# Sustainable Development on Clean Energy

**eliminate SOx, NOx and CO2 Emission**

**Oil/Gas Industry- Workshop No.1- Section No.1**

**Global Warming Avoided, Climate Change Avoided and Eradicate Poverty**

**Aim of Workshop: Developing Human Capability & Capacity for Community Wellbeing**

## Dr. Tariq Masood

**(MSE. M.Phil., PhD, CEng, UK)**


Be **BEST** in the World either way **DIFFERENT** from others and become **LARGER** than Life

**Senior Member**: Institute of Electrical & Electronic Engineers **(IEEE), US,** Credential **ID. 41369946**
**Senior Member**: American Institute of Chemical Engineers **(AIChE), US,** Credential **ID.009903742700**
**Certified Member**: American Society of Certified Engineers **(ASCET), US,** Credential **ID. elect/1950**
**Chartered Engineer**: Royal Engineering Council **(EC), UK,** Credential **ID. 569033**
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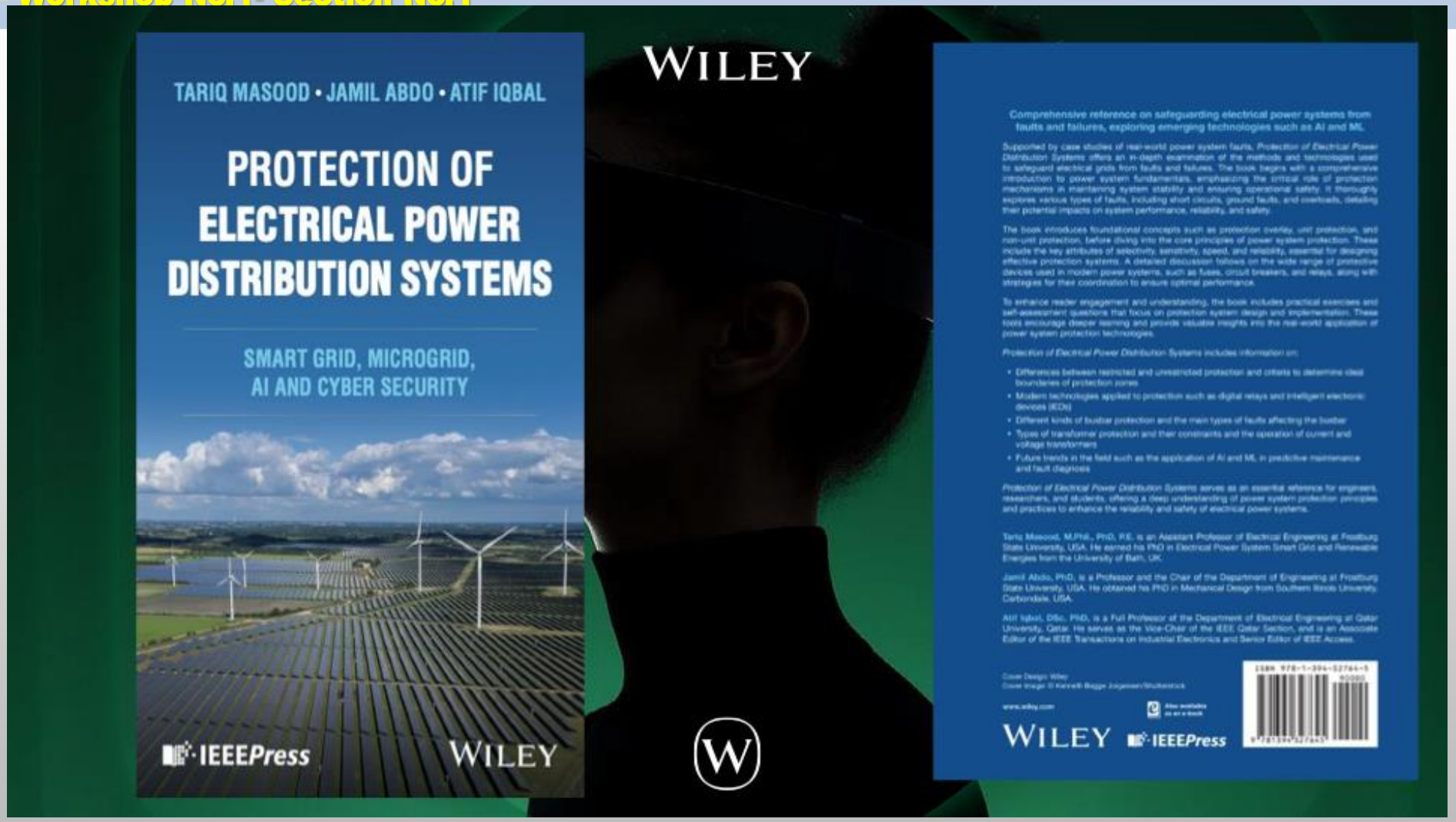

