



COMPLETE ENVIRONMENTAL SOLUTIONS



# Advances In Emission Control Technology For Marine Operations

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*President & CEO*  
*Ship & Shore Environmental, Inc.*



CONSULTING » ENGINEERING » DESIGN » PERMITTING » FABRICATION » INSTALLATION » SERVICE

# Experience & Leadership

INNOVATIVE ENGINEERING SERVICES & SOLUTIONS

## SOLUTIONS

Custom Designed Environmental Solutions that Meet Each Clients Interest, Process, Project & Budget.

## GOAL

Maximize Performance & Develop Cost Effective Abatement & Energy Recovery Systems for Each Unique Application.

## EXPERIENCE

Innovative Engineering Group Dedicated to Excellence and Partnership with Clients. Proven 100% Compliance Track Record.

## REPUTATION

Recognized by SCAQMD, EPA and all other regulatory agencies as BACT. All systems meet & exceed the most stringent regulations and rules.



# Presentation Outline

- **Types of Emission Control Technology**
- **Air Pollution**
- **Thermal Oxidation Technology**
  - Science & Principles
  - VOC Abatement
  - Pollution Abatement Equipment
- **Barge Degassing Technology**
  - Case Study



# Types of Emissions Control Technology

## CLEAN TECH PRODUCTS AND SERVICES



- ❖ Regenerative Thermal Oxidizers
- ❖ Recuperative Thermal Oxidizers
- ❖ Catalytic Oxidizers
- ❖ Steam Generating Thermal Oxidizers
- ❖ Direct Fired Thermal Oxidizers
- ❖ Flares
- ❖ Barge Degassing
- ❖ Heat Recovery Systems
- ❖ Waste Heat & Energy Recovery Systems
- ❖ Carbon/Zeolite Concentrators
- ❖ VOC Collection Systems

# Types of Air Pollution

## **Volatile Organic Compounds (VOCs)**

Organic chemical compounds that have high enough vapor pressures under normal conditions to significantly vaporize & enter the atmosphere. A wide range of carbon-based molecules, such as aldehydes, ketones, and other light hydrocarbons, are VOCs

### Examples of Common VOCs

Toluene	Propanol
Xylene	Butanol
Heptane	Acetone
Hexane	Methanol
Benzene	Isopropyl Acetate
Ethanol	MEK



# Types of Air Pollution

**Hazardous Air Pollutants (HAPs)** – Chemicals known or suspected to cause cancer or to have other serious health effects, such as reproductive effects or birth defects, or that have adverse environmental impact.



# Air Pollution

S&SE AND GOVERNMENTAL REGULATORY AGENCIES

**The US EPA advises that Industrial manufacturing companies with a facility or operation that has VOC or HAP-related emissions problem can either:**

- 1. Change the process** – lower production, reformulate, or relocate
- 2. Collect the VOCs or HAPs** – use carbon adsorption, condensation, etc. to capture pollutants
- 3. Destroy VOCs or HAPs** – use thermal or catalytic processes to eliminate pollutants to the extent *possible (the most economical solution)*



# Thermal Oxidation Technology

SCIENCE AND PRINCIPLES



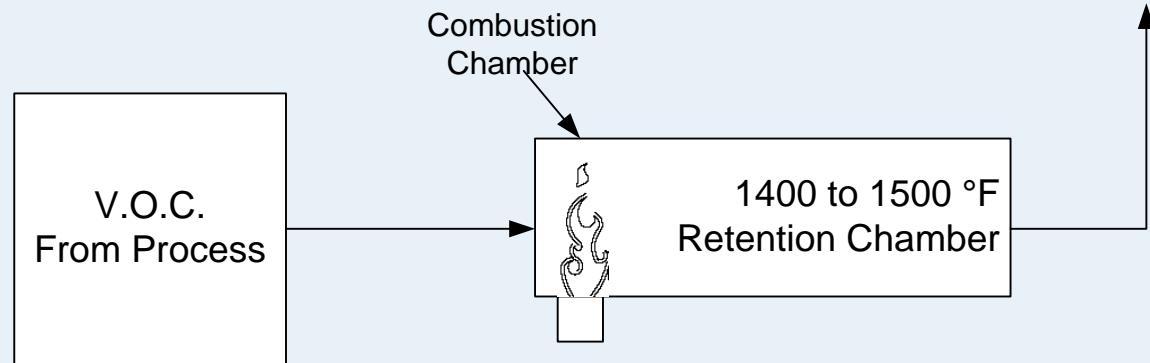
## Change in Enthalpy Temperature

- As Air
  - $T_{in} = 77^{\circ}F$                        $H1 = 0.32 \text{ BTU/cf}$
  - $T_{out} = 1500^{\circ}F$                        $H2 = 28.24 \text{ BTU/cf}$
- $Q = F \times \Delta H$
- Energy Required = Flow x Enthalpy (In-Out)
- VOC also provides energy



