


	MODIFIED STARCH FLASH DRYER PROJECT						
	COMPREHENSIVE CONTROL STRATEGY						
	Project No.	Discipline	Document Type	Plant / Equipment No	Sequence No.	Rev.	
	5204	CN	RP	000	02	00	

FLASH DRYER

COMPREHENSIVE CONTROL



STRATEGY

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## 1.PRIMARY CONTROL LOOPS

### 1.1. MAIN MOISTURE CONTROL LOOP (Cascade Control)

#### Primary Loop - Moisture Control:

- **Sensor:** MT-101 (Moisture Transmitter, 0-50% range)
- **Controller:** MIC-101 (Moisture Indicating Controller)
- **Setpoint:** 12% moisture (adjustable based on product specification)
- **Output:** Setpoint to secondary temperature loop

#### Secondary Loop - Temperature Control:

- **Sensor:** TT-103 (Temperature Transmitter at Fan Inlet, 0-200°C)
- **Controller:** TIC-103 (Temperature Indicating Controller)
- **Setpoint:** Received from MIC-101 (typically 60-80°C)
- **Output:** 4-20mA to Steam Control Valve on Zone 3 Heater (TCV-101)

#### Control Algorithm:



IF MT-101 > Setpoint THEN

    Decrease TIC-103 Setpoint (reduce drying temperature)

ELSE IF MT-101 < Setpoint THEN

    Increase TIC-103 Setpoint (increase drying temperature)

ENDIF

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## 1.2. FEED RATE CONTROL BASED ON MOISTURE

**Control Logic:** In normal operation, moisture control is performed by the **1.1. MAIN MOISTURE CONTROL LOOP (Cascade Control)** until the deviation from the setpoint becomes significant or sudden changes occur in the conditions of the input cake to the dryer; at that point, the control of the dryer is assigned to this loop (**1.2. FEED RATE CONTROL BASED ON MOISTURE**) until conditions stabilize.

- **Master:** MT-101 Moisture reading
- **Slave:** VFD-B6200 (Agitated Feed Vessel speed)
- **WT-B6200:** Weight measurement for feed rate calculation

Feed Rate Adjustment =  $f(\text{MT-101}, \text{Product Throughput})$

IF MT-101 > 15% THEN

Reduce VFD-B6200 speed by 10%

ELSE IF MT-101 < 9% THEN



Increase VFD-B6200 speed by 10%

ENDIF

## 1.3. SECONDARY TEMPERATURE CONTROL LOOP

**After-Heater Temperature Control:**

- **Sensor:** TT-102 (Temperature Transmitter in Dryer Duct, 0-200°C)
- **Controller:** TIC-102 (Temperature Controller)
- **Setpoint:** 170°C (adjustable)
- **Alarms:**
  - TAH-102: High Alarm at 180°C

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- TAL-102: Low Alarm at 100 ((variable based on capacity))
- **Output:** Trim adjustment to main steam valve

### Safety Interlock:

```

IF TT-102 > 185°C THEN
    Close steam valve fully
    Activate emergency stop sequence
ENDIF

```

## 2. SAFETY INTERLOCKS & ESD SYSTEM



### 2.1. EXPLOSION PROTECTION SYSTEM

**Sensors:** XS-101 to XS-106 (Dryer Duct) + XS-F6506 to XS-F6511 (Cyclones) + XS-B6512 (Silo)

```

IF ANY explosion sensor activated THEN
    IMMEDIATE:
    1. Close all steam valves (FT-S101 related)
    2. Stop ID fan (V6515)
    3. Stop the starch cake feed system to the dryer, including screw conveyors M-1
    to M-4 and the starch cake blower (H6204).
    4. Activate quench steam suppression system
    5. Isolate system from plant
    6. Alarm to control room
ENDIF

```

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## 2.2. HIGH TEMPERATURE PROTECTION

```

IF TT-101 > 180°C OR TT-102 > 185°C THEN
    Close steam control valve
    Reduce fan speed to 50%
    Alarm: "HIGH TEMPERATURE - PROCESS INTERRUPTED"
ENDIF

```

## 2.3. PRESSURE SAFETY

```

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IF PT-102 > 1.5 barg OR PT-103 < -0.5 barg THEN
    Stop ID fan (V6515)
    Open emergency vent
    Alarm: "PRESSURE DEVIATION - SYSTEM STOPPED"
ENDIF

