



# Minnkota Power COOPERATIVE

A Touchstone Energy® Cooperative 



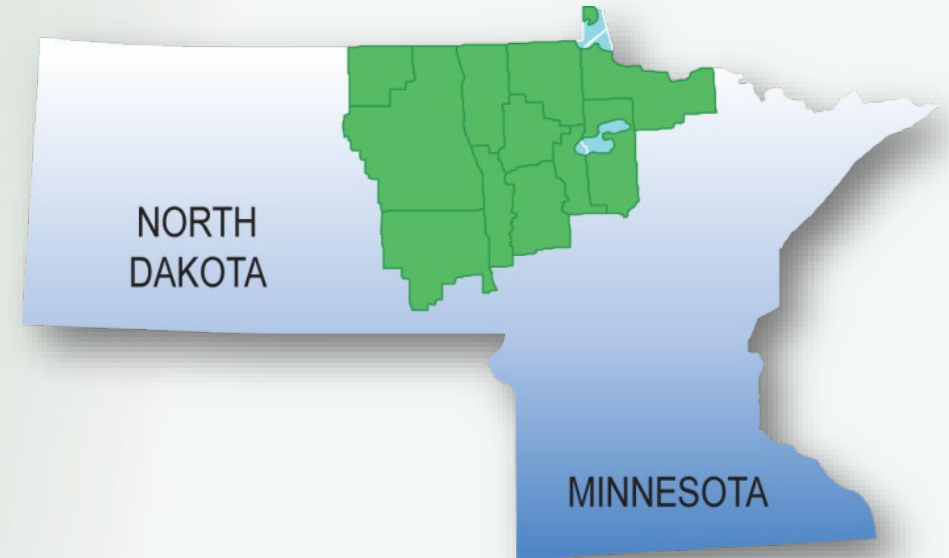
LIGNITE *Energy* COUNCIL

## Plant Level Environmental Compliance

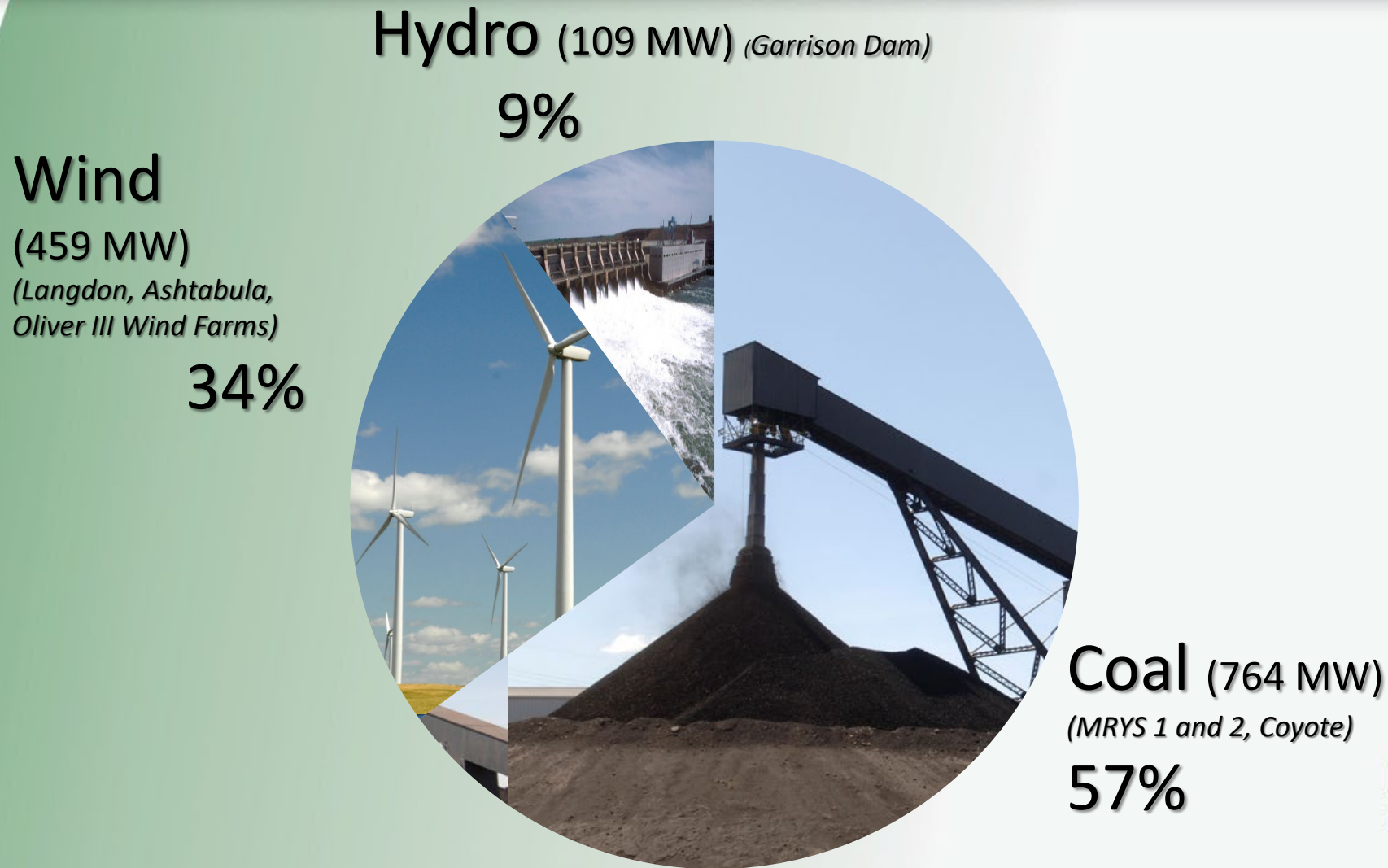
*Scott Hopfauf – Plant Environmental Superintendent  
Minnkota Power Cooperative*

# Minnkota Power Cooperative

- 11 member-owner cooperatives
  - 3 in ND, 8 in MN
- 12 municipals  
(Northern Municipal Power Agency)
- 137,000 customers
- 34,500 square miles
- 399 employees



# Minnkota's Generation Mix – 43% Renewables



# QUESTION



< Activities



Visual settings



Edit



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Text **LIGNITEENERGY220** to **22333** once to join

**What agency has primary regulatory authority over North Dakota's seven coal-based power plants?**

U.S. Environmental Protection Agency  
Office of Federal Surface Mining and Reclamation  
ND Department of Environmental Quality  
ND Public Service Commission  
ND State Water Commission

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# The Original Primary Environmental Laws



- ❖ Did you know that EPA was created in 1970?
- ❖ And that EPA now has 15,000 + employees?

- Air
  - Clean Air Act of 1970
- Water
  - Federal Water Pollution Control Act of 1972
  - (Clean Water Act)
- Land (Waste Disposal)
  - Resource Conservation and Recovery Act of 1976 hazardous/nonhazardous waste

# These primary Environmental Laws are supported by:

1. **Amendments to the original laws (or statutes)** passed by Congress (or state legislatures)
  - A. United States Code,
  - B. ND Century Code
  
2. **Rules (or Regulations)** written by agencies (like EPA or the NDDEQ) to implement the laws passed by the legislature
  - A. Code of Federal Regulations, ND Administrative Code
  - B. Very frequent (Federal Register notices)
  - C. Guidelines (not rules, but tend to be treated like them by Agencies)
  - D. Preamble to draft or final regulations when published in the Federal Register (written by an Agency to explain the rationale/intent behind the rule)



# Clean Air Act of 1970

- National Ambient Air Quality Standards (NAAQS)
  - For assessment of overall ambient air quality, by state
- Criteria pollutants:
  - Nitrogen dioxide (NO<sub>x</sub>)
  - Particulate matter (PM)
  - Sulfur dioxide (SO<sub>2</sub>)
  - Carbon monoxide
  - Lead
  - Ozone

## What is ambient air quality?

- Ambient air quality refers to the quality of outdoor air in our surrounding environment
- Air quality can be quantified by concentrations of substances identified through monitoring
  - It is typically measured near ground level, away from direct sources of pollution

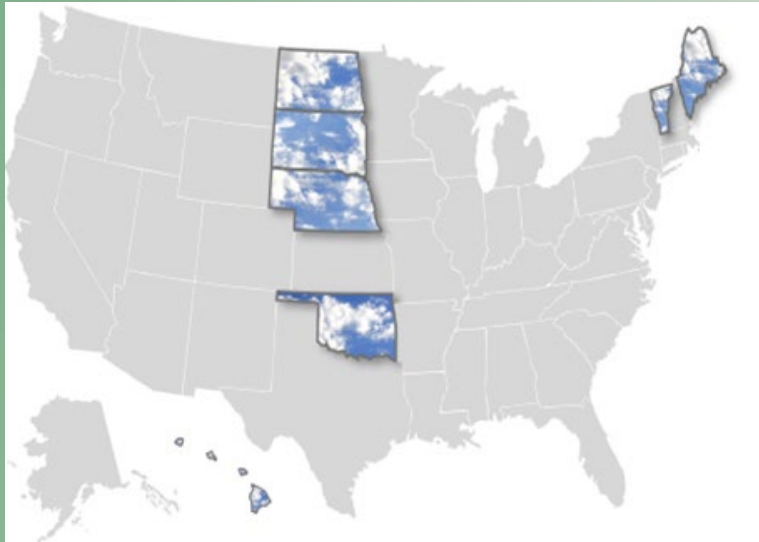




# Clean Air Act of 1970

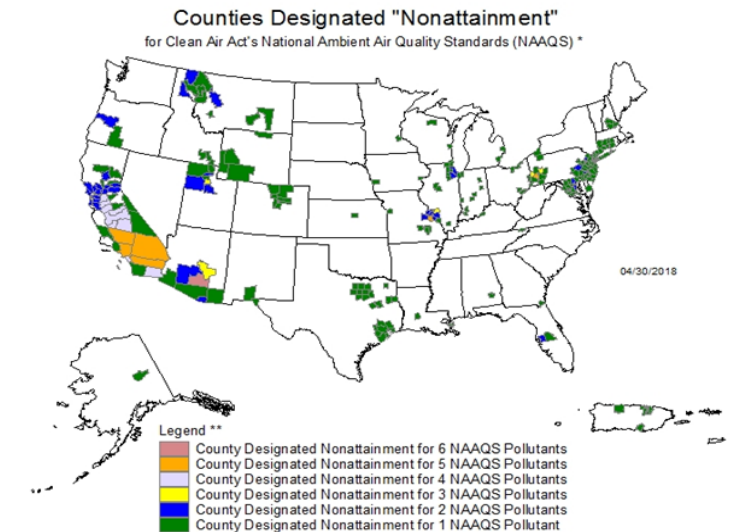
100 % “Attainment” States

Originally only six states....



