Briefing to Blue Ribbon Commission – Reactor and Fuel Cycle Technology Subcommittee

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What is Recycling?

- **There are two basic options for managing Used Nuclear Fuel**
  - **It can either be disposed of directly or recycled**
  - **Direct disposal of used nuclear fuel is referred to as “once-through” or “open fuel cycle”, while recycling is referred to as “closed fuel cycle”**
- **Two recycle technologies considered**
  - **Current reactor technologies (LWR) provide for immediate reuse of Uranium and Plutonium (e.g., Near-Term Recycling)**
  - **Future fast reactors technologies will provide for more efficient use of the fuel and the potential to destroy additional actinides (e.g., Long-Term Recycling)**

Why Recycle?

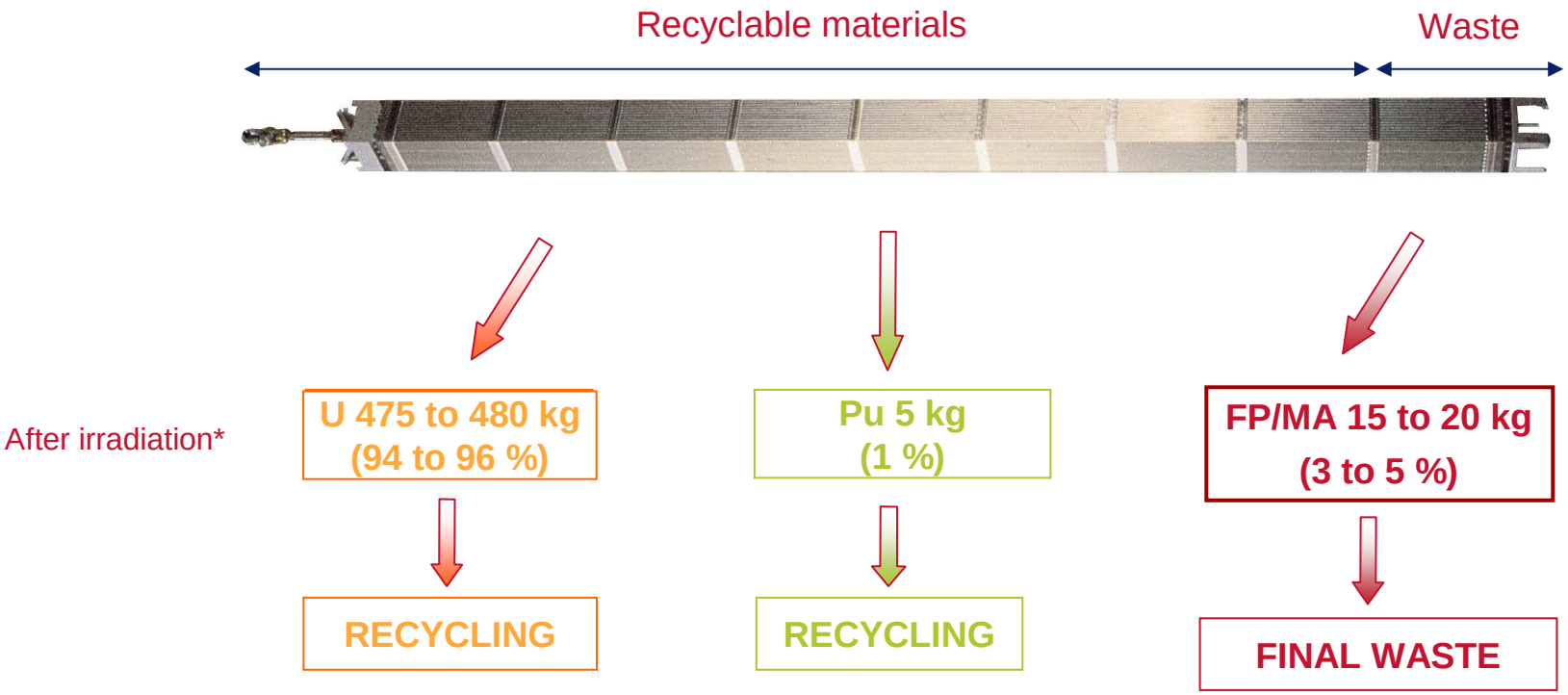
- **Enhances security of fuel supply**
  - **If recycled, the ~62,000 metric tons of used fuel stored at nuclear plant sites today could provide enough fuel to power America's 104 nuclear reactors for six years**
- **Conserves natural resources**
  - **Recycling used fuel saves up to 25% of natural Uranium resources today**
- **Optimizes the final repository design and utilization**
  - **Provides a highly durable and compact waste product**
    - **75% less volume to store (today); 90% less toxic waste contents (today)**
- **Supports non-proliferation objectives**
  - **Reduces the fissile content of used fuel (30% original plutonium consumed today). Its stabilizes or reduces the total inventory of plutonium**

Why Recycle?

