

# The U.S. Nuclear Fuel Cycle: Looking Forward to 2020

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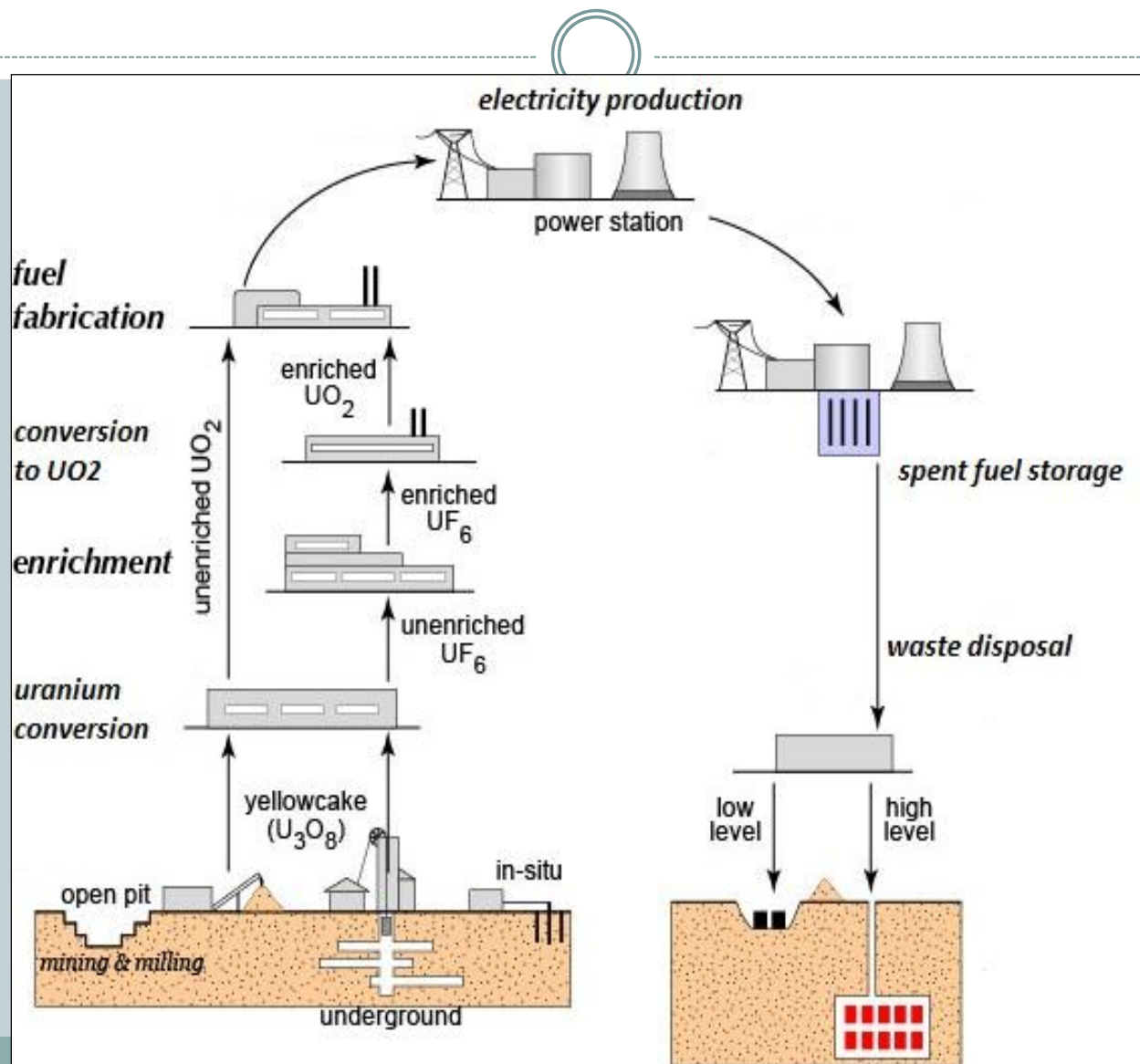
2015 FUEL CYCLE INFORMATION EXCHANGE

# Overview



- **U.S. Nuclear Fuel Cycle in 2015**
- **Uranium production 2020**
- **Fuel cycle facilities 2020: natural uranium conversion, uranium enrichment and fuel fabrication**
- **Spent fuel management 2020**