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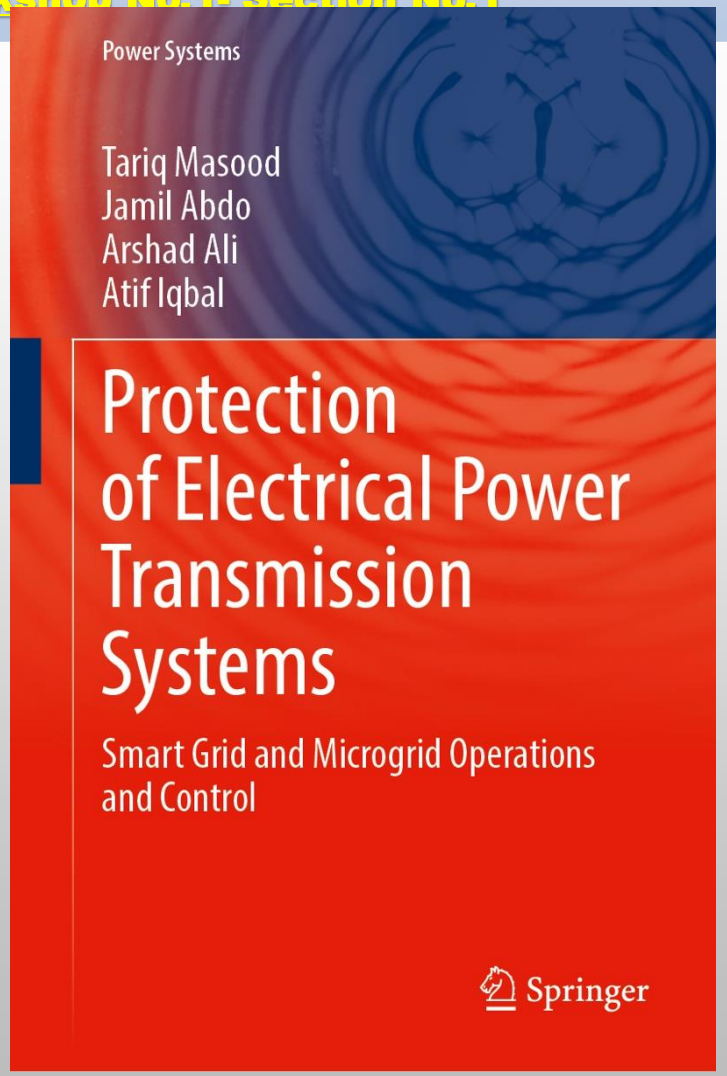

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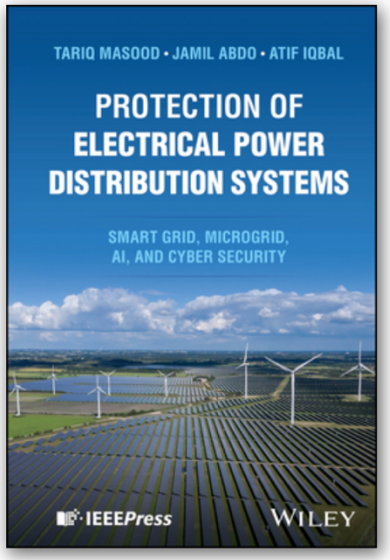


# Protection of Electrical Power Distribution Systems

*Tariq Masood*

**$150.00**

**Publish Date:** October 21, 2025
**Publisher:** Wiley-IEEE Press
**ISBN:** 9781394327645
**Pages:** 432
**Language:** English

