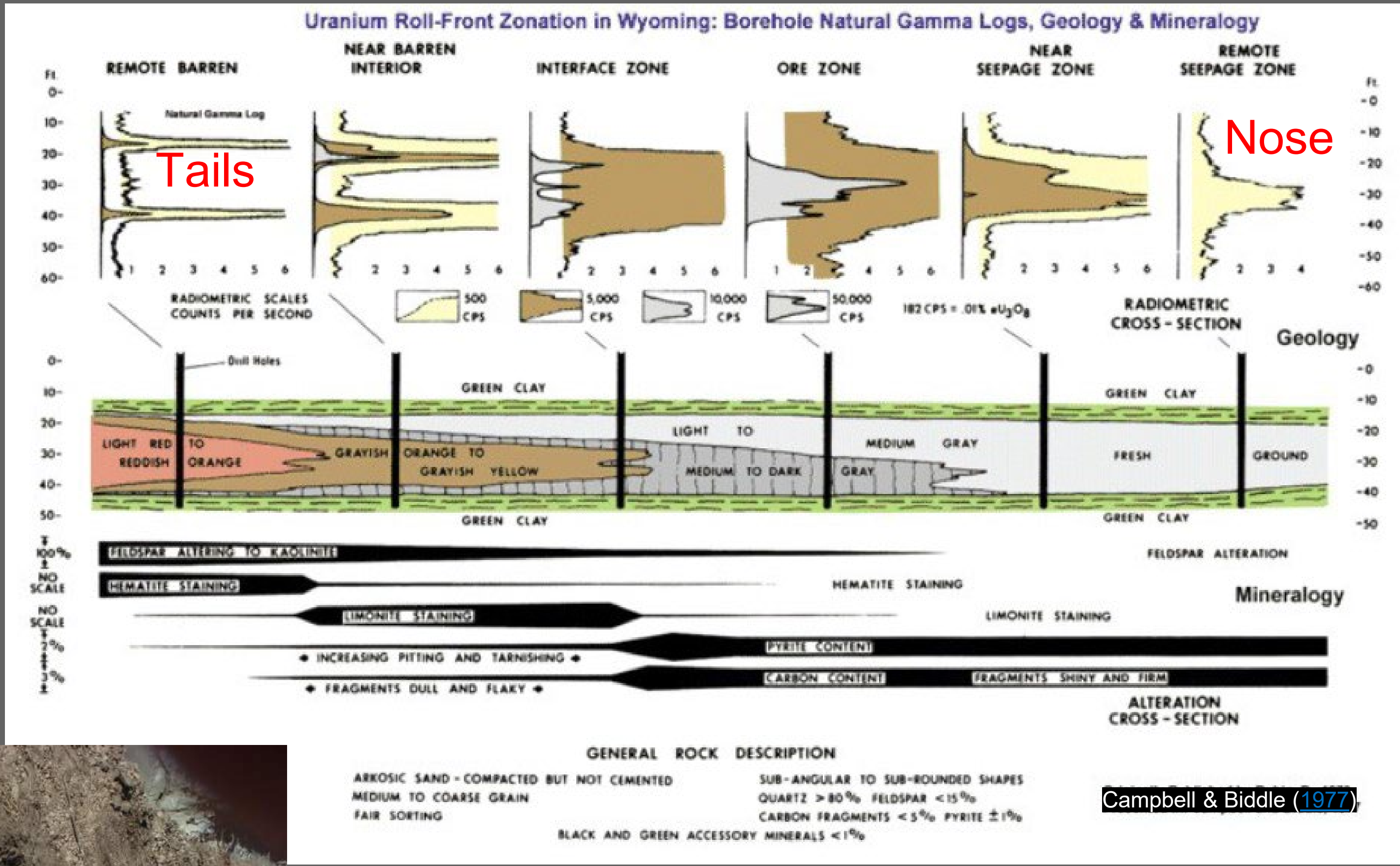
Typical Water-Well Drilling Rigs
Drilling & Installing Production Patterns

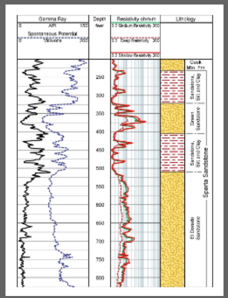


Drill Samples Typically Taken at 5-Foot Intervals:

100 feet TD
200
300
400
500
560 feet TD

Geophysical Logging

A Typical Geophysical Log Recording:

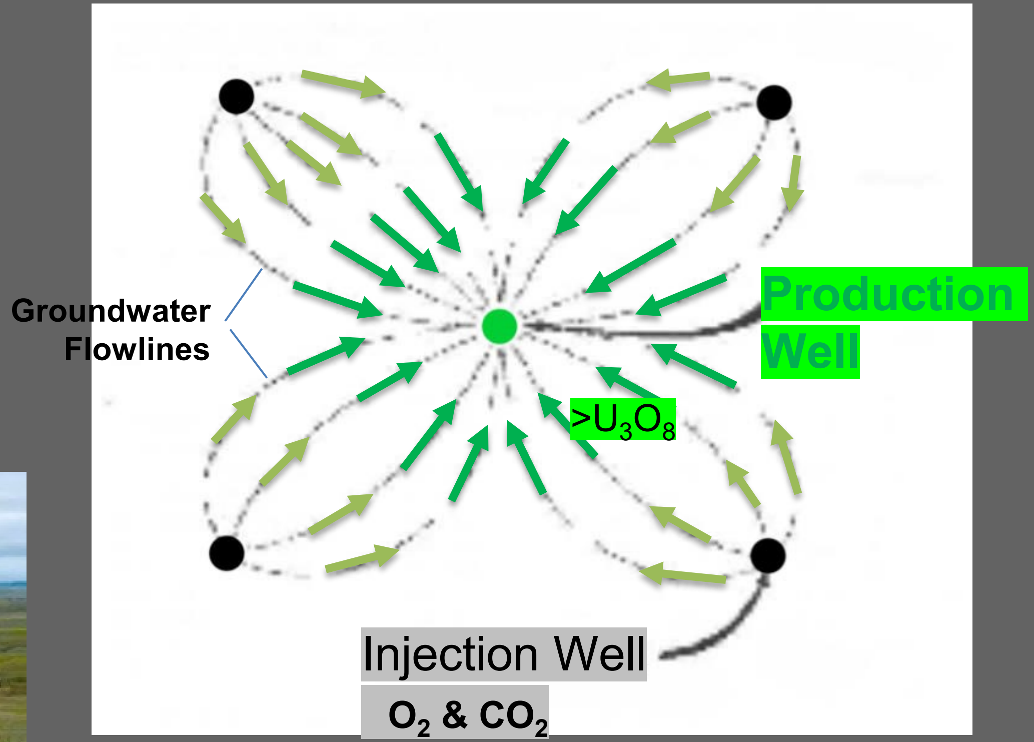


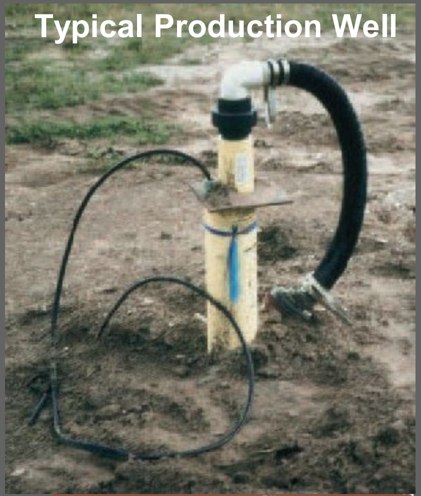
Gamma,
SP.,
Resistivity,

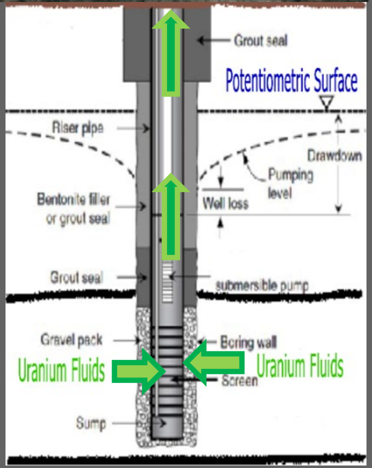
Lithologic Characteristics

Uranium Recovery by Pump & 2-Step Process (Treat) & Recycle