## 15 states

1. Alabama
2. Arkansas
3. Delaware
4. Hawaii
5. Florida
6. Maine
7. Mississippi
8. Nebraska
9. North Carolina
10. North Dakota
11. Oklahoma
12. Rhode Island
13. South Carolina
14. South Dakota
15. Vermont



Guam - Piti and Tanguisson power stations are designated nonattainment for the SO<sub>2</sub> (1971) NAAQS  
Piti and Cabras power stations are designated nonattainment for the SO<sub>2</sub> (2010) NAAQS

\* The National Ambient Air Quality Standards (NAAQS) are health standards for Carbon Monoxide, Lead (1978 and 2008), Nitrogen Dioxide, 8-hour Ozone (2008), Particulate Matter (PM-10 and PM-2.5 (1997, 2006 and 2012), and Sulfur Dioxide (1971 and 2010)

\*\* Included in the counts are counties designated for NAAQS and revised NAAQS pollutants. Revoked 1-hour (1979) and 8-hour Ozone (1997) are excluded. Partial counties, those with part of the county designated nonattainment and part attainment, are shown as full counties on the map.

# Clean Air Act Amendments of 1990

- Acid rain provisions
  - SO<sub>2</sub>/NO<sub>x</sub> emission reductions were required in 1995 and 2000
- 1995 - Continuous Emissions Monitors (CEMS)



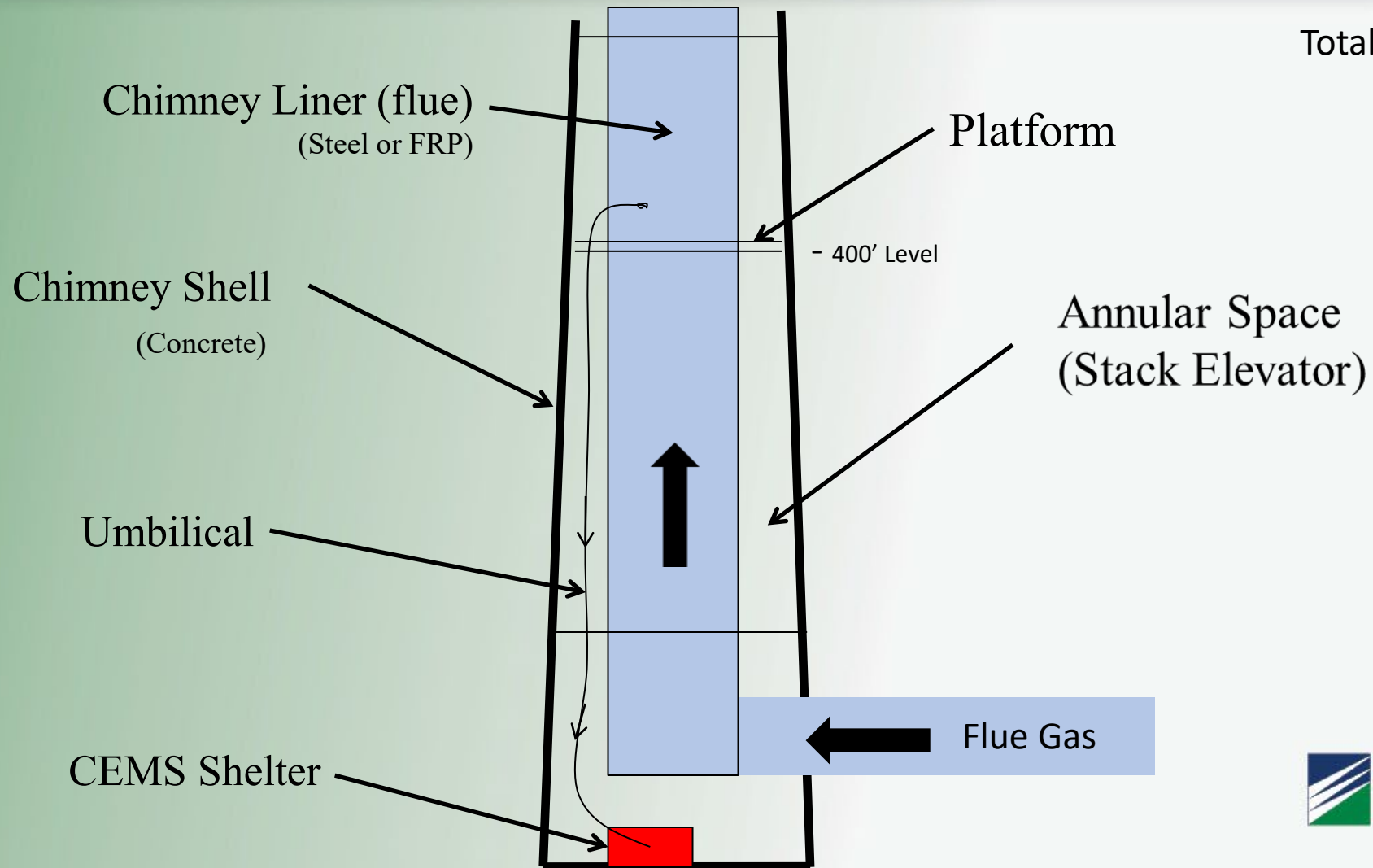
# CEMS



- Continuous Emissions Monitoring System
  - **Criteria Pollutants - SO<sub>2</sub>, NO<sub>x</sub>, PM**
  - Others – Chimney Flow (inlet/outlet), CO<sub>2</sub>, Hg
- Real-time, Quality-Assured data
  - Daily calibration (with “known” gas concentrations)
  - Quarterly linearity (accuracy of analyzers across a range of concentrations)
  - Annual Relative Accuracy Test Audit (RATA) and Relative Correlation Audit (RCA) by emissions monitoring vendor



# MRY Chimneys



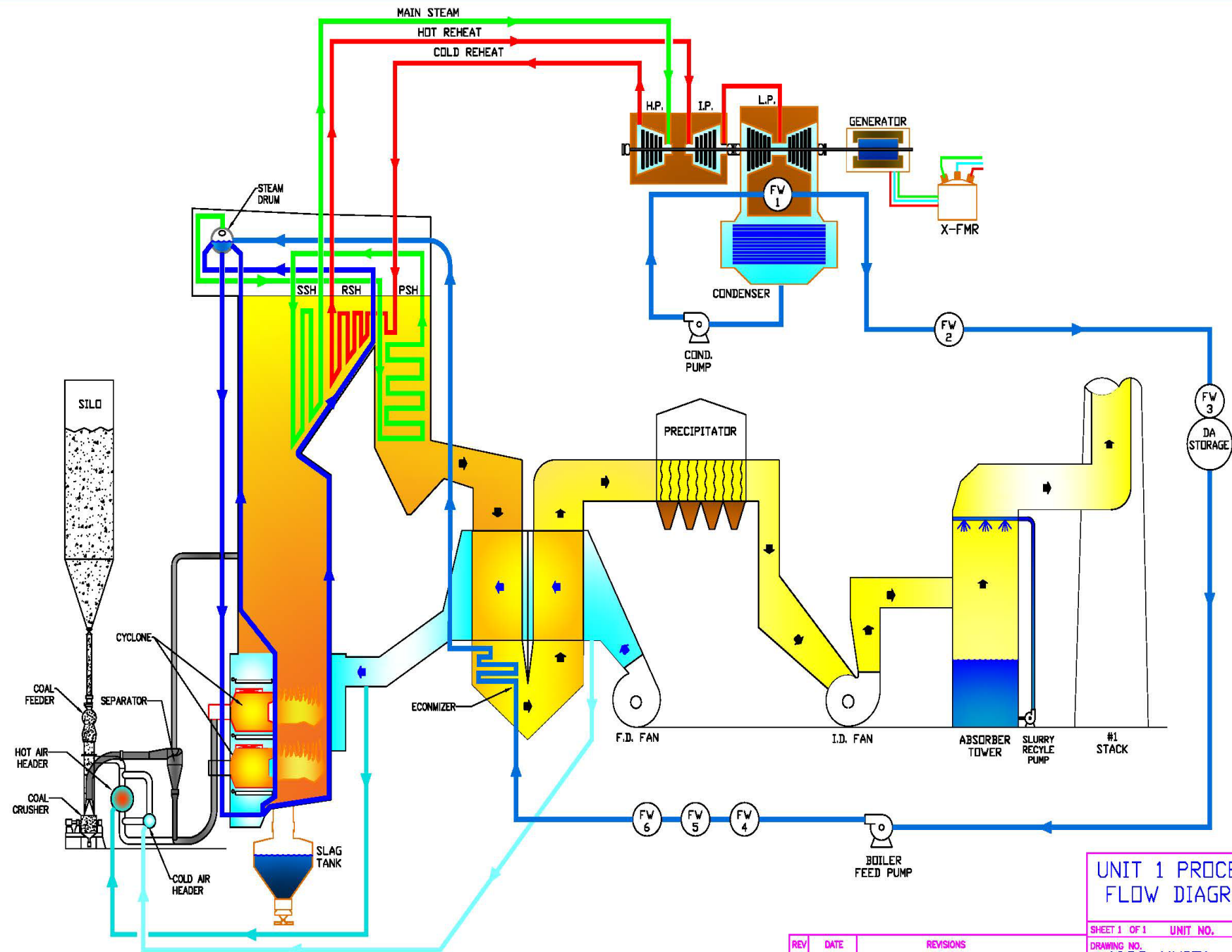
# How are Criteria Pollutants Controlled?