QTY 1

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## DESCRIPTION

# Sustainable Development on Clean Energy

e l i m i n a t e  S O x ,  N O x  a n d  C O 2  E m i s s i o n

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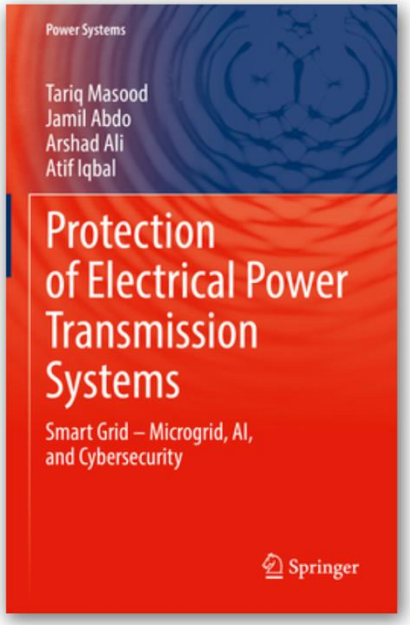


## Protection of Electrical Power Transmission Systems: Smart Grid - Microgrid, Ai, and Cybersecurity (Power Systems)

*Tariq Masood, Jamil Abdo, Arshad Ali*

**$109.99**

**Publish Date:** January 3, 2026
**Publisher:** Springer
**ISBN:** 9783031943119
**Pages:** 371

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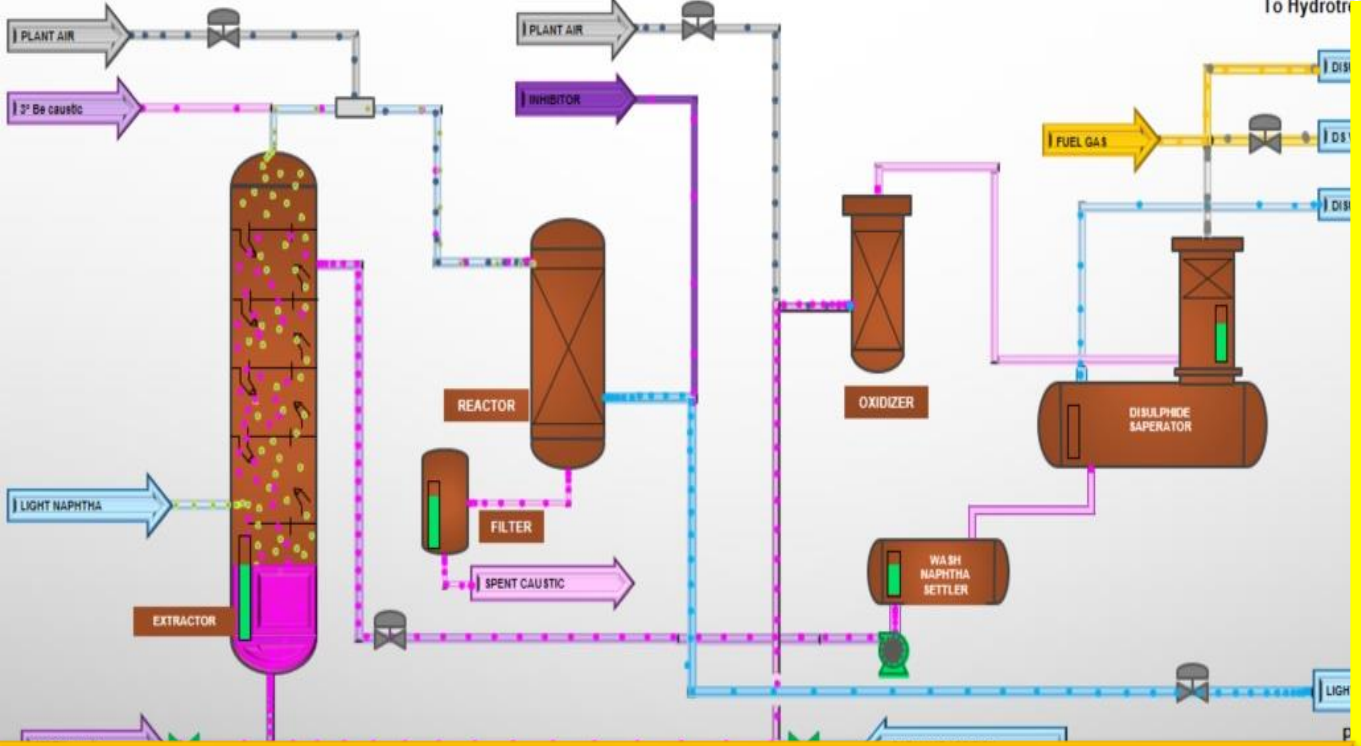
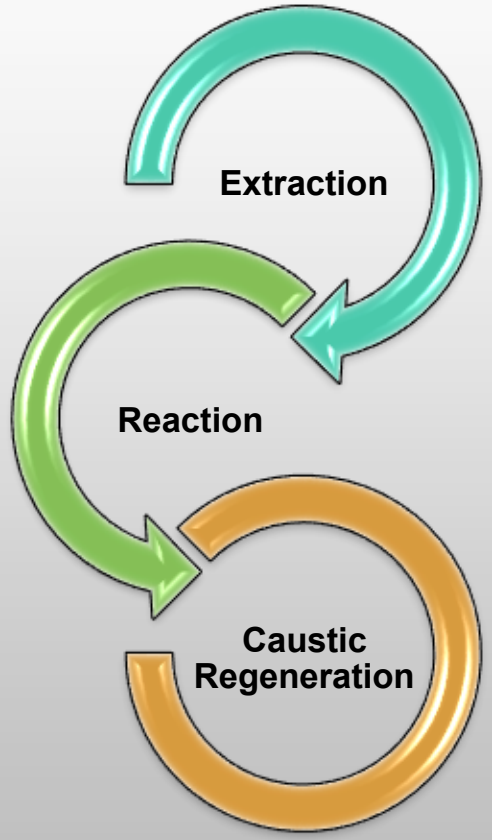



