

# Brief Introduction on H2 generating system

## I. Description on H2 generating unit

### 1. flows chart for H2 generator by water electrolysis

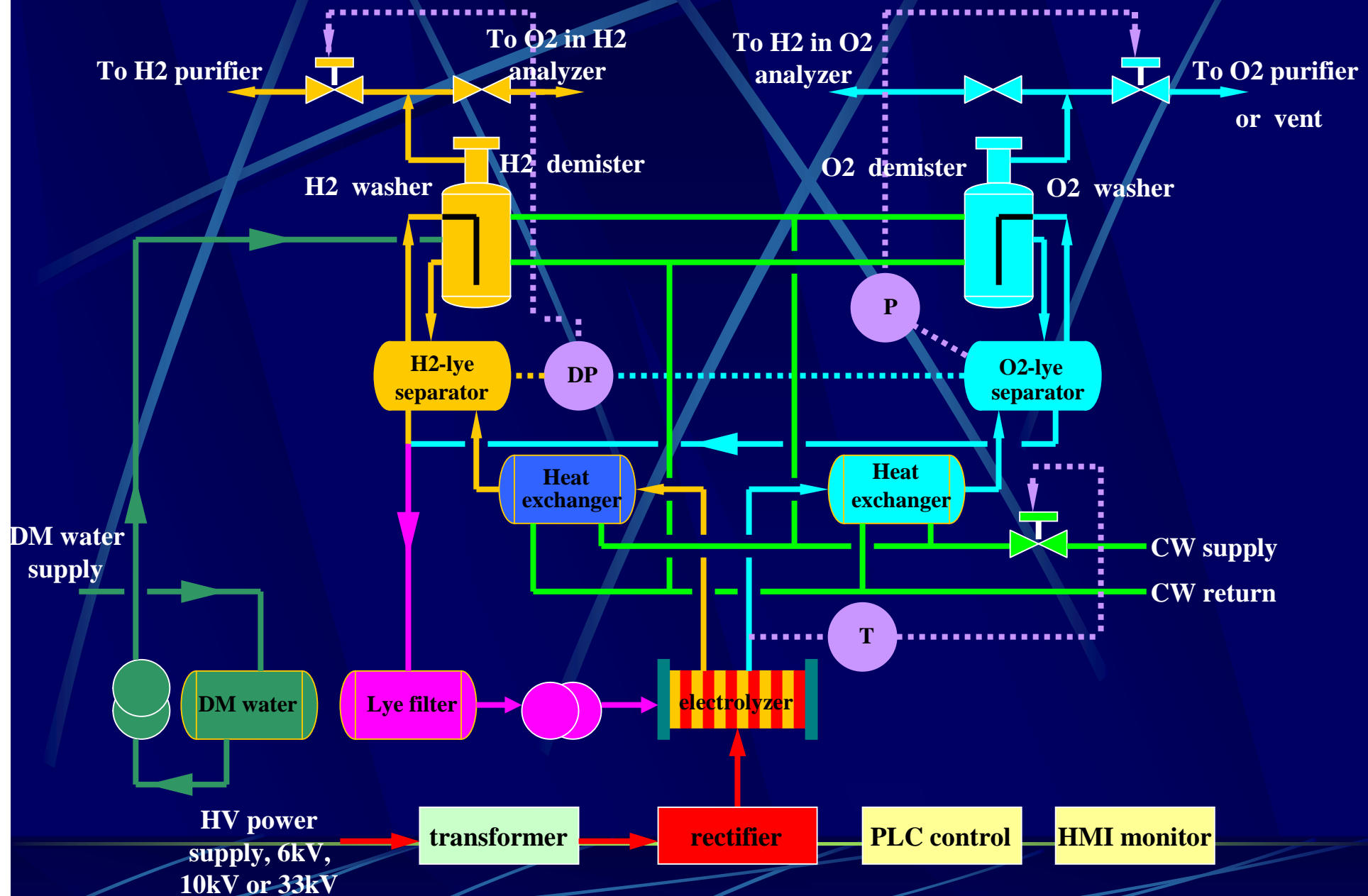
#### 1.1 Description on the processing;

- 1) H2 gas loop and O2 gas loop ;
- 2) Lye cycling loop;
- 3) DM water supplementary loop;
- 4) Cooling water loop;

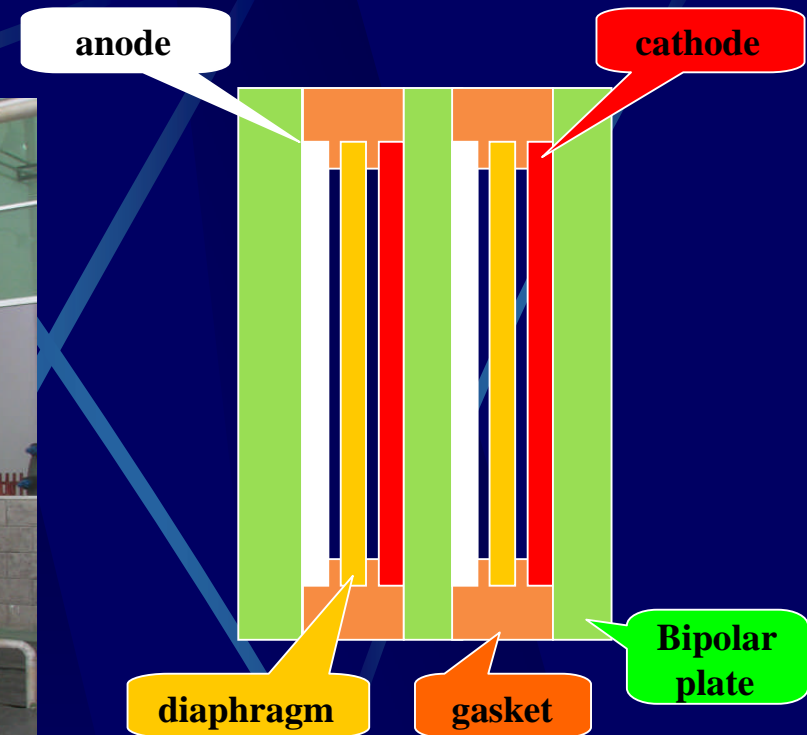
#### 1.2 Description on the automatic control loops

- 1) control loop for operating pressure;
- 2) control loop for balance of H2-lye level and O2-lye level;
- 3) control loop for operating temperature;
- 4) Monitoring the H2 purity, O2 purity, lye flows and H2 concentration.

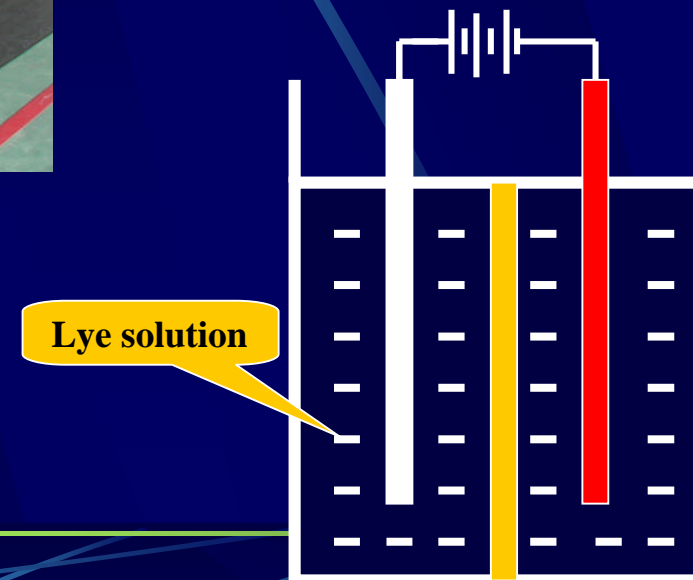
# 1. typical flow chart for H2 generating unit by water electrolysis