- Criteria pollutants:

- Nitrogen dioxide ( $\text{NO}_x$ )
  - Particulate matter (PM)
  - Sulfur dioxide ( $\text{SO}_2$ )
  - Carbon monoxide
  - Lead
  - Ozone

- **Mercury** (Nation Emission Standards for Hazardous Air Pollutants)





UNIT 1 PROCESS  
FLOW DIAGRAM

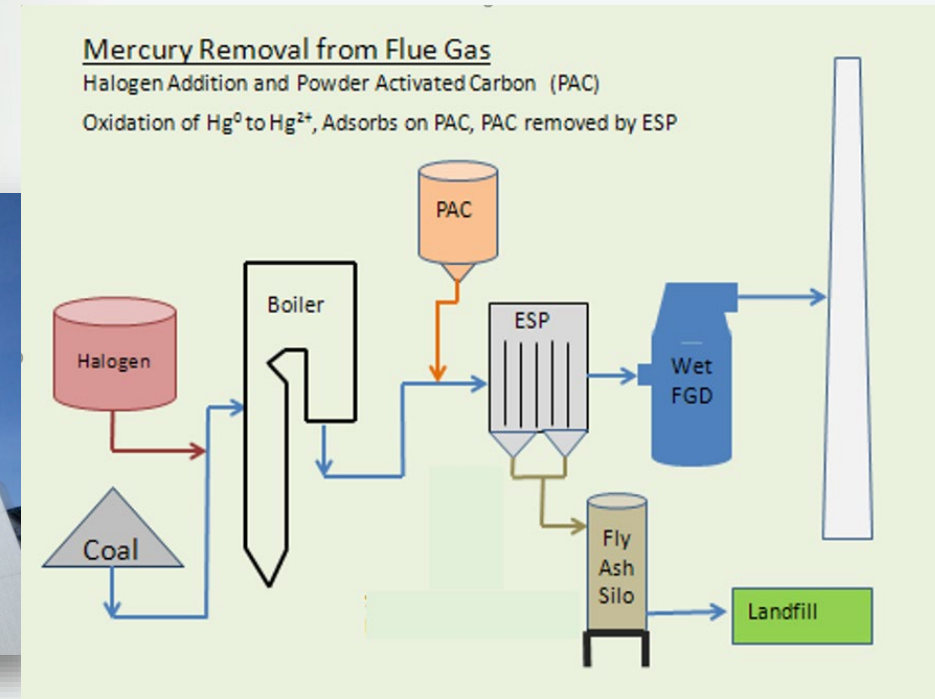
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	1/2015		DRAWING NO.	4038-UNIT1	



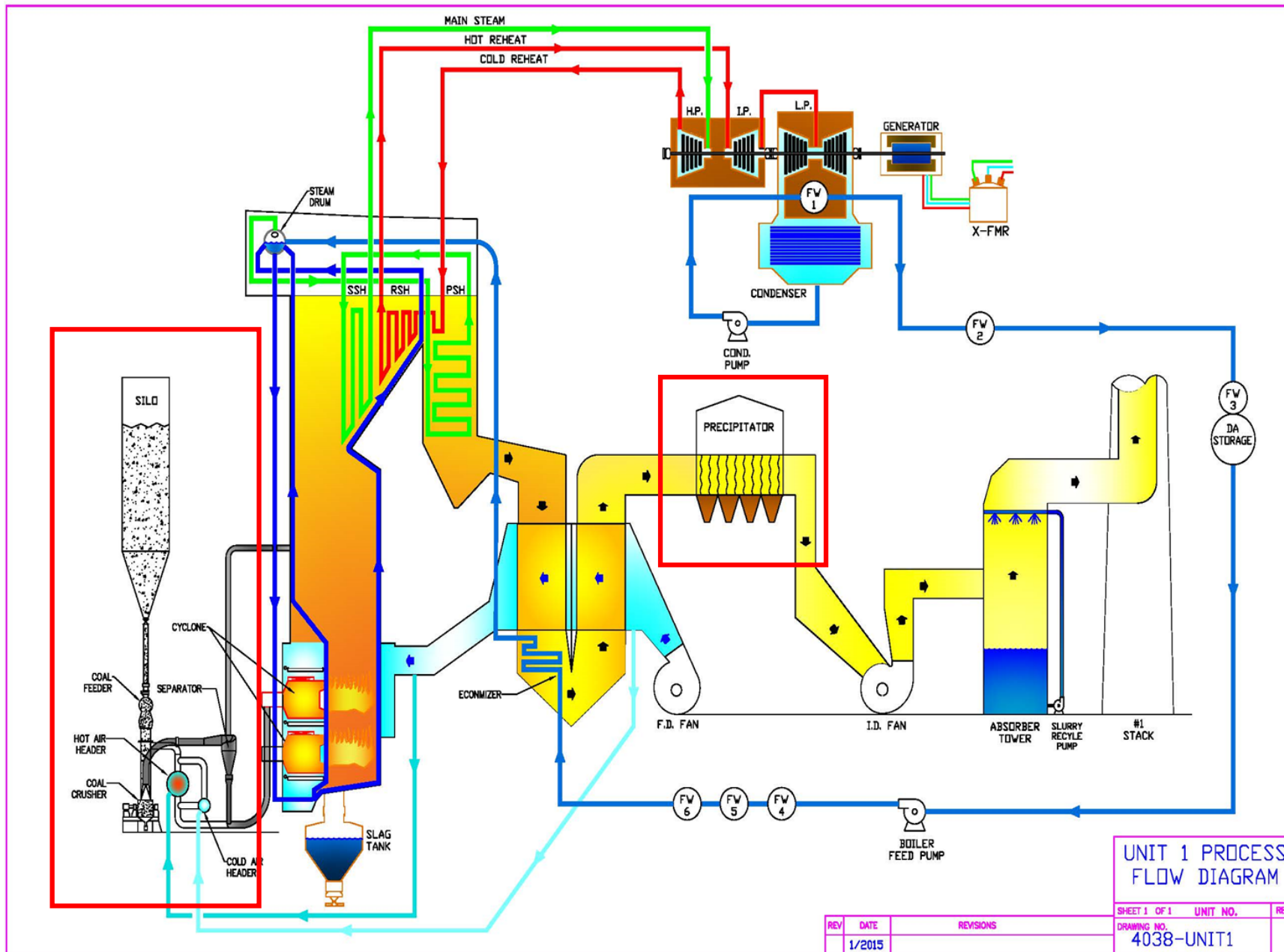
# Mercury Controls

## *(Mercury and Air Toxics Standards)*

- Issued in 2012
- Compliance by April 16, 2015
- Mercury Emission Limit of 4#/Tbtu
- New regulations proposed April 3, 2023







UNIT 1 PROCESS  
FLOW DIAGRAM

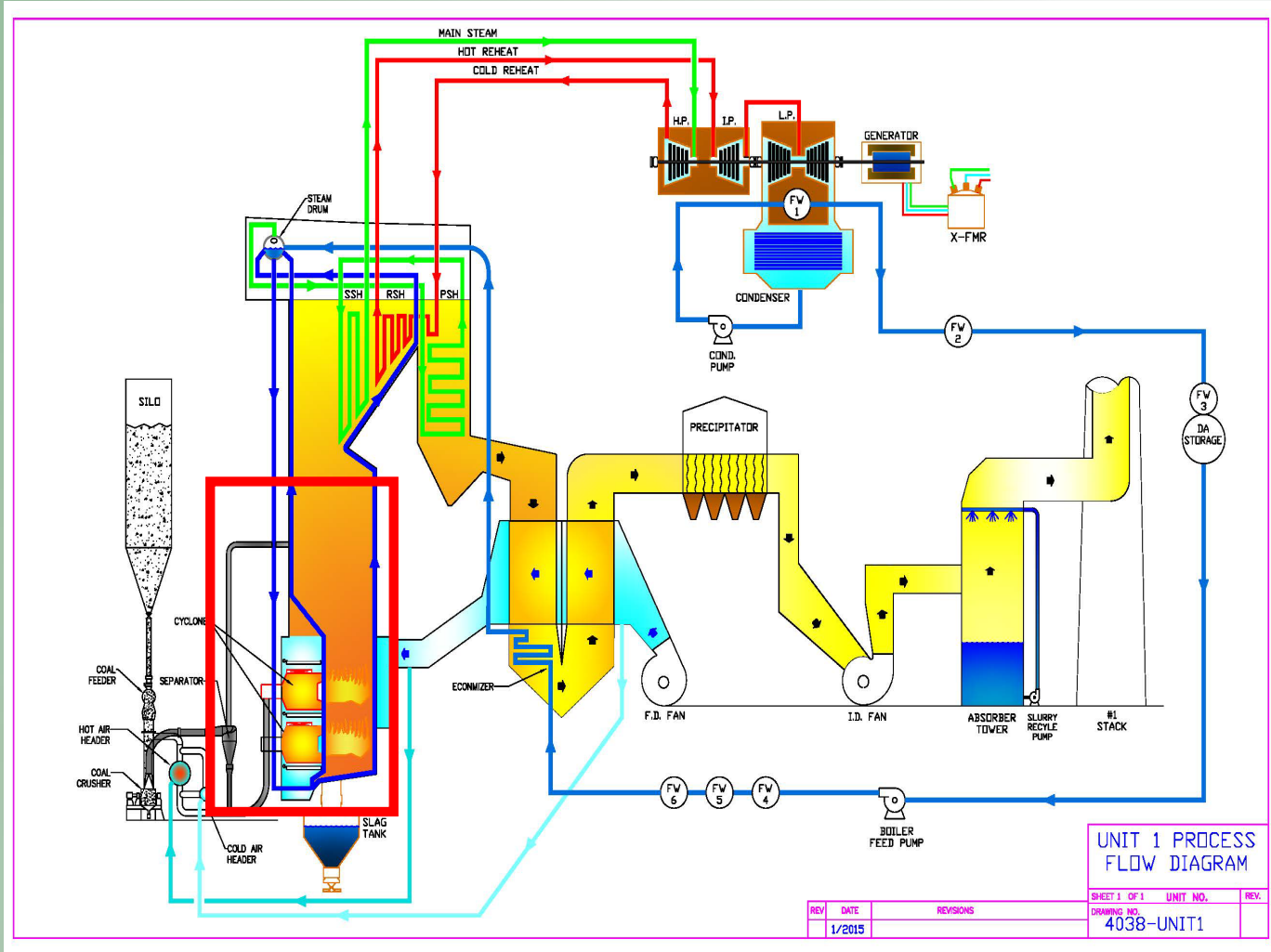
REV	DATE	REVISIONS	SHEET 1 OF 1	UNIT NO.	REV.
	1/2015		DRAWING NO.	4038-UNIT1	

# Formation and Control of NO<sub>x</sub>

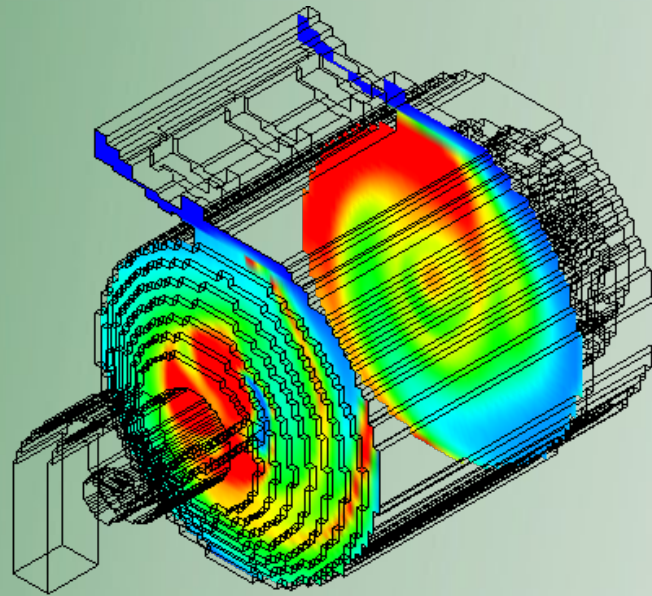
- Oxidized nitrogen compounds (NO<sub>x</sub>) form when:
  - Nitrogen is exposed to high temps during combustion
  - Oxygen from the combustion air is available to present to react and combine with the nitrogen
- Prevent it from forming
  - Control combustion
  - Use less air in the cyclones
  - Complete combustion in the upper furnace, at a lower temperature
  - Called Over-fire" air (or OFA")