## Key Takeaway Points from the Workshops No.1

1. Theoretical approach for Hydrocarbon Treatment
2. What is Treatment process
3. Five key elements of treatment process
4. Treatment process Schematic
5. Artificial Intelligence Light gasoline Treatment model
6. **Production Best Practices Chemistry**
   1. Role of Center of Excellence
   2. Role of Discipline Engineers in Oil/Gas Industry
   3. Engineering Best Practices Initiatives
7. Product Quality and Environment Compliance

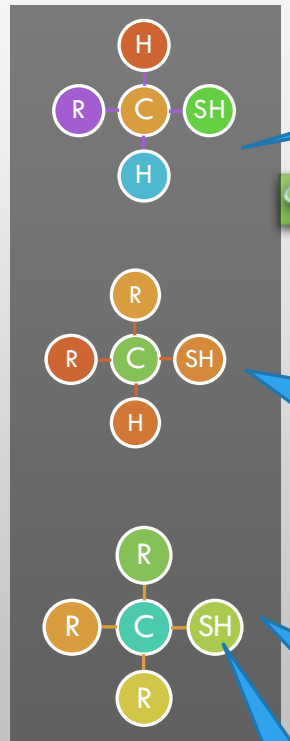
## What is treatment process:

Light gasoline treatment process is synthesized to extract and convert Mercaptan into disulphides which remain in the product. Followings are the key processes to treat sour gasoline product.




**Sometime pretreatment** is required based on feed characteristics. If H2S (hydrogen sulphide is present in low ppm levels inside the light hydrocarbon. **This must be passed through caustic guard scrubber to ensure complete remove of H2S from the feed.** This does not poison the catalyst, but it competes with Mercaptan in presence of the available oxygen

# Types of Mercaptan and Structured Formula




Primary Mercaptan with single Mercaptan "R" Molecule

Secondary Mercaptan with two Mercaptan "R" Molecules

Tertiary Mercaptan with three Mercaptan "R" Molecules

Sulfonyl Group

If H2S (hydrogen sulphide is present in low ppm levels inside the light hydrocarbon. **This must be passed through caustic guard scrubber to ensure complete remove of H2S from the feed.**

Treatment process the Mercaptan converted into disulphides which remain in the product.

