REINHOLD ENVIRONMENTAL Ltd.

2012 APC Round Table
& Expo Presentation

July 16-17, 2012, in Baltimore, MD / Hosted by Duke Energy, Entergy, FirstEnergy, Southern Company & TVA

FGD Waste Water Treatment Workshop
July 16, 2012

Mark Ehrnschwender
Philip Elliott

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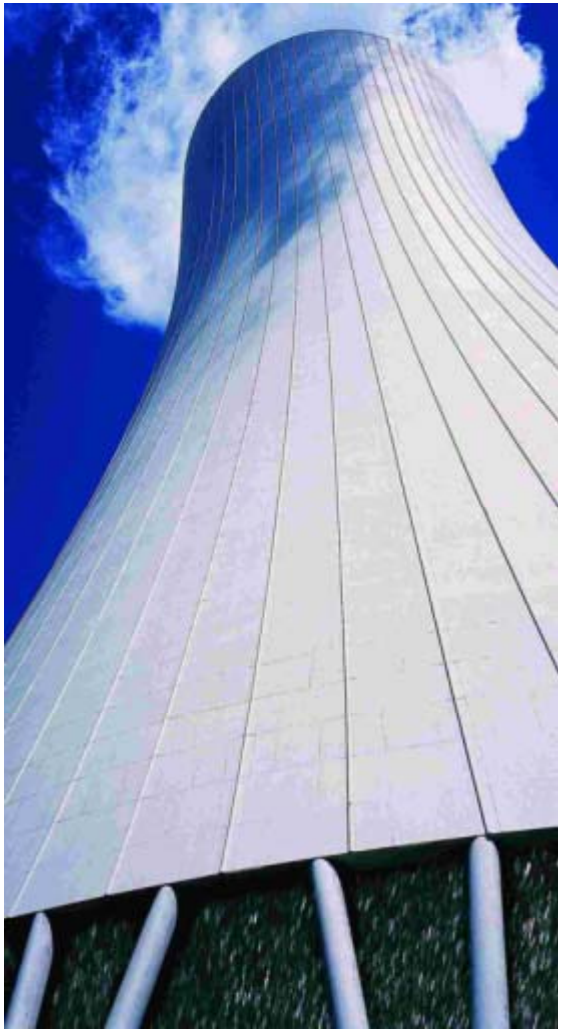
Agenda

- **STEAG and Presenter Biography**
- **Waste Water Treatment History**
- **Plants with FGD**
- **What is Driving the Requirements**



Presenters

Mark Ehrnschwender

Vice President of Enginnering and Business Development

Philip Elliott

Manager of Engineering and Project Services

Progress Energy for Eight Years

Concentration on Mercury and Waste Water at STEAG

STEAG's Coal-Fired Generating Fleet

Weiher

724 Mw_{el}

Fenne

502 Mw_{el}

Walsum

1,400 Mw_{el}

Lünen

500 Mw_{el}

Herne

1,150 Mw_{el}

Voerde

2,234 Mw_{el}

Bergkamen

778 Mw_{el}

Bexbach

773 Mw_{el}

Marl

600 Mw_{el}

Leuna

58 Mw_{el}

Köln-Godorf

211 Mw_{el}

Paipa, Colombia

165 Mw_{el}

Iskenderun, Turkey

1,320 Mw_{el}

Mindanao, Philippines

232 Mw_{el}

Ayas, Turkey

600 Mw_{el}

COD 2013

COD = projected commercial operation date

STEAG's Waste to Energy

2 X 15 MW Herten

1 X 22 MW Asdonkshof

1. STEAG Owner's Engineer
2. Operator of Plants

Waste Water Treatment Options

- **Dilemmas Faced by Operators**
  - **Uncertainty of inlet water quality**
  - **Change of fuels changing waste water treatment inlet parameters**
  - **Various Discharge Requirements**
  - **Different Waste Water Treatment Designs**

- **Goals for Operators**
  - **Investigate a range of proven wastewater treatment options**
  - **Establish strategies for treatment implementation**

Why is Waste Water Becoming More Important?