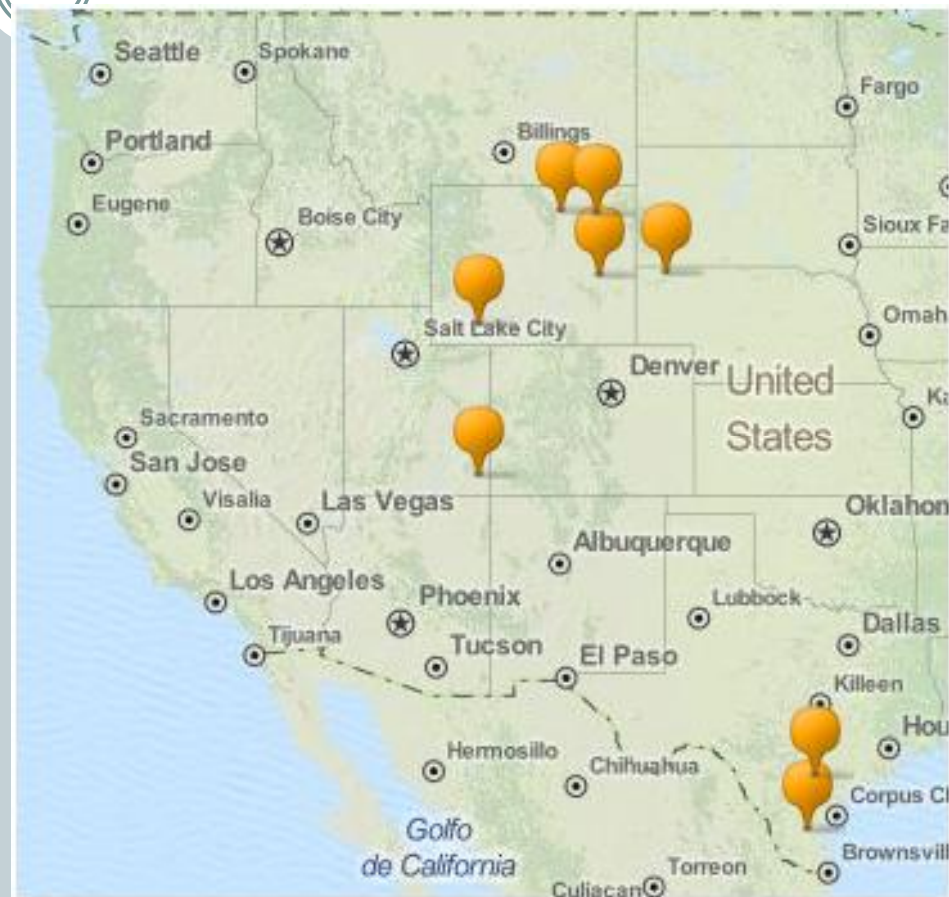
# Nuclear Fuel Cycle in U.S.



# U.S. Nuclear Fuel Cycle in 2015

## – U.S. Uranium Production

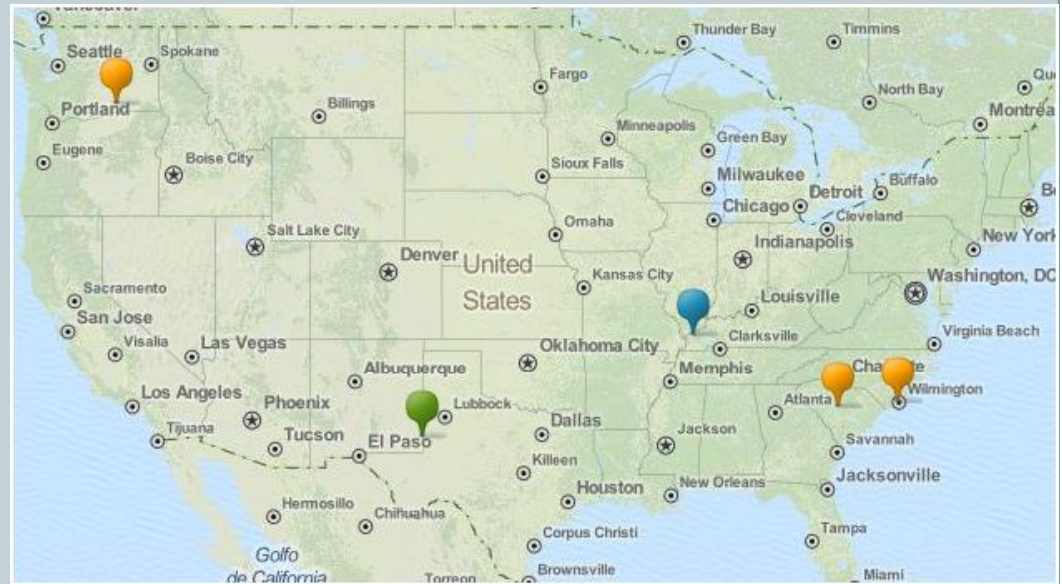
- In 2014, U.S. uranium production was 4.9 million pounds  $U_3O_8$  from 8 facilities in Nebraska, Texas, Utah and Wyoming.
- Most production from in-situ recovery (ISR) facilities.
- Several additional facilities are partially or fully permitted and licensed.
- Wellfield development on hold at several ISR facilities and as is production at the operating conventional mill.
- Uranium production in 2015 expected to decline from 2014 levels.



