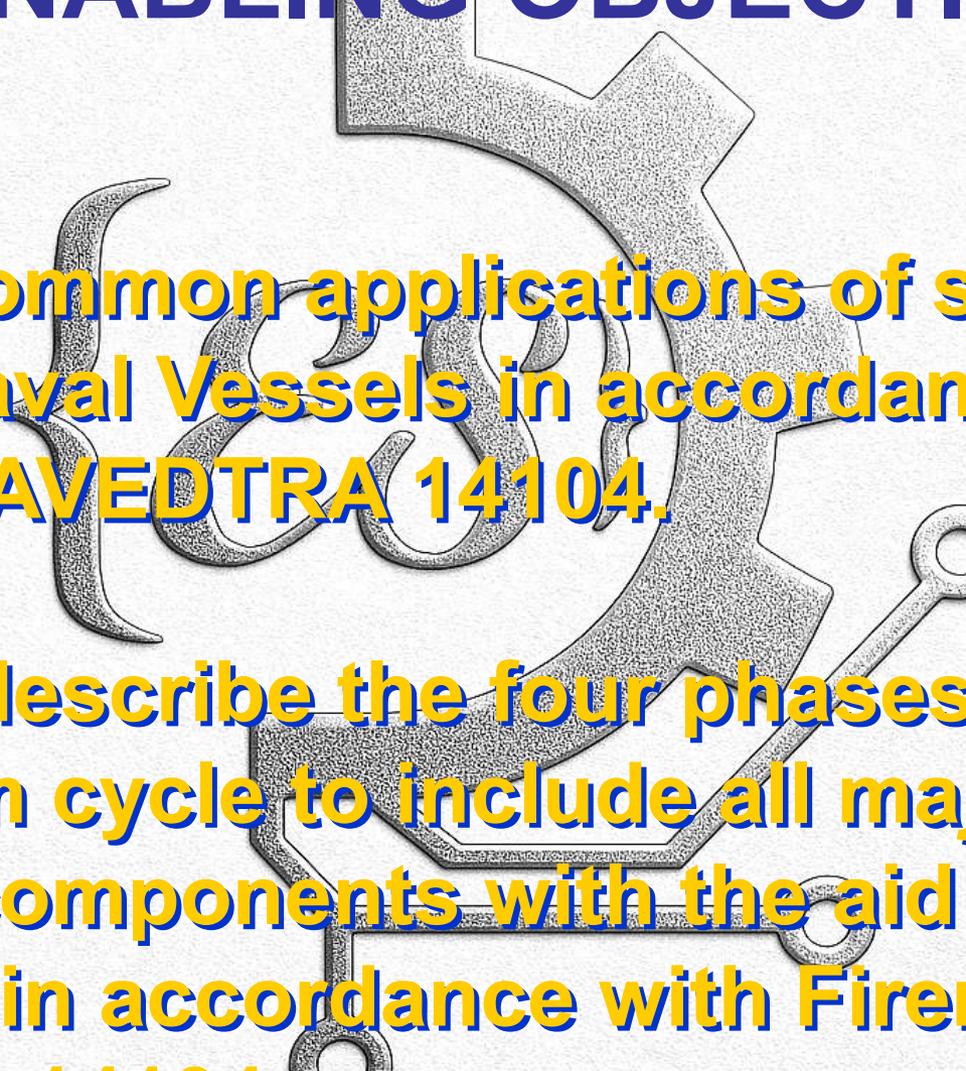




ES  
EM-300  
NAVAL STEAM PLANT

# ENABLING OBJECTIVES

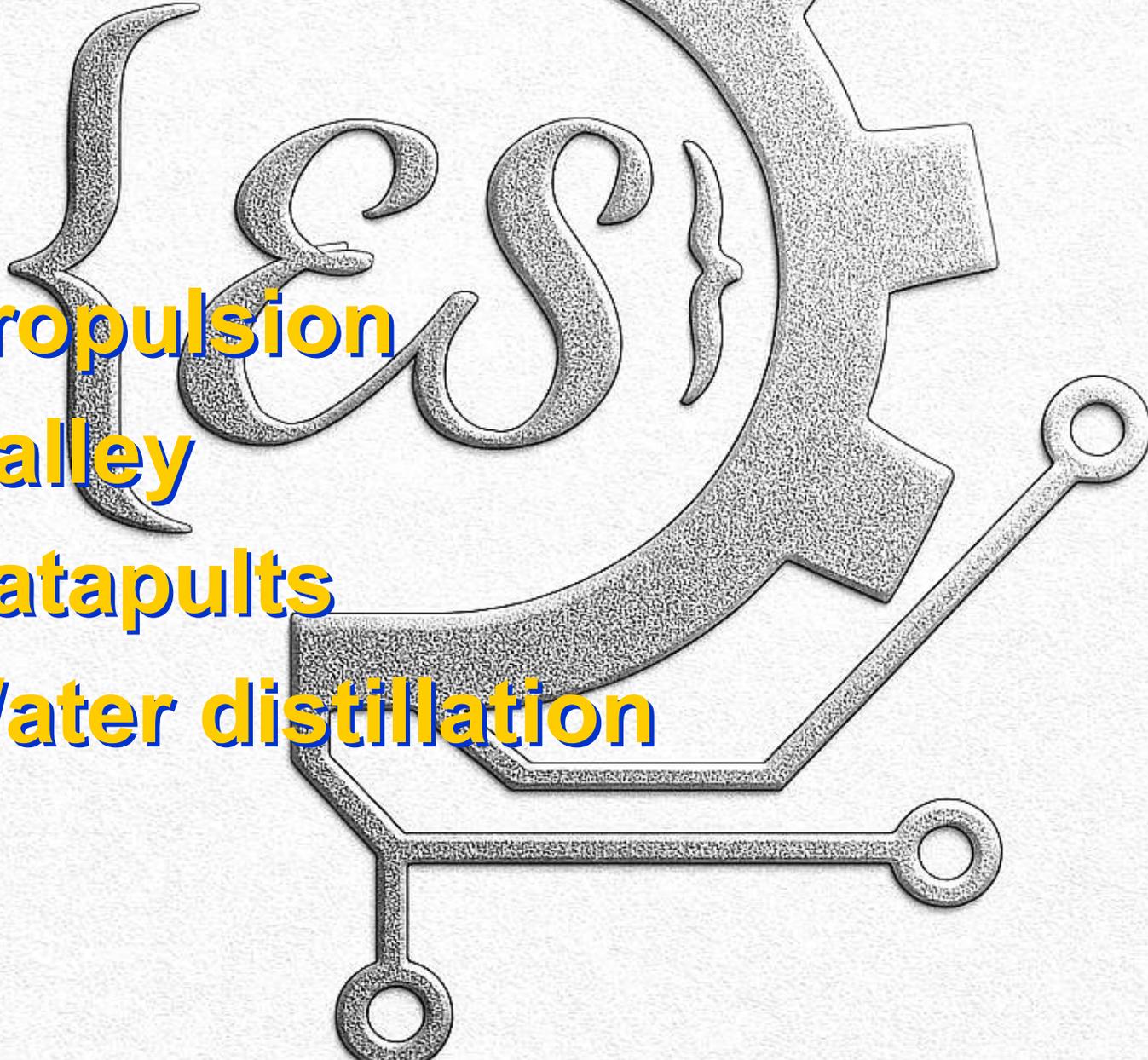


**State the common applications of steam onboard Naval Vessels in accordance with Fireman, NAVEDTRA 14104.**

**Label and describe the four phases of the basic steam cycle to include all major operating components with the aid of an illustration in accordance with Fireman, NAVEDTRA 14104.**

# COMMON APPLICATIONS

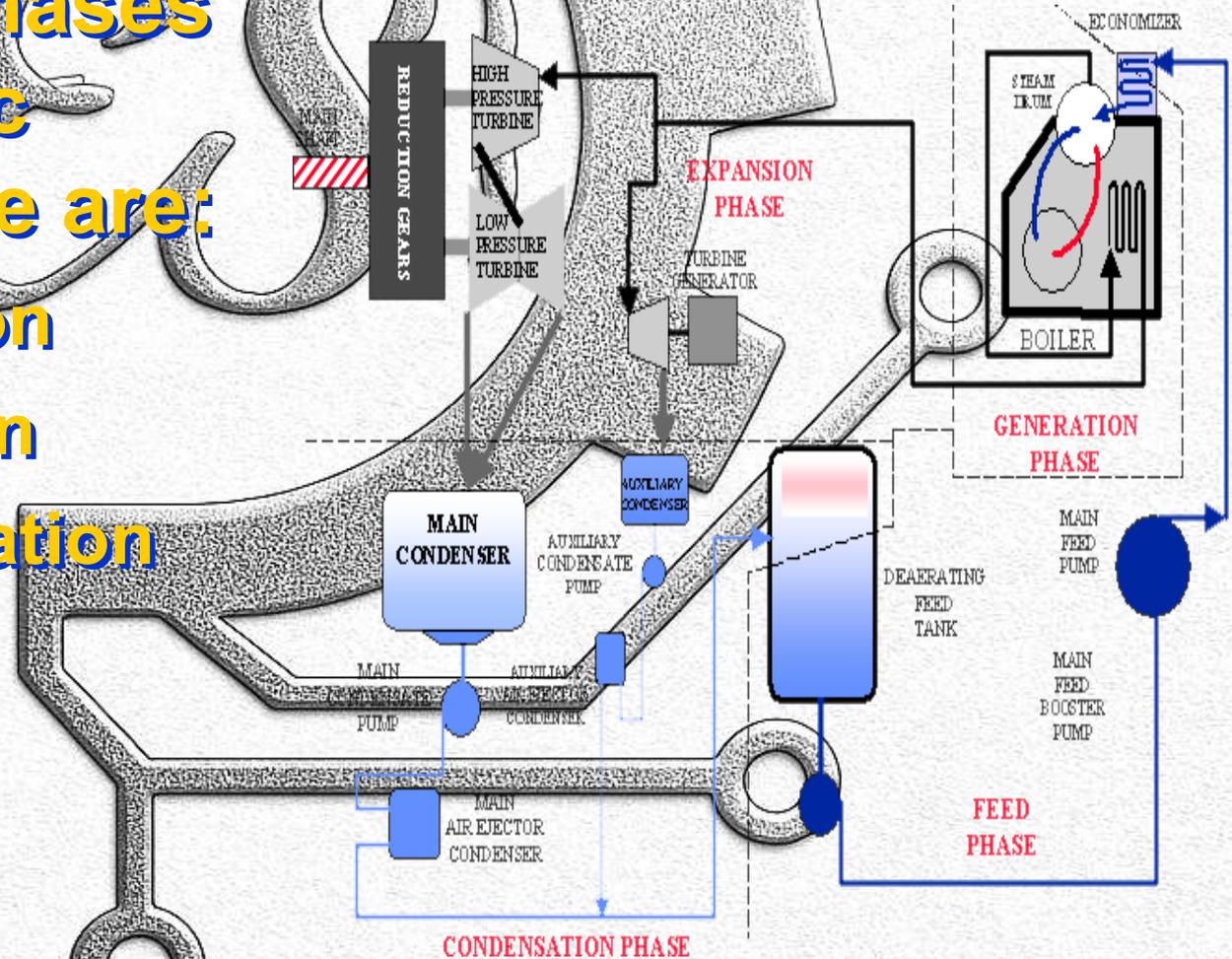
- **Propulsion**
- **Galley**
- **Catapults**
- **Water distillation**