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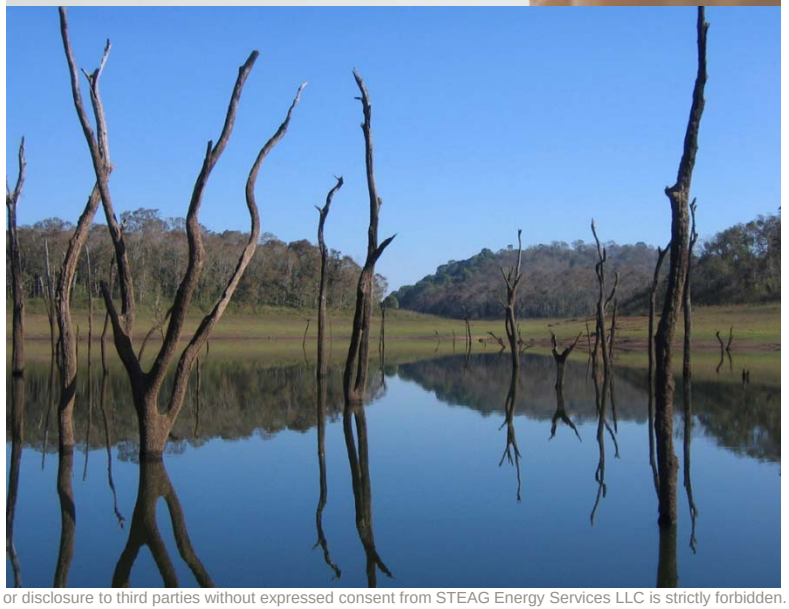
- 51% of Coal Fired Generation expected to have FGD for SO_2 control
- Plants are using scrubbers for co-benefit to meet other environmental mandates, i.e. mercury
- Waste Water Discharge Regulations are becoming more stringent and focusing on different constituents, i.e. Selenium
- Natural Gas Cost Driving Factor in Viability of Operating Coal Plants
- Coal Fired Plants are being forced to move in direction of zero discharge

Regulatory Atmosphere

- **Regulations Vary by State**
- **Discharge in most cases is cleaner than coming in**
- **Expected standard is 12 ppt Hg and 6 ppb Se**
- **Drinking water standard is 2 ppb for Hg, 50 ppb for Se**



