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EPA Coal Ash Rule Impacts to the Waste & Recycling Industry

Presented By

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Coal Combustion Residuals (CCRs)

- **Solid residuals produced as a byproduct of power generation, captured/generated by air pollution control devices**
  - Electrostatic precipitators
  - Baghouses
  - Flue Gas Desulfurization (FGD) scrubbers

- **~ 130 million tons produced in 2014**

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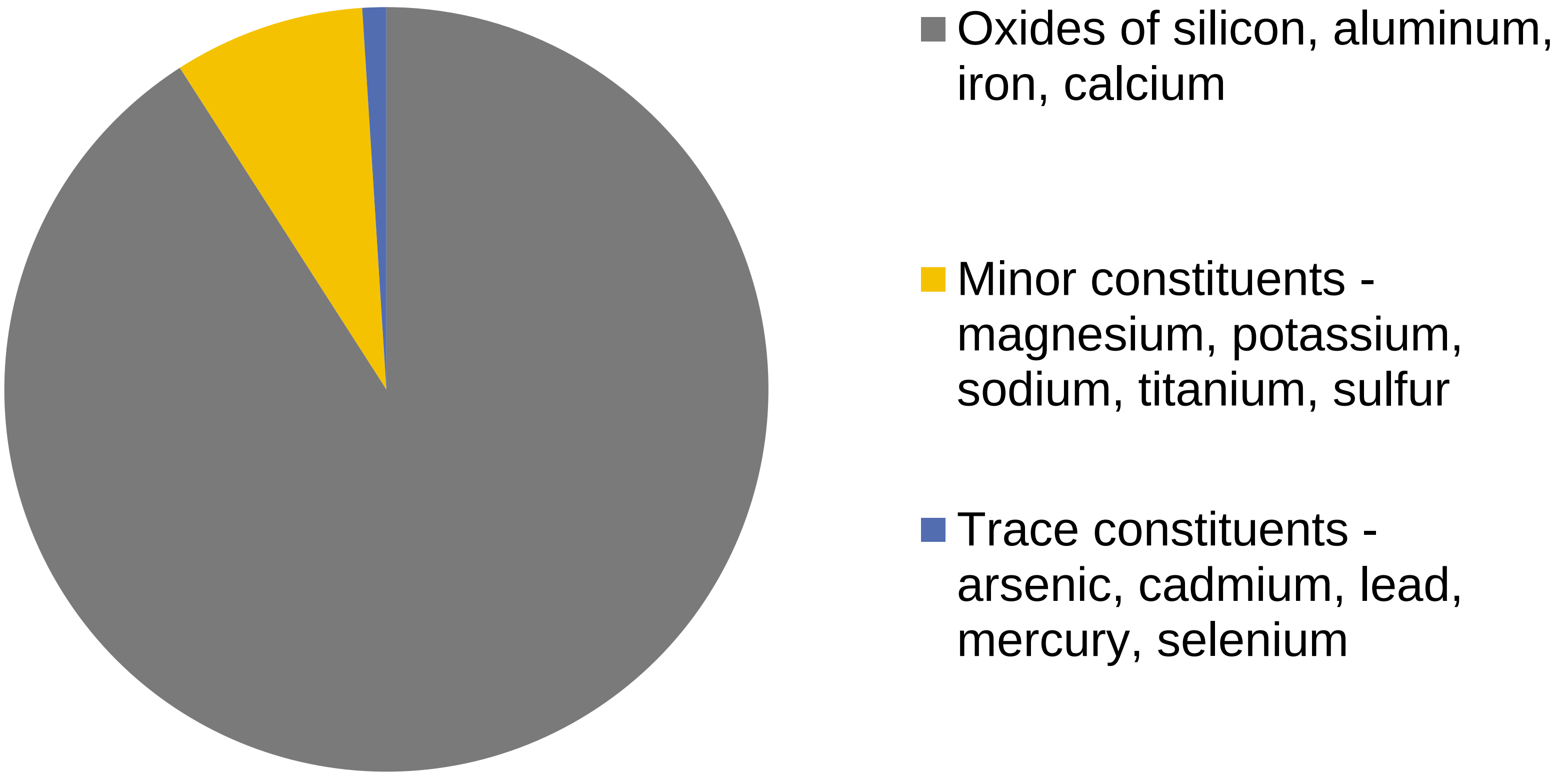
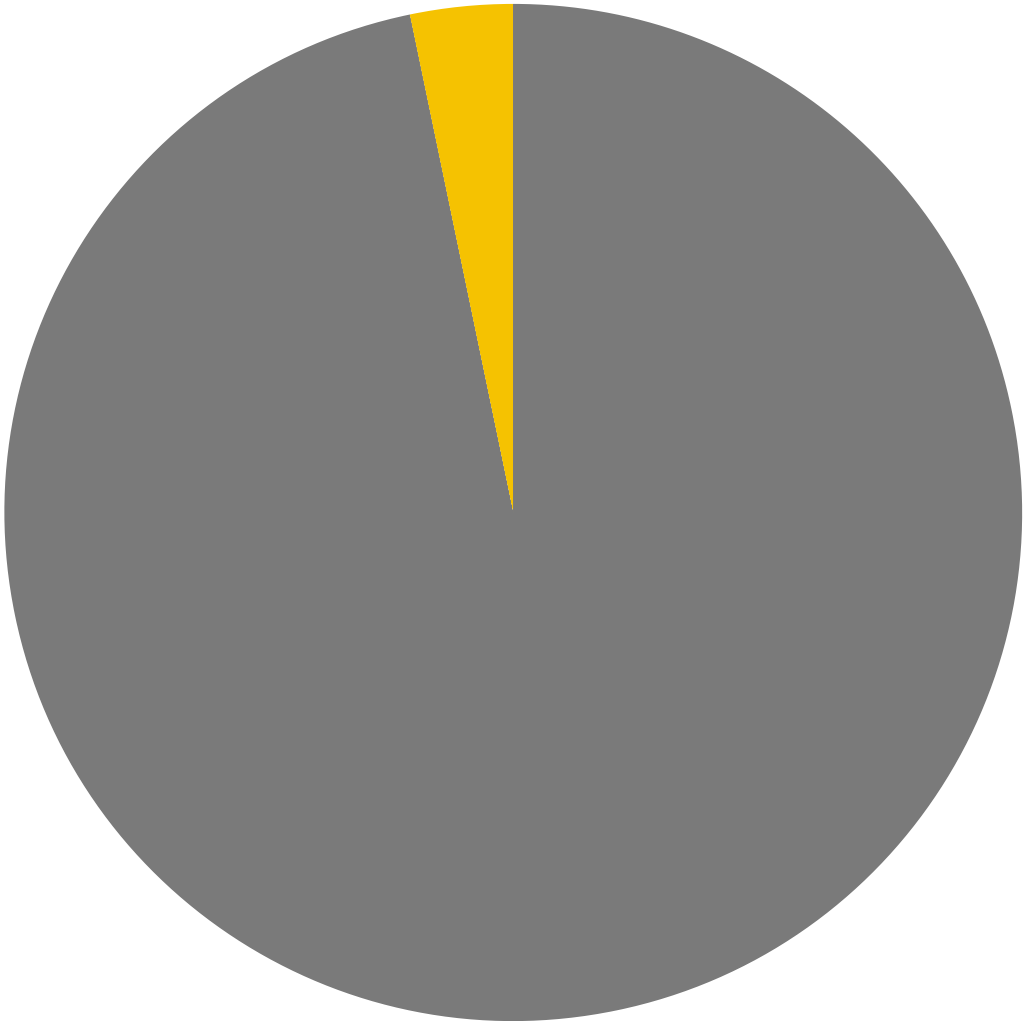
What's in Coal Ash?



What's In Synthetic Gypsum?