In fact, the Mercaptan extracted form the low boiling point hydrocarbon c3/c4 and light gasoline which contains low molecule weight Mercaptan which is desired and easy to remove. The amount and molecule wt of Mercaptan can not be controlled this is function of crude source and distillation cut of the feed

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## What is Extraction Process:

- The extraction process applied for gas and liquid streams to extract/ remove Mercaptan content from both streams. The completeness of extraction depends upon the solubility of Mercaptan in the alkaline solution, primarily, this depends on the following.

Alkyl Group

Sulfonyl Group

$$RSH + NaOH \rightarrow NaSR + H_2O$$

Oil phase

Aqueous phase

Aqueous phase

- Molecule weight of Mercaptan
- Degree of Branches of Mercaptan
- NaOH Concentration
- Temperature of the System

Molecule weight increase the solubility will decrease. Secondly if Chain of Mercaptan Branches increase the Solubility will also decrease. If NaOH concentration decline solubility will decrease. High feed temperature may impact the catalyst activity

Merox process to completely regenerate caustic for depends on the following equation

$$NaSR + {}^1/_4\,O + {}^1/_4\,H_2\,O \leftrightarrow NaOH + {}^1/_2\,RSSR$$

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**What is sweetening process chemical reaction:**

- **Sweetening** unit reaction will take place only in alkali environment
- **Where:** organic compound with Sulfhydryl function **(-SH)**

**R**: hydrocarbon chain, Straight, branched or cyclic. Second, the chain can be saturated and unsaturated. In fact, there could be mixture of Mercaptan to the extent of R Chain might have **1,2,3… 10 or more carbon atoms** in the chain. When reaction occurred two different Mercaptan might enter in the reaction.

This shows R and R' in the reaction

$$RSH + \frac{1}{4}O_2 \rightarrow \frac{1}{2}RSSR + \frac{1}{2}H_2O$$

$$2R'SH + 2RSH \rightarrow 2R'SSR + 2H_2O$$

This reaction occur spontaneously, but at very low rate, whenever any sour Mercaptan bearing distillate is exposed to atmospheric

## Five Key Parameters for Treatment process

### 1. Catalyst:

This is vendor trademark, secondly not variable element. After passage of time the catalyst activity will decline gradually, to recover its activity fresh catalyst is mandatory to be added

Charcoal impregnated with 1.4kg of UOP and Reagent/m3 of charcoal (0.086 pounds/ft3).

**Catalyst Selectivity:** ability to direct the reaction to yield a particular product.

**Catalyst Activity:** The **activity** of a **catalyst** is its ability to increase the rate of a particular reaction

## Five Key Parameters for Treatment Unit

### 2. Oxygen:

Oxygen is mandatory to oxidize Mercaptan, at STP Standard Temp and Pressure 01 $M^3$ of atmospheric air contains 0.28kg of oxygen

Oxidize 01kg of Mercaptan, total 0.88 $M^3$ air is required at STP

Excess amount of air 1.2-2.0 times theoretical required to oxidize Mercaptan completely

RSH: Mercaptan Sulphur

$$(Air) = \frac{1.5(K)(feed\ Rate)(S.G)(RSH)}{10000}$$

Air= air injection rate at STD m3/hr

K= Constant: 8.81

Feed: m3/hr

S.G: Specific Gravity at 15 C

## Five Key Parameters for Treatment Unit

### 3. Alkalinity:

This is needed to selectivity drive the Mercaptan oxidization reaction, which is provided by NaOH or caustic Solution

→ 2-10 wt-ppm of NaOH at caustic concentration 3-5° baume (2-3 wt-% is normally sufficient

↓ To maintain drain effluent 9-12 pH

Thiophenol, when present with olefins, can easily be oxidized to a thioether-hydrope oxide gum precursor
Sufficient caustic must be injected to convert thiophenol into disulfides

→ Thus sufficient caustic must be injected to convert into disulfide

## Five Key Parameters for Treatment Unit

### 4. Contact:

This is intimacy of mixing of the reactant, this can be accomplished by one of several means

→ Characterized in duration of mixing time by volumetric ratio or by differential pressure which implies degree of dispersion

Porous structure of charcoal provides the vast interfacial surface area for contact between Hydrocarbon, caustic and catalyst

→ With fixed flow restriction, the differential pressure is directly related to the linear velocity, this could be process variables