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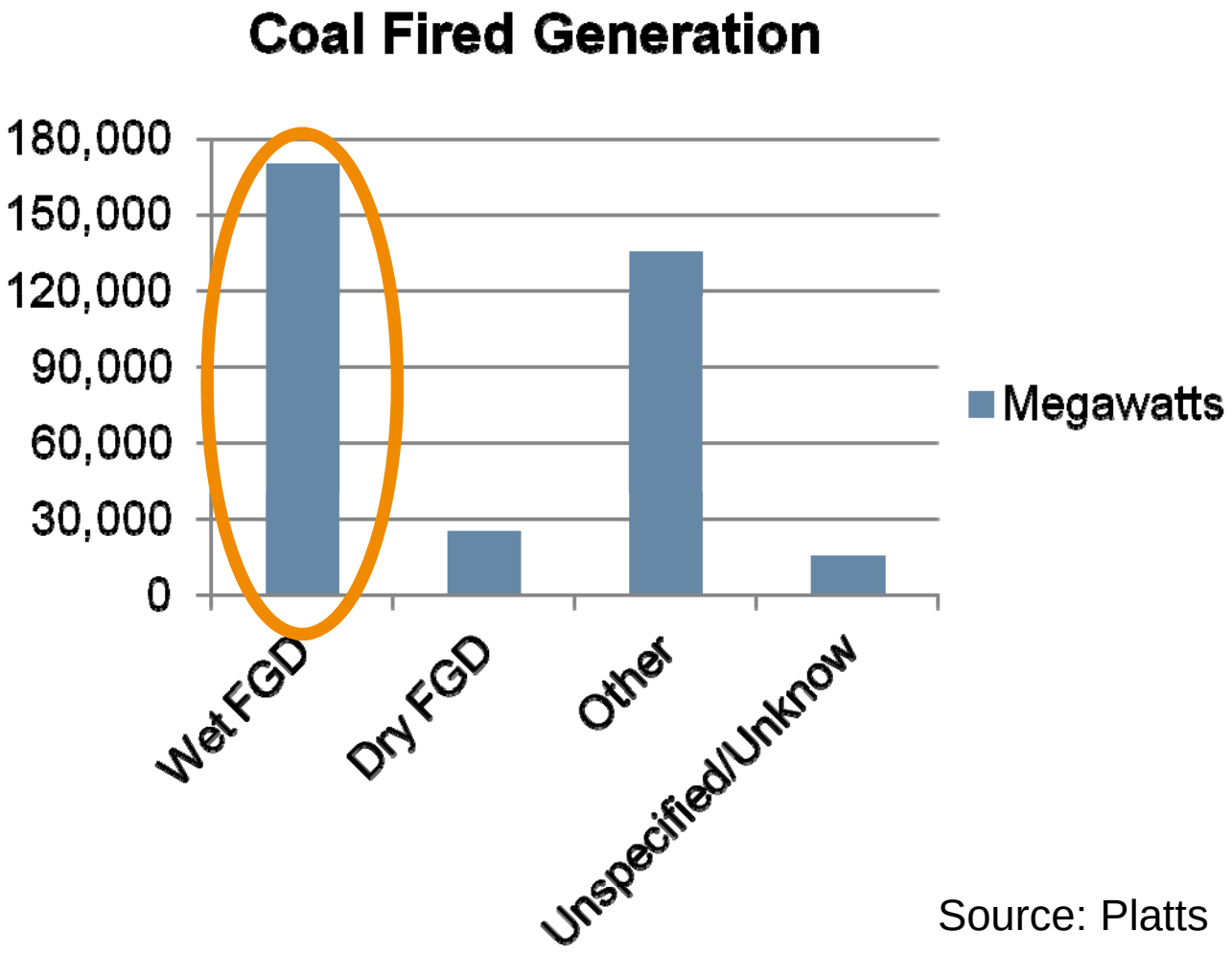