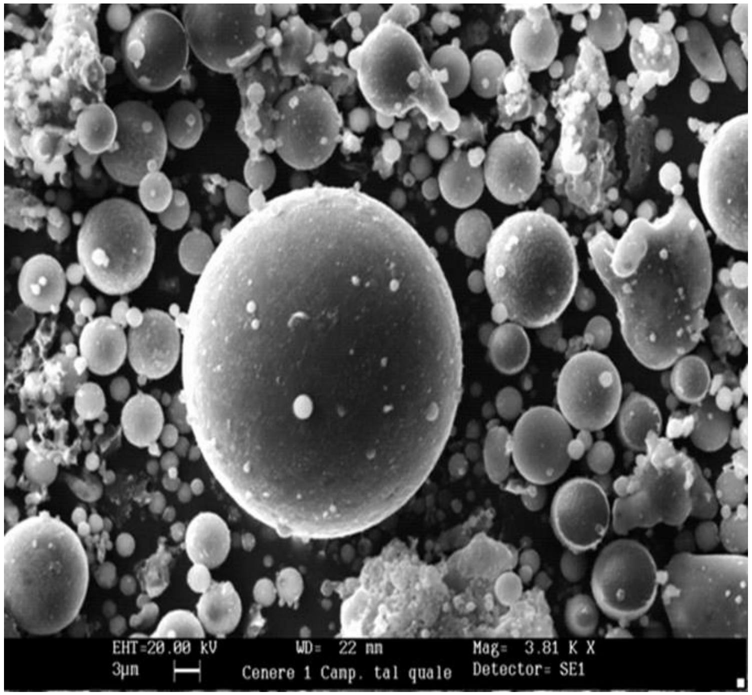


- Calcium sulfate
- Quartz, magnesium oxide, calcium oxide, calcium hydroxide

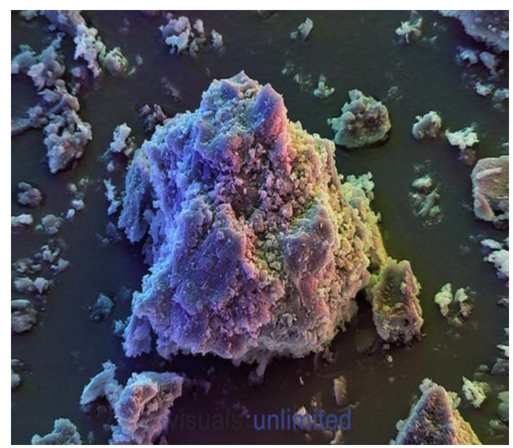
CCR Production in 2014

FGD: 38%

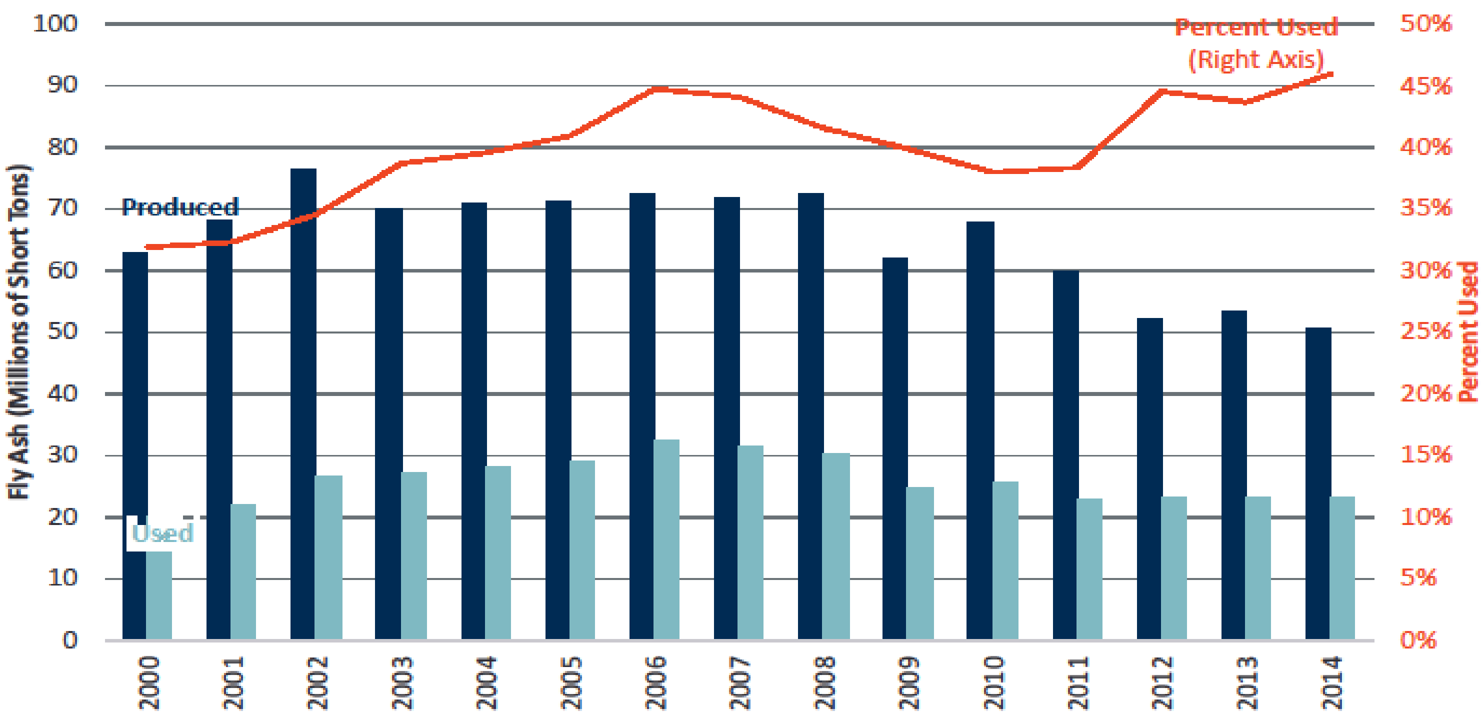
Fly Ash: 40%



Bottom Ash: 10%

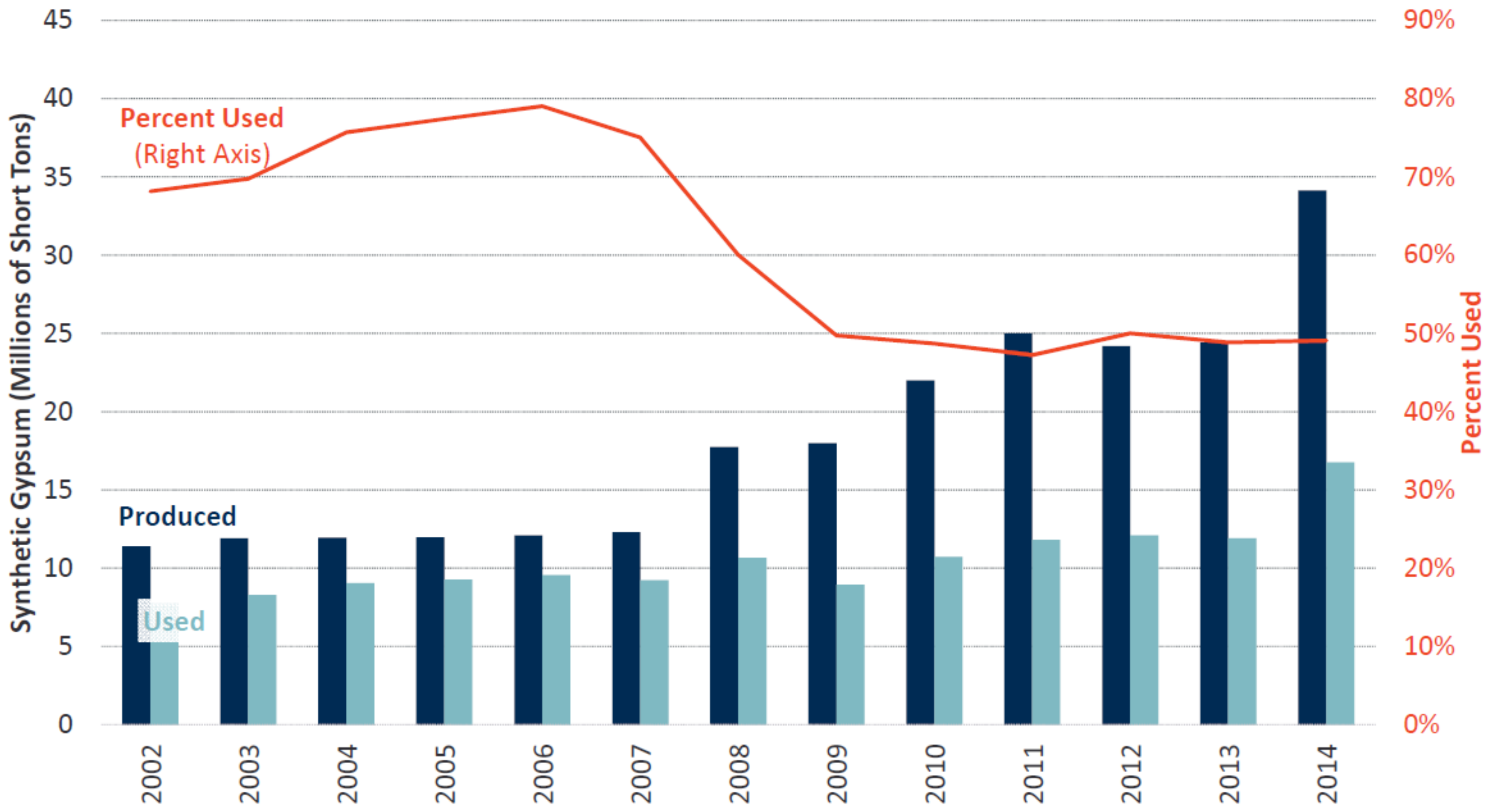