# VOC Abatement

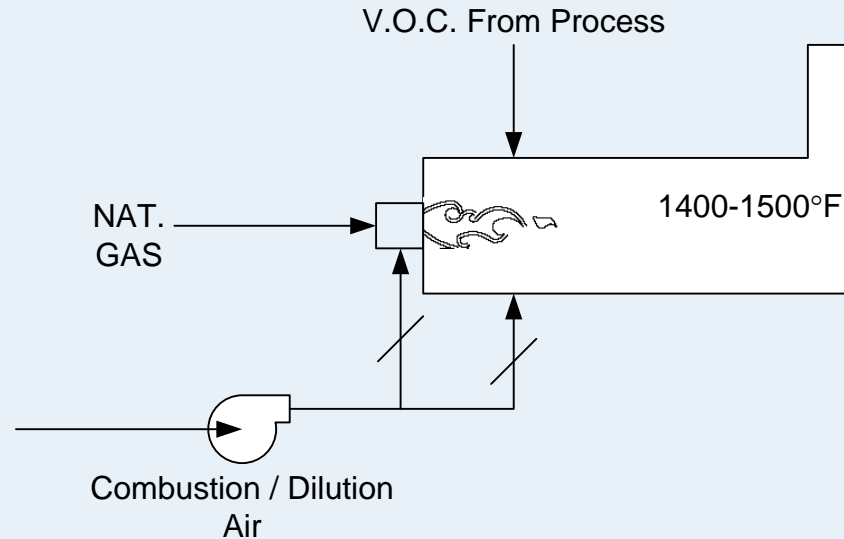
## BY THERMAL OXIDATION



- VOC is a hydrocarbon compound
- Low concentrations of VOC will not sustain a flame, however, provides a BTU value
- Most oxidation occurs in a combustion chamber
- Final oxidation occurs in a retention chamber