Typical Pattern Layout in Texas
Production/Injection Piping on the Surface







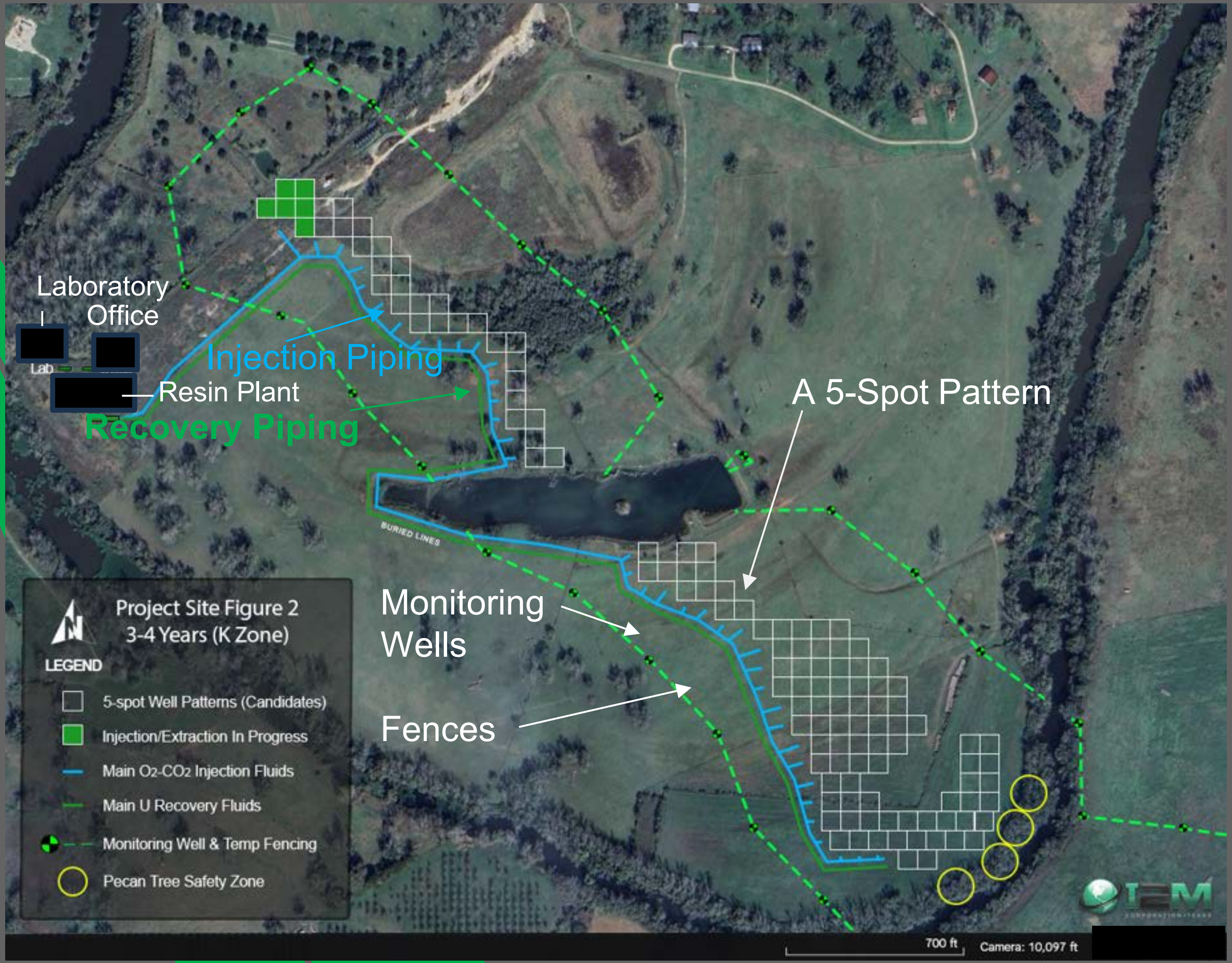
Typical Pattern Layout in Wyoming
Winterized Covered Wellheads & Buried Piping