Fly Ash Production and Use



Source: ACAA

Synthetic Gypsum Production and Use



Source: ACAA

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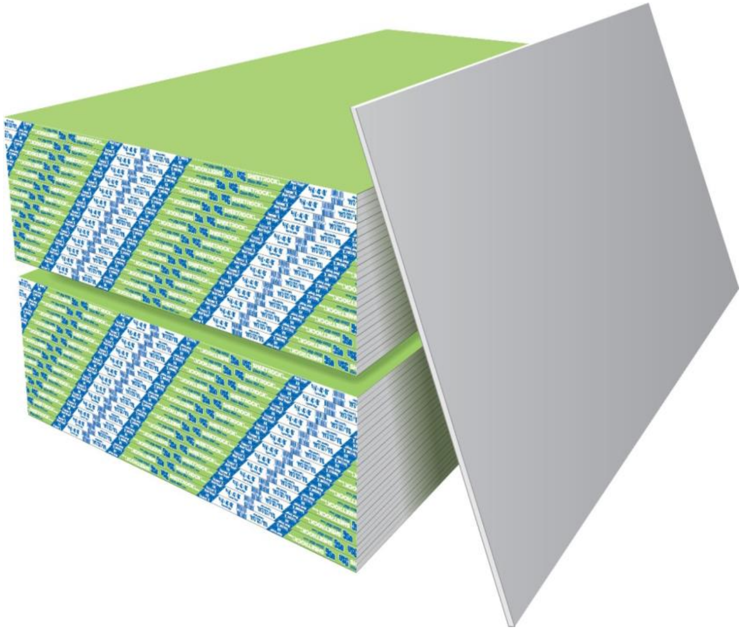
Primary Beneficial Uses of CCRs

In 2014, 62 million tons (48%) beneficially used

Fly ash - concrete

FGD - wallboard



Primary Methods of Disposal - Landfills ("dry handling")

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Primary Methods of Disposal - CCR Impoundments ("wet handling")

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CCR Rule (40 CFR Parts 257 and 261) - Overview