- **Spurs economic development - creates jobs**
  - **Up to 18,000 direct jobs during construction**
- **Improves public acceptance of Nuclear Energy**
  - **Provides a sustainable approach for the Back-End of the fuel cycle**
    - **“Throwing away” used nuclear fuel is a debatable option particularly when new reactors are going to be built in the U.S.**
  - **Provides time to decide and to convince the public for opening a repository**
  - **Addresses societal concerns**
    - **Recycling allows this generation to make progress to avoid leaving nuclear waste totally to the next generation**
  - **Provides public and market confidence that used fuel is being actually managed**
- **Is economically comparable - on a life cycle basis – with other used fuel management options**

96% of the Content of the Used Fuel Assembly is Recyclable

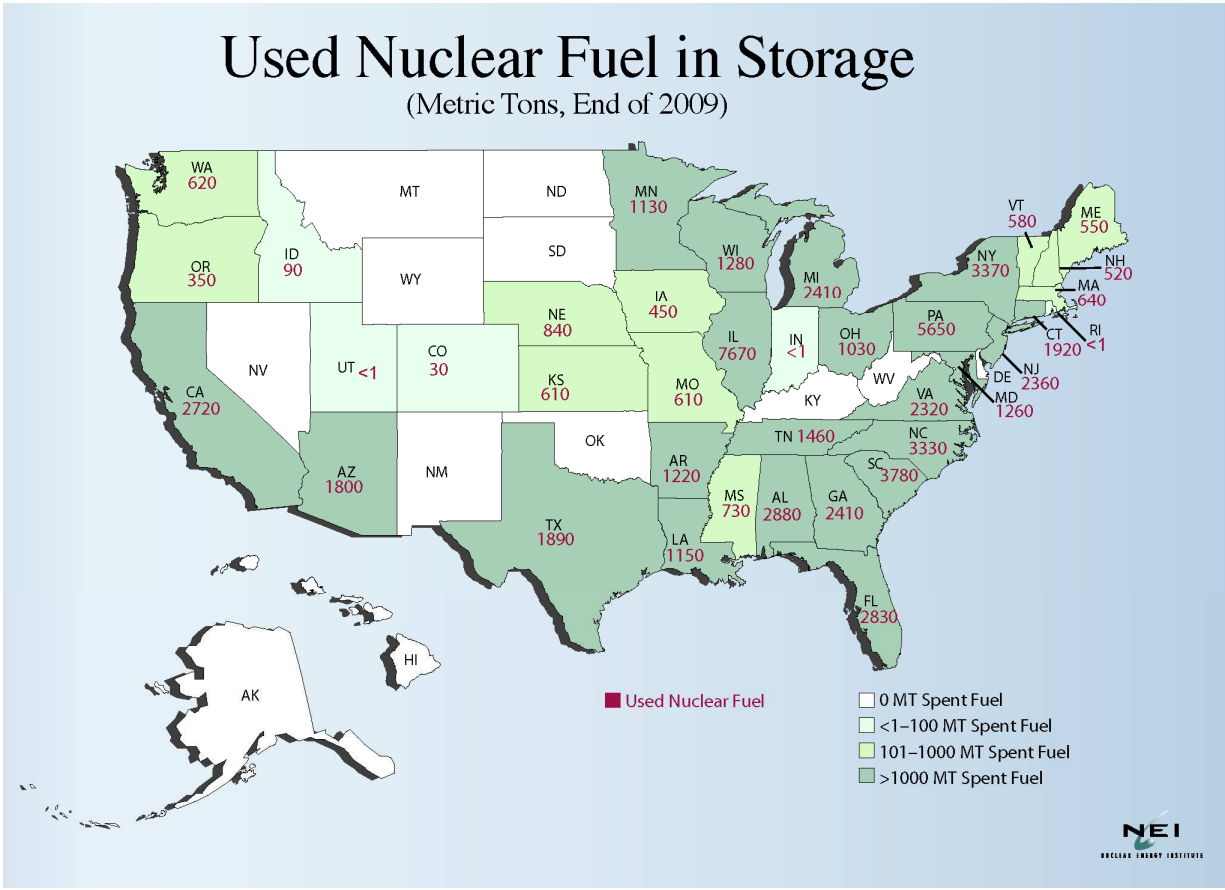
- **Composition of used light water reactor fuel**
  - 1 LWR fuel assembly = 500 kg uranium before irradiation in the reactor