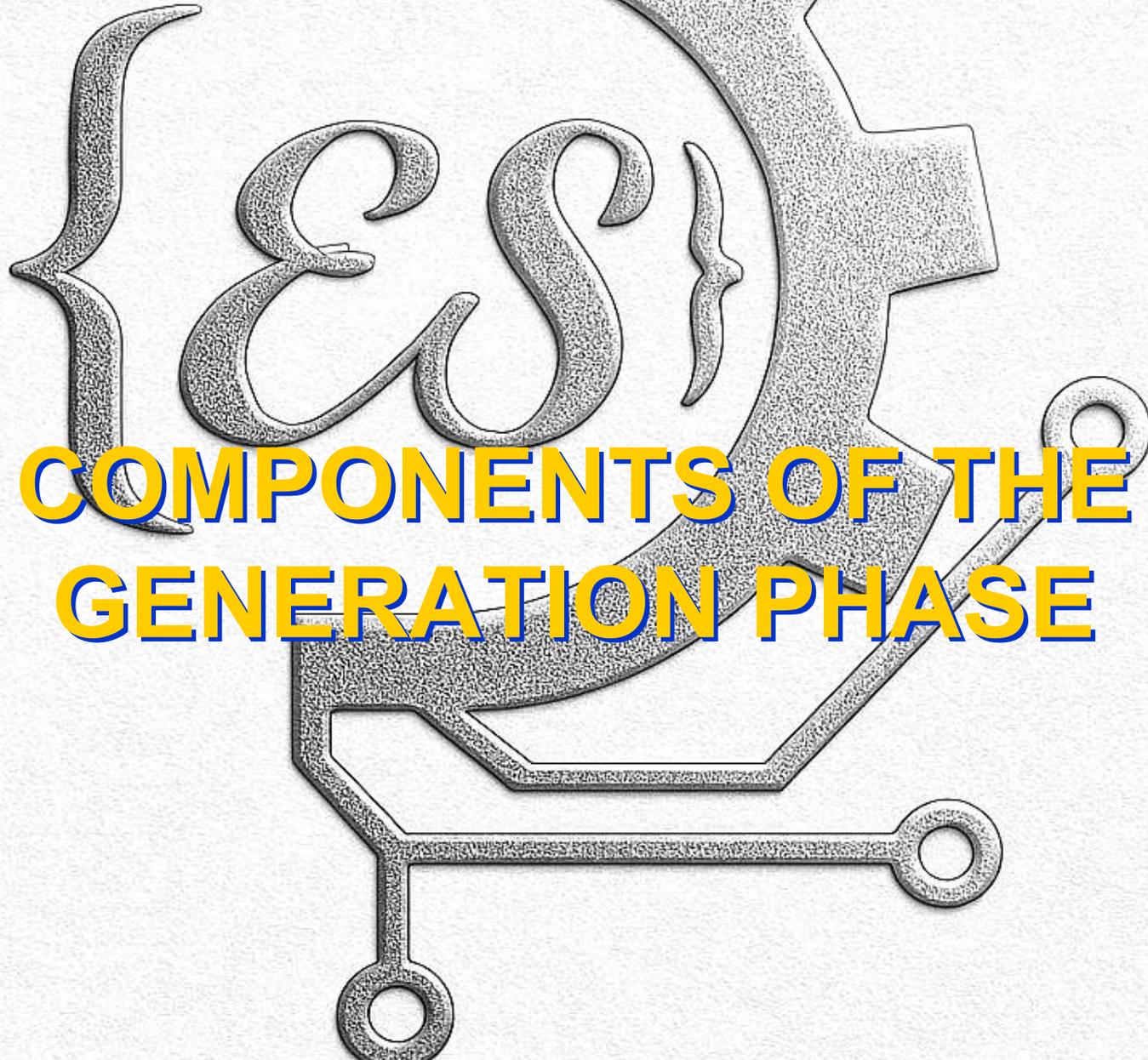
# Basic Steam Cycle

- The four phases of the basic steam cycle are:

- Generation
- Expansion
- Condensation
- Feed



# GENERATION PHASE



## COMPONENTS OF THE GENERATION PHASE

# GENERATION PHASE

## ***Boiler***

- **Burners**
  - Where fuel is atomized and air is admitted in a swirling motion to create combustion.



# GENERATION PHASE

- **Furnace**
  - Is a large, room-like space where air and fuel are mixed for combustion, which is lined with refractory



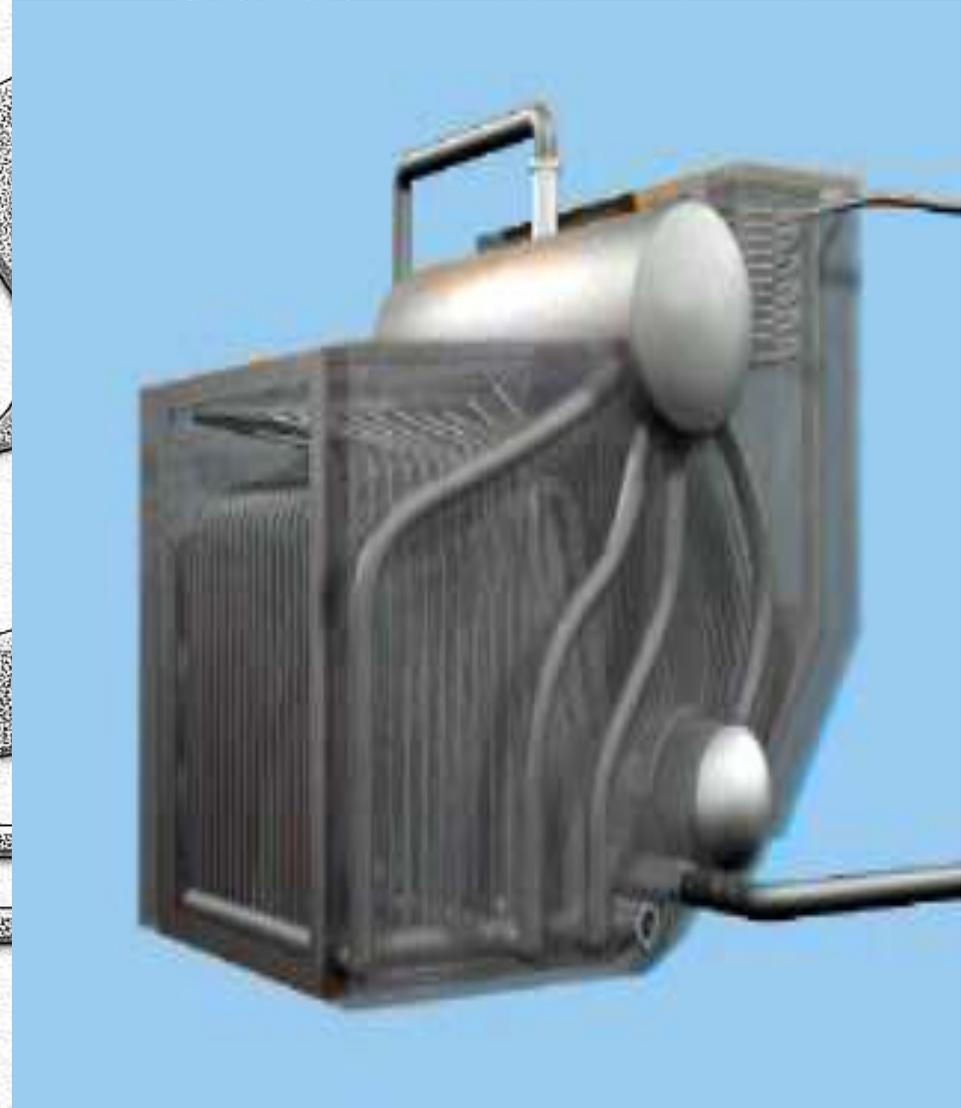
# GENERATION PHASE

- **Economizer**
  - An arrangement of tubes installed in the uptake space from the furnace; they are heated by the combustion gases leaving the stack