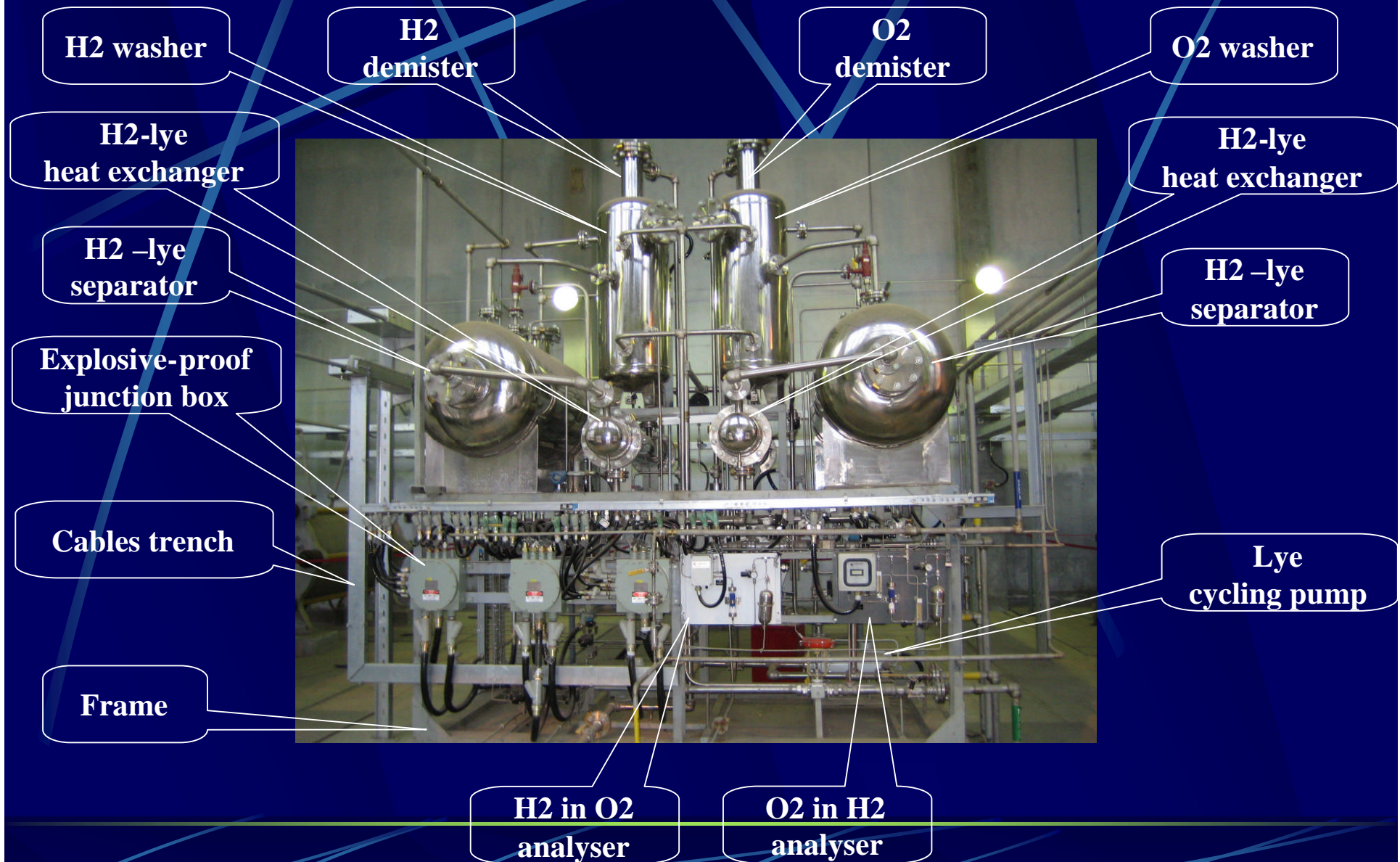
# Electrolyser:



Electro-chemical reaction:



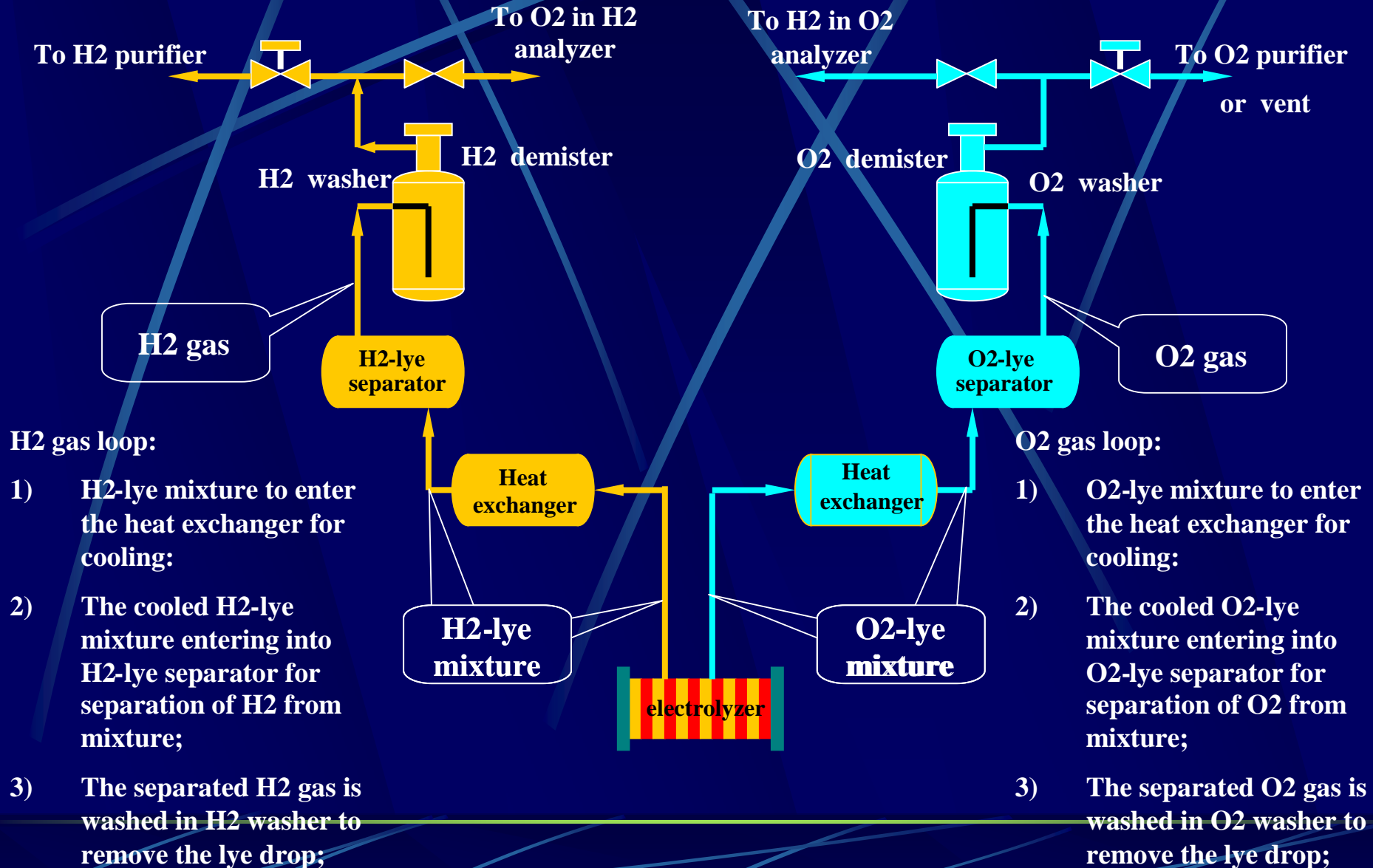
# Skid of gas-lye treater



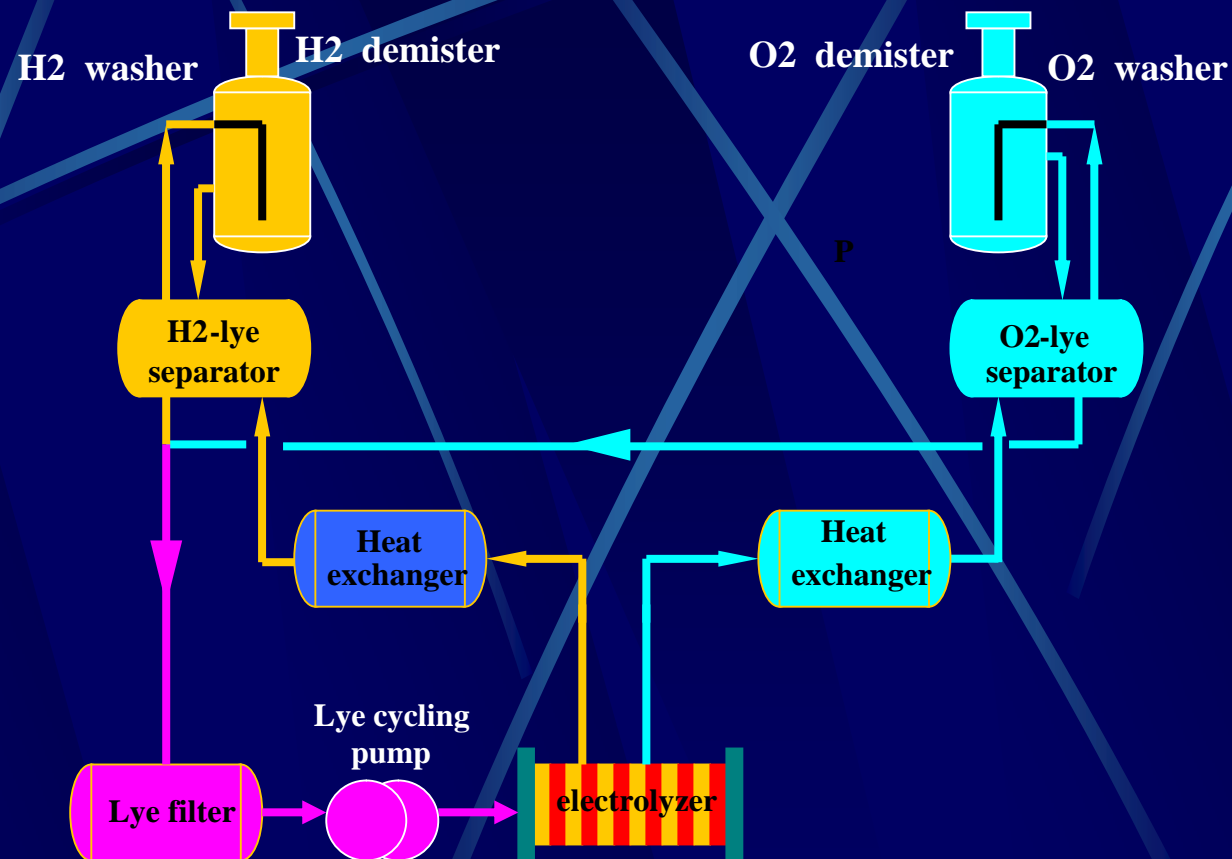


# Description on the process of H<sub>2</sub> generation unit

## 1. H<sub>2</sub> gas loop and O<sub>2</sub> gas loop:



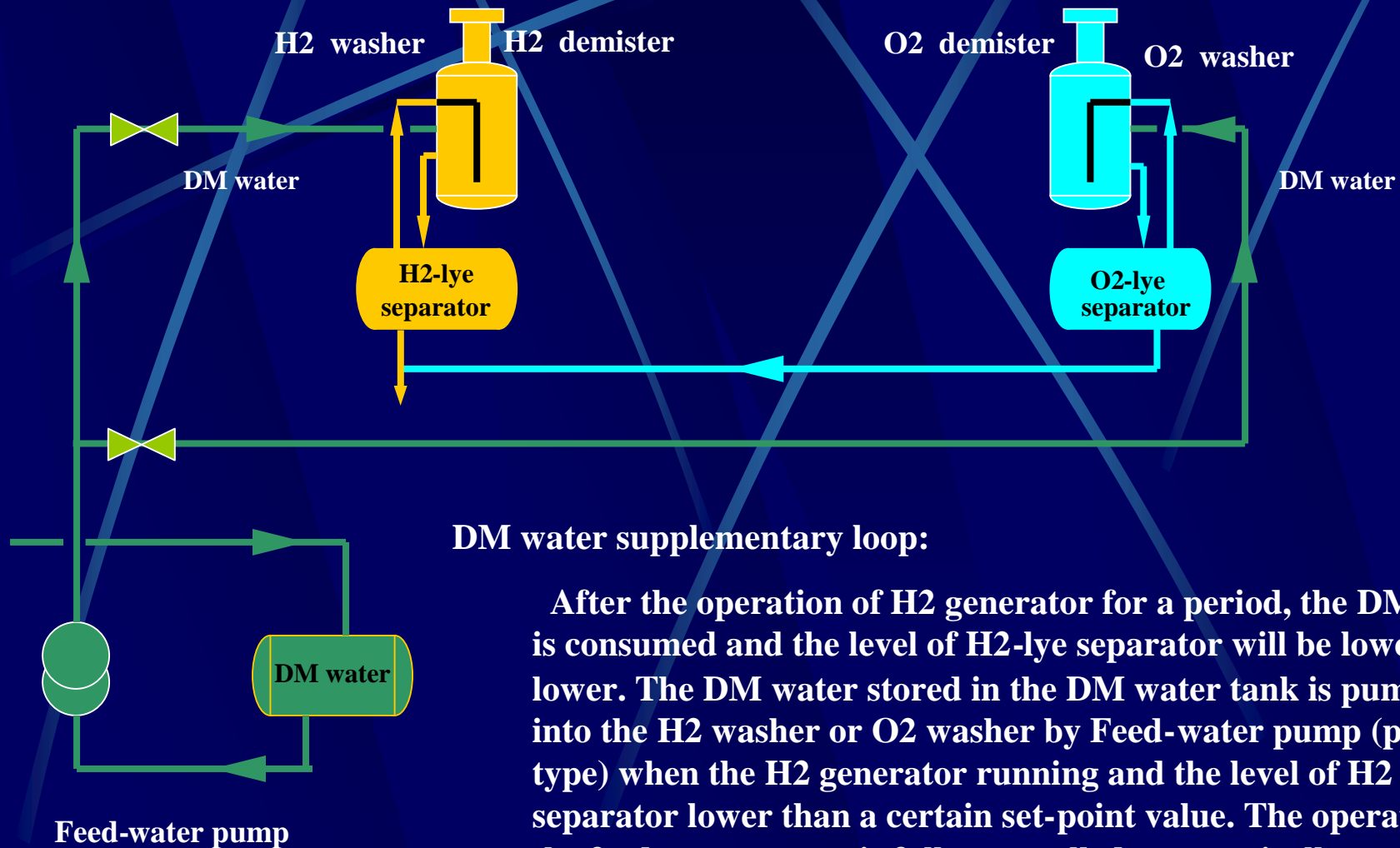
## 2. Lye cycling loop:



### Lye cycling loop:

The separated lye in the H<sub>2</sub>-lye separator and O<sub>2</sub>-lye separator is combined together and flows into the lye filter, then is pumped into the electrolyser by lye cycling pump for further water electrolysis. The accumulated lye in the H<sub>2</sub> washer and O<sub>2</sub> washer is overflowed from the washer to the corresponding separator.

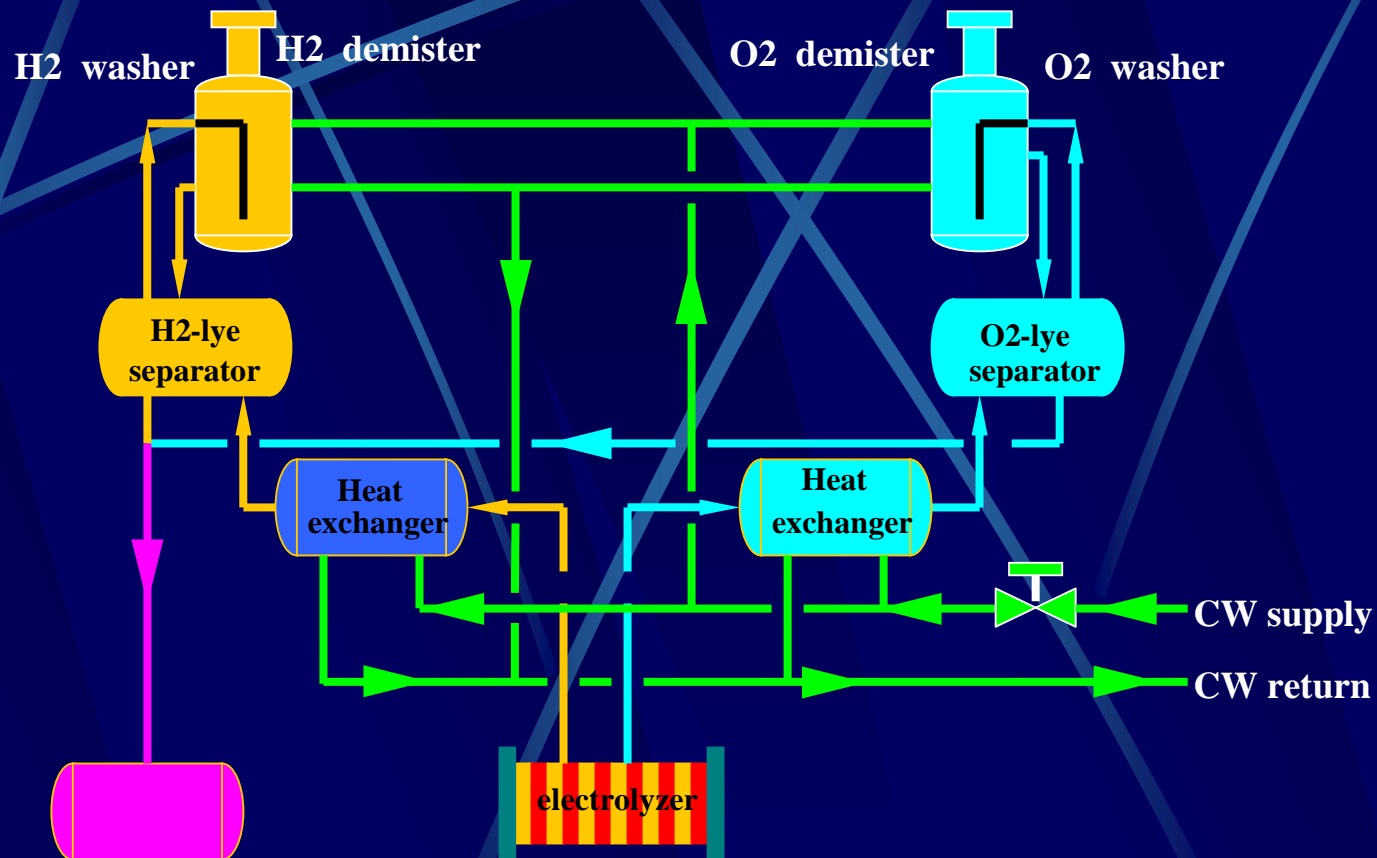
### 3. DM water supplementary loop



#### DM water supplementary loop:

After the operation of H<sub>2</sub> generator for a period, the DM water is consumed and the level of H<sub>2</sub>-lye separator will be lower and lower. The DM water stored in the DM water tank is pumped into the H<sub>2</sub> washer or O<sub>2</sub> washer by Feed-water pump (plunge type) when the H<sub>2</sub> generator running and the level of H<sub>2</sub> separator lower than a certain set-point value. The operation of the feed-water pump is fully controlled automatically as per PLC control logic.