# Straight Thermal Oxidizer

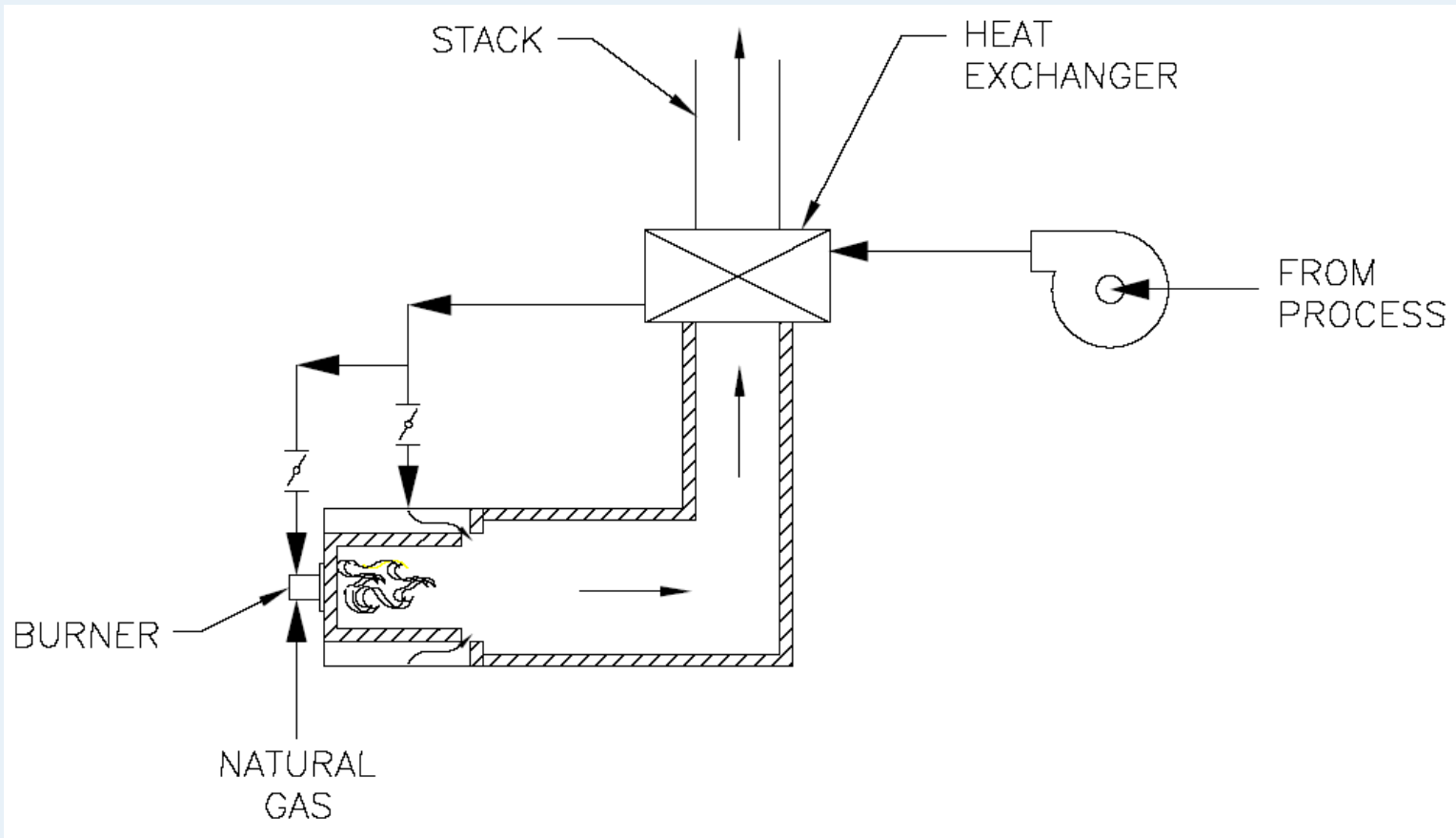
HIGH VOC CONCENTRATIONS



- VOC concentration up to 50% LEL
- Destruction rate 99%+
- High VOC concentrations results in low fuel consumption