* Percentages may vary based on fuel burnup

Used Nuclear Fuel

- **U.S. reactors currently discharge >2,000t used nuclear fuel/y with a total inventory of >62,000t used nuclear fuel stored at reactor sites around the country**



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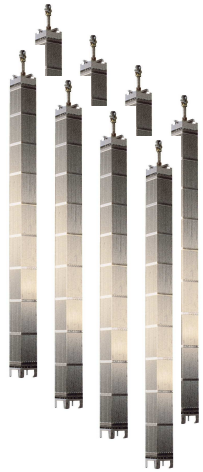
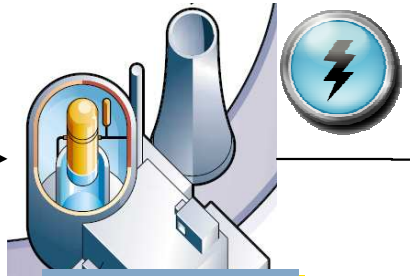
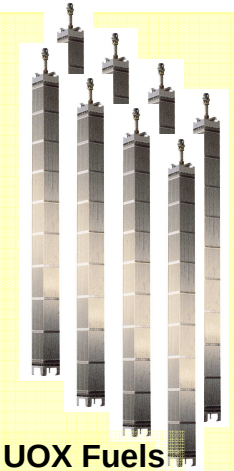
Near-Term Recycling Using State-of-the Art Technology



Fresh UOX Fuel
×8

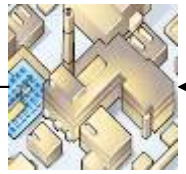


Direct Disposal cycle



Used UOX Fuels
×8

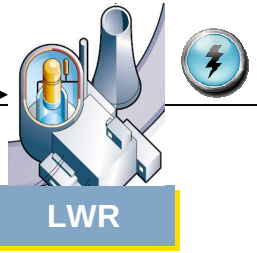
Enrichment



Used Fuel Recycle

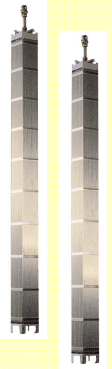
MOX Fuel
×1

RepU Fuel
×1



Recycling once

Waste
(FP, MA)



Used Fuel
×2

Used MOX fuel storage for recycling in advanced reactors

•Actual value depends on fuel burn-up and enrichment

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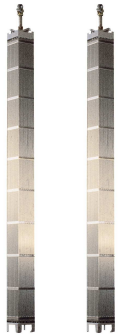
Initial Recycling Facility

- **Recycling capacity matched to market demand**
- **Propose an initial "*Pilot*" 800 tHM/y capacity plant that builds on best available proven technology to minimize risk**
- **COEX™ Separations process so "NO" separated pure Pu**
- **Manage recycled product using existing nuclear infrastructure with continued R&D on advanced fuel cycles**
- **LWR MOX is an "*interim*" step for closing the cycle**
- **Pilot Facility could supply MOX fuel to:**
  - **Limited number of existing LWR's or**
  - **~4 Gen III+ new build reactors or**
  - **500 MWe fast reactor**

Long-Term Recycling



USED MOX Fuel

Storage for Advanced reactor

PYRO / Aqueous?

Used Fuel Recycle

Waste

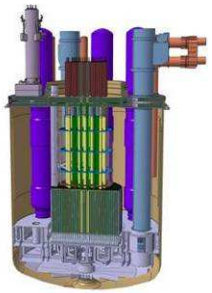
Fresh Transmutation Fuel

Metal or Oxide?

Homogeneous or Targets?

R&D needed to define long-term approach – multiple options open

Used Transmutation Fuel



Advanced Reactor (MA burner)

