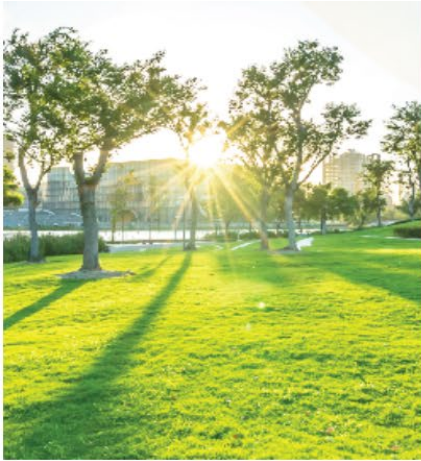


Management of Operational Low Level Waste at Constellation

Low Level Waste Advisory Committee Meeting
September 29, 2023

About Constellation



#1
producer of
carbon-free
energy in the
U.S.



10%
of the
nation's
carbon-free
electricity

32,400 MW

of capacity consisting of nuclear, wind, solar,
natural gas and hydro, enough to power 15
million homes

215 TWh

of power served
to Commercial
customers

3/4

of Fortune 100
companies
count on us for
their energy
needs

Constellation's Nuclear Fleet



Limerick Generating Station

Pottstown, Pennsylvania



R.E. Ginna

Ontario, New York



Nine Mile Point

Oswego, New York



Calvert Cliffs

Lusby, Maryland



James A. FitzPatrick Nuclear Power Plant

Oswego, NY



Peach Bottom Atomic Power Station

Delta, Pennsylvania



Quad Cities Generating Station

Cordova, Illinois



LaSalle County Generating Station

Marseilles, Illinois



Dresden Generating Station

Morris, Illinois



Byron Generating Station

Byron, Illinois



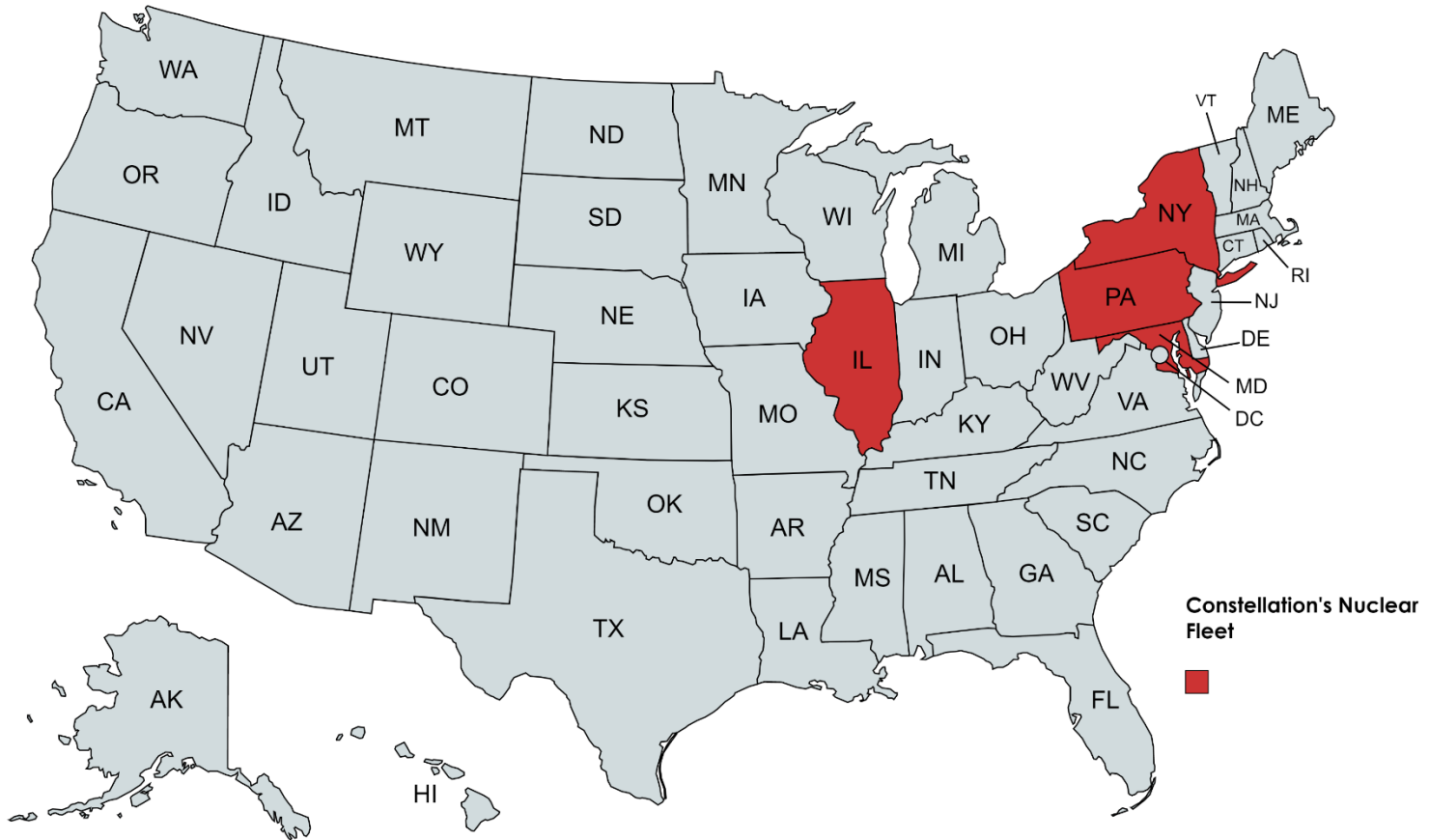
Clinton Power Station

Clinton, Illinois



Braidwood Generating Station

Braceville, Illinois



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Constellation Low Level Waste Management Structure

- Constellation separates the management of High Level Waste (Spent Fuel) and Low Level Waste as the two types of waste require a vastly different processes to disposition.
- Constellation has standardized process for the management of liquid and solid radioactive waste management.
 - Federal Regulations require Nuclear Power Plants to have Process Control Program (PCP), which outline the processes used to manage the radioactive waste generated.
 - Constellation has a Fleet PCP that each site implements.
 - Creates consistency in our waste management that provides regulatory margin and efficiencies in packaging and transportation.
 - A standard set of liquid radwaste processing and solid radwaste generation parameters are monitored and trended on a monthly basis. This data is reported to Corporate who monitors the performance across the Fleet.
 - Standardized approach to waste packaging of common waste streams which ensures regulatory compliance and achieves cost savings for the Fleet.
 - There are Fleet procedures for the shipping of low level waste. This ensures that a consistent application of shipping packaging, marking and labeling.

Waste Stream Management

- US Nuclear Plants establishes waste streams that bins low level waste that are produced with similar radioisotopic and physical characteristics together. Examples are spent resin, dry active waste and contaminated oil.
- Constellation has a Fleet procedure outlining the management of waste streams which includes:
 - Required sampling frequency of waste streams and acceptance criteria for a valid sample.
 - Trending of waste stream radioisotopes over a multiyear period to ensure they are representative of plant operation and to detect potential changes to the waste classification or required disposal packaging.
 - Plant radiochemistry data is evaluated on a periodic basis to monitor for changes in plant operation that could impact the waste streams radioisotopic characteristics. There are administrative goal that would trigger an evaluation by the technical staff and an administrative limit that would require resampling of the waste streams.