Characterize contact is residence time in the charcoal bed, this is expressed volume of feed/hour of catalyst bed, for common term liquid hourly space velocity (LHSV) as residence time increases, LHSV decrease, Mercaptan conversion increases

## Fifth Key Parameters for Treatment Unit

### 5. Heat:

Sweetening unit supported by the high temperature, if feed temperature high the Mercaptan conversion will increase

→ But high temperature will also give adverse impact on other processes

↓ Gum precursor formation and premature catalyst bed deactivation and metallurgical consideration

← Therefore, the feed temperature must be kept as low as low possible within 40-48 Degree Celsius

# ARTIFICIAL INTELLIGENCE

## TREATMENT **SIMULATION** MODEL

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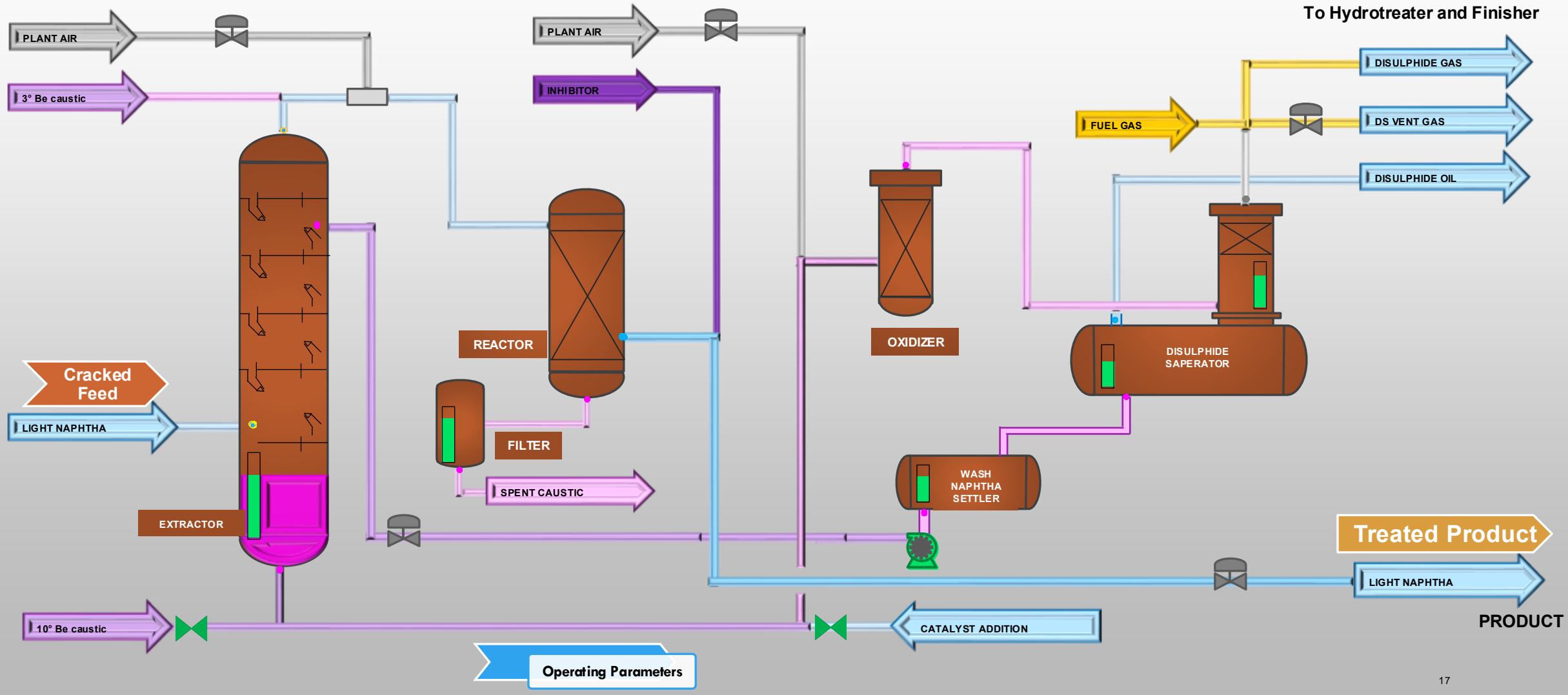