#### 4. Cooling water loop:



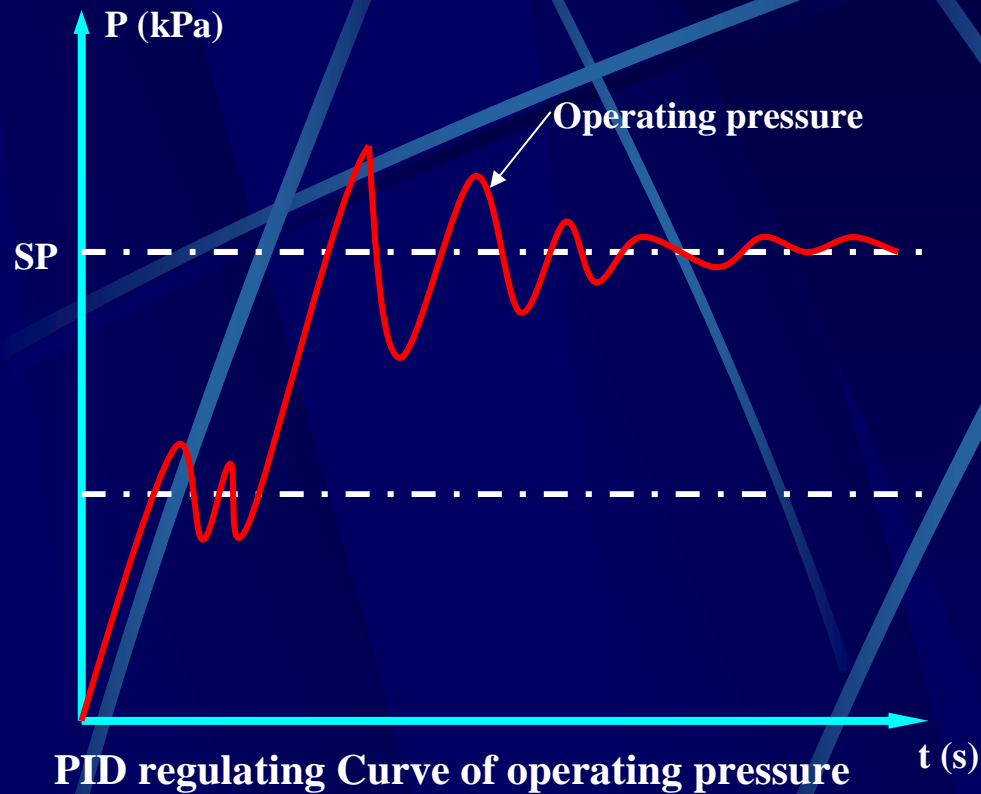
#### Cooling water loop:

With the operation of H<sub>2</sub> generator, the heat by water electrolysis shall be brought and the temperature shall be controlled. The heat is exchanged via lye cycling loop in the heat exchanger with the cooling water. The cooling water enters into the exchanger to cool the lye from electrolyser, the cooled lye flows back to electrolyser via lye cycling loop. The flows of cooling water is controlled to decide the heat exchanging.

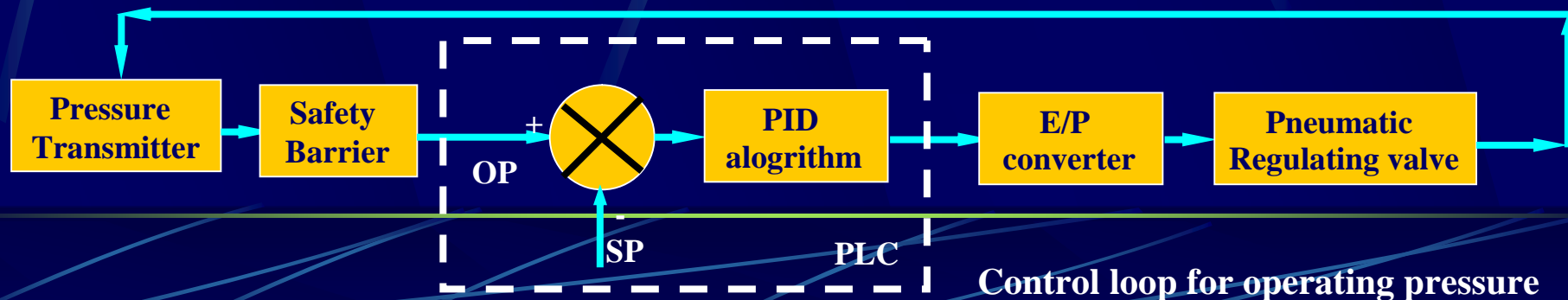
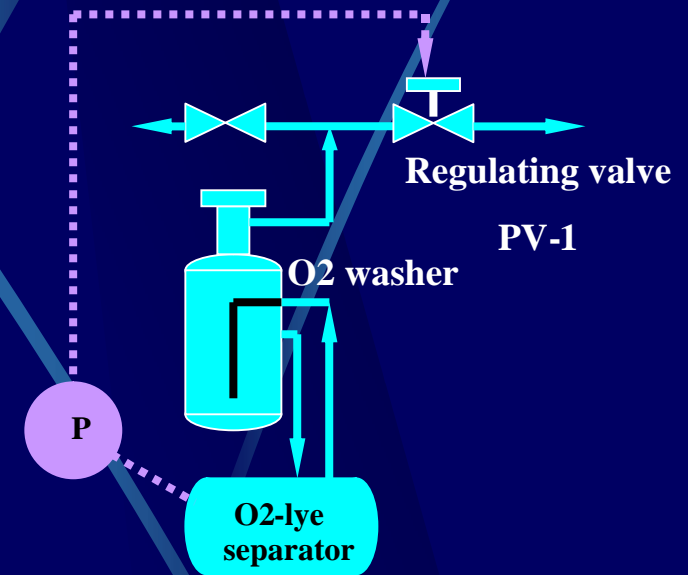


# Description on control loops of H2 generation unit

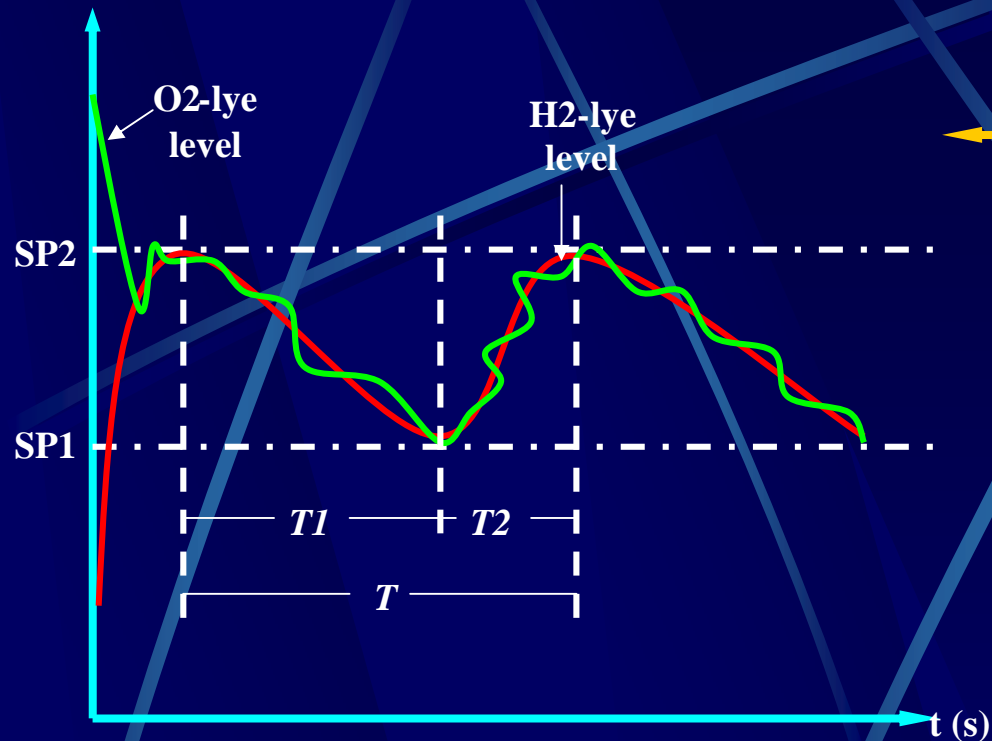
## 1. Control loop for operating pressure