Liquid Radioactive Waste Processing

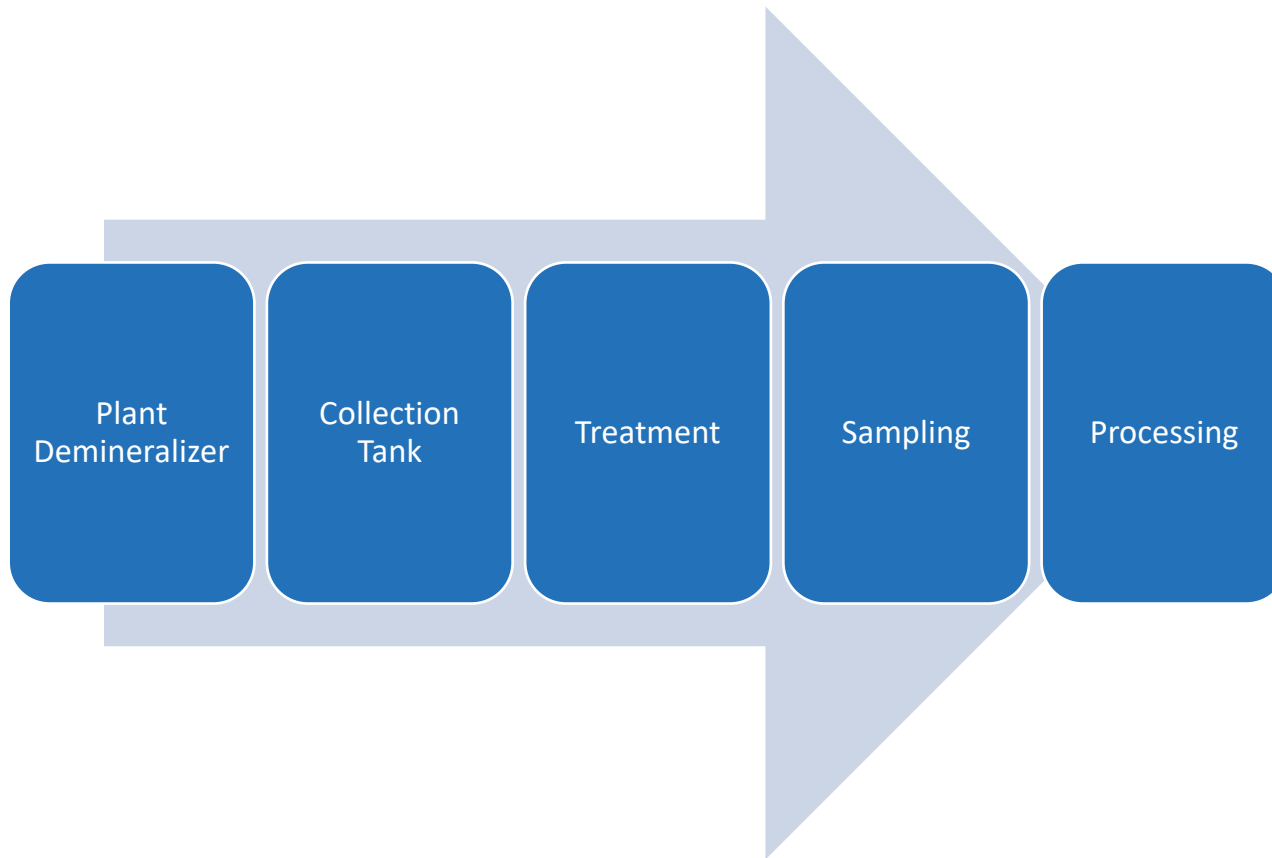
- Pressurized Water Reactors

- Purpose is to reduce liquid radioactive waste activity to discharging.
- Procedural goals and limits for activity to ensure regulatory compliance but Constellation strives to keep radioactive activity in releases as low as reasonably achievable.
- General approach to processing is to use granular activated carbon, cation resin, anion resin in series followed by a polishing bed consisting of both cation and anion resin.