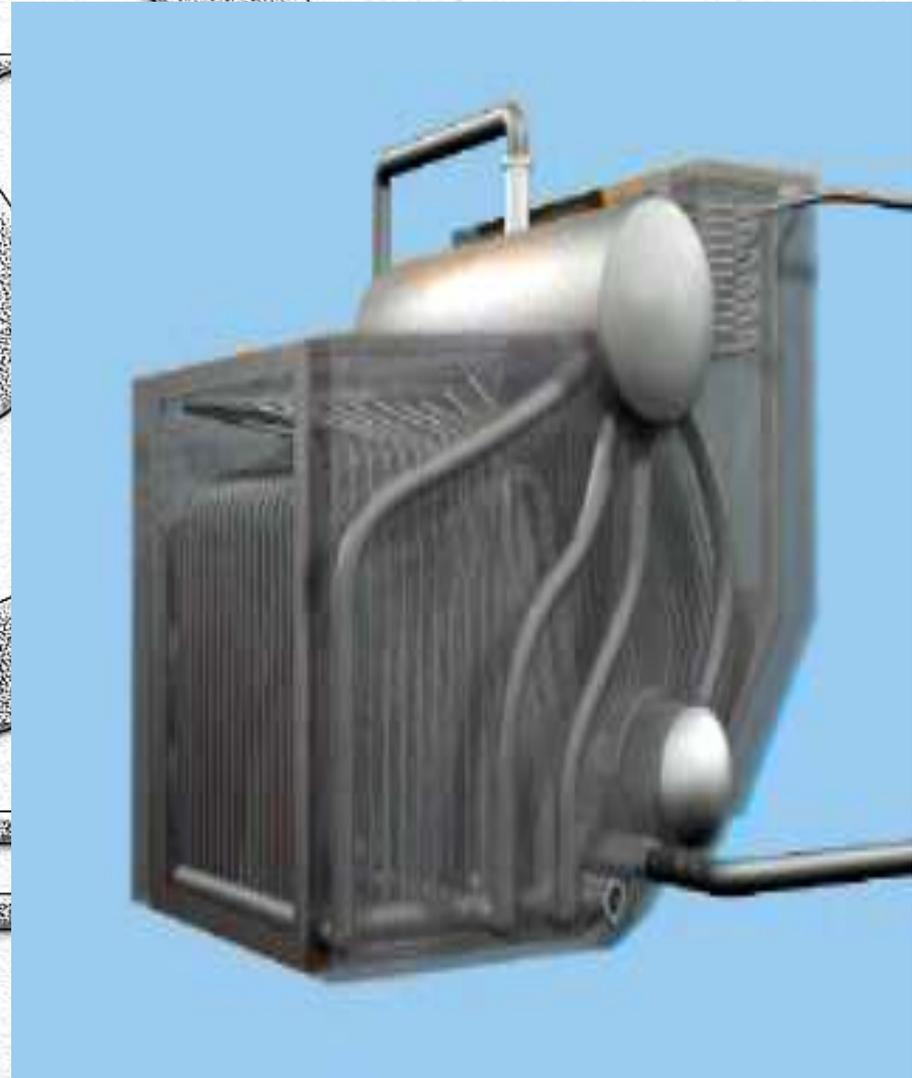
# GENERATION PHASE

- **Steam Drum**
  - Located at the top of the boiler
  - Contains moisture separators and connected to many of the important fittings and instruments required for operation and control of the boiler



# GENERATION PHASE

- **Downcomers**
  - **Located between the inner and outer casing of the boiler to maintain proper Natural Circulation of the boiler.**



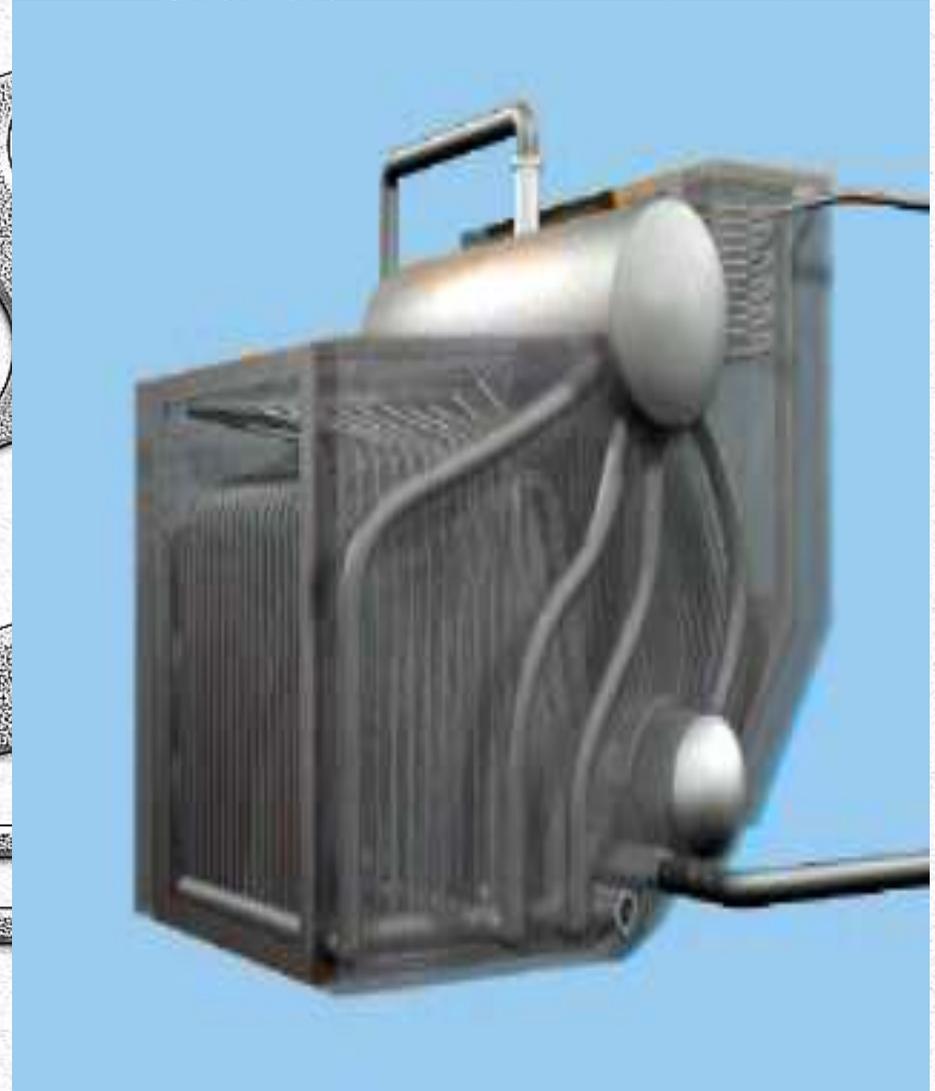
# GENERATION PHASE

- **Water Drum**
  - Located at the bottom of the boiler
  - Equalizes the distribution of water to the **Generating tubes**



# GENERATION PHASE

- **Generating Tubes**
  - **Banks of tubes connecting the Water Drum to the Steam Drum**
  - **Transfers surrounding heat from the combustion gases to flowing water inside the tubes turning it into a saturated vapor**