SP: Set-point value of operating pressure



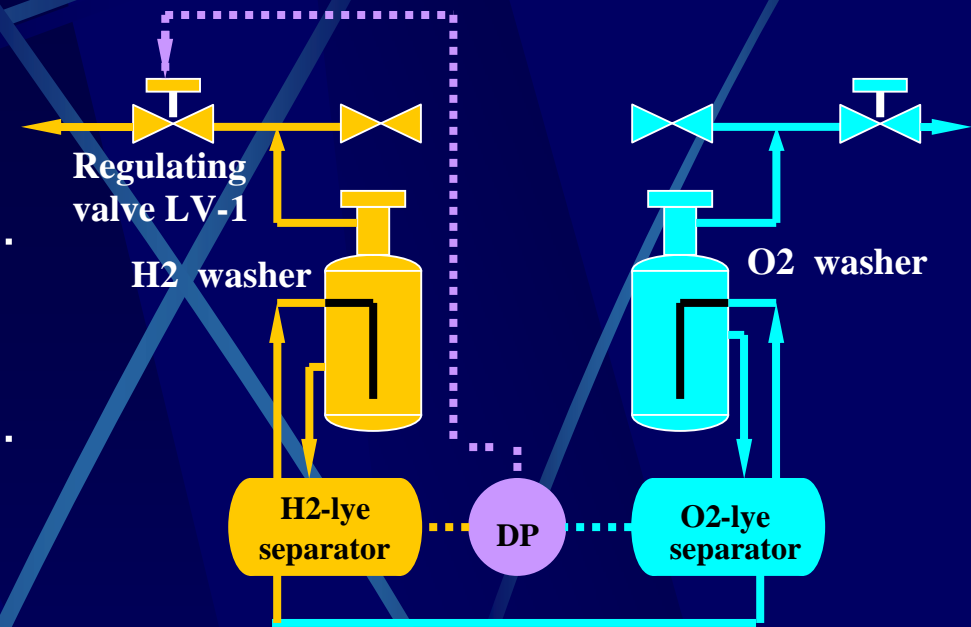
## 2. Control loop for balance between H2-lye level and O2-lye level



PID regulating Curve of balance of levels

SP1: low limit of DM water supplementary;

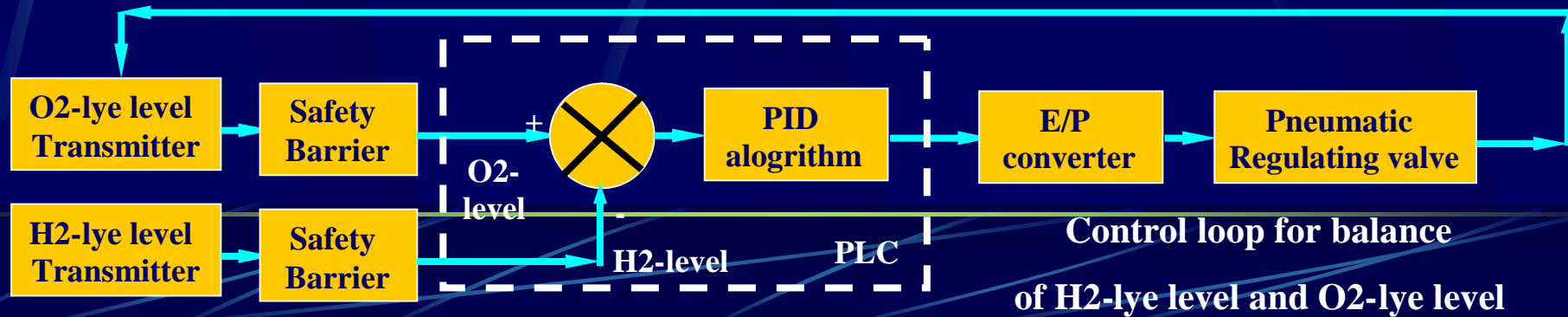
SP2: high limit of DM water supplementary;



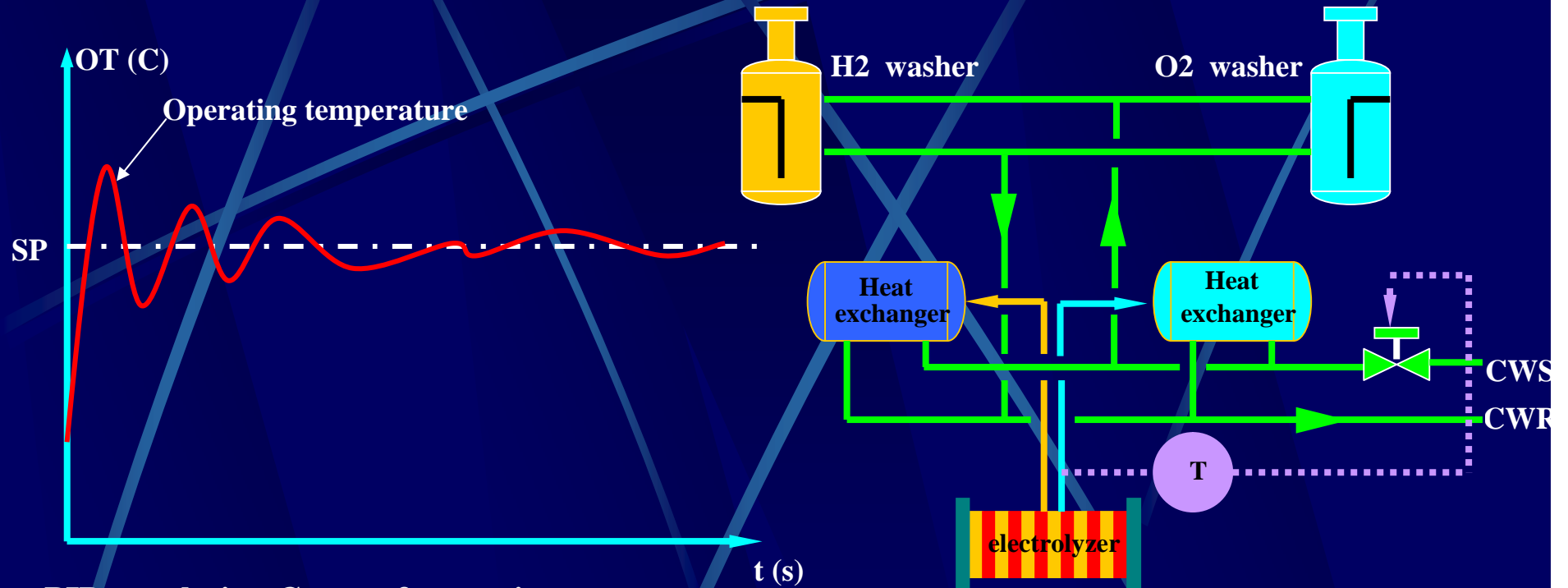
T1: period of H2 generator operating;

T2: period of DM water supplementary;

T: One period ;  $T = T1 + T2$  ;