# Recuperative Thermal Oxidizer

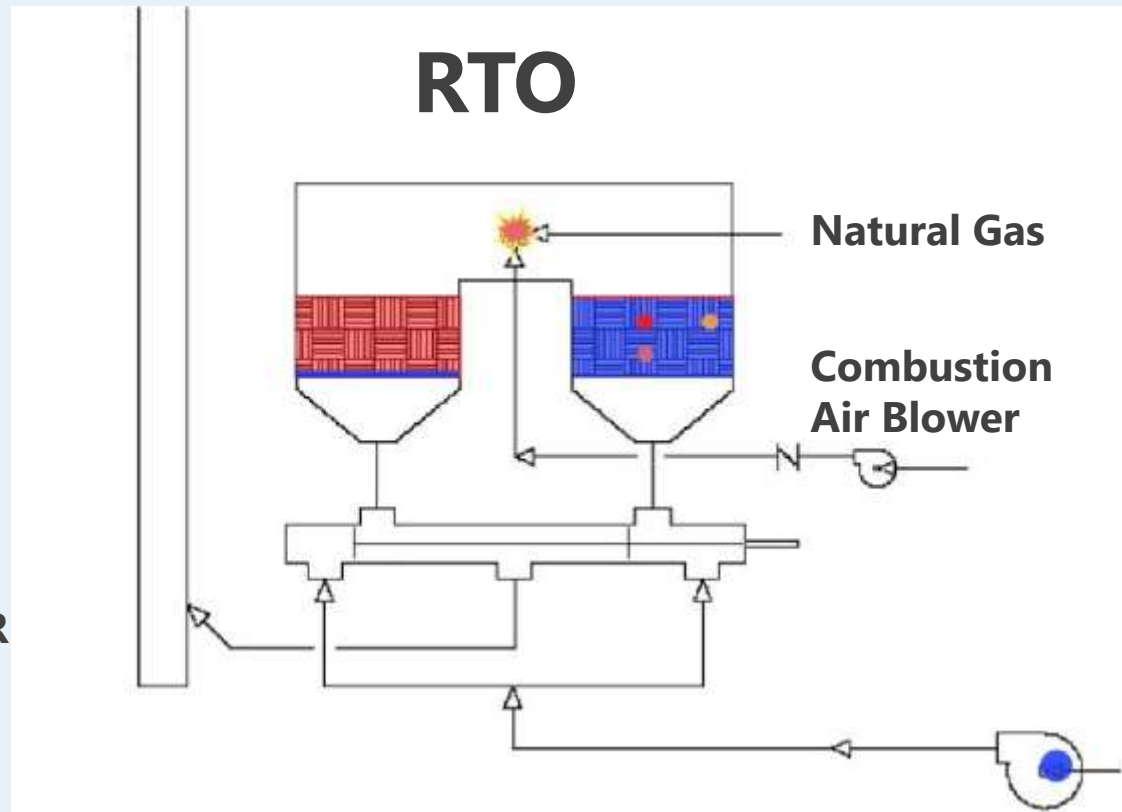
VOC CONCENTRATIONS 10-35% LEL



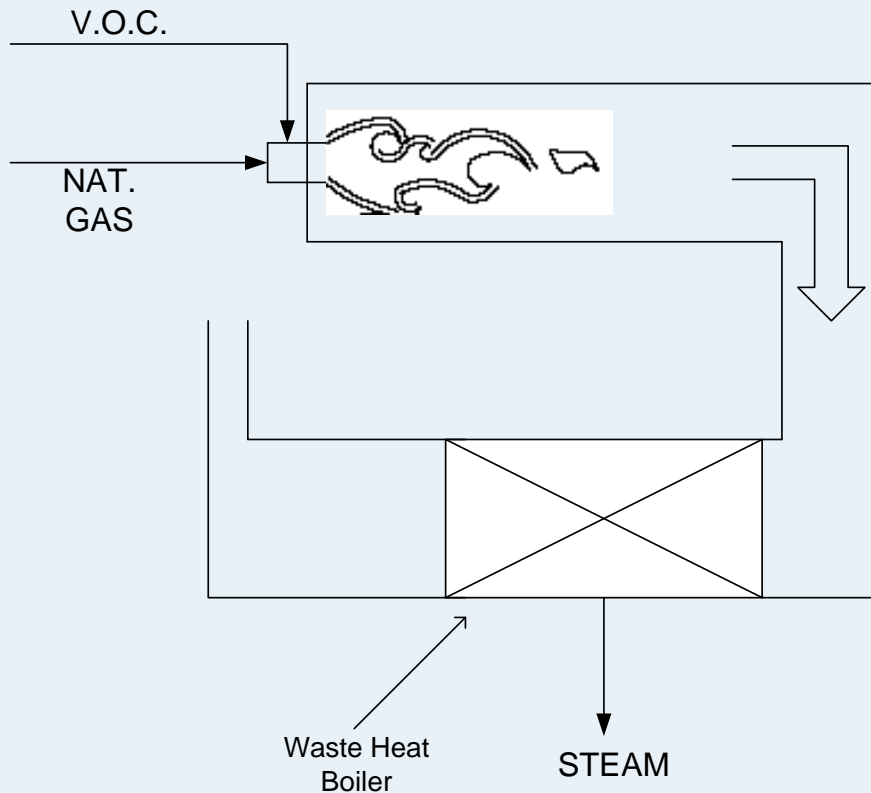
# Regenerative Thermal Oxidizer

## STACK

- ❖ TYP V.O.C. < 10% LEL
- ❖ High Flows & Low Concentration
- ❖ Fuel Efficient
- ❖ Destruction up to 99% DER



# Steam Generating Thermal Oxidizer



- Steam Generated with Waste Heat
- VOC contributes to fuel reduction
- TYP 70% efficient

# Waste Heat Recovery

SAVE AND RE-USE ENERGY WHILE REDUCING OPERATING COST.