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## Role of Disciplines Engineers

1. Petroleum
2. Chemical
3. Electrical Power
4. Instrument & Control System
5. Mechanical
6. Industrial
7. Civil

## Specialty

1. Loss Prevention Engineer
2. Safety Engineer
3. Process Engineer
4. Operations Engineer
5. Optimization Engineer
6. All Disciplines Mainten
7. Corrosion Engineer
8. Integrity Engineer
9. Reliability Engineer
10. Cost/Budgeting Engineer
11. Project Engineer

**Center of Excellence For Engineering Best Practices**

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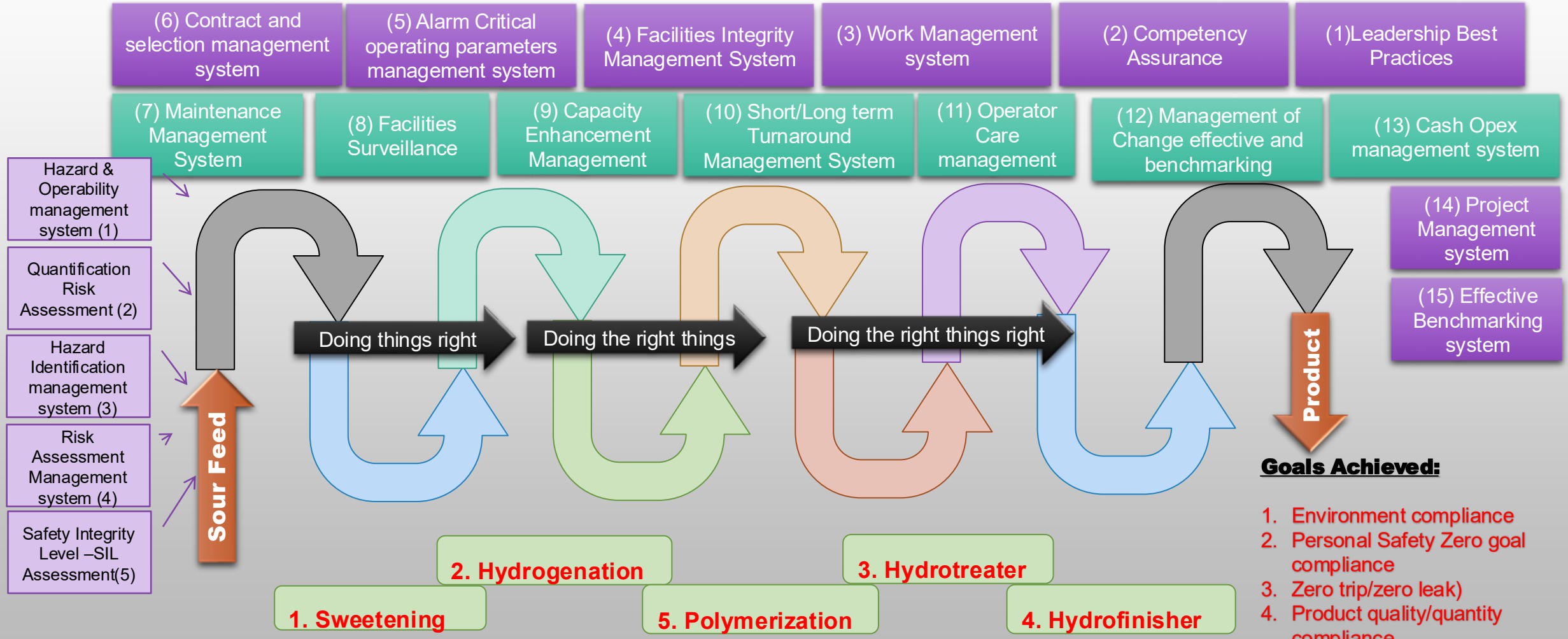


**Goals Achieved:**

1. Environment compliance
2. Personal Safety Zero goal compliance
3. Zero trip/zero leak)
4. Product quality/quantity compliance
5. Optimized operating cost

**Conclusion:**

- Achieved **NOx, SOx and $CO_2$** releases as guaranteed
- Achieved product quality as planned/guaranteed

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