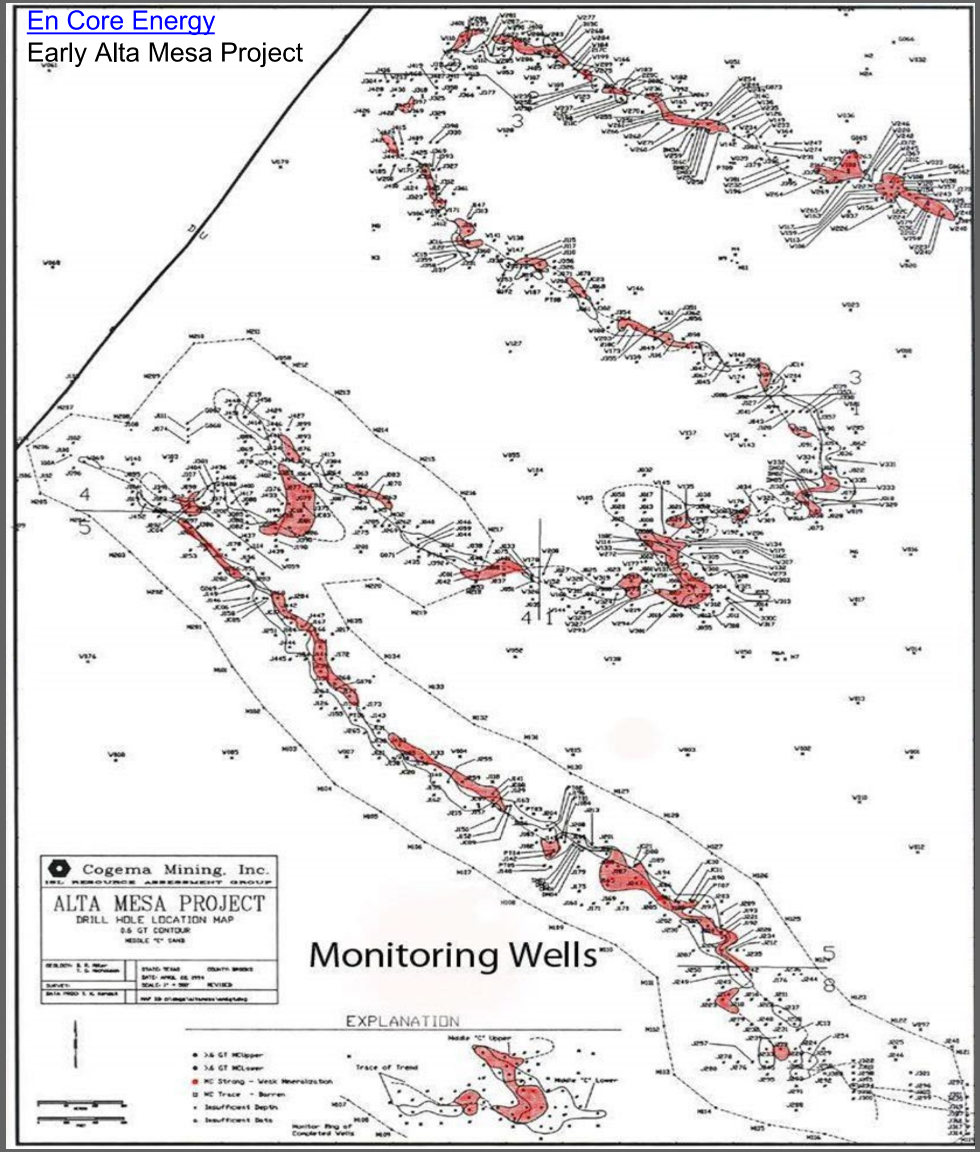
A Typical 5-Spot Uranium Production Pattern

- Injection of O_2 and CO_2 Dissolves Uranium Minerals into Groundwater Containing Low U_3O_8 Concentrations & Very Low Radioactivity, and
- Under Hydrogeological Control, using 2-Step Process to Convert Fluids to Yellowcake and then Fluids are Re-Cycled & Reinjected.

In-Situ Uranium Recovery Permitting

- Planning Production Authorized Areas (PAAs)
- Anticipated Monitoring Well Ring & Fencing
- Accommodating Cattle and Pecon Harvesting