**Heat Exchanger Installed on RTO Exhaust Stack to Capture Waste Heat & Provide Warm Process Air**



**Heat Exchanger**



**Condensing Economizer**



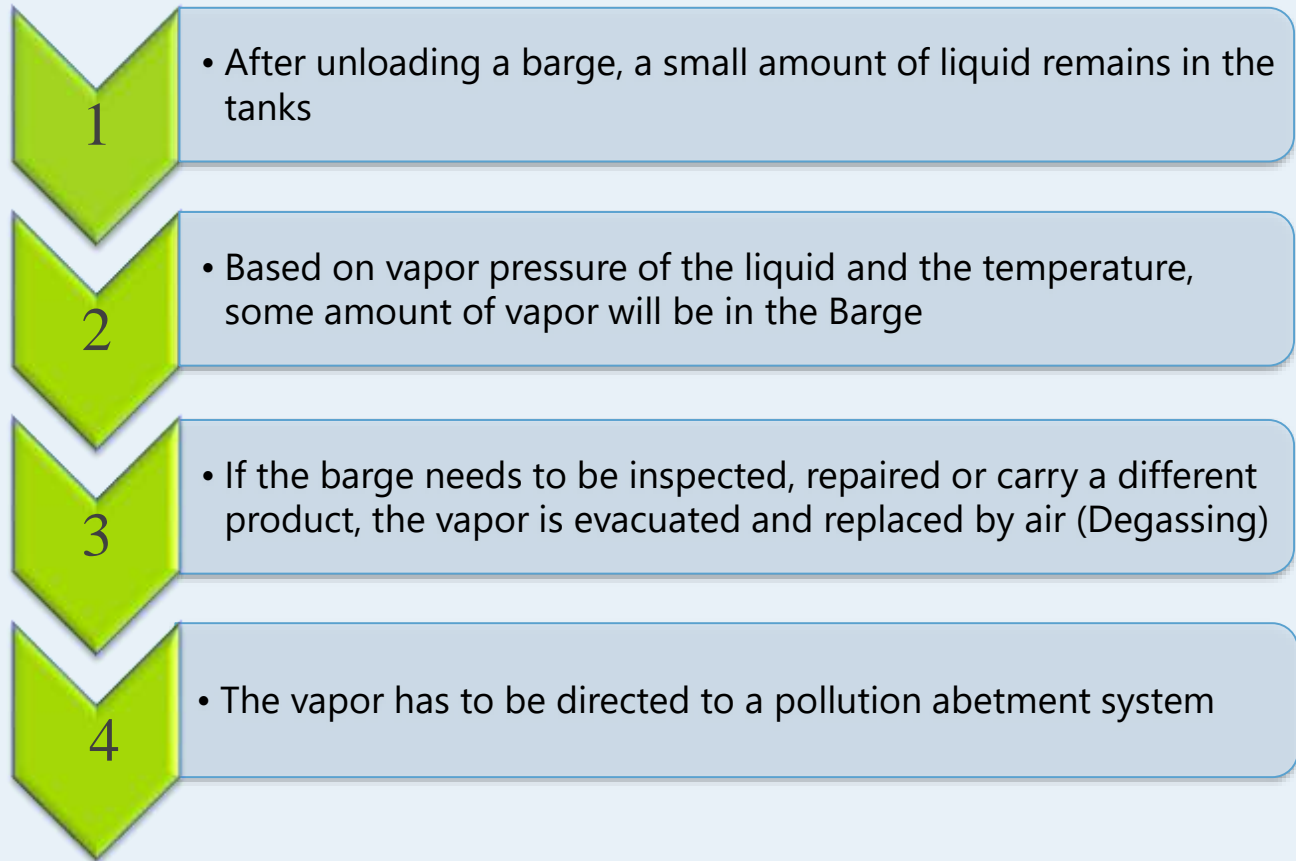
# Barge Degassing

SYSTEM DESIGNED FOR MARINE OPERATION ENVIRONMENTAL COMPLIANCE



# Barge Degassing

SYSTEM DESIGNED FOR MARINE OPERATION ENVIRONMENTAL COMPLIANCE





# Barge Degassing

## TYPICAL METHODS



**Flaring**



**Oxidation**



# Barge Degassing

SAFETY AND ENVIRONMENTAL REGULATIONS



- **Department of Homeland Security Coast Guard (46 CFR Chapter I Part 39)**
  - *Part 39: VAPOR CONTROL SYSTEMS*
  - *Subpart 39.3000- Vapor Collection Operations During Cargo Transfer*
- **EPA**
- **1-96 NAVIC CFR**
- **CFR 154 Subpart P : Marine Vapor Control System**

# Barge Degassing

SAFETY IN OPERATION



1

- During the degassing process, the vapor concentration can fall between LEL and UEL zone which can be dangerous

2

- For the oxygen levels to remain low, the vapor stream to the combustion device must be:
  - Enriched
  - Inerted and Diluted


3

- Enriching needs lots of fuel and its costly.