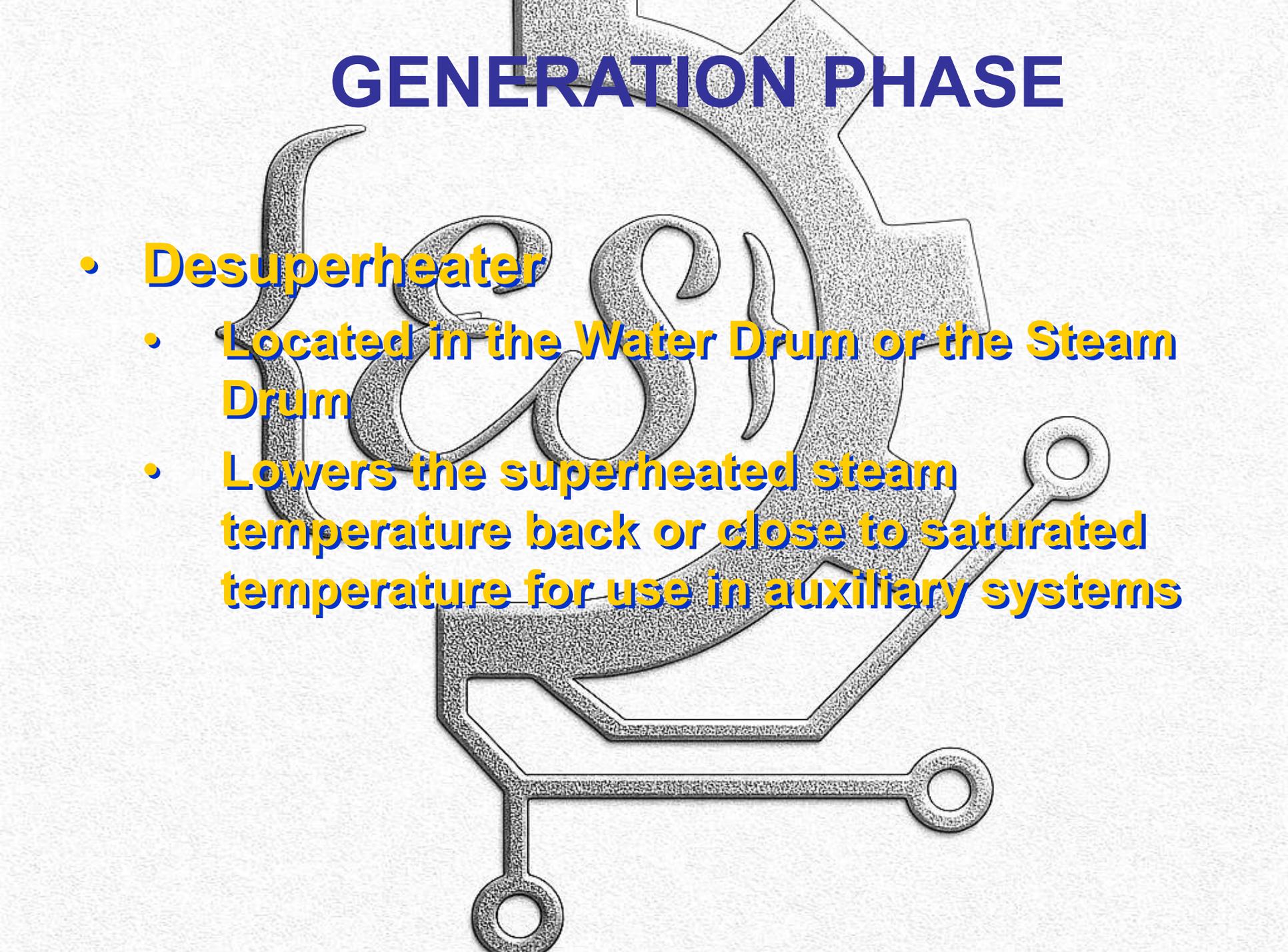


# GENERATION PHASE

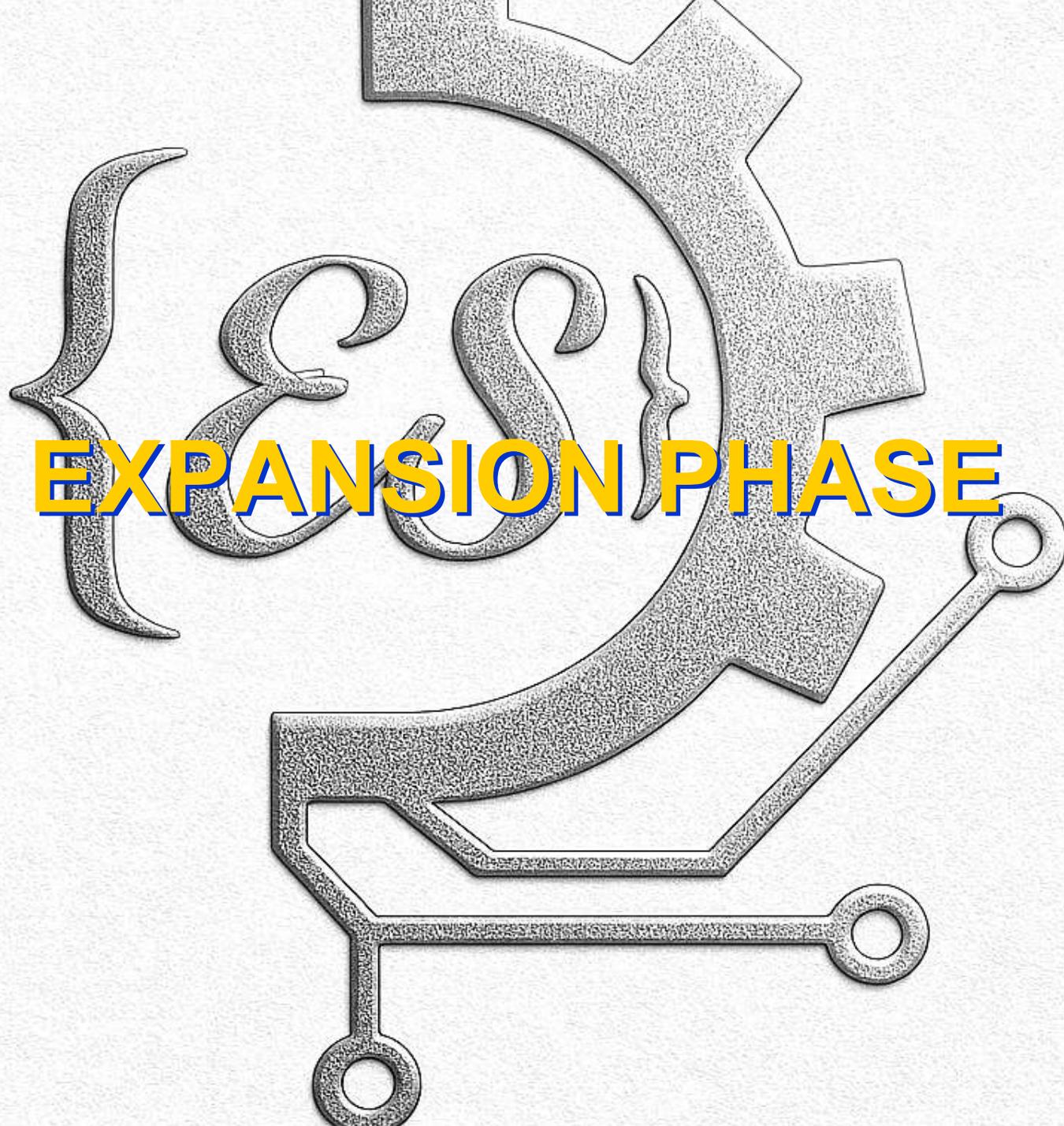
- **Superheater**
  - **Convection heated U-Tube heat exchanger**
  - **Increases thermal energy of the steam 100 % of steam flows through the Superheater**



# GENERATION PHASE



- **Desuperheater**
  - **Located in the Water Drum or the Steam Drum**
  - **Lowers the superheated steam temperature back or close to saturated temperature for use in auxiliary systems**



# EXPANSION PHASE

## 2 TYPES OF TURBINES

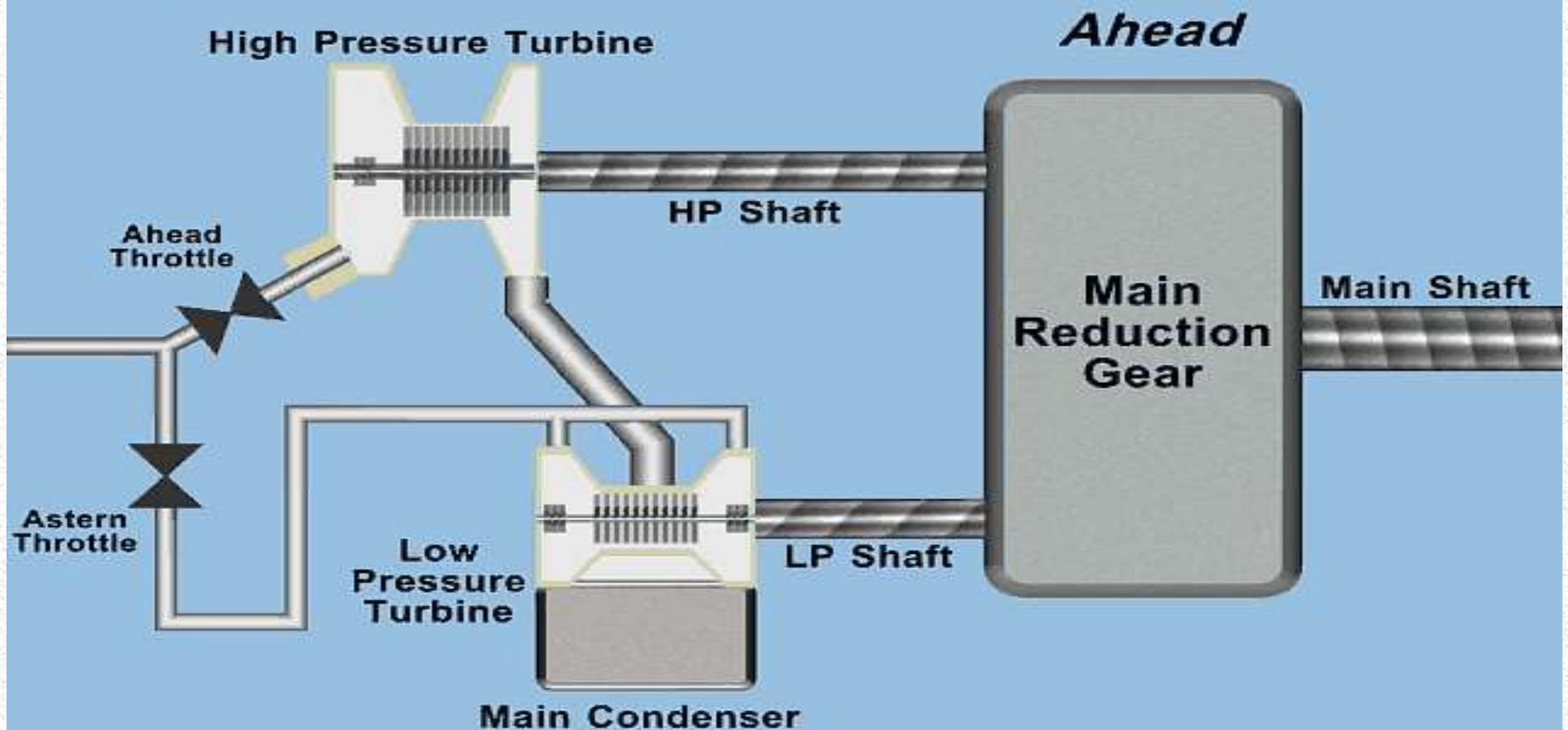
- IMPULSE TURBINE (HP TURBINE)
- REACTION TURBINE (LP TURBINE)

# EXPANSION PHASE

- **Impulse Turbine (HP Turbine)**
  - **Blades moved by a direct push, or impulse, by the steam**