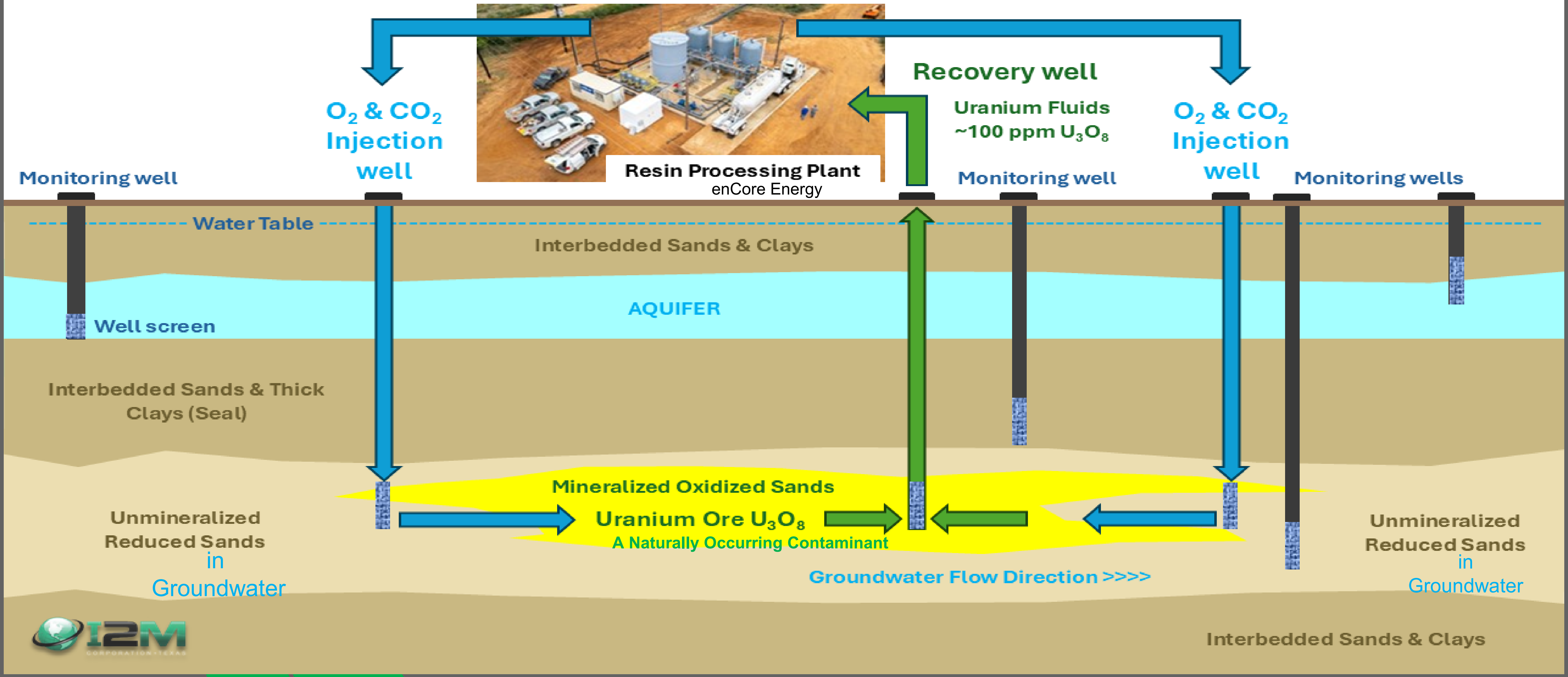




Past In-Situ Operations in South Texas

- Shows 3 PAAs & Monitoring Well Ring
- Shows Mineralized Zones Produced (Red)

In-Situ Uranium Recovery System & Monitoring Well Systems



Loaded Resin into Yellowcake

- **Production Fluids** Pumped from Well Patterns to Resin Plant.
- **Tank Truck Transports** Loaded Resin to Final Processing.

Resin

Unloading Resin Truck for Final Treatment & Processing at Plant

- **Processing Extracts** U_3O_8 from Resin, Adjusts Chemistry to Remove all but U_3O_8 & Dries Product to Make Yellowcake.