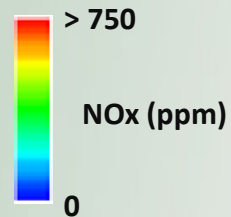
# Over-fire air (OFA)



# OFA reduces the air used in the Cyclone Barrels

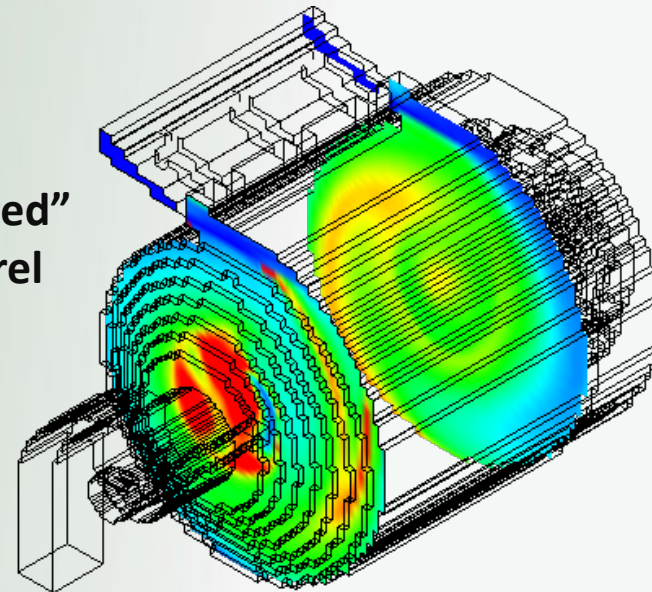


Baseline Barrel



Fuel-rich  
conditions in the  
staged barrels  
produce a lower net  
NO<sub>x</sub> formation

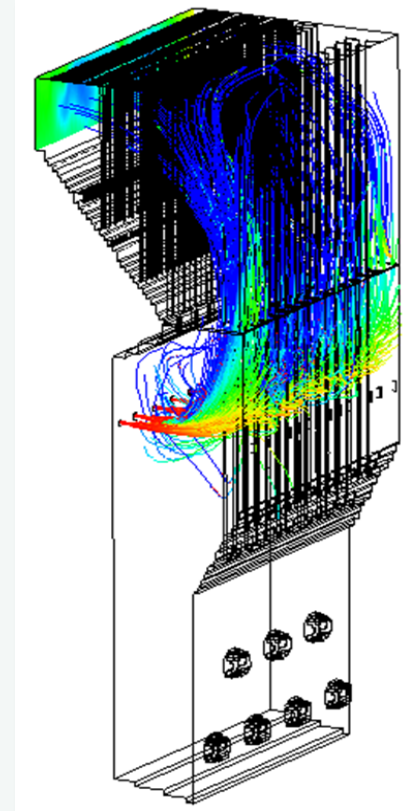
"Staged"  
Barrel





# Post-Combustion NO<sub>x</sub> Reduction

- Take NO<sub>x</sub> out after it's formed...
- SNCR (Selective Non-Catalytic Reduction)
  - Urea injection in upper furnace will react with and reduce NO<sub>x</sub>
  - The reaction breaks down NO<sub>x</sub> to nitrogen, carbon dioxide and water



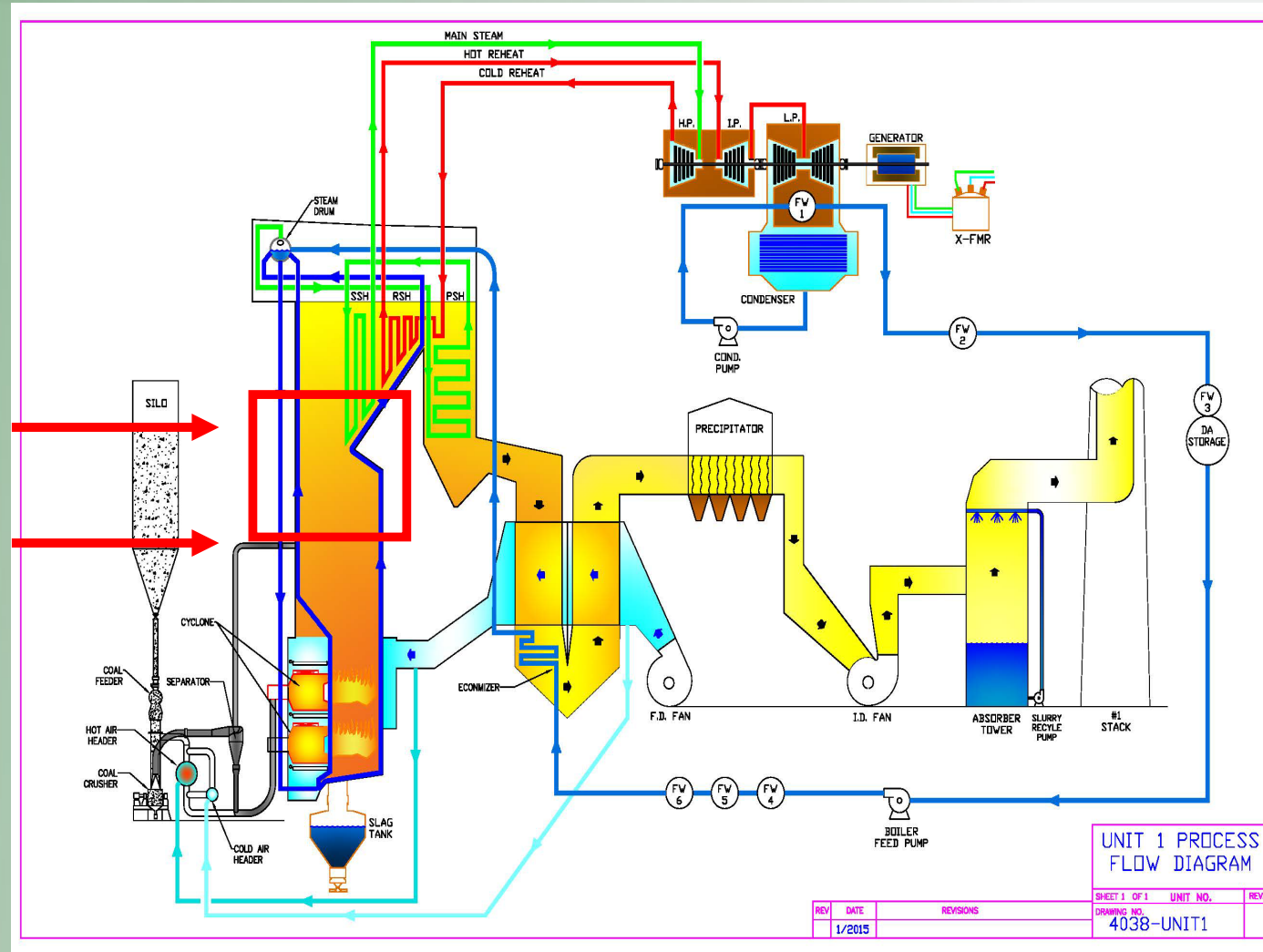


# SNCR

## Selective Non-Catalytic Reduction

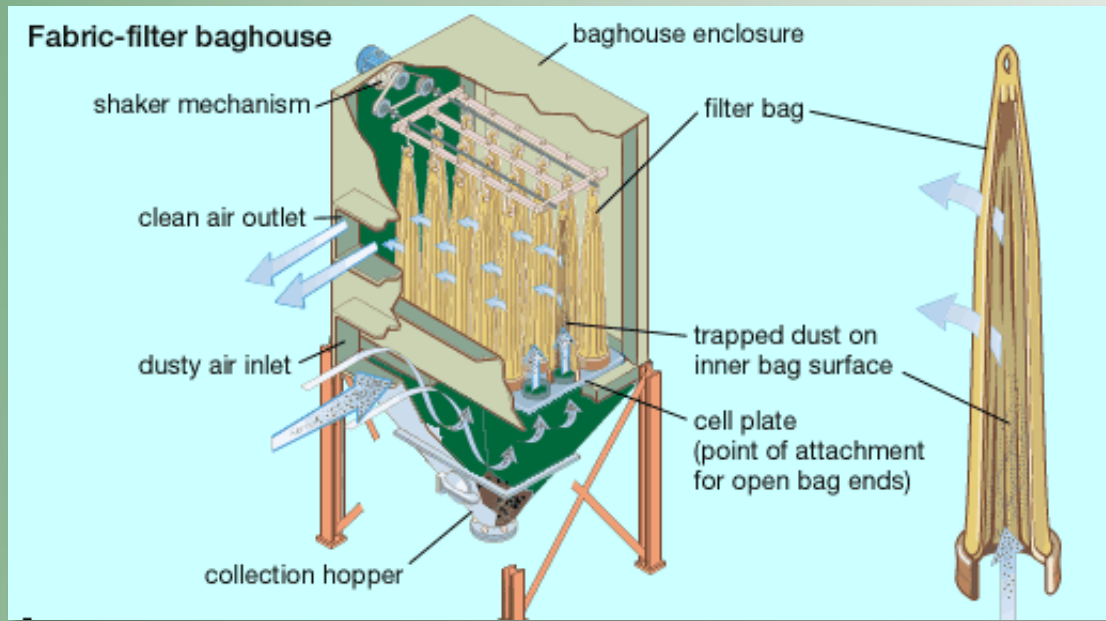
1,650 deg. F.