- Subtitle D non-hazardous waste rule
- Self-implementing, enforced through citizen suits
- Reduce risk of catastrophic failure
- Protect groundwater
- Regulation of inactive units
- EPA intends to revisit regulatory determination

CCR Rule - Schedule

- ►Proposed June 2010
- ►Signed December 19, 2014
- ►Publication Date: April 17, 2015
- ►Effective Date: October 19, 2015

Scope of the CCR Rule

- **All new and existing landfills & surface impoundments**
- **Inactive surface impoundments**
- **Does NOT apply to:**
  - Inactive landfills (ceased receiving CCRs prior to October 19, 2015)
  - CCR units at facilities no longer producing power
  - Beneficial use of CCRs
  - CCR placement at underground or surface coal mines
  - Facilities not classified as utilities or independent power producers
  - Residuals from other fossil fuels
  - MSW landfills that receive CCRs

What is Beneficial Use?

- (1) The CCRs must provide a functional benefit;
- (2) The CCRs must substitute for the use of a virgin material, conserving natural resources that would otherwise need to be obtained through practices such as extraction;
- (3) The use of CCRs must meet relevant product specifications, regulatory standards, or design standards when available, and when such standards are not available, CCRs are not used in excess quantities; and
- (4) When unencapsulated use of CCRs involve placement on the land of 12,400 tons or more in non-roadway applications, user must demonstrate that environmental releases are comparable to or lower than those from analogous products made without CCRs ...

CCR Compliance

Requirement	New CCR Landfills	Existing CCR Landfills	New CCR Ponds	Existing CCR Ponds	Inactive CCR Ponds	Initial Date Required for Facilities
Location Restrictions						
Placement above the Uppermost Aquifer						Oct. 2018
Wetlands						
Seismic Impact Zones						
Fault Areas						
Unstable Areas						
Design Requirements						
Composite Liner						Oct. 2016
Leachate Collection & Removal Systems						Prior to Initial Receipt
Groundwater Monitoring						Oct. 2017

CCR Compliance

Requirement	New CCR Landfills	Existing CCR Landfills	New CCR Ponds	Existing CCR Ponds	Inactive CCR Ponds	Initial Date Required for Facilities
Structural Integrity Criteria						
Marker						**Dec. 2015**
Hazard Potential Classification Assessments						Oct. 2016
Emergency Action Plan						Apr. 2017
History of Construction						Oct. 2016
Construction Plan						Prior to Initial Receipt
Structural Stability Assessments						Oct. 2016
Safety Factor Assessments						Oct. 2016
Weekly Inspections						**Oct. 2015**
Annual Inspections						**Jan. 2016**

CCR Compliance

Requirement	New CCR Landfills	Existing CCR Landfills	New CCR Ponds	Existing CCR Ponds	Inactive CCR Ponds	Initial Date Required for Facilities
Other						
Fugitive Dust Controls						**Oct. 2015**
Run-on, Run-off Controls						Oct. 2016
Hydrologic & Hydraulic Capacity Requirements						Oct. 2016
Closure Requirements						Oct. 2016
Post Closure Care						Oct. 2016

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CCR Impoundment Closure Triggers

- **Structural integrity/Safety factor assessments**
- **Groundwater monitoring exceedances (unlined ponds)**
- **Location Restrictions**
  - Wetlands
  - Aquifer
  - Fault areas
  - Seismic impact zones
  - Unstable areas
- **Alternative closure requirements & extensions to closure schedule**

Structural Integrity/Safety Factor Assessments

- **Applicability –**
  - Height > 20 feet, or
  - Height > 5 feet and storage volume > 20 acre-feet
- **Inspect and calculate safety factors**
- **Post prior to Oct. 17, 2016 and every 5 years after**
- **Failure to meet safety factors could cease sluicing prior to April 17, 2017**