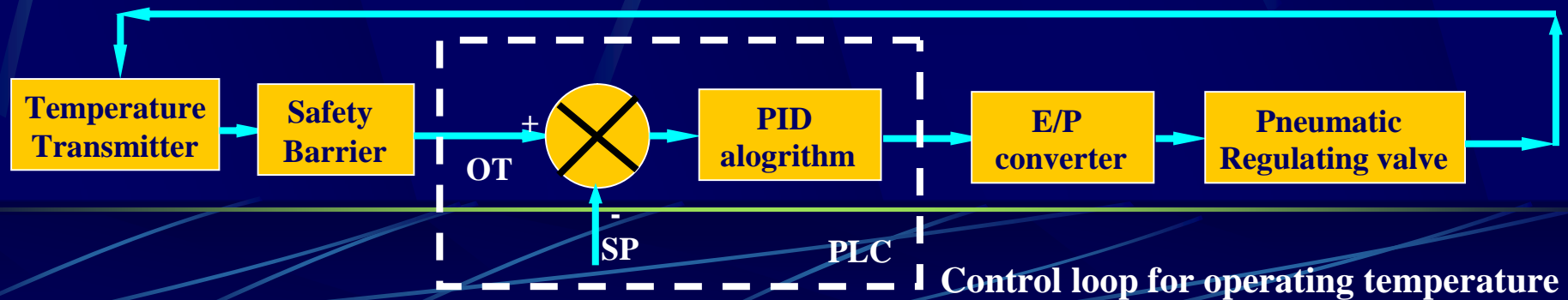


### 3. Control loop for operating temperature

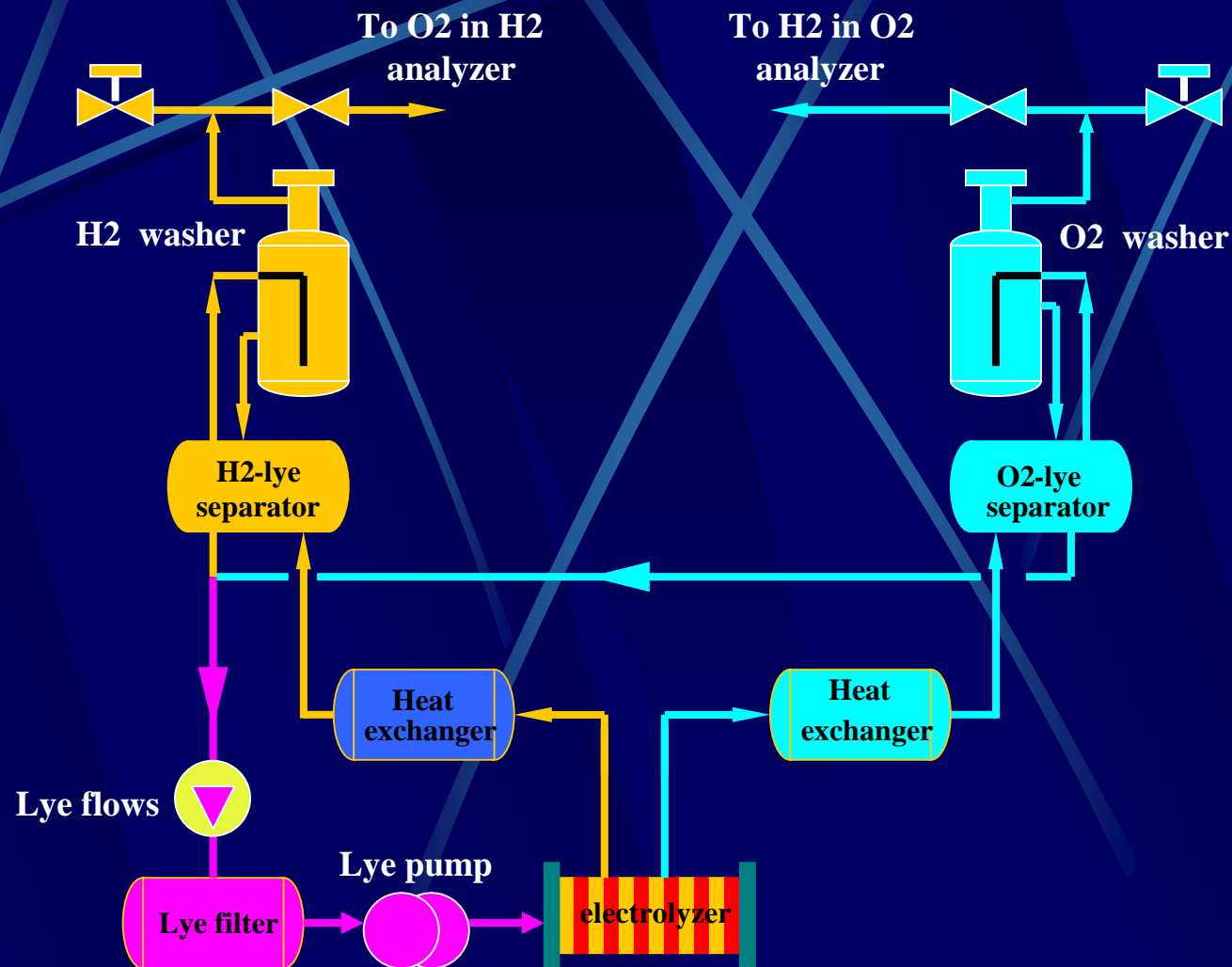


PID regulating Curve of operating temperature

SP: Set-point value of operating temperature



#### 4. Monitoring for H<sub>2</sub> purity, O<sub>2</sub> purity, lye flows and H<sub>2</sub> concentration



Note:

Action of alarm and / or interlock will be taken, in case the monitored parameters exceeds to their alarm / interlock set point values, to protect the operation of H<sub>2</sub> generator. One more, the secondary protection by pressure switch is designed in case the automatic control becomes out of order and the signal from the pressure switch is transmitted to rectifier to cut off the power to electrolyser directly.

## II. Description on the process of H2 purification unit

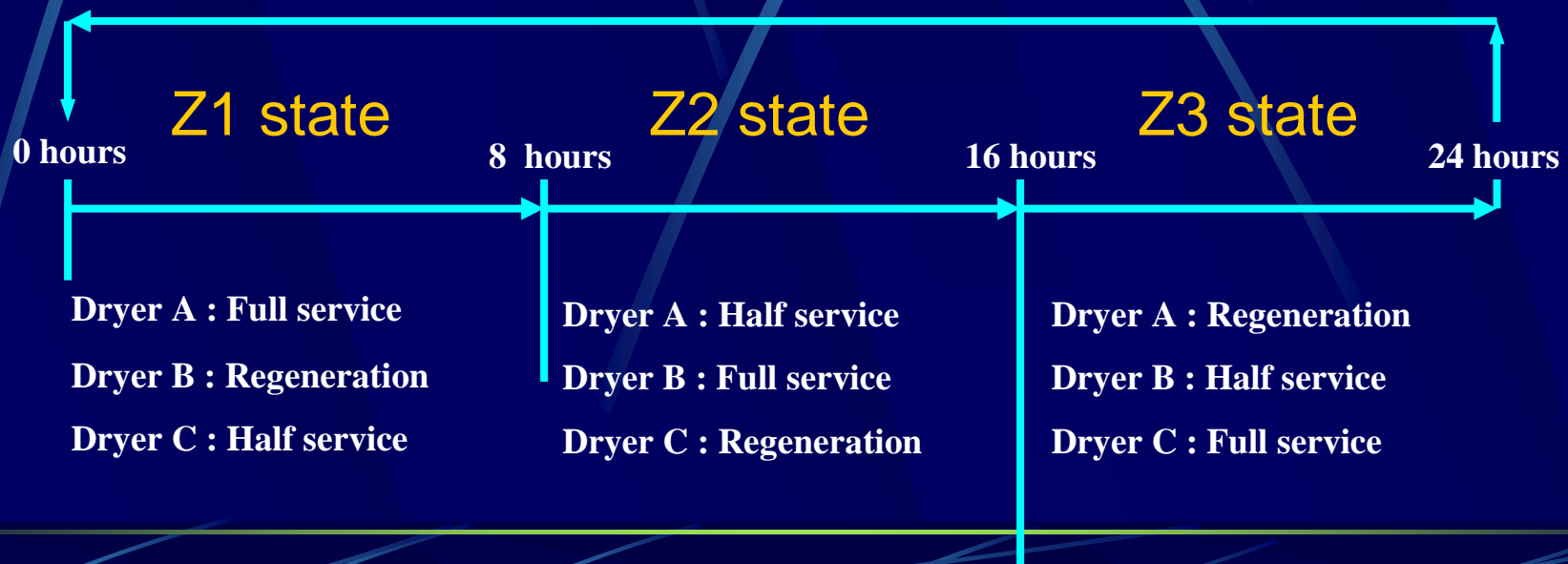
### 1. flows chart for H2 purification unit

#### 1.1 Description on the processing:

- 1) Structure of De-oxy tower;
- 2) Structure of H2 dryer;

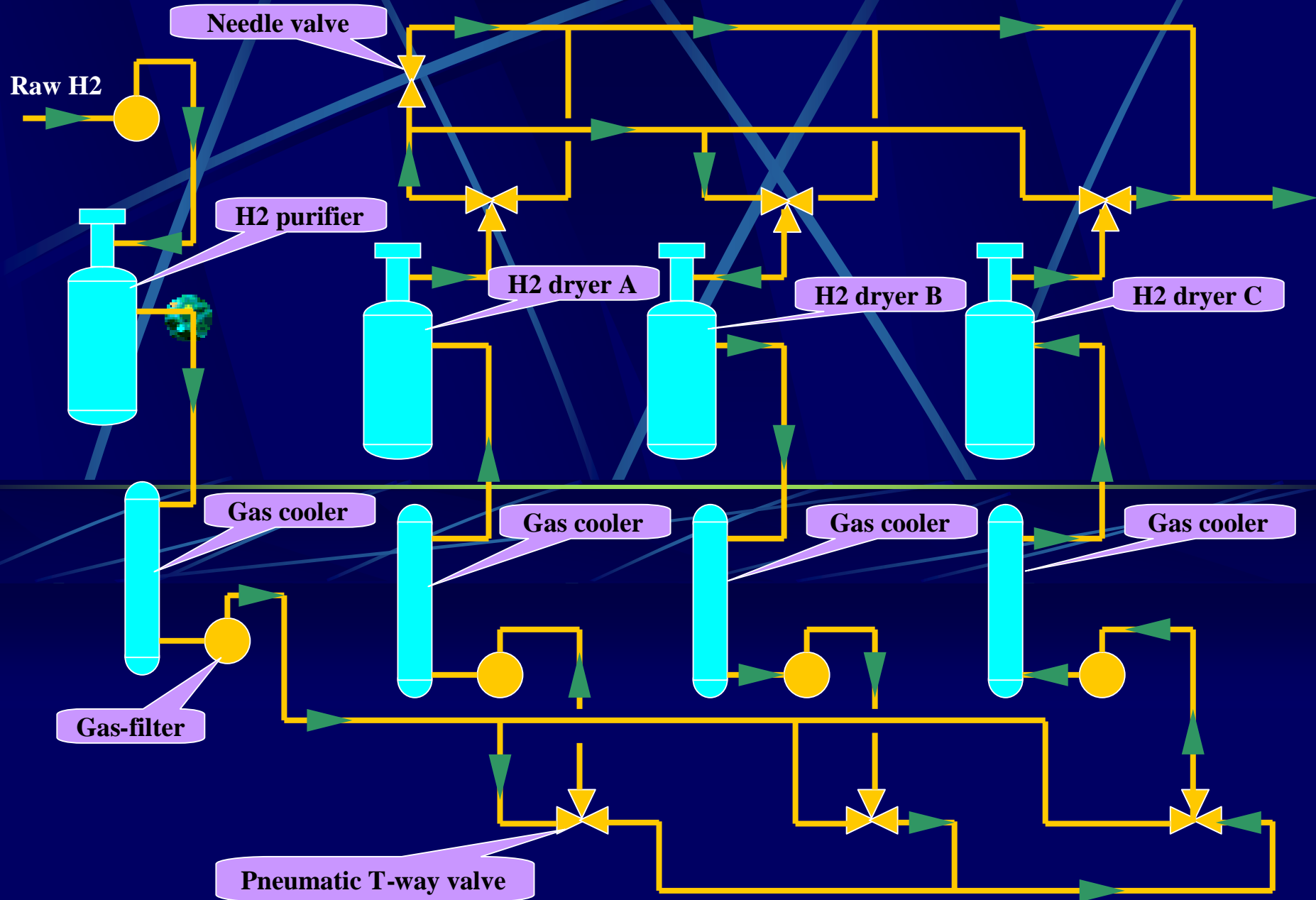
#### 1.2 Description on the automatic control loops

