Generate a developer documentation for the following code:

```
PROGRAM UreaReactionControl
VAR
  // Inputs
  stAmmoniaValve: BOOL; // TRUE when ammonia valve is open
  stCO2Valve: BOOL; // TRUE when CO2 valve is open
  rCurrentPressure : REAL;
  rCurrentTemperature : REAL;
  // Outputs
  stAmmoniaValveControl: BOOL; // TRUE to open ammonia valve
  stCO2ValveControl: BOOL; // TRUE to open CO2 valve
  // Internal variables
  stStep1 : BOOL := FALSE; // Load raw materials
  stStep2 : BOOL := FALSE; // Control reaction
  stReactionFinished: BOOL:= FALSE; // Reaction finished flag
  // Parameters
  rTargetPressure: REAL:= 175.0; // Target reactor pressure in bars
  rPressureTolerance: REAL:= 5.0; // Pressure tolerance in bars
  rTargetTemperature : REAL := 185.0; // Target reactor temperature in °C
  rTemperatureTolerance: REAL:= 2.0; // Temperature tolerance in °C
  tReactionTime : TIME := T#30m; // Total reaction time
  tReactionTimer : TIME; // Reaction timer
END_VAR
// Main Sequence
IF NOT stReactionFinished THEN
  // Step 1: Load raw materials
  IF NOT stStep1 THEN
    stAmmoniaValveControl := TRUE;
    stCO2ValveControl := TRUE;
    IF stAmmoniaValve AND stCO2Valve THEN
       stStep1 := TRUE;
       tReactionTimer := CURRENT_TIME;
    END IF
  // Step 2: Control reaction
  ELSIF NOT stStep2 THEN
    // Check pressure and temperature
    IF (rCurrentPressure > = rTargetPressure - rPressureTolerance) AND
(rCurrentPressure <= rTargetPressure + rPressureTolerance) AND
(rCurrentTemperature > = rTargetTemperature - rTemperatureTolerance) AND
(rCurrentTemperature <= rTargetTemperature + rTemperatureTolerance) THEN
       IF CURRENT_TIME >= tReactionTimer + tReactionTime THEN
         stStep2 := TRUE;
       END_IF
    ELSE
       // Adjust valves based on pressure and temperature
       stAmmoniaValveControl := (rCurrentPressure < rTargetPressure) OR
(rCurrentTemperature < rTargetTemperature);
       stCO2ValveControl := (rCurrentPressure < rTargetPressure) OR
(rCurrentTemperature < rTargetTemperature);
    END_IF
  END_IF
ELSE
```

The UreaReactionControl program is responsible for controlling a urea production process. The process consists of loading raw materials (ammonia and CO2),

UreaReactionControl Developer

Celsius.

CO2 valve.

Outputs

Variables Inputs * `stAmmoniaValve`: BOOL - Indicates the status of the ammonia valve (TRUE) when open, FALSE when closed).

* *stco2valve*: BOOL - Indicates the status of the CO2 valve (TRUE when open,

• `rCurrentPressure`: REAL - The current reactor pressure in bars.

monitoring and adjusting the reaction conditions (pressure and temperature), and

`rCurrentTemperature`: REAL - The current reactor temperature in degrees

FALSE when closed).

stopping the process once the reaction is complete.

stAmmoniaValveControl := FALSE;

stCO2ValveControl := FALSE;

stReactionFinished := TRUE;

Documentation

END_IF

END_PROGRAM

Overview

`stAmmoniaValveControl`: BOOL - Command to open (TRUE) or close (FALSE) the ammonia valve.

`stCO2ValveContro1`: BOOL - Command to open (TRUE) or close (FALSE) the

Internal Variables

`stStep1`: BOOL - Step 1 flag (Load raw materials) which is set to TRUE when

* stStep2*: BOOL - Step 2 flag (Control reaction) which is set to TRUE when the

`stReactionFinished`: BOOL - Reaction finished flag, set to TRUE when the reaction process is completed.

(default: 185.0).

reaction is complete.

both raw materials are loaded.

Parameters

`rTargetPressure`: REAL - The target reactor pressure in bars (default: 175.0).