2,100 deg. F.

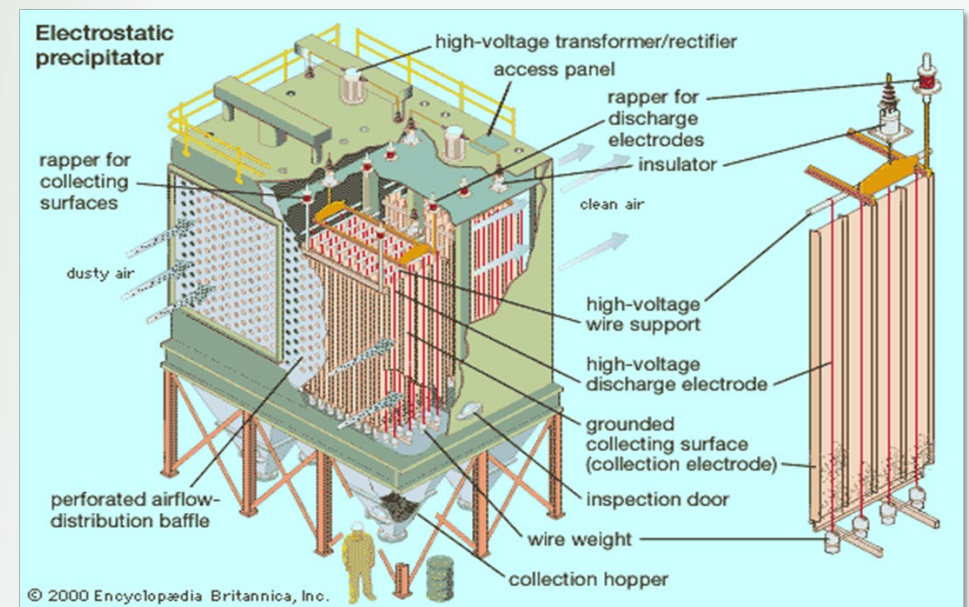


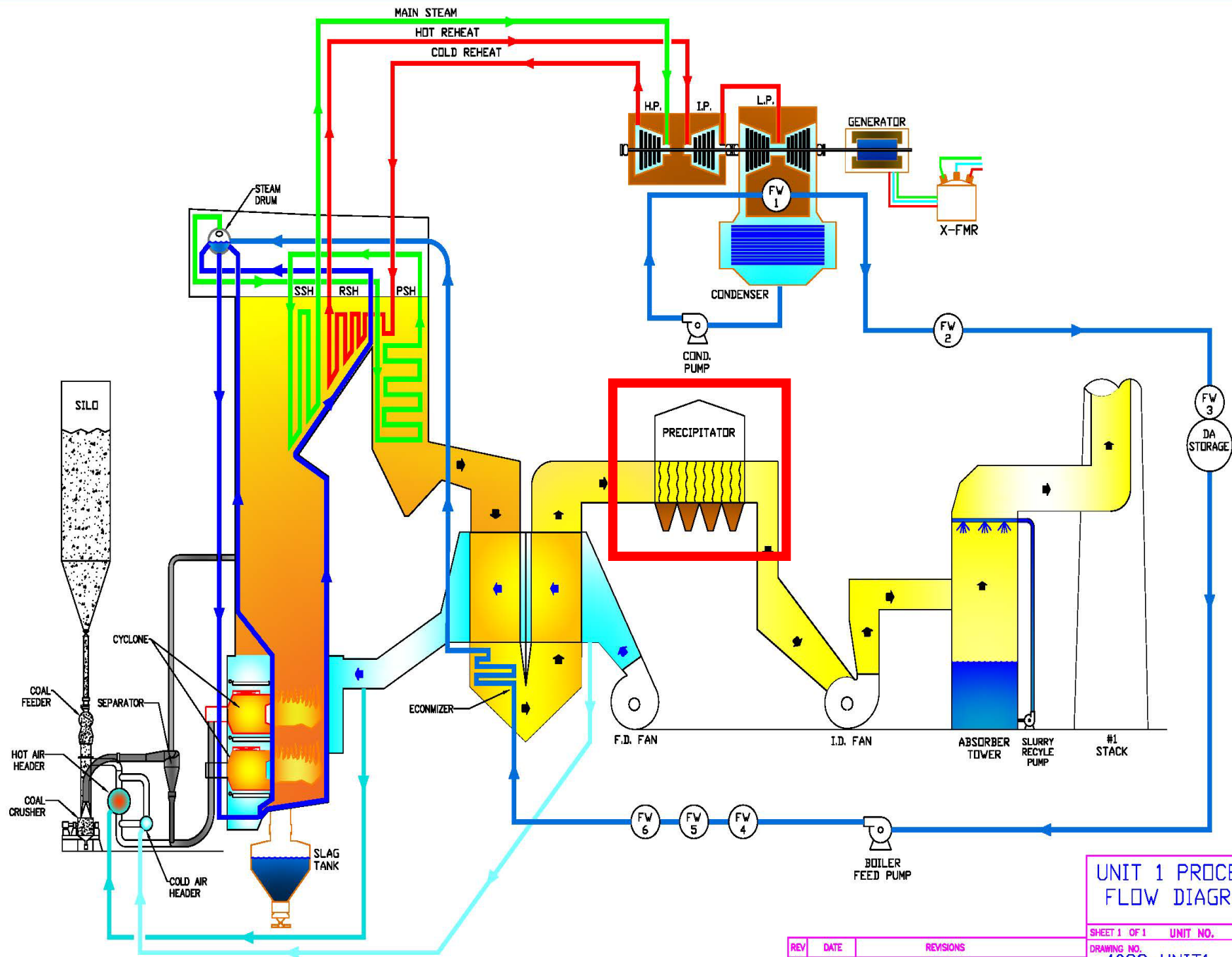
# Particulate Removal Equipment

## *Fabric Filter Baghouse*



## *Electrostatic Precipitator*





UNIT 1 PROCESS  
FLOW DIAGRAM

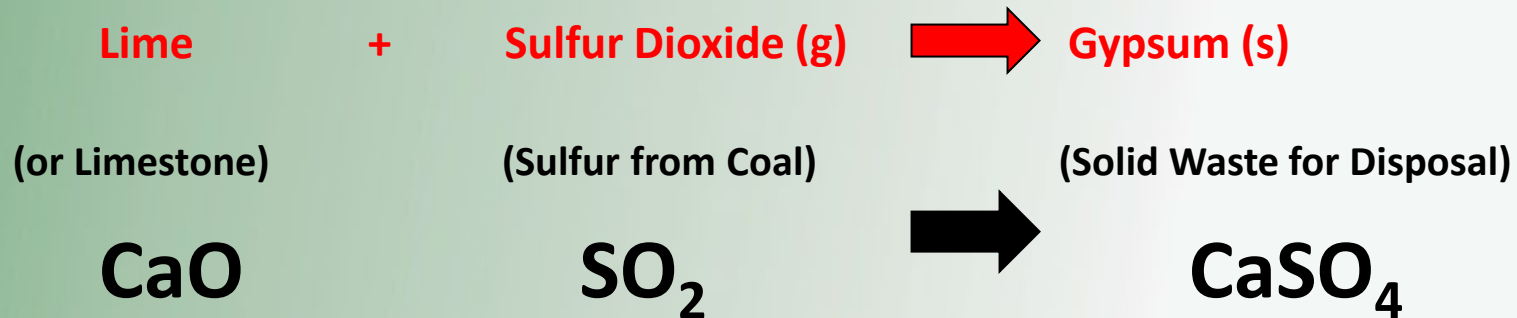
REV	DATE
	1/2015

REVISIONS

SHEET 1 OF 1	UNIT NO.	REV.
DRAWING NO.		
4038-UNIT1		

# Control of SO<sub>2</sub>

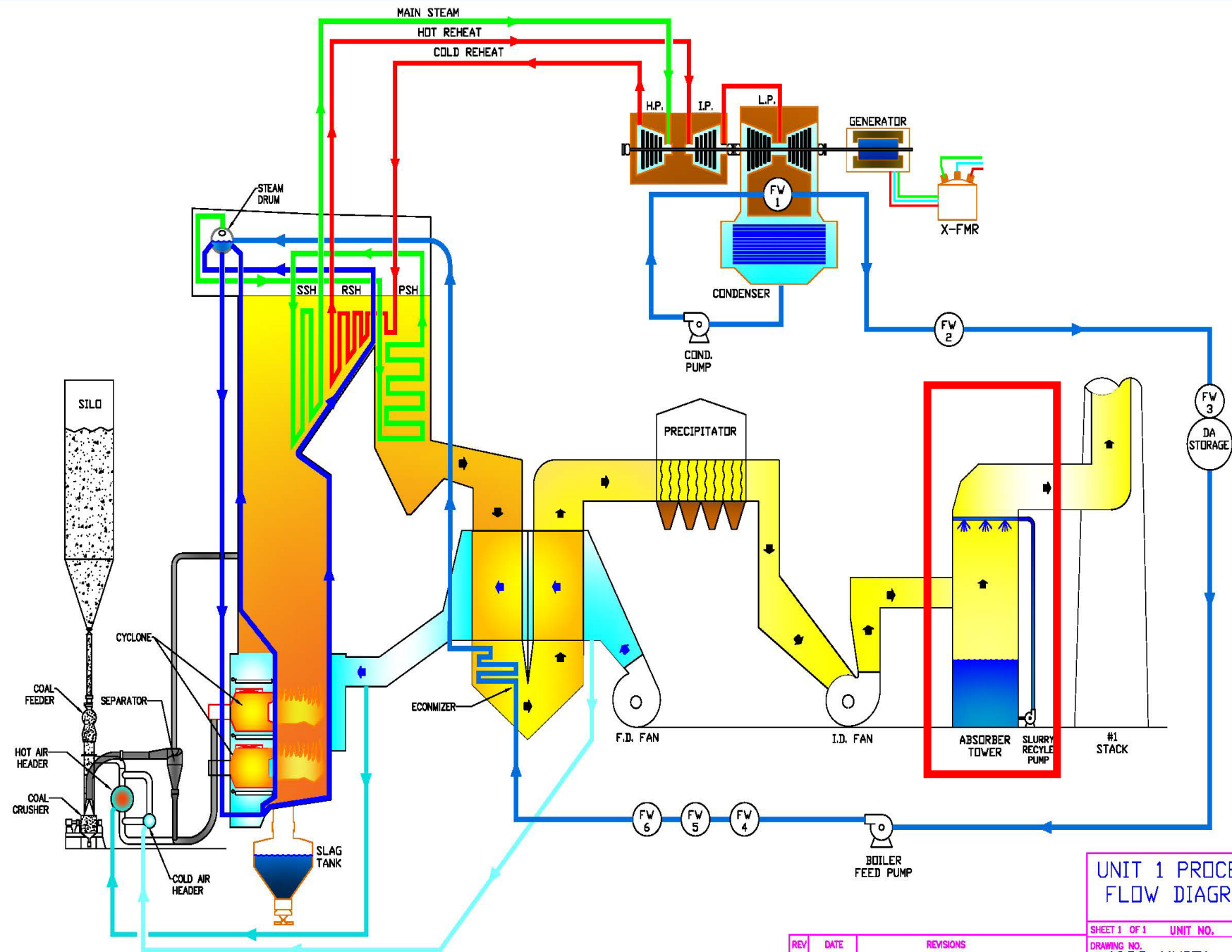
## *Flue Gas Desulfurization (FGD) Scrubber*