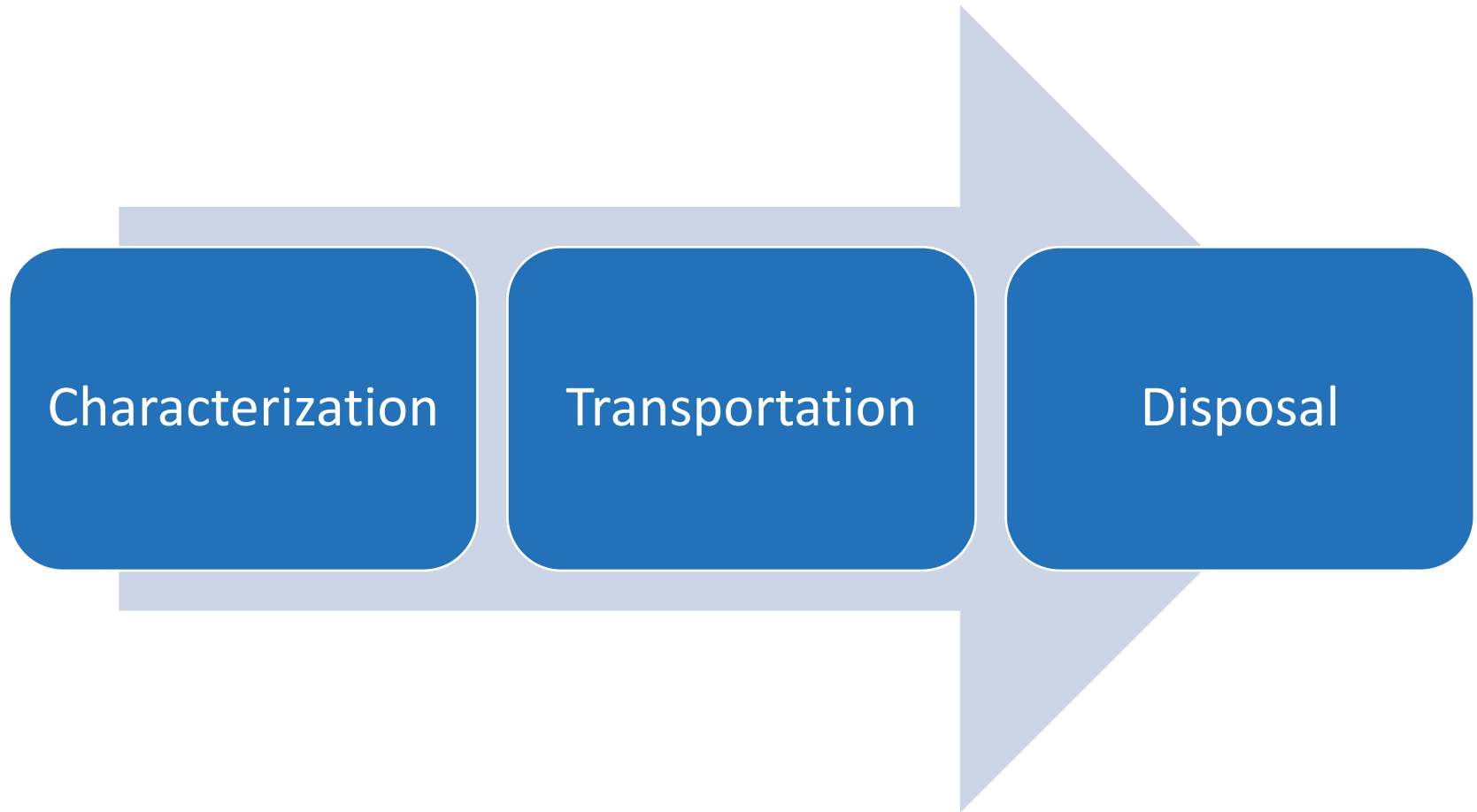
- Boiling Water Reactors

- Purpose is to process liquid radioactive waste to produce reactor quality water for reuse in the plant.
 - System allow for reprocessing to achieve the chemistry goals.
 - Discharges are possible but are not common at most of the plants.
- Wide variety in approaches to processing including using vessels in series like our PWRs, use of evaporators and using deep bed demineralizers.

Wet Solid Radioactive Waste Processing



Wet Solid Radioactive Waste Processing



Constellation's Fleet of Type A and B Casks

- Includes seven Type A casks capable of shipping 14 drums or packages with a volume up to 205.8 ft³ (5.83m³).
 - Two casks are heavily shielded with ~3" Pb equivalent.

- Includes one Type B cask capable of shipping 10 drums or packages with an external volume up to 160 ft³ (4.53m³).
 - Heavily shielded at 5.1" Pb equivalent.



Dry Radioactive Waste Processing

- Constellation's philosophy is to minimize the volume of dry active waste (DAW) sent to burial through volume reduction techniques offered by vendors.
- Fleet procedures establishes guidelines for materials used in the plant to reduce unnecessary waste generation.
- Onsite Handling:
 - Each Plant has a designated location where DAW is sort, weighed and radiation measured.
 - DAW that is a candidate for volume reduction is segregated to the best extent possible.
 - Metal is segregated to support recycling vs disposal.
 - Oil and similar aqueous waste is collected in drums and sent for processing.
 - Intermodal shipping containers are commonly used for the transportation package.

Irradiated Metal Processing

- Boiling Water Reactors generate a waste stream of irradiated metal components that are discharged from the reactor during normal operations.
- The waste is typically stored in the spent fuel pool if space is available. There is adequate space for storage to allow for multiple cycles of operation before it requires action.
- Two pathways for managing the waste stream:
 - Onsite Storage: Licensed non-fuel waste storage systems are utilized to extend onsite storage and free up storage space in the spent fuel pool. The waste is characterized to determine waste classification and is packaged to meet burial site requirements to facilitate
 - Disposal: Waste is processed using commercially available equipment to efficiently utilize the volume in the disposal package.

Oversight of Low Level Waste Management

- Constellation has a multi-tiered approach to oversight of the generation of radioactive waste.
- There is a company high-level performance indicator that monitors the total solid radioactive waste generated at each plant that gets review monthly.
- There are department specific performance indicators that monitor the more specific aspects to radioactive waste:
 - Total volume processed by liquid radwaste system
 - Total volume discharged from plant
 - Wet solid waste generated by plant specific system
 - DAW and Metal waste generated
 - Onsite storage of packaged waste.
- Constellation uses EPRI's Radbench to compare the Fleet's performance to the rest of the Industry and takes that into account during the goal setting process.

Fuel Channel Disposal Approach

- US Industry practices are to process fuel channels along with other irradiated metal waste and disposed of as Class B/C waste.
- Fuel Channels consist of traces levels of Niobium in the zircaloy and based upon manufacturer's estimate that resulted in Nb-94 activity driving the waste classification to Class C.
- Constellation sent the material to a lab to further analyses the alloy composition, which resulted in a lower Nb concentration.
- Nb-94 no longer driving the waste classification to Class C and the waste was calculated to be Class B based upon shorter lived nuclides.



Fuel Channel Disposal Approach

- Constellation shifted its strategy to dispose of fuel channels separate from other irradiated metal waste.
- They are processed into an individual disposal packaged underwater in the Spent Fuel Pool.
- Then transferred to an onsite storage facility to allow for decay of short-lived nuclides.
- Once the waste decays to Class A in ~8 years, the waste will be shipped to disposal.





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