# U.S. Nuclear Fuel Cycle in 2015

- Fuel cycle facilities include:

- i One uranium conversion plant
  - i One gas centrifuge enrichment plant
  - i Three fuel fabrication facilities

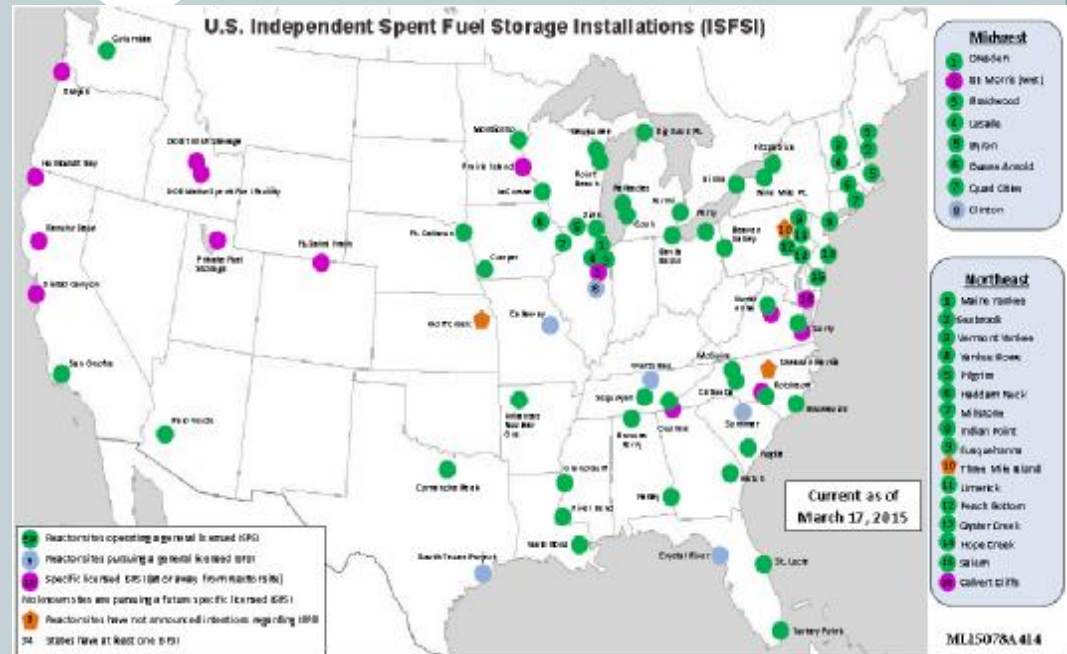


- Nuclear fuel inventories held by nuclear operating companies are at record levels – at more than twice annual requirements
- Inventories at supplier facilities are at record levels (includes supplier inventories, U.S. and international customer inventories, trader inventories, etc.). Storage space is at a premium.



# U.S. Nuclear Fuel Cycle in 2015

- Spent fuel (SNF) management:
  - i 59 ISFSIs storing SNF under general license
  - i 15 ISFSIs with site-specific licenses
  - i No active program for geologic disposal



# Uranium production 2020

- **U.S. uranium production by 2020.**

- i U.S. production could increase in future over 2014 levels, depending on market conditions:**

- ÷ Existing ISRs and conventional mill
    - ÷ Expansion of existing ISR
    - ÷ Restart of idle ISRs and conventional mills
    - ÷ Development of prospective ISRs and conventional mines

- i U.S. production expected to be < 15% of U.S. annual requirements.**

- **U.S. nuclear operators will continue to import an estimated 85-90% of uranium through 2020.**