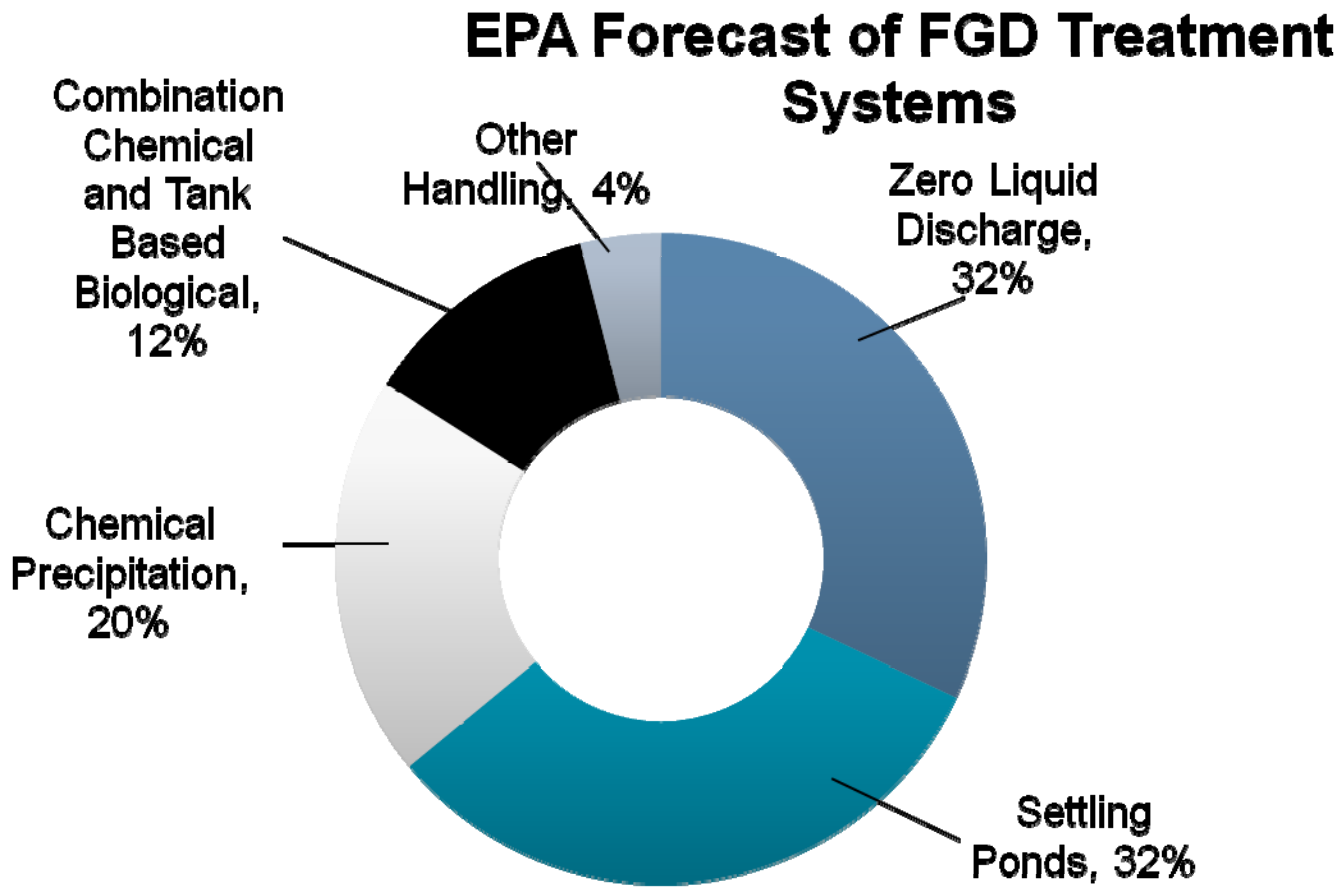
Philip Elliott, 7/15/2012