Product for Sale

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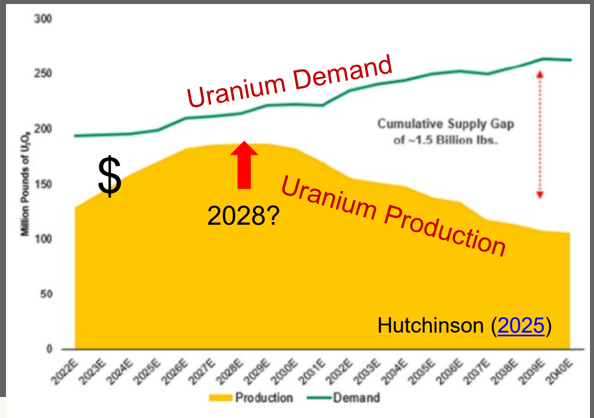
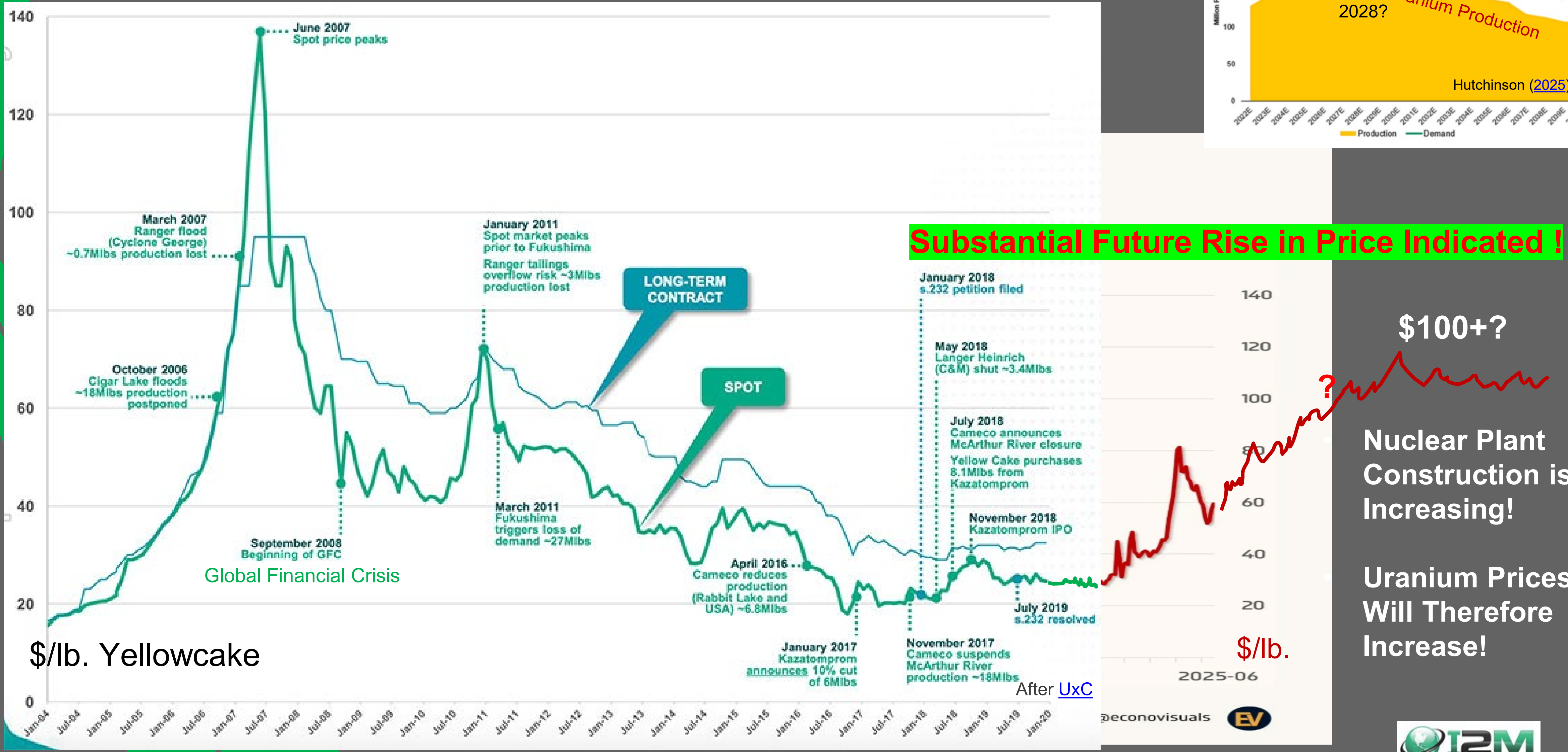
Average Price History of Yellowcake 2004 to 2025+





Nuclear Plant Construction is Increasing!

Uranium Prices Will Therefore Increase!