# High Pressure / Low Pressure Turbines



# EXPANSION PHASE

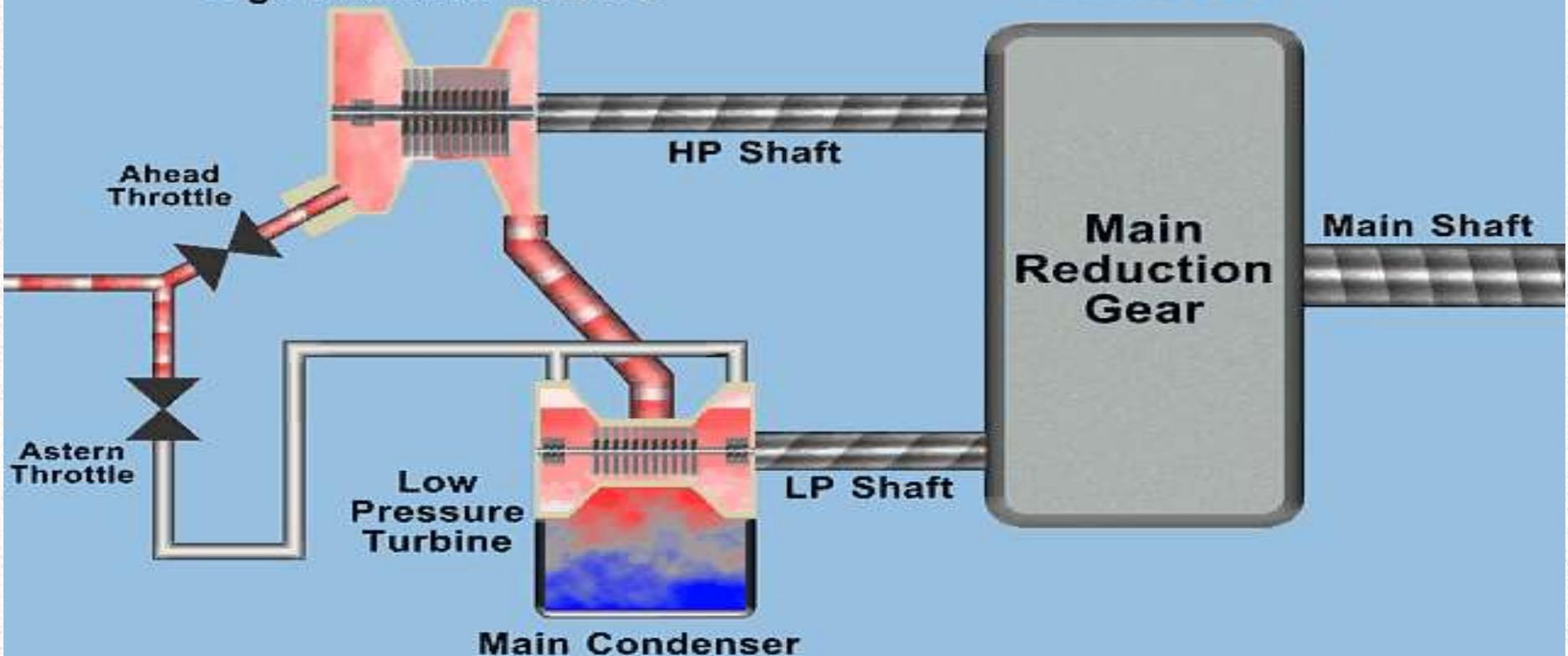
- **Reaction Turbine (LP Turbine)**
  - **Blades moved by reactive force of steam through the blades.**