SO_2 Control Technologies

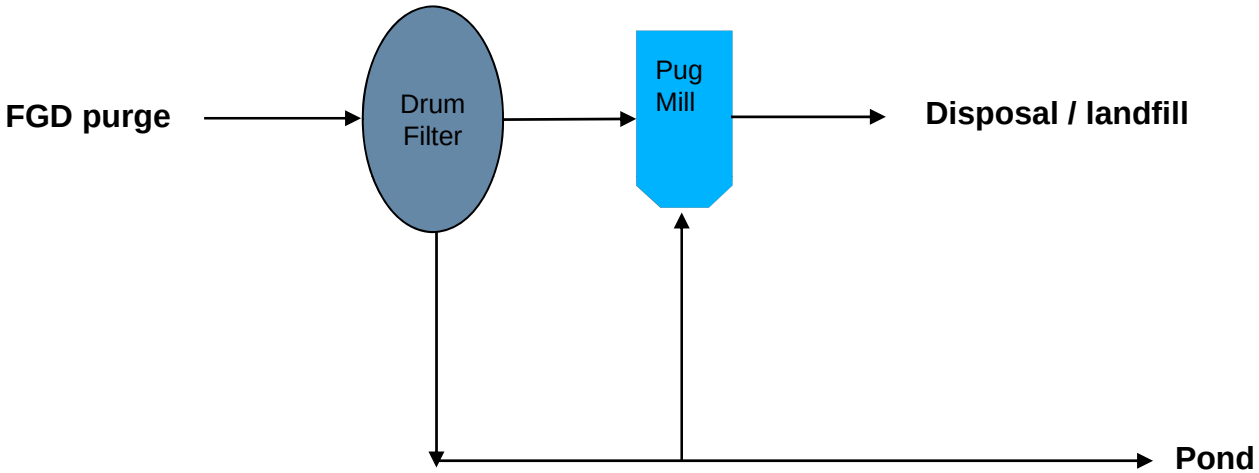


Source: Platts

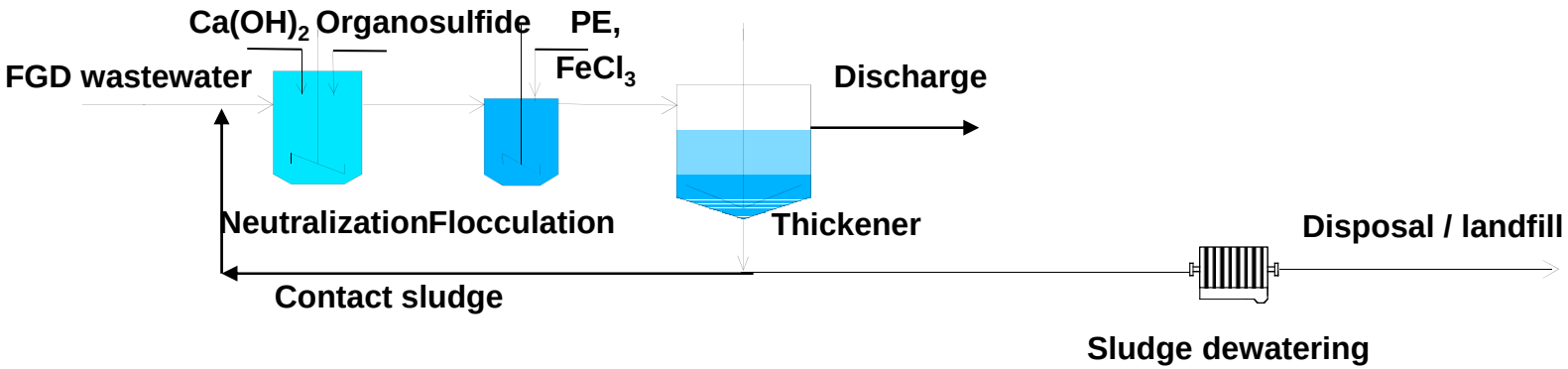
Waste Water Control Technologies



Phase 0 of Waste Water Treatment

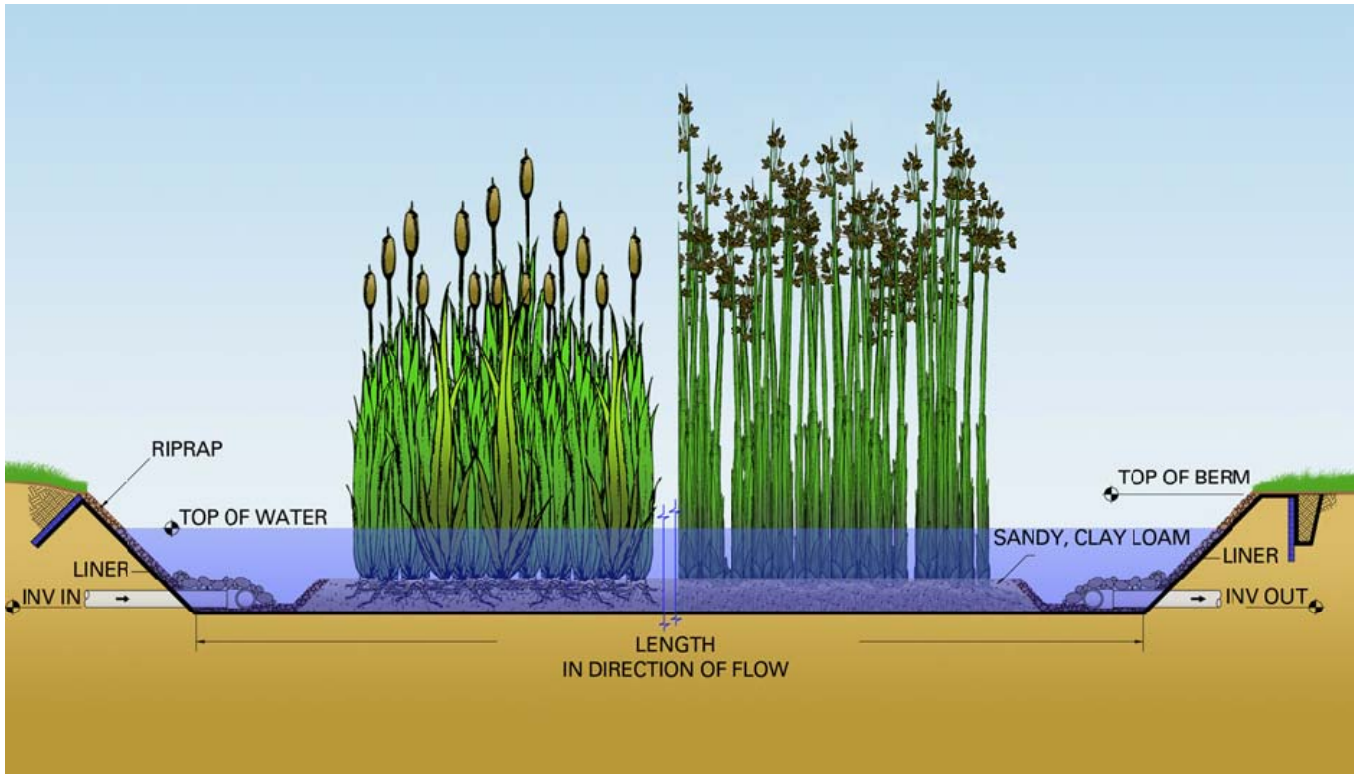


Phase I of Waste Water Treatment



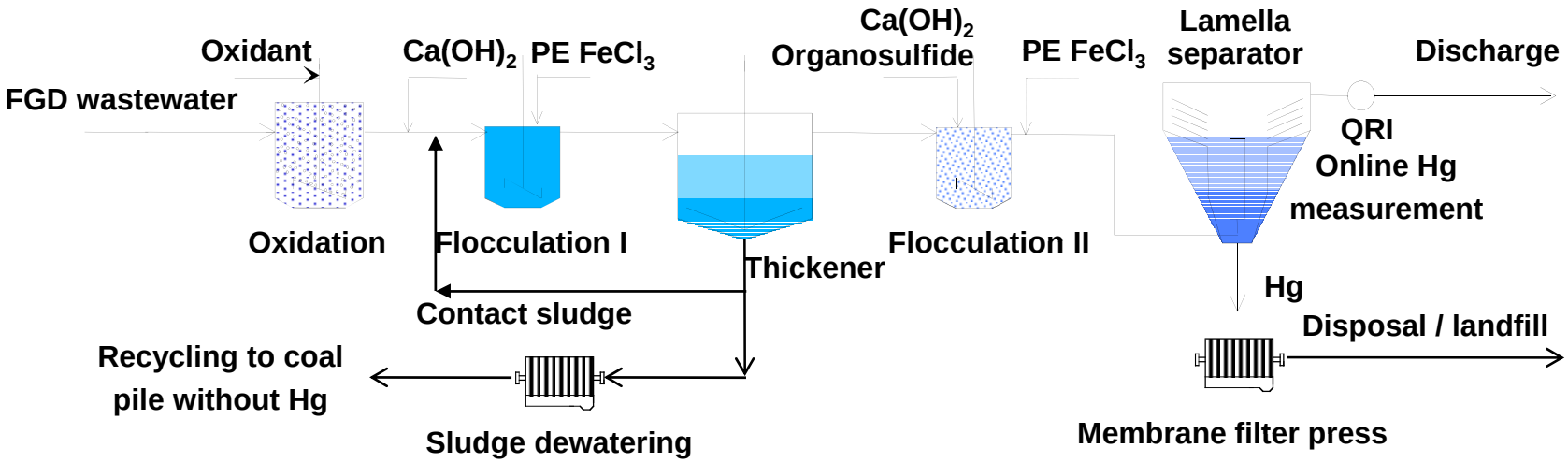
Phase II Waste Water Treatment

Constructed Wetlands



Source: Natural Systems International