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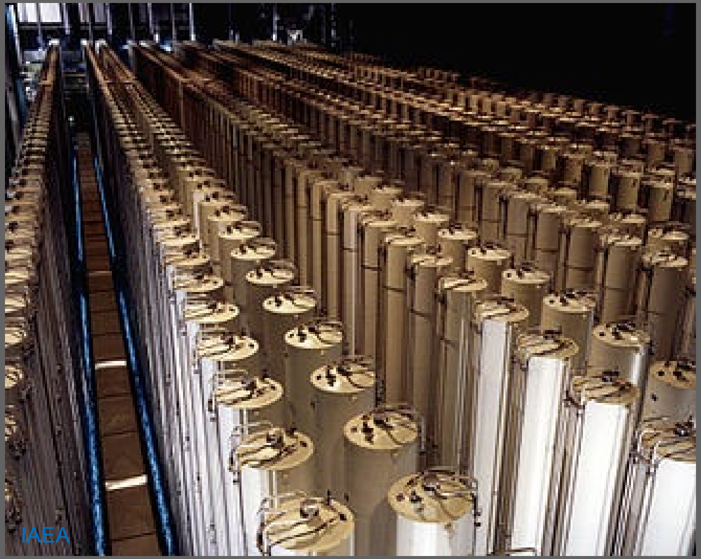
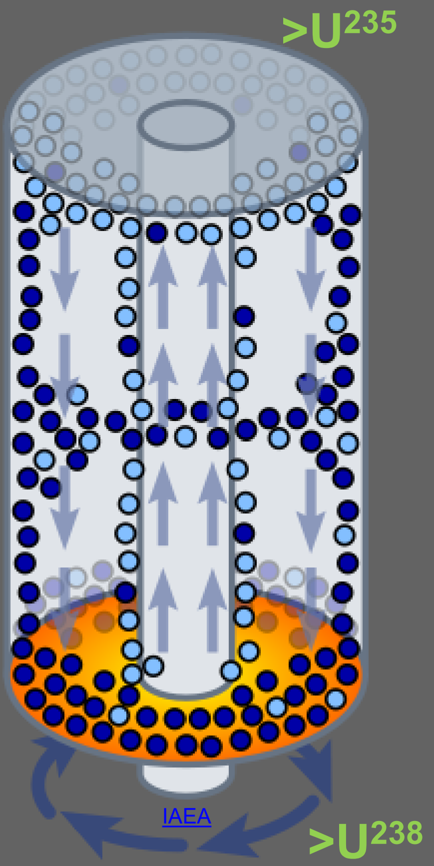
Yellowcake to UF_6 to Fabricated Pellets to be Loaded into Assemblies and into Nuclear Power Plants

UF_6



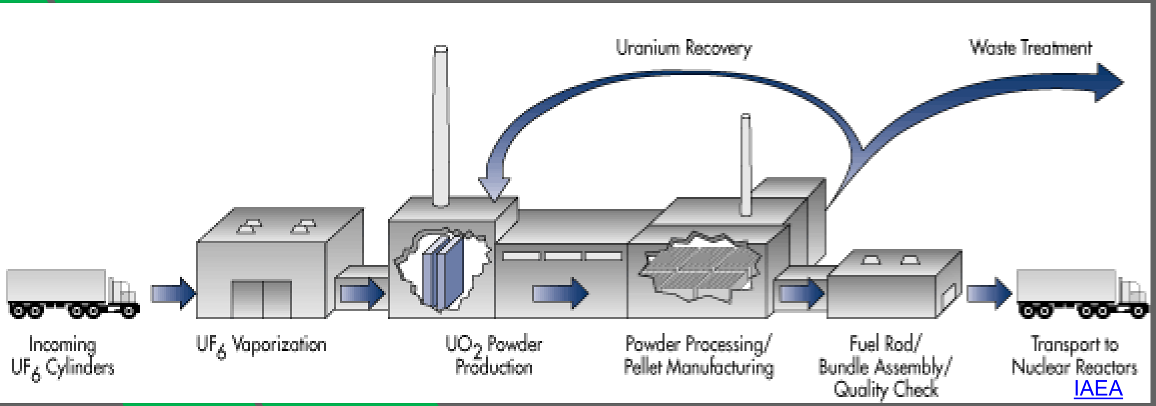
Production Centrifuges



0.07% U^{235} to………… 3% to 15% U^{235}

In Yellowcake

In New Reactors



See Campbell, M.D.,(2012) for groundwater study at DOE enrichment plant in Kentucky.

SMRs Are On The Way ?

- Small Modular Reactors (~300 MW).
- Micro Modular Reactors (10-50MW).
- Will Allow Micro-Grids (no blackouts)
- Safe & Reliable to Operate in all Weather Conditions.
- Will Replace Some Wind & Solar.
- Company Competition will Decide.
- Widely Available by 2030 or Sooner ?

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53 Companies Want To Sell SMRs

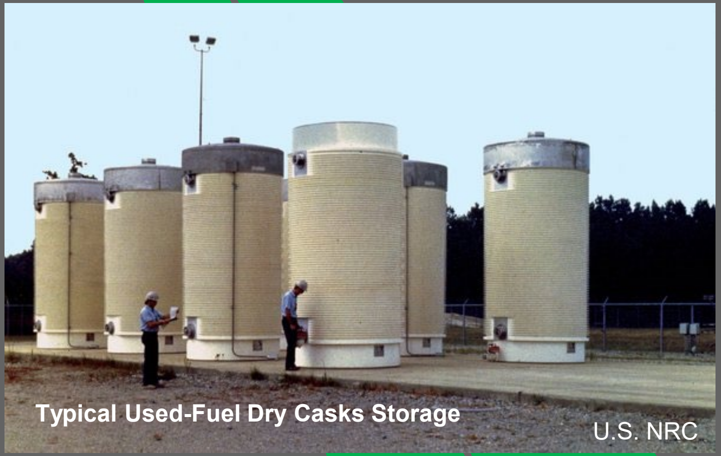
Which Ones Will Survive?
What Chemistry? What Size (MW)? Cost? When?