`rTargetTemperature`: REAL - The target reactor temperature in degrees Celsius

* `rPressureTolerance`: REAL - The pressure tolerance in bars (default: 5.0).

* `rTemperatureTolerance`: REAL - The temperature tolerance in degrees Celsius (default: 2.0).

* `tReactionTime`: TIME - The total reaction time (default: 30 minutes).

* `tReactionTimer`: TIME - A timer to track the reaction time.

Main Sequence 1. If the reaction is not finished (`stReactionFinished` is FALSE), proceed with the

a. Step 1 (Load raw materials): If `stStep1` is FALSE, open both ammonia and

CO2 valves by setting `stAmmoniaValveControl` and `stCO2ValveControl` to

TRUE. When both valves are open, set `stStep1` to TRUE and start the reaction

timer by assigning the `CURRENT_TIME` to `tReactionTimer`. b. Step 2 (Control reaction): If `stStep1` is TRUE and `stStep2` is FALSE, check if the current pressure and temperature are within the specified tolerance

following steps:

set `stStep2` to TRUE. If the conditions are not within the specified range, adjust the valves based on the current pressure and temperature.

2. If the reaction is finished (`stStep2` is TRUE), close both ammonia and CO2

range. If the conditions are within the range and the reaction time has elapsed,

and set `stReactionFinished` to TRUE. continue

a. Set `stAmmoniaValveControl` and `stCO2ValveControl` to TRUE to open both

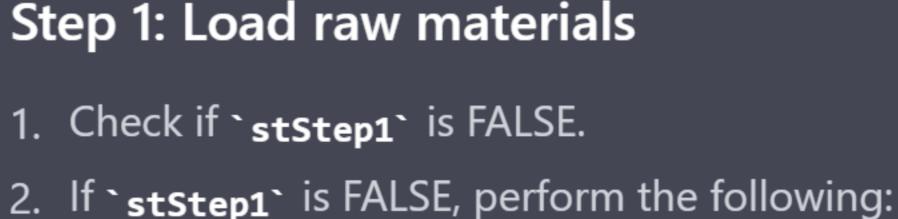
b. Check if both `stAmmoniaValve` and `stCO2Valve` are TRUE.

`tReactionTimer` by assigning the `current time` to it.

c. If both valves are open, set `stStep1` to TRUE and initialize the

valves by setting `stAmmoniaValveControl` and `stCO2ValveControl` to FALSE,

Detailed Sequence



valves.

Step 2: Control reaction Check if `stStep1` is TRUE and `stStep2` is FALSE. 2. If both conditions are met, perform the following:

- a. Check if the current pressure (`rCurrentPressure`) and temperature (`rCurrentTemperature`) are within the target pressure and temperature ranges
- (considering the specified tolerances). b. If the conditions are within the specified ranges, check if the `current Time` is greater than or equal to the `tReactionTimer` plus `tReactionTime`.

2. If `stStep2` is TRUE, perform the following:

- c. If the current time exceeds the `tReactionTimer` plus `tReactionTime`, set `stStep2` to TRUE, indicating that the reaction is complete. d. If the current pressure and temperature are not within the specified ranges,
- adjust the ammonia and CO2 valves based on the current pressure and temperature by setting `stAmmoniaValveControl` and `stCO2ValveControl`.
- **Step 3: Finish reaction** 1. Check if `stStep2` is TRUE.

a. Set `stAmmoniaValveControl` and `stCO2ValveControl` to FALSE to close both

b. Set `stReactionFinished` to TRUE, indicating that the reaction process is completed.

valves.

Use Cases

Adjusting Parameters You can adjust the parameters for the target pressure, pressure tolerance, target

temperature, and temperature tolerance to modify the reaction conditions. This flexibility allows you to optimize the process based on the specific urea production requirements. **Monitoring Reaction Progress**

By monitoring the `stStep1`, `stStep2`, and `stReactionFinished` variables, you can track the progress of the urea production process. This information can be used for process visualization or to trigger additional control logic in your automation system.

Ensuring Safe Operation The program ensures that the reaction conditions are maintained within the specified pressure and temperature tolerances. This helps to ensure safe operation and prevent equipment damage due to excessive pressure or temperature during

the urea production process.