Phase II Waste Water Treatment



Phase III Waste Water Treatment

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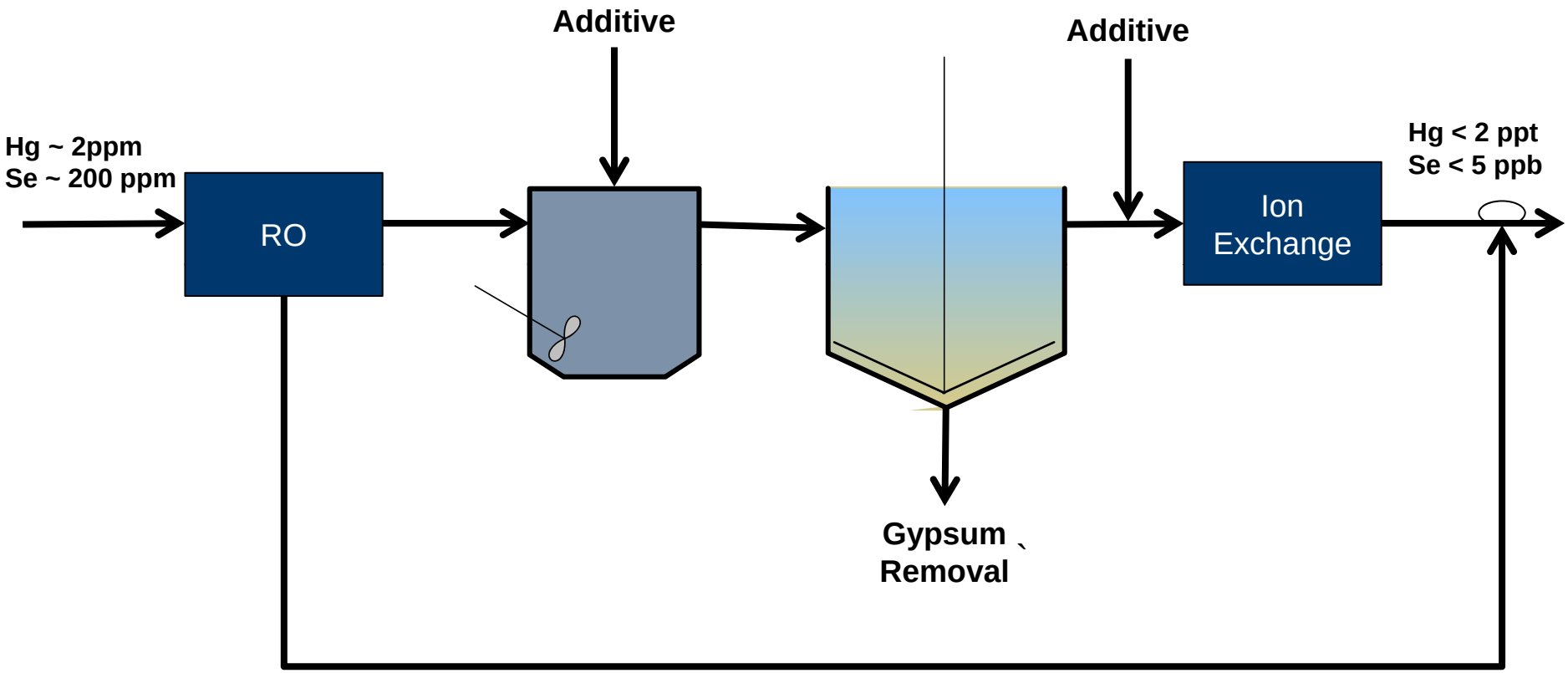
Bioreactor

Source: Duke Energy Roxboro Plant

Phase III Waste Water

- **Zero Liquid Discharge (ZLD)**
- **Produce up to 100 – 200 tons per day of residue**
- **Corrosive environment**
- **Calcium chlorides is the greatest component**
- **Very Energy Intensive**
- **Liquid Evaporated using steam or electrical**
- **Reverse Osmosis**

Current STEAG Development
The Selenium/Mercury Removal Step



Drinking water has a limit mercury limit of 12 ppt!

Water can be reused into the cooling tower / boiler feed make-up – Beginning steps of Zero Liquid Discharge (ZLD).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