# High Pressure / Low Pressure Turbines

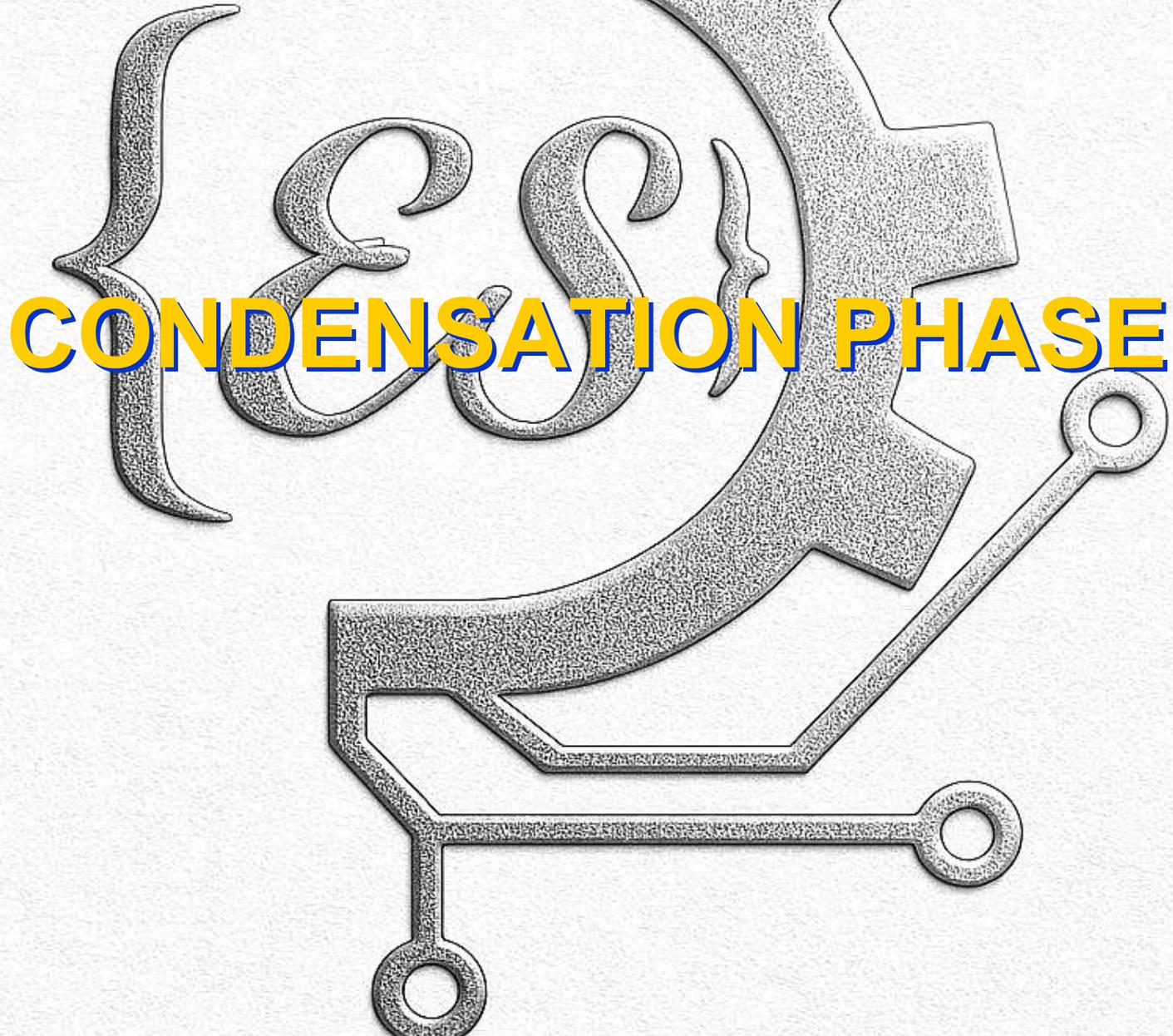
High Pressure Turbine

*Reverse*

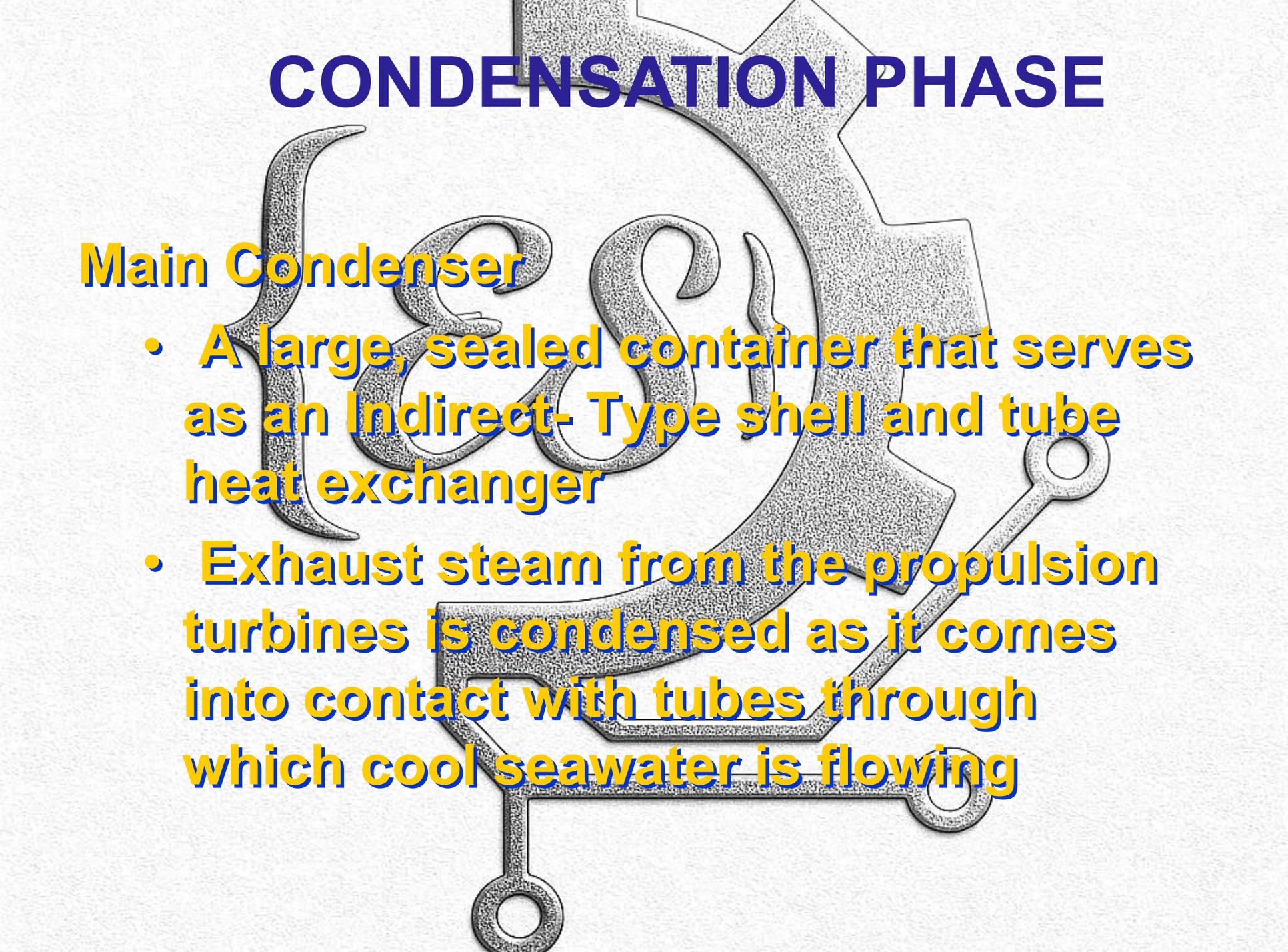


**CONDENSATION PHASE**

**CONDENSATION PHASE**



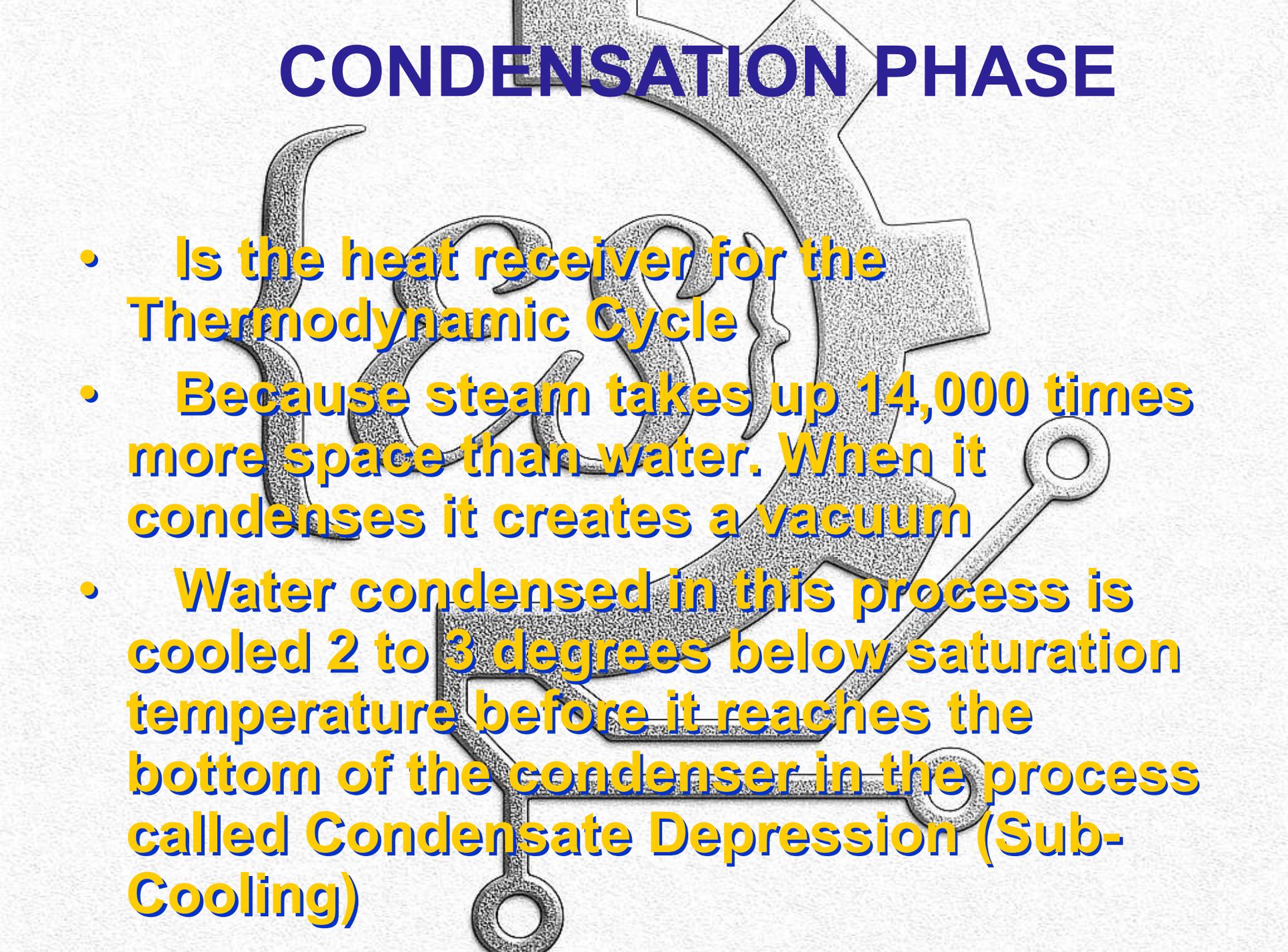
# CONDENSATION PHASE



## Main Condenser

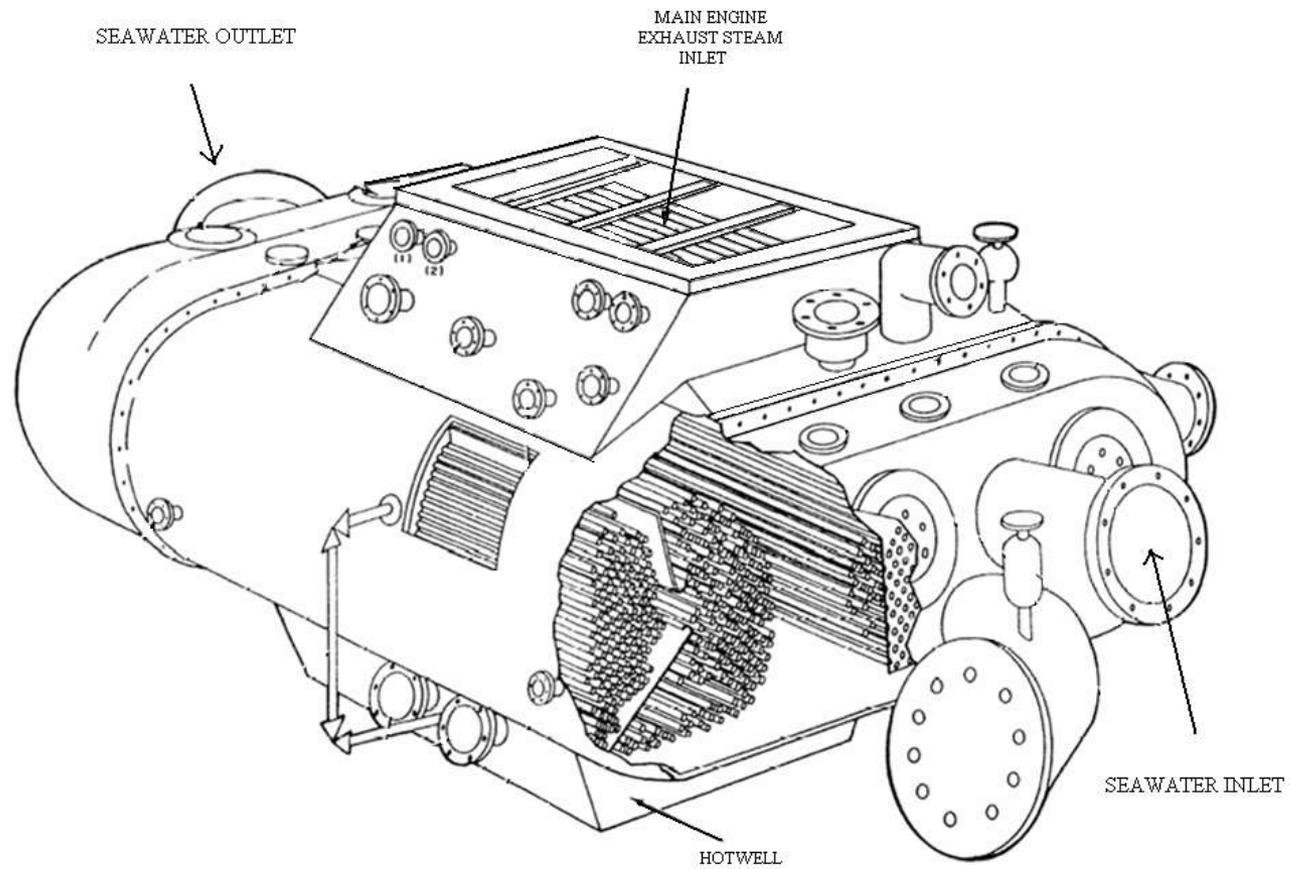
- A large, sealed container that serves as an Indirect- Type shell and tube heat exchanger
- Exhaust steam from the propulsion turbines is condensed as it comes into contact with tubes through which cool seawater is flowing