# Fuel Cycle Facilities 2020

- Conversion of  $U_3O_8$  to uranium hexafluoride ( $UF_6$ )
  - Metropolis Works, Metropolis, Illinois – operated by Honeywell
  - Production capacity of 15 million kgU as  $UF_6$
  - Has operated ~ 10 million kgU as  $UF_6$  in recent years
  - U.S. requirements for conversion services ~ 18 million kgU annually
- U.S. nuclear operators will continue to import significant quantities of natural  $UF_6$  or  $UF_6$  feed contained in enriched uranium product from Canada, Europe, Russia and China.
- U.S. will export natural  $UF_6$  feed to enrichers in Europe and possibly Russia and China.
- Stability in transport package certification is a necessity for reliable fuel supply in the U.S. and with our international partners.





# Fuel Cycle Facilities 2020

- **Uranium enrichment**

- U.S. requirements for enrichment services are ~ 15 million SWU annually.
  - Urenco USA, Hobbs, New Mexico – gas centrifuge enrichment facility operated by Louisiana Energy Services, LLC.
    - ÷ Capacity is currently 4.2 million separative work units (SWU) annually.
    - ÷ Licensed capacity is 10 million SWU.
    - ÷ Capacity of 4.7 million SWU by year-end 2015 and capacity of 5.7 million SWU by 2022.



- U.S. will continue to import significant quantities of enriched uranium with corresponding need for processing of import licenses of enriched  $UF_6$  from Europe, Russia and China.
- Export of U.S. enriched uranium to other countries.
- Maintenance of existing approvals for transport packages and approval of new packages for the shipment of enriched uranium.

# Fuel Cycle Facilities 2020



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Part II

Nuclear Regulatory Commission

10 CFR Parts 20 and 61  
Low-Level Radioactive Waste Disposal; Proposed Rule

### — Uranium enrichment

#### i Regulatory impacts – Changes to 10 CFR Part 61 and impact on $\text{DUF}_6$ disposal

- ÷ Changes to site characterization requirements for disposal
- ÷ Concerns regarding possible changes to waste classification

#### i New Facilities by 2020?

- ÷ Two gas centrifuge enrichment facilities have been licensed by NRC
  - ⌘ Areva's Eagle Rock Enrichment Facility, Idaho
  - ⌘ Centrus Energy's American Centrifuge Plant, Ohio
- ÷ One laser enrichment facility has been licensed
  - ⌘ Global Laser Enrichment facility, North Carolina

#### i Under projected market conditions, it is unlikely that any of these facilities will be constructed and operational by 2020.

# Fuel Cycle Facilities 2020

## – Fuel fabrication

### i Three fabrication facilities

- ÷ Areva, Richland, Washington - PWR and BWR fuel
- ÷ Global Nuclear Fuels – America, Wilmington, North Carolina - BWR fuel
- ÷ Westinghouse Electric, Columbia, South Carolina - PWR and BWR fuel



- i Fabricators are expected to continue to seek approval for new fuel design features to address fuel reliability and fuel cycle economics.
- i New fuel designs may require NRC resources for review and approval of designs, materials, lead test assembly (LTA) programs, etc.

# Fuel Cycle Facilities 2020

## – Fuel fabrication

### i Possible new entrants to U.S. fabrication market

- ÷ Lightbridge Corporation LTAs – advanced metallic fuel rods
- ÷ Russian fuel manufacturer TVEL - 17x17 PWR LTAs of TVS-Kvadrat in a Swedish PWR



### i Regulatory issues:

- ÷ NRC Generic Letter 2015-01: Treatment of Natural Phenomena Hazards in Fuel Cycle Facilities
- ÷ Shipment of  $\text{UO}_2$  powder,  $\text{UO}_2$  pellets, and fabricated fuel to facilities in Europe and Asia will require:
  - ⌘ Continued attention to import/export licenses
  - ⌘ Approval and maintenance of Certificates of Compliance for transportation packages