Groundwater

- **Begin detection monitoring and collect 8 samples from each well no later than October 17, 2017**
  - Establish baseline concentrations for 22 parameters
  - Complete analysis of initial detection monitoring results and complete first annual report by January 31, 2018
- **In the event of a statistical exceedance over background –**
  - Begin assessment monitoring prior to April 17, 2018
  - Groundwater protection standard established and second sample taken prior to July 17, 2018
  - Potential to cease sluicing to unlined ponds in January 2019 and begin closure or retrofit

Location Restrictions

- ► **Demonstrate impoundments meet each of the five location restrictions: aquifer, wetlands, fault areas, seismic or unstable areas**
- ► **Demonstration report required before October 17, 2018**
- ► **Potential to cease sluicing by April 2019 if any of the criteria is not met**

Alternative closure requirements & Extensions to impoundment closure schedule

- **Alternative closure requirements**
  - No alternative CCR disposal capacity (continue to receive CCRs for a maximum of an additional **five** years)
  - Permanent shutdown of boiler by a specific date
    - <40 acres, complete closure before October 17, 2023
    - >40 acres, complete closure before October 17, 2028

- **Extensions to impoundment closure schedule**
- **Five year closure timeframe**
  - <40 acres, maximum of 2 years
  - >40 acres, maximum of five, two-year extensions

CCR Rule – Bottom Line Issues

- **Compliance Deadlines**
- **Many/Most Impoundments will Close**
  - Location Restrictions
  - Safety/Structural Standards
  - Corrective Action
- **Dual State/Federal Regulations**
- **Citizen Suits** → **Patchwork Interpretations**
- **EPA May Revisit Regulatory Determination**

Changes to CCR Handling

- **How will new Rules affect disposal?**
  - Plants will convert to dry ash handling (some will shut down – depends on continued power market)
  - Disposal will shift to landfills over the next 5 to 7 years, could be captive on-site landfill or off-site Class I landfill
  - Most impoundments will be closed within 5 years of the issuance of the rules
  - Clean closure of existing CCR units

Opportunities for TDEC Class I Disposal Facilities and Companies

- ► **Accept CCR at Existing Class I MSW Landfill**
- ► **Build/Operate New CCR Landfill (monofill) at existing MSW Landfill Site**
- ► **Build Dedicated Cell for CCR (monofill) at MSW Landfill**
- ► **Build/Operate CCR Landfill at Generating Station**

Engineering Properties

- **Fly Ash**
  - Fine grained, silt-size
  - Spherical, well-graded within
  - the fine fraction
  - Class F non-cementing from eastern coal – no cohesion
  - Class C self-cementing from western coal
  - Dry Density 65 to 90 pcf
  - Friction angle 25^o to 45^o - typical 30^o to 35^o
  - Permeability 10^{-4} to 10^{-6} cm/sec - typical $5x10^{-4}$ cm/sec

Engineering Properties

- **Bottom Ash**
  - Fine to coarse grained, sand size
  - Angular, well-graded
  - Dry Density 65 to 100 pcf
  - Friction angle 25º to 45º - typical 35º to 40º
  - Permeability 10^{-1} to 10^{-3} cm/sec - typical $5x10^{-3}$ cm/sec

Engineering Properties

- **Flue Gas Desulfurization (FGD)**
  - Fine grained, silt size; similar to fly ash
  - Dry Density 65 to 90 pcf
  - Friction angle 20º to 40º depending on moisture content and if the material is stabilized
  - Cohesion and permeability depend on type of air pollution control system
  - May be non-cohesive or self-cementing
  - Permeability 10^{-4} to 10^{-7} cm/sec

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Engineering Properties

- **Advantageous Engineering Properties**
  - CCRs in General
    - Usually high friction angle / shear strength
    - Can be self-cementing
    - Easy site grading (for non-cementing)
    - Good compaction when water content is controlled

Engineering Properties

- **Advantageous Engineering Properties**
  - CCRs in General
    - Uniform, relatively fine grained material – lightweight cushion geotextile and/or protective layer adjacent to geomembrane liner
    - Creates solid and smooth liner subgrade
    - Chemical compatibility with geomembrane not an issue