4

- We designed a system that not only oxidize the gasses, but produces inert, oxygen deprived, gas for the degassing operation

# Barge Degassing Steam & Inert Gas Generating Thermal Oxidizer



**Takes safety of degassing, fuel consumption, waste heat recovery, and environmental compliance into one solution**

**The system utilizes steam generating thermal oxidizer (SGTO) where the heat from combustion of the vapors in the barge are used to generate steam (which can be used to clean the barge)**

**The boiler's exhaust gas will be used for inerting the barge**

# Barge Degassing System

CASE STUDY – SHIP & SHORE CUSTOMER

## CUSTOMER

- Shipyard Company in Baytown, TX
- Builds and repairs ships and barges

## PROCESS

- Barges were emitting a variety of highly flammable and explosive hydrocarbon vapors



# Barge Degassing System

CASE STUDY – SHIP & SHORE CUSTOMER

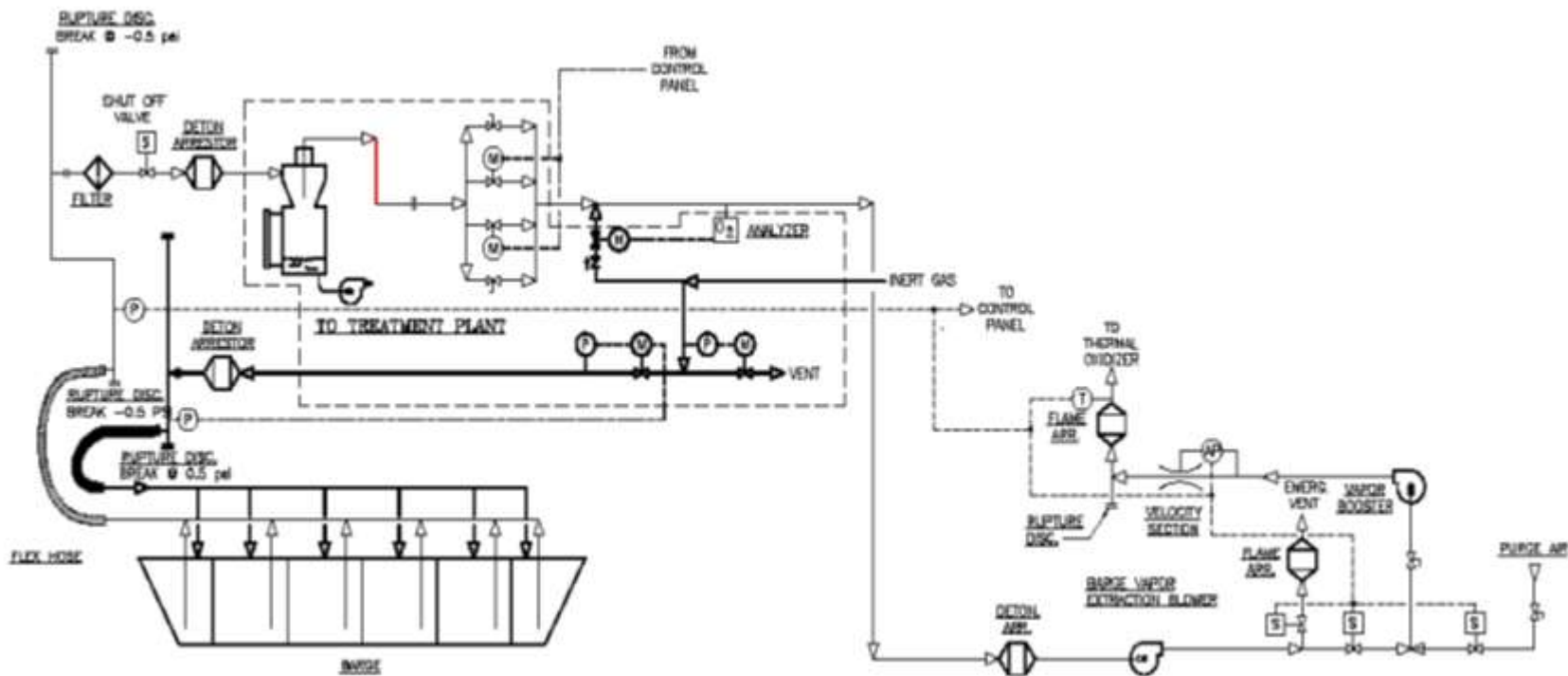
## **SOLUTION**

- Custom-designed barge degassing system to evacuate hydrocarbons from barges
- Oxygen-deprived gas introduced to barge to prevent explosive conditions
- Barge emissions directed to abatement system:
  - SGTO
  - Boiler
  - Fume Preheat Exchanger & Flue Gas Heat Exchanger
  - Vapor/Liquid Separator
- System was approved by the Coast Guard and recognized as Best Available Control Technology (BACT)