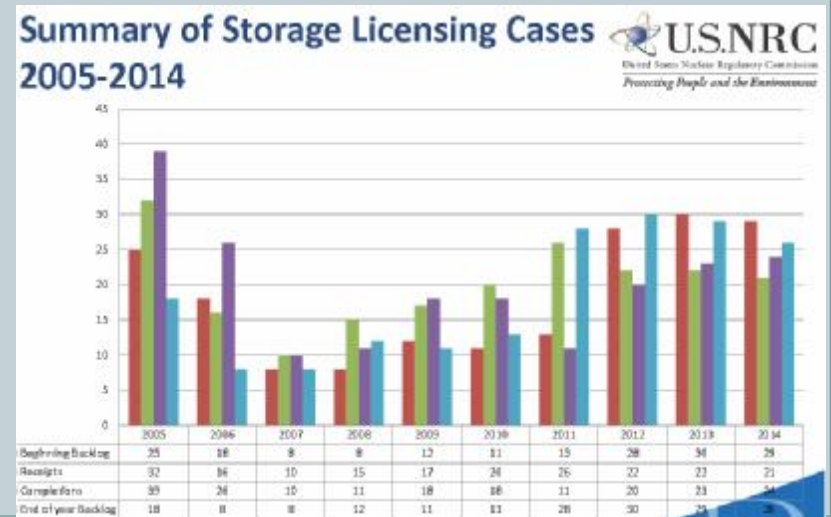
# Spent Fuel Management 2020

## – At-Reactor SNF Storage – wet and dry

### i By 2020:

- ÷ 87,000 MTU of SNF arisings
- ÷ 36,000 MTU in dry storage in ~3,000 casks
- ÷ Dry storage at almost every plant site expected ~72 to ~75 ISFSIs (including INEL)
- ÷ Four sites with recently shutdown reactors plan to transfer SNF from pool storage to dry storage by ~ 2020

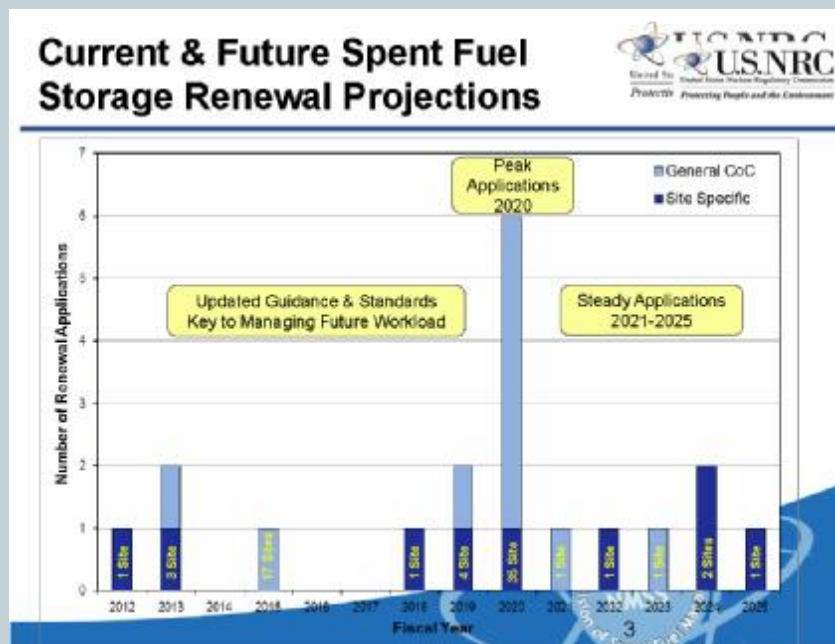
### i Amendments to existing Part 72 and Part 71 CoCs and review of applications for new storage technologies are expected to continue at same rate seen in recent years.





# Spent Fuel Management 2020

- At-Reactor SNF Storage – wet and dry
  - i License renewal for site-specific licenses at 6 ISFSIs will be in process (North Anna, Rancho Seco, Trojan, DOE TMI-2, DOE-INEL, GE Morris )
  - i License renewal for 7 cask designs certified in accordance with 10 CFR 72, Subpart L
    - ÷ VSC-24 (ongoing)
    - ÷ NUHOMS (ongoing)
    - ÷ TN-32
    - ÷ TN-68
    - ÷ HI-STAR 100
    - ÷ HI-STORM 100
    - ÷ NAC MPC
    - ÷ NAC UMS



# Spent Fuel Management 2020

## – Centralized Storage?

- i Two companies have proposed sites in Texas and New Mexico
- i DOE supports a pilot facility for storage of SNF from shutdown plants
- i Can the Nuclear Waste Policy Act be amended to allow the Nuclear Waste Fund to be used to pay for interim storage?

## – Geologic Disposal?

- i DOE plans to separate disposal of defense waste and commercial SNF
- i Restart of Yucca Mountain licensing or start of a new siting process for one or more repositories?