+







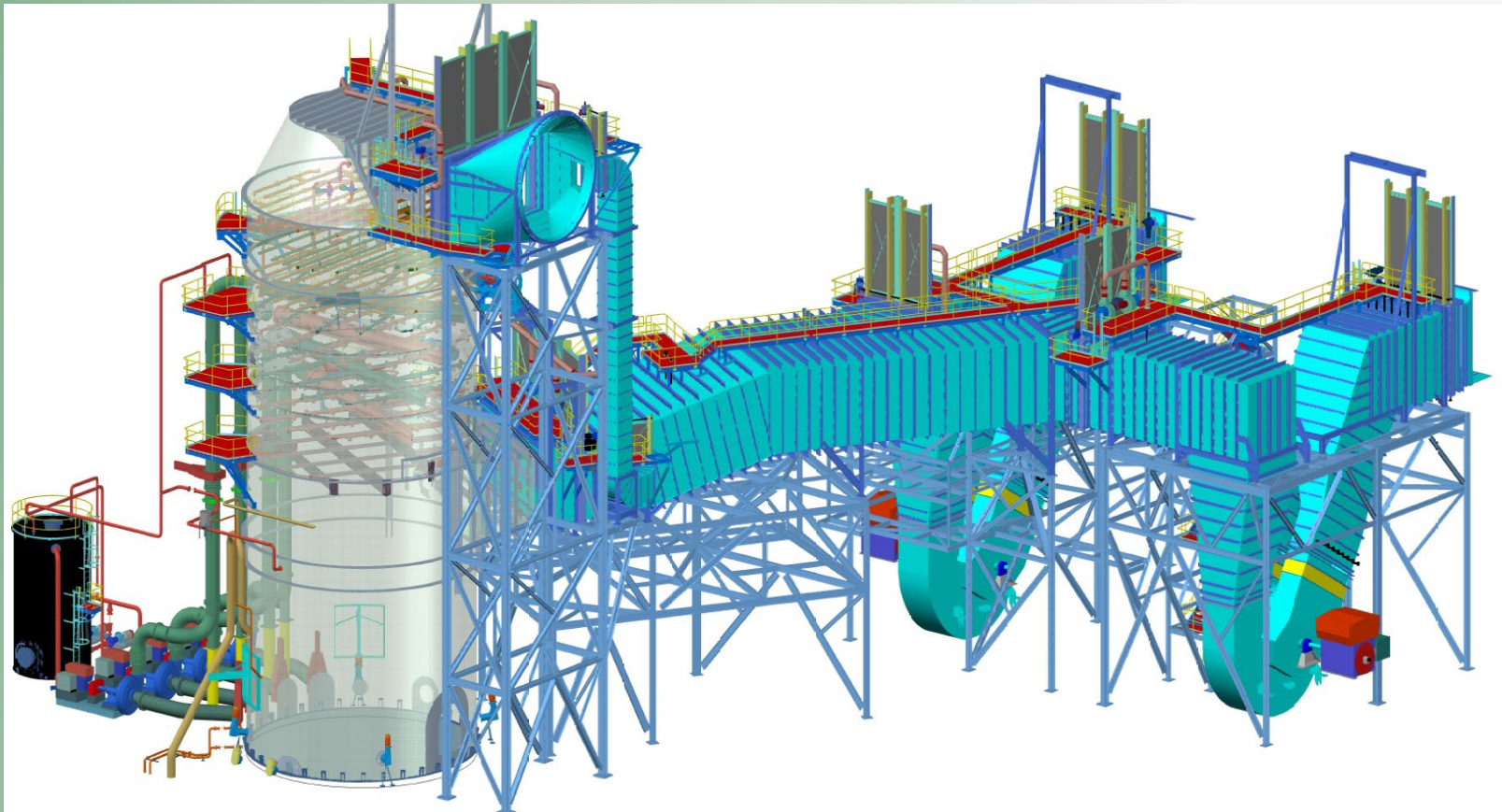
UNIT 1 PROCESS  
FLOW DIAGRAM

REV	DATE	REVISIONS	SHEET 1 OF 1	UNIT NO.	REV.
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# SO<sub>2</sub> Scrubber Absorber Vessel

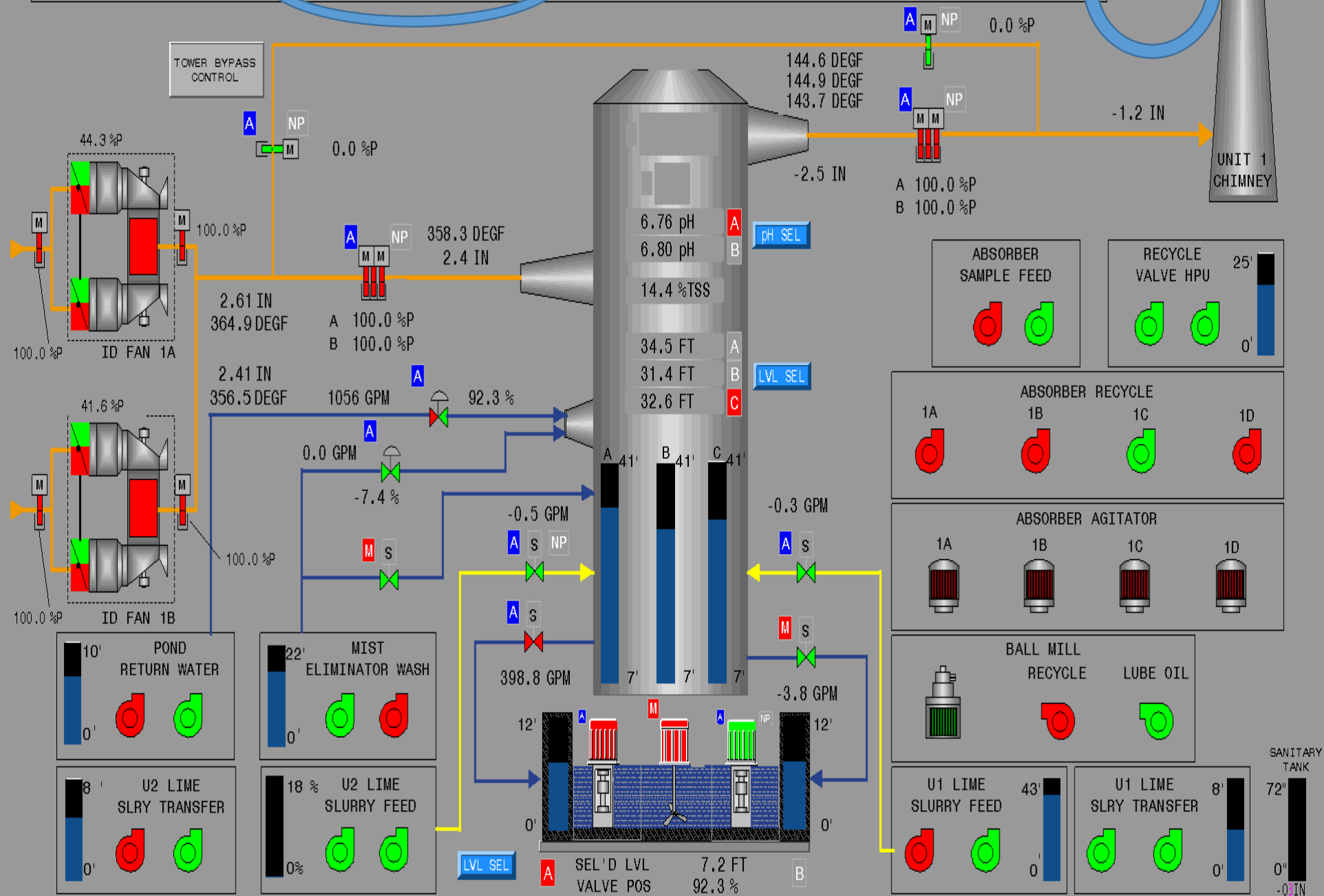
- 40-foot diameter, 100 feet high



# UNIT 1 FGD OVERVIEW

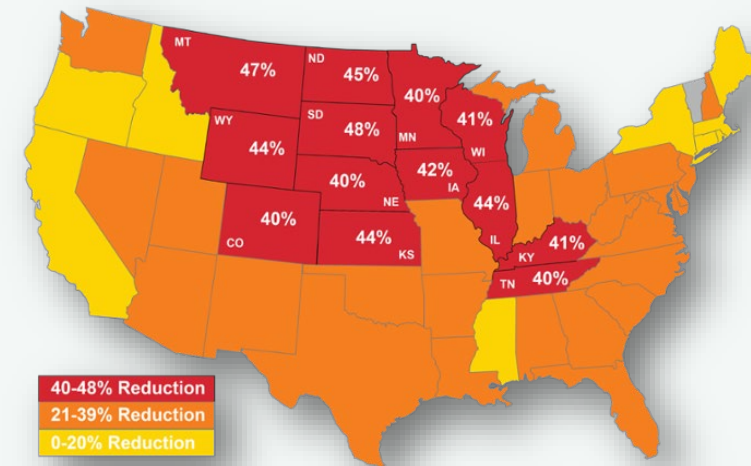
2900

CHIMNEY FLOW	691 KSCF	FGD INLET SO2	703.8 PPM	2.039 #/MB	OPACITY	20.2 PCT	NOX	162.0 PPM	SO2 REMOVAL 98.02 %
CHIMNEY TEMP	0.2 DEGF	CHIMNEY OUTLET SO2	13.8 PPM	0.040 #/MB	PARTICULATE	0.001 PPM	CO2	10.9 PCT	