# CONDENSATION PHASE

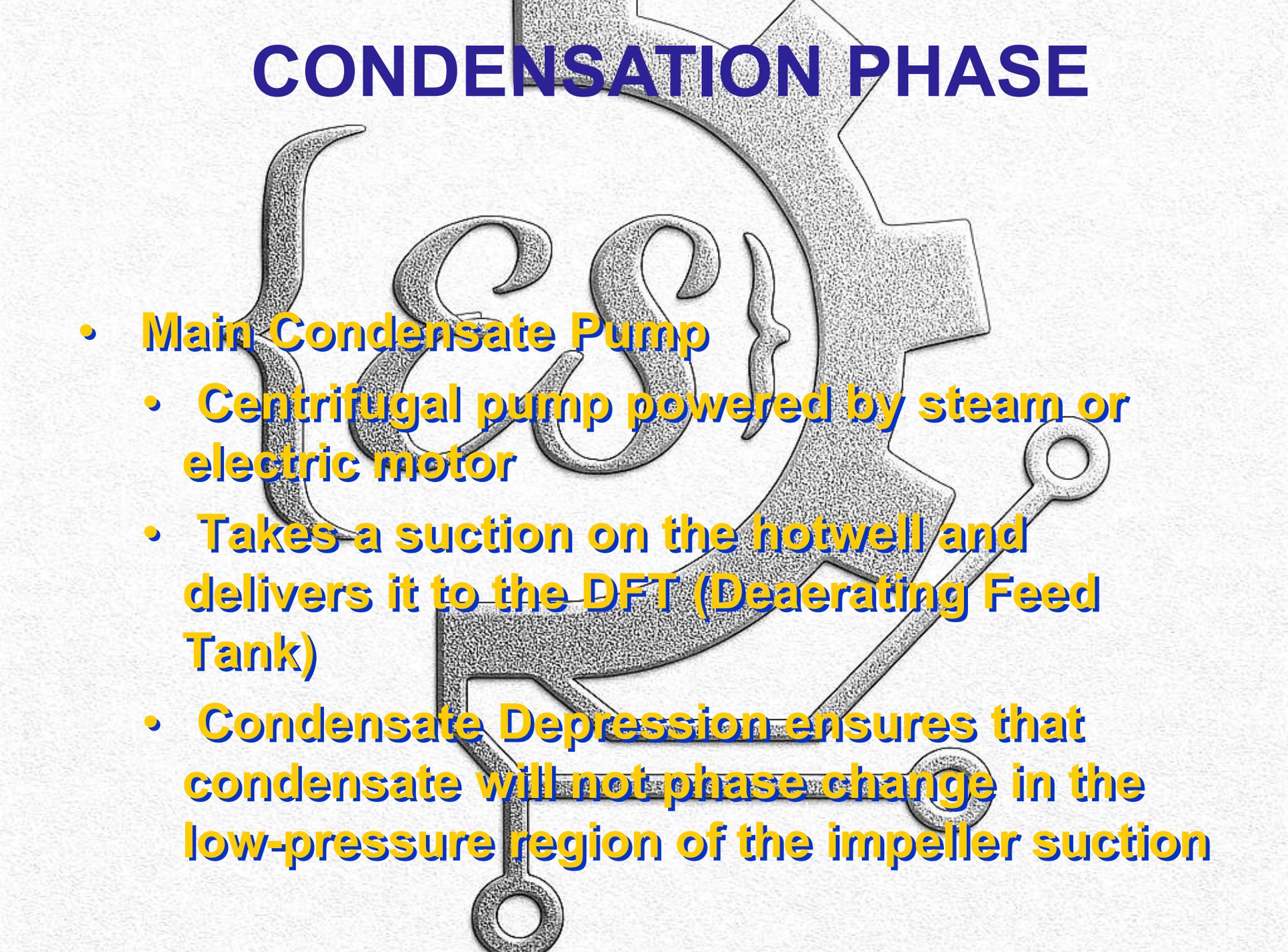


- **Is the heat receiver for the Thermodynamic Cycle**
- **Because steam takes up 14,000 times more space than water. When it condenses it creates a vacuum**
- **Water condensed in this process is cooled 2 to 3 degrees below saturation temperature before it reaches the bottom of the condenser in the process called Condensate Depression (Sub-Cooling)**

# MAIN CONDENSER

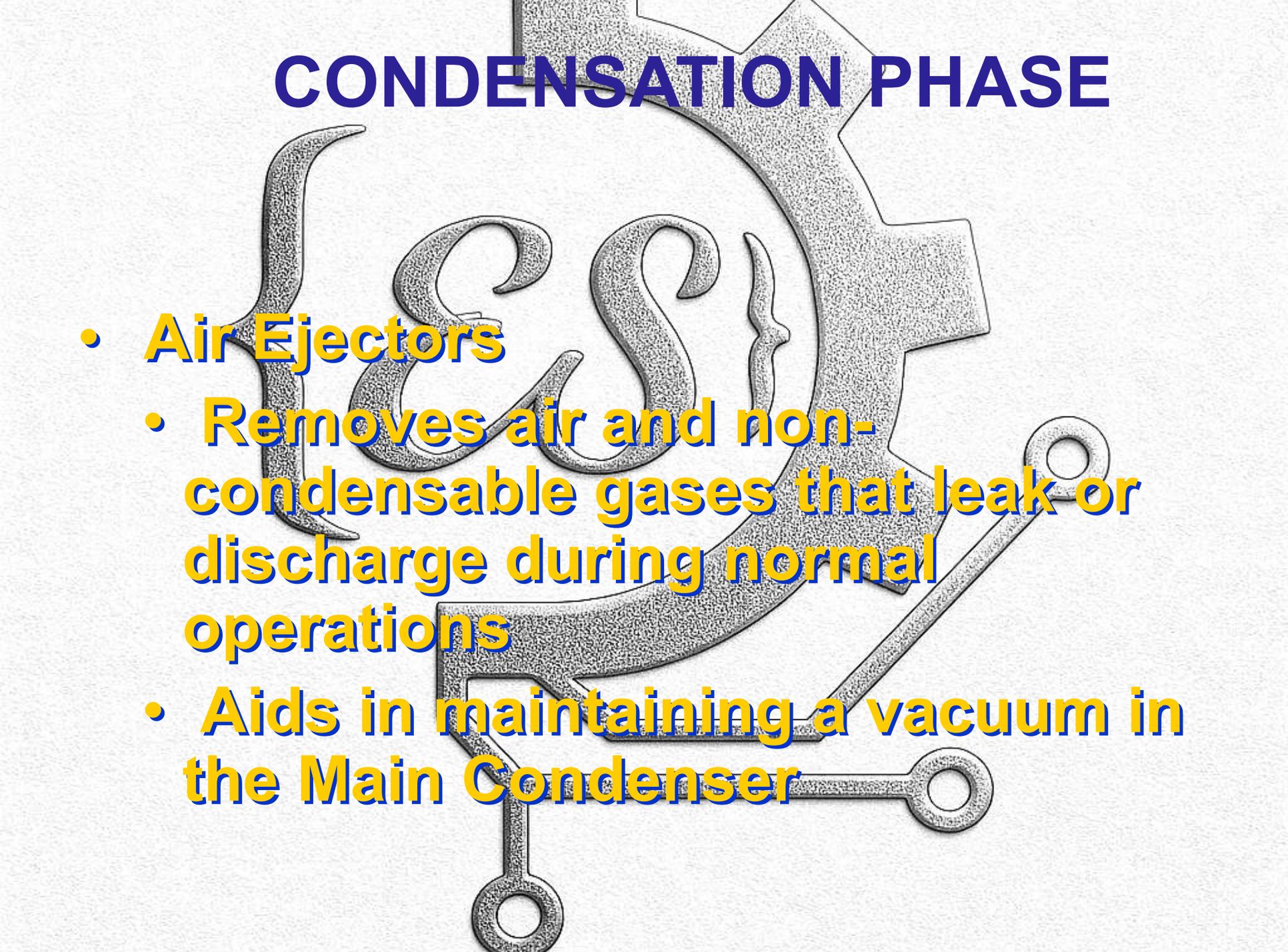


# CONDENSATION PHASE



- **Main Condensate Pump**
  - **Centrifugal pump powered by steam or electric motor**
  - **Takes a suction on the hotwell and delivers it to the DFT (Deaerating Feed Tank)**
  - **Condensate Depression ensures that condensate will not phase change in the low-pressure region of the impeller suction**