Engineering Properties

- **Advantageous Engineering Properties**
  - Bottom Ash
    - Good component of drainage layer
    - Often filter compatible with fly ash
    - Use as bridge lift or with a reinforcing geotextile for soft ground improvement
    - Use on roads within landfill to improve traction

Engineering Properties

► **Challenges Handling CCRs**

- Highly erosive for Non-Self-Cementing
- Fine, lightweight, no cohesion, leads to significant dust issue
- Can be liquefiable
- FGD may be hard to dewater (calcium sulfite)
- Filter compatibility with leachate collection system
- Chemical compatibility with Geosynthetic Clay Liner (GCL)

CCR Landfill Issues / Solutions

- **Filter compatibility of geotextiles with CCRs**
  - Fly ash or FGD is very fine grained and difficult to demonstrate filter compatibility with any geotextile
  - Aggregate filters may be appropriate using bottom ash
  - Woven geotextile is better for long-term performance due to physical nature of material (more sieve-like)
  - Manufacturers addressing this issue with combination of nonwoven/woven geotextile
  - Gradient ratio, long-term flow, hydraulic conductivity ratio – test methods by GRI

CCR Landfill Issues / Solutions

- **GCL compatibility with CCRs**
  - Ion exchange – calcium substitution for sodium reduces swell and increases permeability of bentonite
  - Manufacturers producing CCR-resistant bentonite
  - Combined with timing of hydration likely solves this issue

CCR Landfill Issues / Solutions

- **Chemical precipitation (calcium-based) in the leachate drainage system**
  - These materials contain high levels of calcium and leachate is usually highly alkaline. Definitive estimate of scaling potential due to calcium precipitation difficult to predict.
  - Use conservative factor of safety for clogging
  - Utilize redundant design features where practical
  - Include cleanouts in design

Challenges for MSW Landfills Handling CCRs

- **Odor/Gas Generation**
  - FGD can be calcium sulfite, magnesium sulfite, calcium sulfate
  - Compounds are highly soluble
  - Under conditions within a landfill, bacteria can convert the sulfates and sulfites into hydrogen sulfide which can cause odor problems
  - pH likely will increase – may kill microorganisms and affect gas generation and extraction
  - Avoid comingling FGD and MSW to the extent possible

Challenges for MSW Landfills Handling CCRs

- **Leachate/Water Quality**
  - Anticipate the potential leachate quality changes and the impacts on leachate management strategies – collection, treatment, and disposal systems
  - pH likely will increase – may change other contaminant levels
  - Mercury could become an issue in ash/leachate
  - The USEPA expects TDEC to require a MSW landfill accepting CCR to include inorganic indicators known to be associated with CCRs (boron, calcium, chloride, fluoride, pH, TDS) in the groundwater detection monitoring plan

Challenges for MSW Landfills Handling CCRs

► **Pozzolanic Reaction**

- Fly Ash is a pozzolan - siliceous material that reacts with calcium hydroxide in the presence of water to form cementitious compounds
- Can create issues if landfilled without consideration
- Reaction creates heat – must consider in regard to landfill gas temperature monitoring

Challenges for MSW Landfills Handling CCRs

- **Operations**
  - Generating stations typically generate large quantities of CCR (several million tons/yr) and operate and produce CCR 24/7/365
  - Evaluate daily permit tonnage limits
  - Dusting potential and control methods
  - Odors
  - Additional truck traffic both at the landfill and on public roads
  - Additional personnel and equipment may be needed to handle larger volumes

Challenges for MSW Landfills Handling CCRs

- **Operations**
  - May need to segregate materials requiring additional equipment required to handle and compact the CCR
  - Geotechnical considerations – may create saturated zones and slip planes if comingled
  - Potential for CCRs to stick in trucks when unloading
  - The USEPA expects TDEC to require a MSW landfill accepting CCR to prepare a CCR Acceptance Plan. Plan is to address physical and chemical characteristics of CCR and address dust, structural integrity, and not compromise the leachate and gas collection systems.

Questions?

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