# Carbon dioxide control CO<sub>2</sub>

- Clean Power Plan (CPP) August 2015
  - EPA's first effort to regulate carbon dioxide (CO<sub>2</sub>)
  - Mandates that CO<sub>2</sub> from power plants be reduced
  - Each state given a different CO<sub>2</sub> requirement
  - North Dakota required to reach 45% (by rate) reduction by 2030
  - Although EPA predicted reductions in electricity rates, utilities projected minimum cost increases of 50%
  - Repealed 2017



# Carbon dioxide control CO<sub>2</sub>

- Affordable Clean Energy Plan(ACE)  
June 2019
  - EPA's second effort to regulate carbon dioxide (CO<sub>2</sub>)
  - Mandates that CO<sub>2</sub> from power plants be reduced by improving plant efficiencies. (Heat Rate Improvements)
  - The six candidate technologies are;
    - Neural Network/Intelligent Soot blowers
    - Boiler Feed Pumps
    - Air Heater and Duct Leakage Control
    - Variable Frequency Drives
    - Blade Path Upgrade (Steam Turbine)
    - Redesign/Replace Economizer
- REMANDED on January 19, 2021
- **New proposed regulations May 11, 2023**



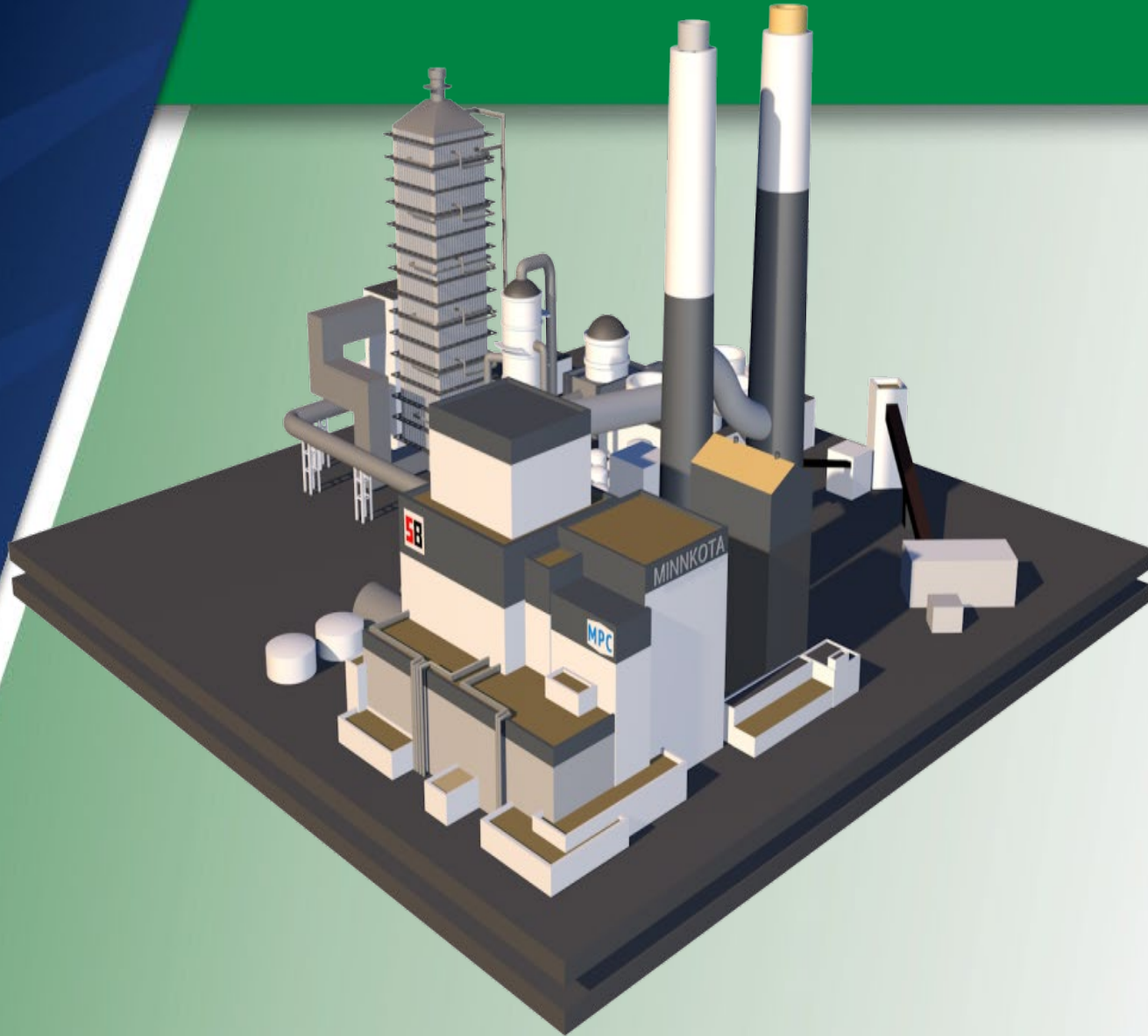


# Carbon dioxide control CO<sub>2</sub>

- Carbon constraint world
  - MRY is a billion dollar asset
  - Vast consumable coal reserves
  - Now what?????



# Carbon dioxide control CO<sub>2</sub>



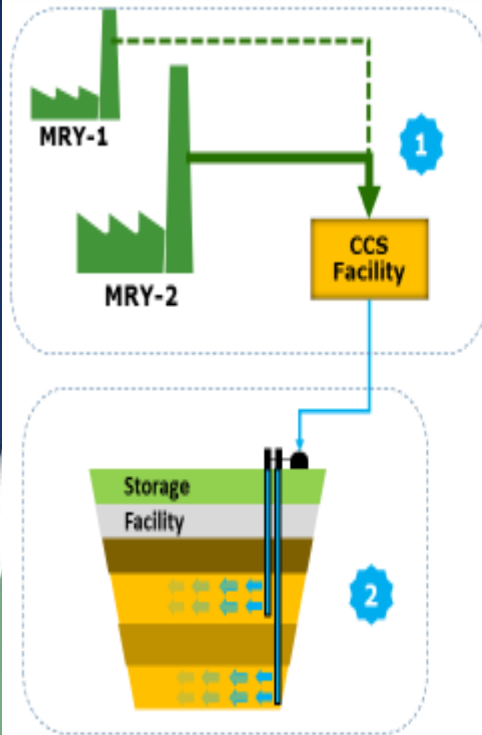
**SB** **Square Butte**  
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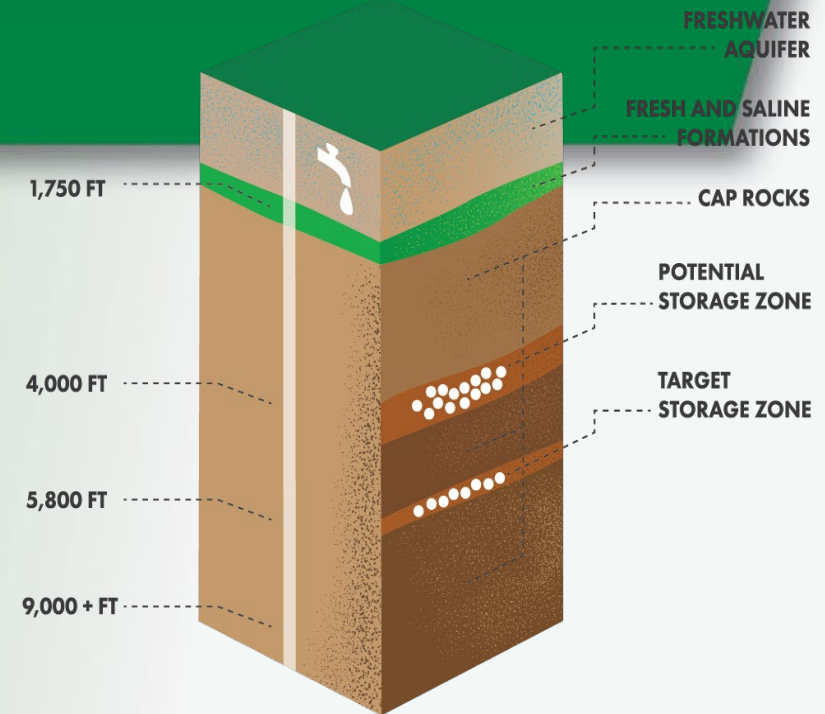
# PROJECT TUNDRA