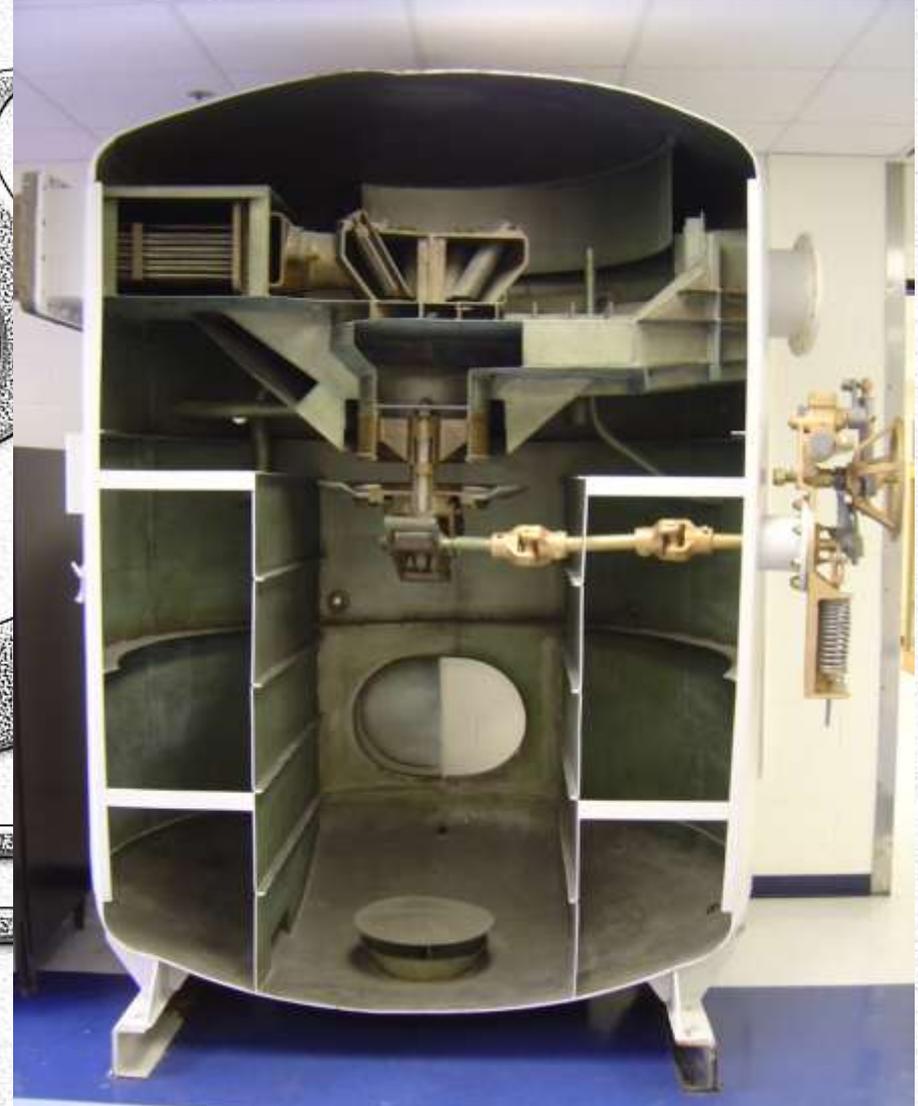
# CONDENSATION PHASE



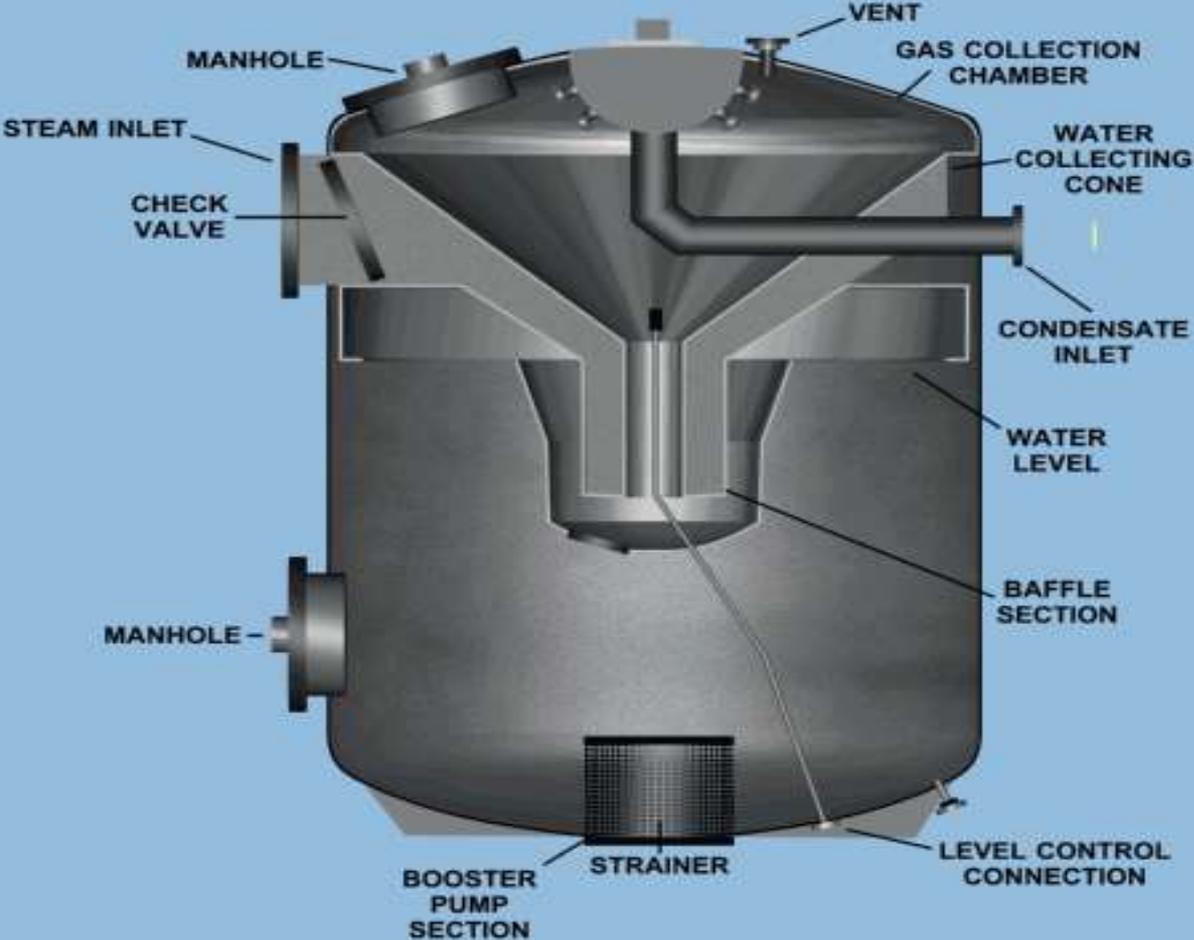
- **Air Ejectors**
  - Removes air and non-condensable gases that leak or discharge during normal operations
  - Aids in maintaining a vacuum in the Main Condenser

# CONDENSATION PHASE

- **Deaerating Feed Tank**
  - **Direct contact heat exchanger**
  - **Removes dissolved oxygen and non-condensable gases from condensate**  
**( INVERSE SOLUBILITY)**
  - **Preheats feed water**
  - **Stores feed water**

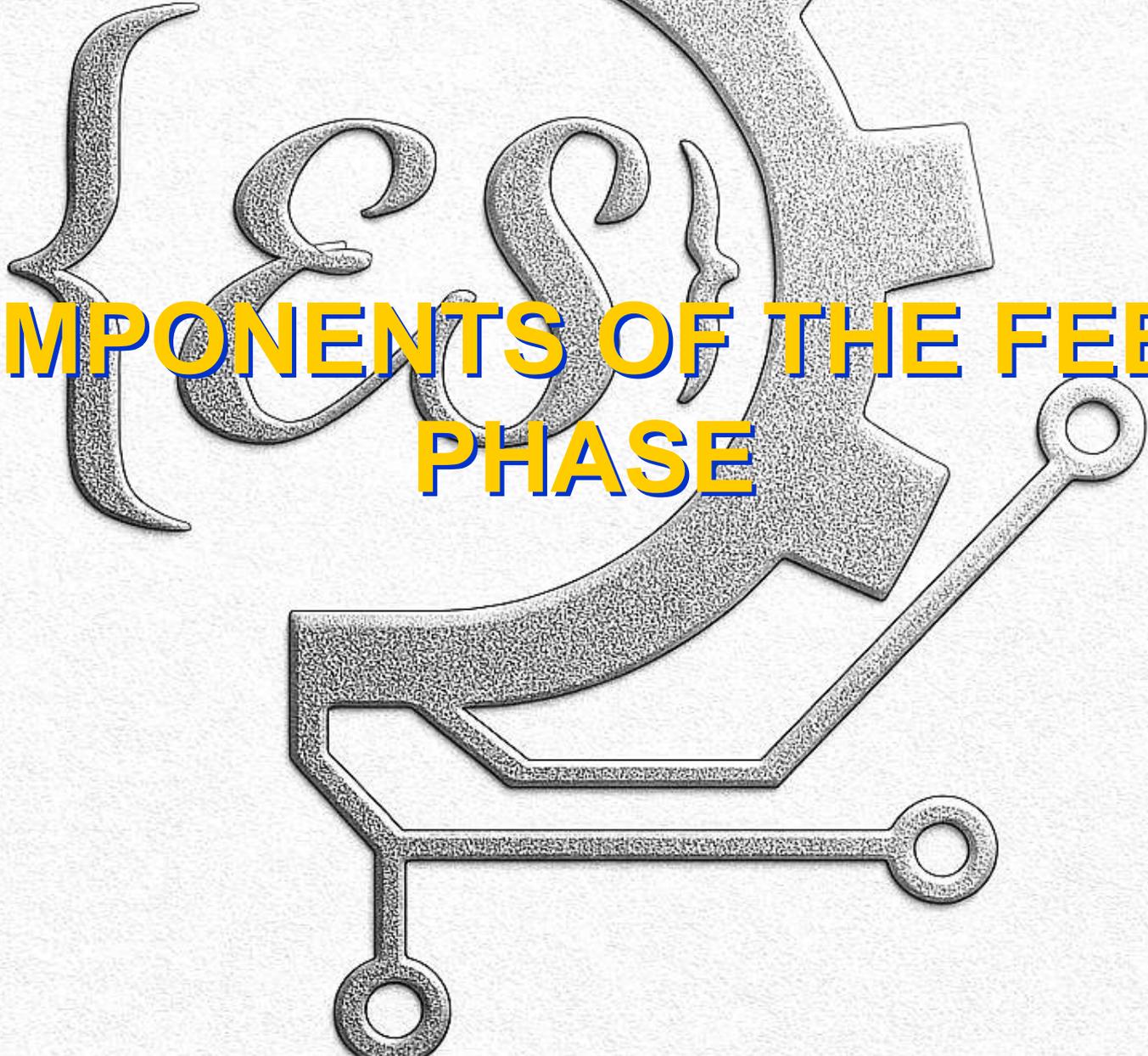


# DEAERATING FEED TANK



**FEED PHASE**

**COMPONENTS OF THE FEED  
PHASE**



# FEED PHASE

- **Main Feed Pump**
  - **Centrifugal pump powered by steam or electric motor**
  - **Delivers feed water to the Economizer**



# BASIC STEAM CYCLE

## BASIC STEAM CYCLE