- 1) gas flows for the H2 purification units





# 1. typical flow chart for H<sub>2</sub> purifying system by catalyst



# 1.1 Description on the process

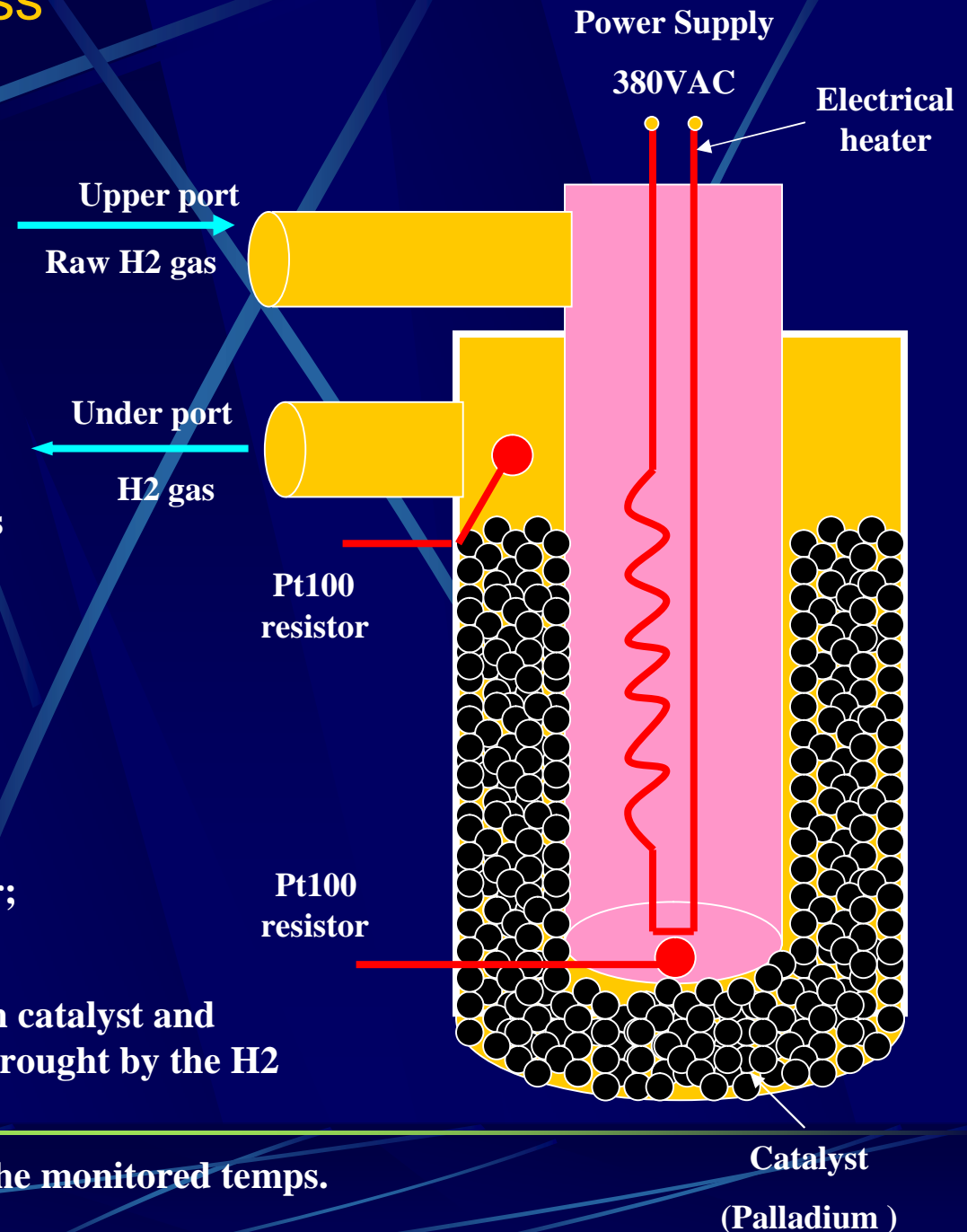
## 1) Structure of de-oxy tower

Explanation on the structure:

- (1) There are two cylinders combined together; the small cylinder is in the middle of big cylinder;
- (2) Inside of the small cylinder, electrical heater is installed and its power is depended on the gas capacity.
- (3) At the bottom of small cylinder, there is temperature sensor to detect the gas temperature;
- (4) At the outlet of big cylinder, there is another temperature sensor to detect the gas temperature;
- (5) The catalyst is filled fully in the space between small cylinder and big cylinder;

Principle :

- (6) Mini oxygen is reacted with H<sub>2</sub> gas with catalyst and moisture is generated; the moisture is brought by the H<sub>2</sub> gas flows;
- (7) The working of heater is depended on the monitored temps.



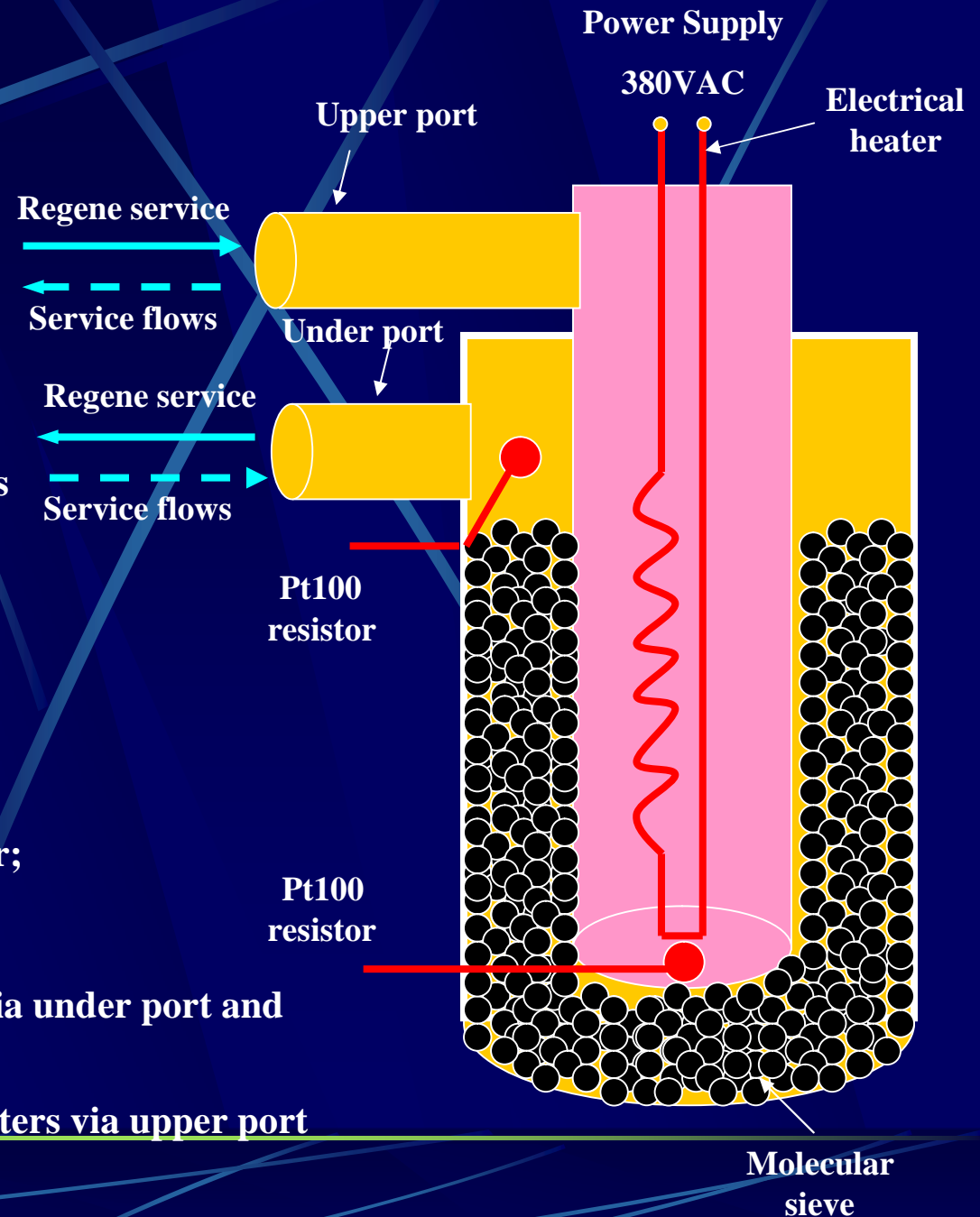
## 2) Structure of H<sub>2</sub> dryer

Explanation on the structure:

- (1) There are two cylinders combined together; the small cylinder is in the middle of big cylinder;
- (2) Inside of the small cylinder, electrical heater is installed and its power is depended on the gas capacity.
- (3) At the bottom of small cylinder, there is temperature sensor to detect the gas temperature;
- (4) At the outlet of big cylinder, there is another temperature sensor to detect the gas temperature;
- (5) The desiccant is filled fully in the space between small cylinder and big cylinder;

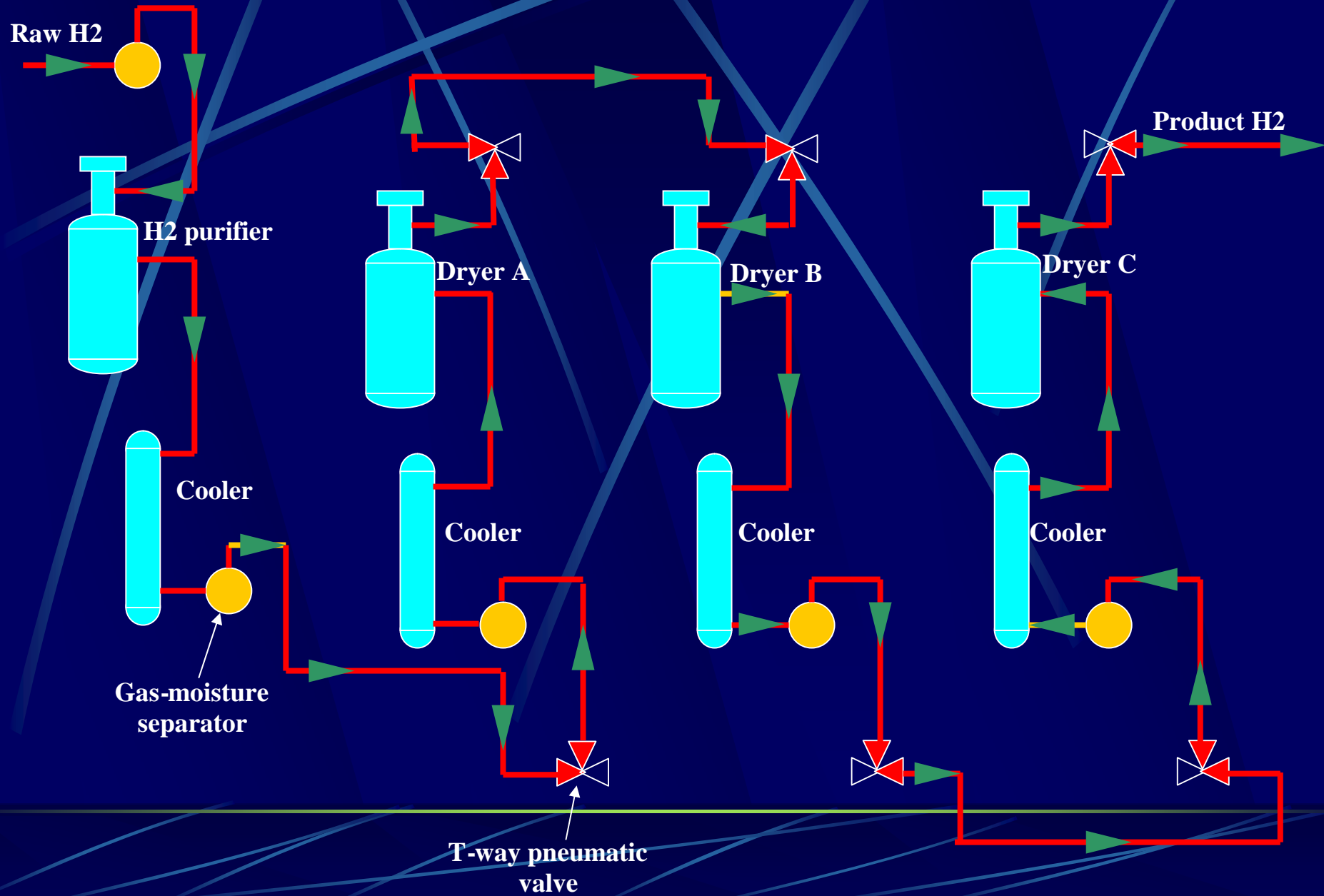
Principle :

- (6) When the dryer in service, gas enters via under port and flow out from upper port;
- (7) When the dryer in regeneration, gas enters via upper port and flows out from under port.

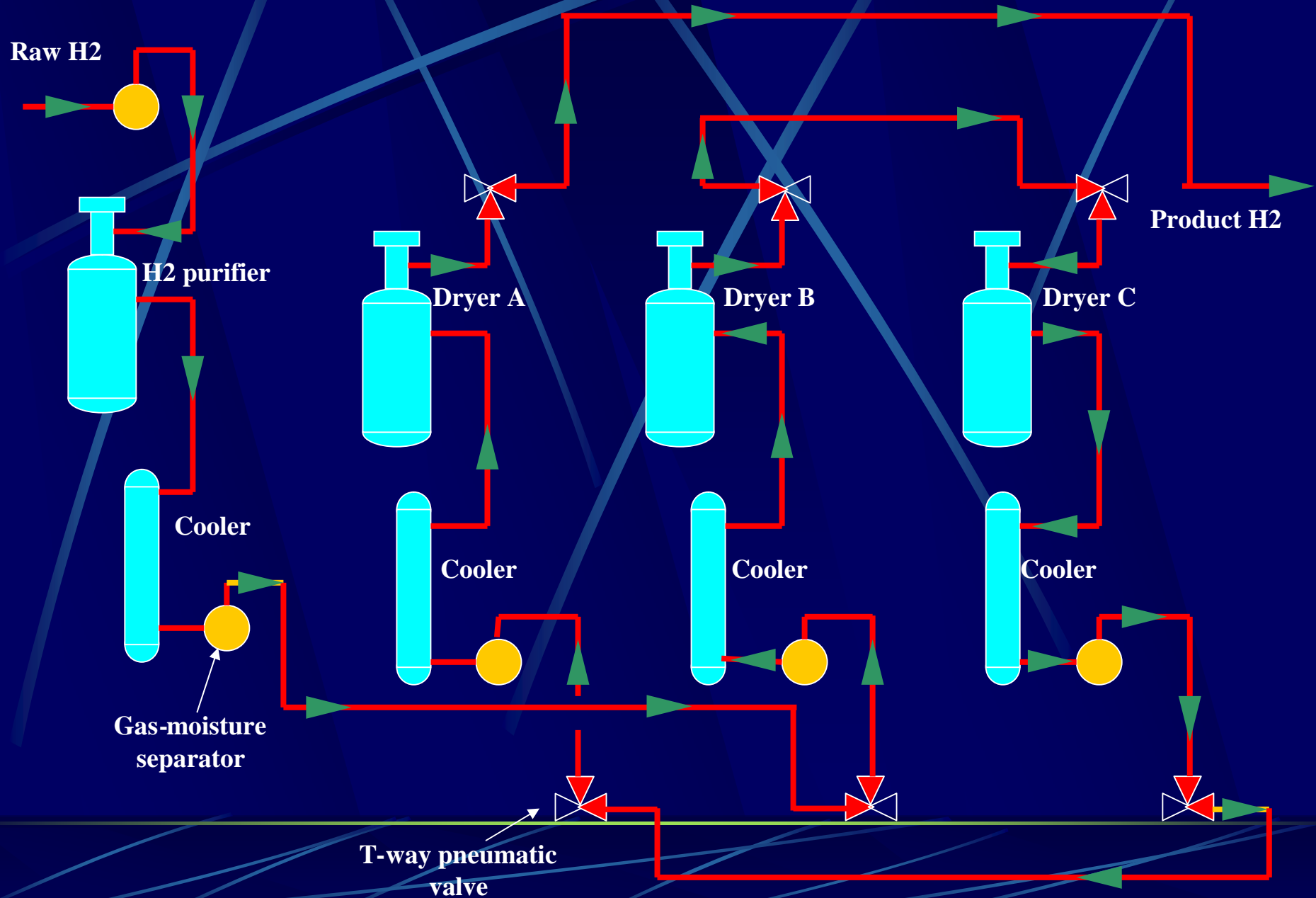


## 1.2 Gas flows in the hydrogen purification unit

### 1) When the purification unit is in Z1 state



## 2) When the purification unit is in Z2 state





### 3) When the purification unit is in Z3 state