1. Steady Energy
2. Oklo Inc.
3. NuScale Power
4. Kairos Power
5. Rolls-Royce
6. GE Hitachi
7. Westinghouse
8. TerraPower
9. Terrestrial Energy
10. ARC Clean Technology
11. X-energy
12. General Atomics
13. Holtec International
14. Aalo Atomics
15. Rosatom
16. China Nat'l Nuclear Corp
17. Last Energy
18. Blue Energy
19. Radiant Industries
20. Thorcon
21. Flibe Energy
22. Moltex Energy
23. Terra Innovatum
24. Natura Resources
25. NuWard (EDF)
26. Newcleo
27. Core Power
28. Exodys Energy
29. Shine Technologies
30. Nano Nuclear
31. Curio Energy
32. Copenhagen Atomics
33. Seaborg Technologies
34. Blykalla (LeadCold)
35. Dual Fluid
36. BWX Technologies
37. Smart Power
38. NuCube Energy
39. Thorizon
40. Calogena
41. Deep Fission
42. MicroNuclear
43. Huaneng
44. HolosGen
45. U-Battery
46. NPCIL (India)
47. Mitsubishi Heavy Ind.
48. KEPCO
49. Gen4 Energy
50. StarCore
51. Atomic Alchemy
52. Valar Atomics
53. Antares Nuclear

Sources: Company websites, Perplexity, https://www.energy.gov/articles/department-energy-announces-initial-selections-new-reactor-pilot-program

After Robert Bryce (2025)

Used Fuel is Not All Waste



Typical Used-Fuel Dry Casks Storage

U.S. NRC

- No evidence of any serious leaks of radioactive materials over many decades.
- Since the 1970s, the Federal Government has failed attempts to provide a waste storage facility, not because of technical issues but because of Politics.…
- The project that failed after $ billions spent was the Yucca Mountain Repository in Nevada.
- Used fuel with likely be recycled in the future.
- Thousands of such storage containers reside safely on more than 100 nuclear power sites that are either in operation or have been decommissioned over the years.
- The project that remains a success is the WIPP Facility in New Mexico for transuranic waste stored by the Defense Department from weapons.

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Our Principal Perspectives:

1. Uranium is widespread in the environment in the soil and groundwater in low concentrations,

2. Uranium is concentrated by natural subsurface processes at favored sites as a natural contaminant within some fluvial aquifers,

3. Uranium is recovered from the subsurface in fluids under strict hydrogeological control of groundwater flow of very low radioactivity by in-situ pumping methods very similar to those employed in groundwater environmental remediation projects,

4. Uranium fluids load resins as in similar water-treatment plants (ion-exchange process) and then further processed and dried to produce yellowcake,

5. Yellowcake is processed into fuel to enrich the U^{235} isotope to < 15% for nuclear fuel for small modular reactors (SMRs) and for large advanced reactors. Nuclear Bombs require ~90% U^{235},

6. SMRs (and MMRs) will slowly replace wind and solar in years ahead in micro-grids,

7. Other sources of energy, such as geothermal, hydrogen, and batteries, will fill our energy needs whenever economics and environmental issues allow, and

8. Fusion Energy might be the final source of energy by the end of the Century.

The End?

…. Or, is it just the beginning of your appreciation of exploring & recovering uranium from naturally occurring uranium roll-front mineralization in fluvial sands within naturally contaminated aquifers in Texas?

Additional Information

- In-Situ Uranium Recovery, Articles in Support & Unfounded Anti-Uranium Articles Reviewed for Bias (**here**) and (**here**).
- Beyond Hydrocarbons (**here**).
- Confronting Media Bias (or Ignorance?) (**here**).
- U.S. Uranium Miners Ready to Support Nuclear Power Expansion (**here**).
- And I2M Consulting, LLC, a subsidiary of The I2M Corporation (Texas).
- Press Release on Landmark Report by the I2M Corporation (**here**).
- Recent Uranium Reporting (**here**) and Recent Nuclear Power Reporting (**here**).

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