# Barge Degassing System

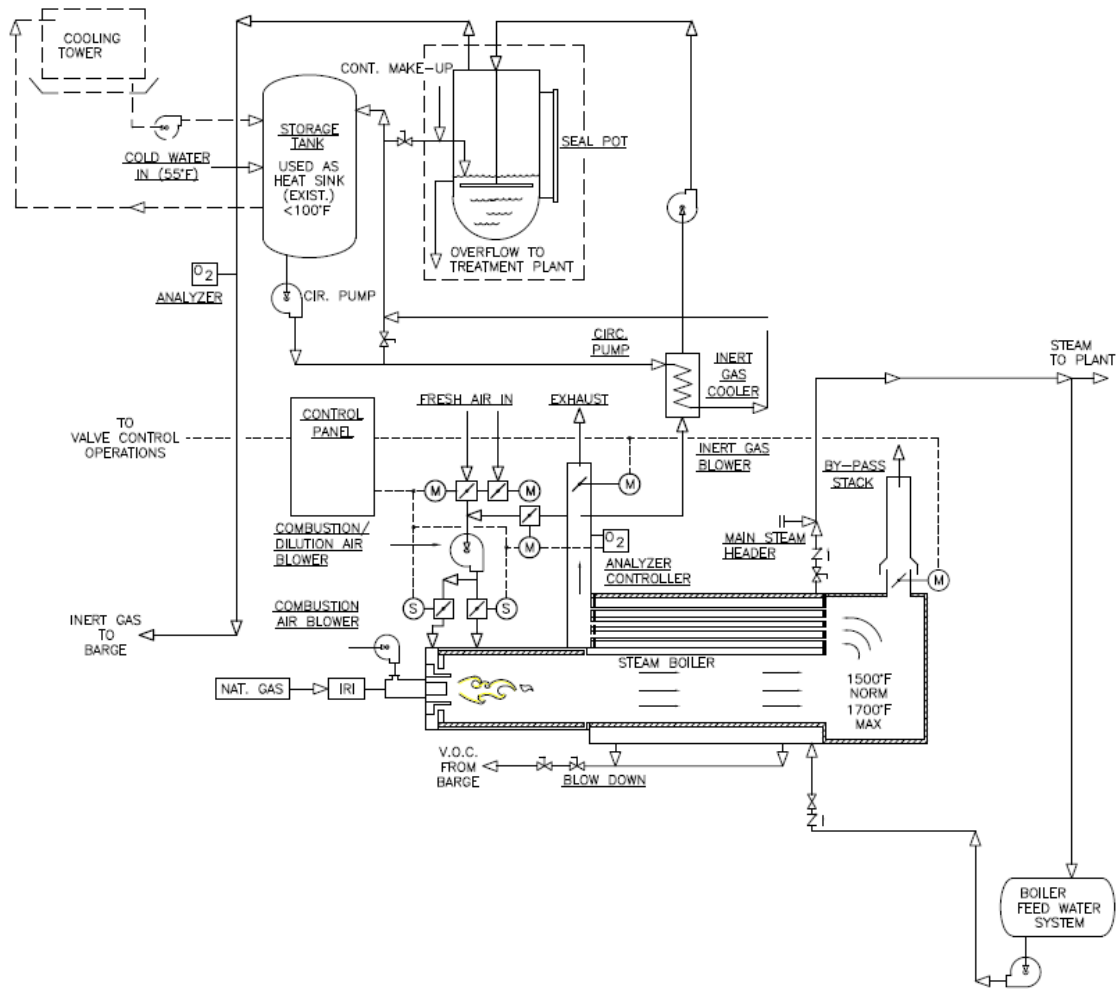
## VOC COLLECTION SYSTEM FROM THE BARGE



Drawing of Collection System from the Barge

# Barge Degassing System

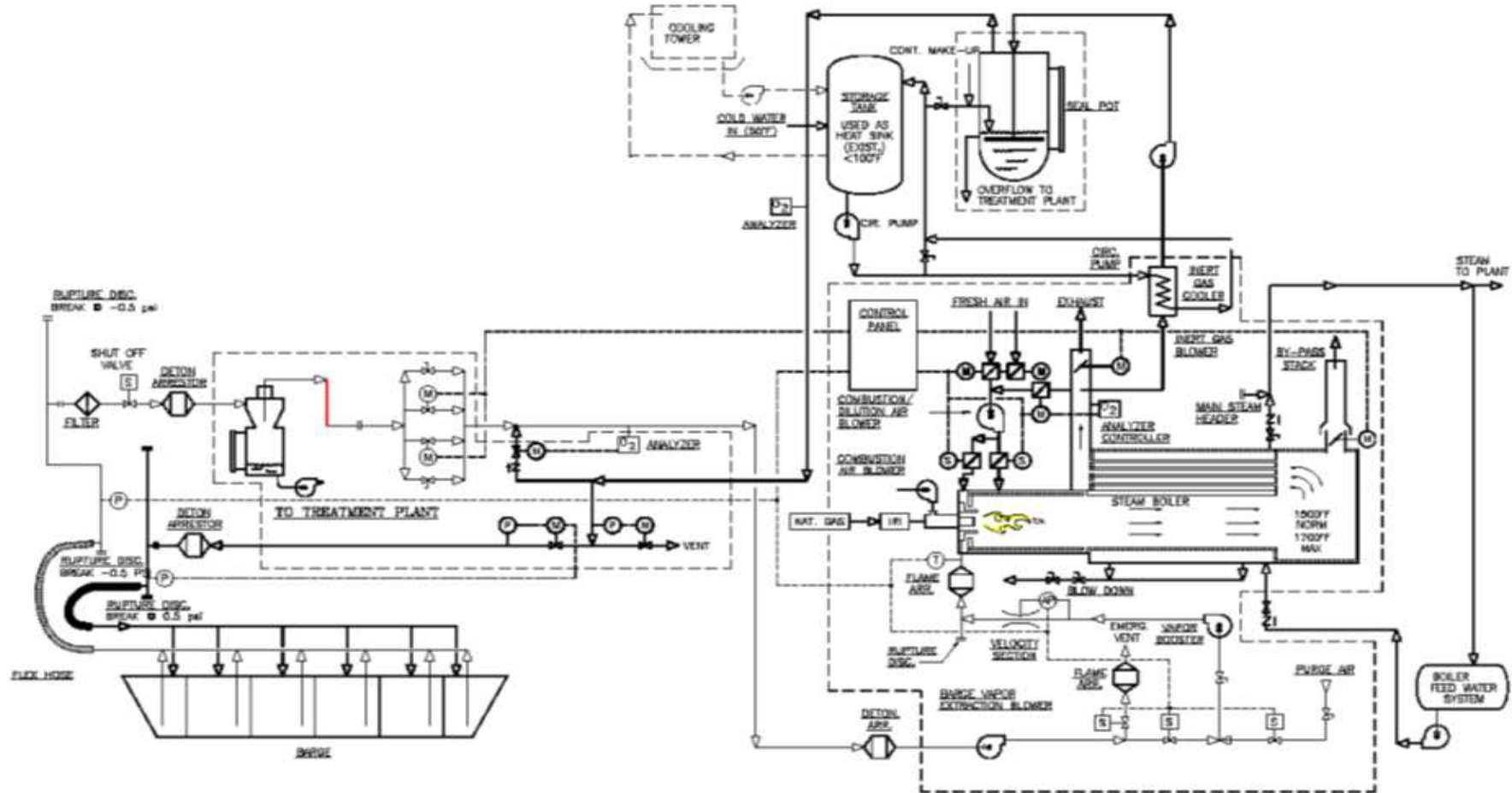
STEAM AND INERT GAS GENERATING THERMAL OXIDIZER





# Barge Degassing System

COMPLETE SYSTEM = COLLECTION SYSTEM + THERMAL OXIDIZER



# S&SE Clean Tech Systems

MOST ECONOMICAL VOC ABATEMENT SYSTEM FOR INDUSTRY



**MAXIMUM VOC  
CAPTURE  
CONTROL &  
COMPLIANCE**



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