## Project Tundra Overview



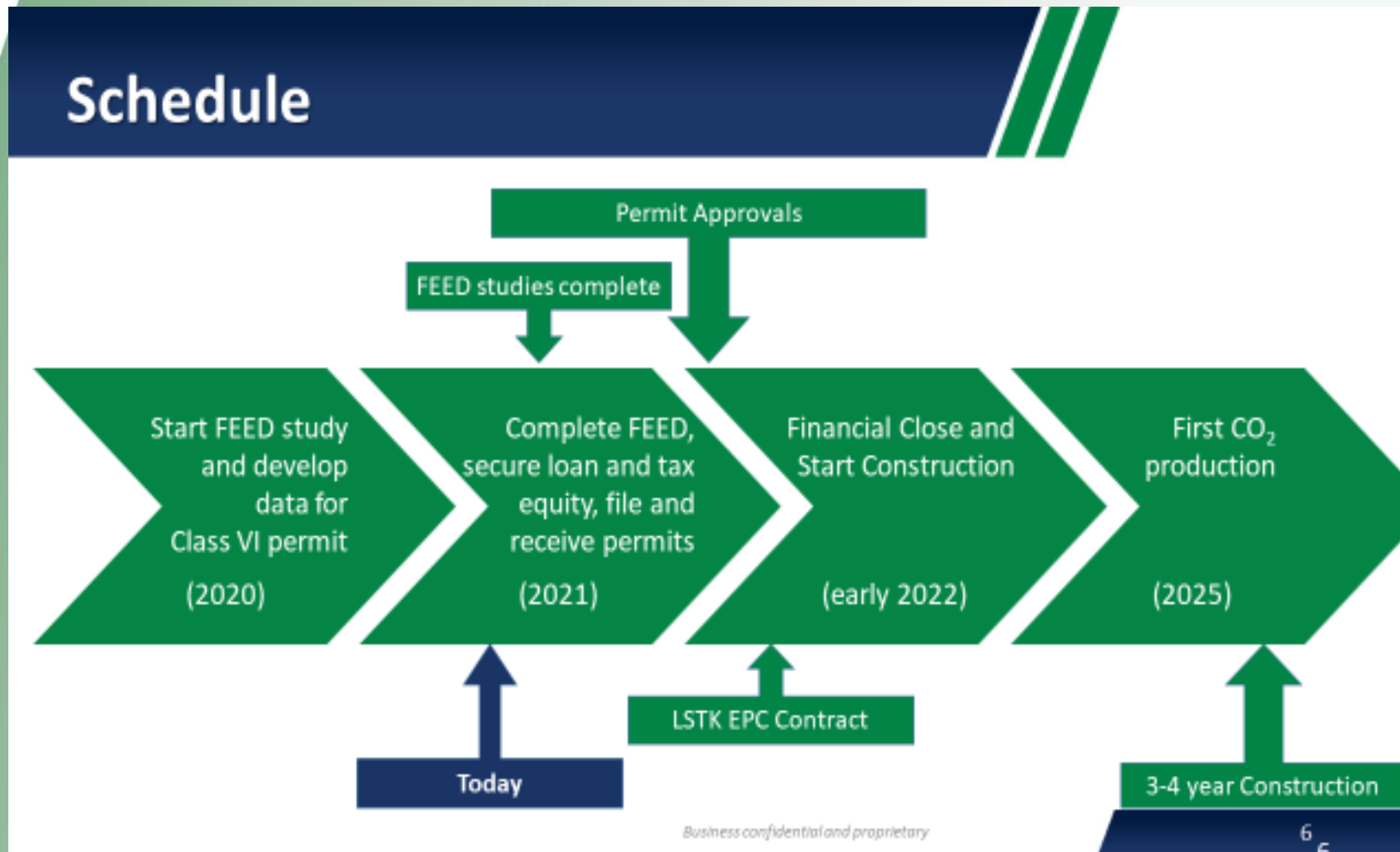
### Two Projects in One

1. Divert flue gas then separate CO<sub>2</sub> in a carbon capture system that strips out the CO<sub>2</sub> then liquifies under pressure.
2. Inject CO<sub>2</sub> into storage formation over a mile below lignite mine.



**SB Square Butte**  
ELECTRIC COOPERATIVE

# Project Tundra construction schedule



**Square Butte**  
ELECTRIC COOPERATIVE

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# QUESTION



< Activities



Visual settings



Edit



Respond at [PollEv.com/ligniteenergy220](https://poll-ev.com/ligniteenergy220)

Text **LIGNITEENERGY220** to **22333** once to join, then **A, B, C, D, E...**

**The primary "criteria pollutants" that power plants must currently manage are:**

- Nitrogen dioxide (NO<sub>x</sub>) A
- Sulfur dioxide (SO<sub>2</sub>) B
- Particulate matter (PM) C
- Sulfur trioxide (SO<sub>3</sub>) D
- Carbon dioxide (CO<sub>2</sub>) E
- Items A through C F
- All of the above G
- None of the above H

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# Land (Waste Disposal) Resource Conservation and Recovery Act of 1976

## North Dakota Solid Waste Management Rules (1980s)

- Permitting and requirements for landfills for coal ash and FGD waste
- Location standards, liners, groundwater protection and monitoring, operating standards, and financial assurance required

## ■ New Federal Coal Combustion Residuals Rule (“CCR” Rule, effective April, 2015)

- Layered “Over the Top” of existing ND Rules
- Public-facing websites required
- Originally, no permitting, but reliance on “citizen lawsuits” by E-NGO’s (Sierra Club, NRDC, etc.) WINN Act allows States to regulate
- Very similar to ND Rules, although there are some conflicting requirements NDDEQ adopted CCR regulations Jan, 2019.
- **New proposed regulations May 18, 2023**

## CCR Rule Compliance Data & Information

### Milton R. Young Station

Location Restrictions >

Design Criteria >

Operating Criteria >

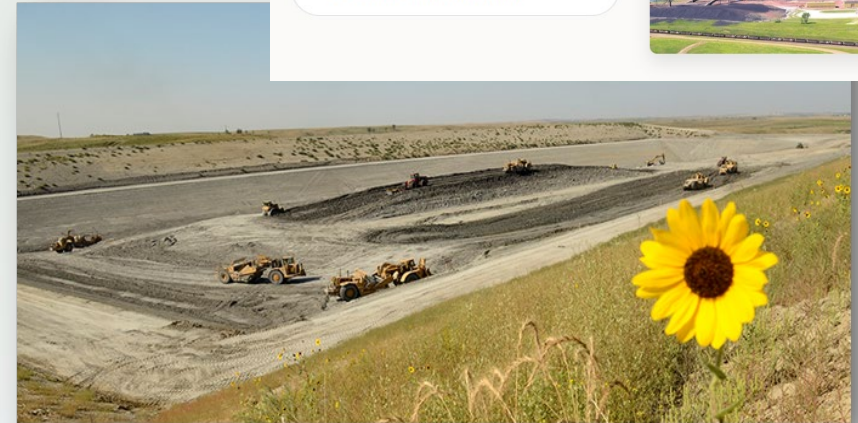
Groundwater Monitoring >

Closure & Post Closure >



### Coyote Station

Coyote CCR Data and Information >



# Composite Liner Construction

## *Clay and Synthetic Membrane (HDPE)*





# Beneficial Uses of Coal Combustion Residuals





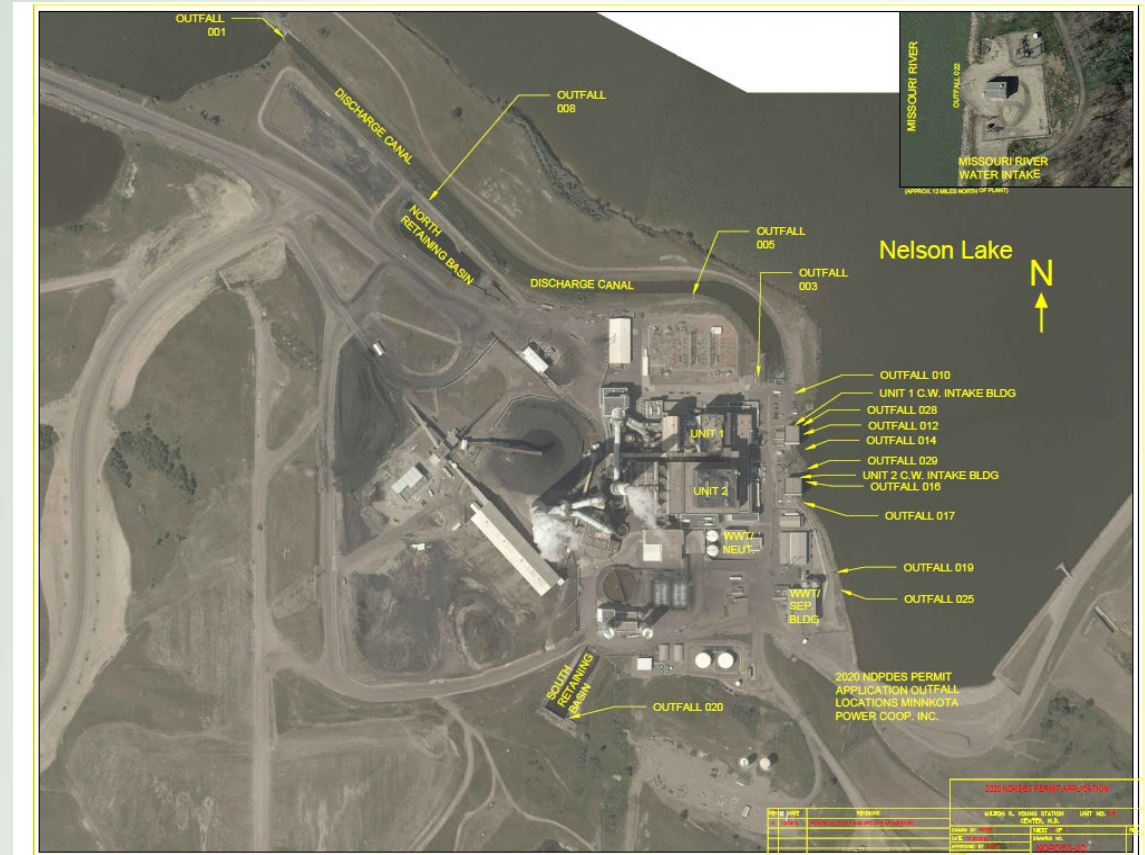
# Federal Water Pollution Control Act of 1972 (Clean Water Act Regulations) NPDES

- North Dakota Pollutant Discharge Elimination System (NDPDES) permits
  - Point Sources
  - Sampling and reporting
  - Effluent limitations
  - **New proposed regulations March 29, 2023**
- Stormwater permits
  - Non-Point Sources
  - Sampling and reporting
- Spill Prevention and Countermeasures Plans (SPCC)
  - Oil spill prevention



# Federal Water Pollution Control Act of 1972 (Clean Water Act Regulations) Nation Pollutant Discharge Elimination System NPDES

- North Dakota Pollutant Discharge Elimination System (NDPDES) permits
  - 14 Outfalls
  - Sample frequency varies
  - Whole Effluent Test reproduction rate of water flea, weight gain on minnows.





# Federal Water Pollution Control Act of 1972 (Clean Water Act Regulations) NPDES

- North Dakota Pollutant Discharge Elimination System (NDPDES) permits
- Stormwater permits
  - Non-Point Sources
  - 13 outfalls are monitored







# Conclusion - Key Points

- Regulations and standards apply to all facilities
- Compliance with regulations is non-negotiable
- Every facility has unique design circumstances and may have different emission control line-ups
- Permitting cycle varies and regulations allow to increase frequency
- Investments in technology have reduced emissions dramatically
  - \$2 billion in APC installed in ND (\$400M at MRYS)
  - \$100 million per year in O&M (\$15M/year at MRYS)
- Advances in technology continue to be made
- Our industry has a history of meeting the challenge of new regulations
- Technology being developed in the U.S. is state-of-the-art
- Technology developed here will meaningfully impact the worldwide development and use of coal



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# Questions?