* MA = minor actinides

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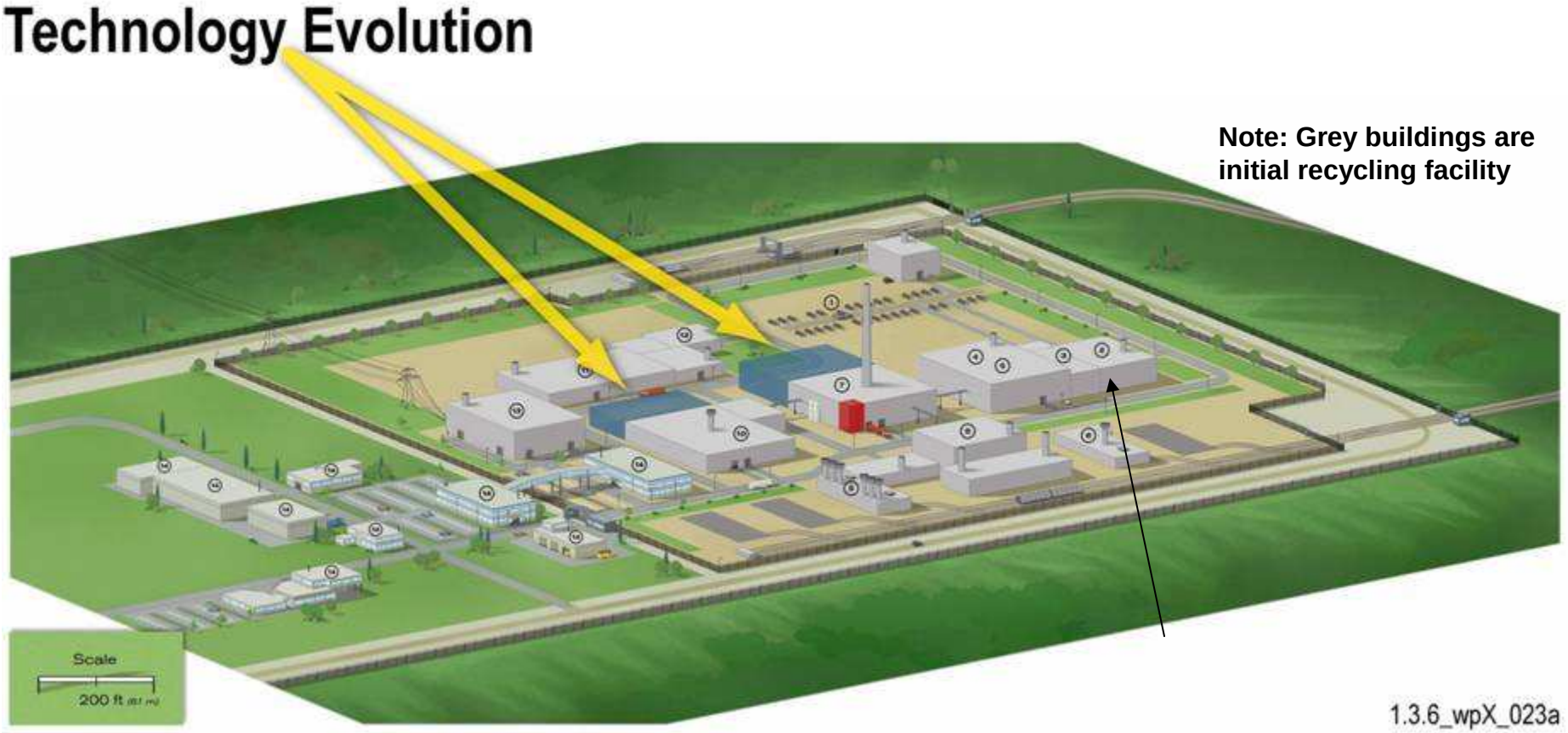
Pilot Facility with Incorporation of Advanced Technology



- ***Advanced separations and transmutation fuel production are an addition to the Pilot Facility and not a replacement***
- ***Pilot facility serves as ideal location for interim storage with early receipt***

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Why Start Recycling Near-Term?

- **The biggest public issue with nuclear power continues to be, “what do we do with the used nuclear fuel?”**
- **Starting “near term” with a Pilot Recycling Plant, is the first step to**
  - **Limit accumulation of a huge stock of used fuel**
    - **Currently ~62,000t used nuclear fuel stored at reactor sites**
    - **~2,000t more generated each year**
    - **>150,000t by 2050 if we do nothing**
  - **Address societal concerns**
    - **Recycling allows this generation to make progress to avoid leaving nuclear waste totally to the next generation**
  - **Provide public and market confidence that used fuel is being actually managed**

Conclusion

- To support nuclear growth in US, we need an Integrated Used Nuclear Fuel management strategy with options for recycling, interim storage and disposal
- Key Federal actions include:
  - Implementation responsibility transferred to a new FedCorp
  - Establishment of stable regulatory framework for licensing recycle facilities
- Nuclear industry cannot wait for “leap-frogging” or transformational technology from the government
- Two step recycling is proposed: start recycling in existing reactors (with MOX) and evolve towards advanced reactors when commercially available
- Progressive deployment is recommended
  - Public and stakeholders acceptance with long term political support is mandatory