```



## 2.4. DOOR SAFETY INTERLOCKS

**Sensors:** GS-101 to GS-106 (Heater & Duct doors) + GS-B6200 to GS-H6512, GS-H6513 (Equipment access)

```

IF ANY door open during operation, THEN
    Stop relevant equipment section
    Prevent restart until door closed
    Local indication + Control room alarm
ENDIF

```

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### 3. SEQUENCE CONTROL

#### 3.1. STARTUP SEQUENCE

##### PHASE 1: PRE-START CHECKS

- All doors closed (GS-xxx verification)
- No active alarms
- Utilities available (steam, power, air)
- Safety systems armed

##### PHASE 2: COLD START

1. Start exhaust fan V6515 at 20% speed
2. Open steam valve gradually to reach TT-A102 = 50°C
3. Start feed system (B6200 → H6202 → H6203 → H6204)
4. Ramp up fan speed to 50%
5. Increase temperature to setpoint (TT-102 = 170°C)

##### PHASE 3: NORMAL OPERATION

- Engage moisture control loop (MT-101 → TIC-103)
- Monitor all parameters
- Ramp to 100% capacity



#### 3.2. NORMAL SHUTDOWN SEQUENCE

##### STEP 1: Feed system stop

- Stop B6200 (feed vessel) after WT-B6200 tend to Zero
- Stop H6202 (screw conveyor)+Delay Time
- Stop H6203 (feeder) +Delay Time
- Stop H6204 (wet blower) +Delay Time

##### STEP 2: Drying system cooldown

- Reduce steam valve to 10%

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- Maintain fan at 30% for 10 minutes
- When TT-103 < 50°C, stop fan

#### STEP 3: Complete shutdown

- Close steam valve
- Isolate system
- Purge if necessary

### 3.3. EMERGENCY SHUTDOWN SEQUENCE

#### TRIGGERS:

- ESD button pressed
- Explosion detected (XS-xxx)
- Fire alarm
- Power failure
- Critical parameter deviation

#### ACTIONS:

##### IMMEDIATE (0-2 seconds):

1. Close all steam valves
2. Stop all rotating equipment
3. Activate suppression if needed



##### FOLLOW-UP (2-30 seconds):

4. Purge system with inert gas
5. Isolate from plant
6. Full system alarm

### 3.4. OPERATIONAL MODES

#### AUTO MODE:



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- All control loops active
- Automatic startup/shutdown
- Recipe-based operation

#### MANUAL MODE:

- Operator control of individual devices
- Override capability
- For maintenance/troubleshooting

#### RECIPE MODE:

- Product-specific parameters
- Automatic adjustment for different starch types
- Historical data logging

## 4. MONITORING & DATA ACQUISITION

### 4.1. CRITICAL PARAMETERS MONITORING



#### TEMPERATURES (All TT-xxx):

- TT-S101: Steam header (0-220°C)
- TT-101: Dryer inlet (0-200°C)
- TT-102: Dryer process (0-200°C)
- TT-103: Fan inlet (0-200°C)
- TT-C101-C104: Condensate temperatures

#### PRESSURES (All PT-xxx & PG-xxx):

- PT-S101: Steam pressure (0-16 barg)
- PT-102/103: Process pressures (0-2 barg)
- Trend analysis for filter clogging detection

#### FLOW:

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- FT-S101: Steam flow (0-xxx kg/hr)
- FT-C101: Condensate flow

#### MOISTURE:

- MT-101: Product moisture (0-50%)

## 4.2. EQUIPMENT STATUS MONITORING

#### MOTOR STATUS:

- V6515: Fan status, speed, vibration (VT-V6515)
- Temperature monitoring: TT-V6515A/B (motor), TT-V6515C/D (bearings)

#### ROTATING EQUIPMENT:

- Speed sensors ST-M1 to ST-M7
- Vibration monitoring for predictive maintenance



#### LEVEL MONITORING:

- LSH-B6506 to LSH-B6512: Hopper/silo high level
- LSL-B6512: Silo low level
- LT-B6515: Condensate tank level

## 4.3. ALARM MANAGEMENT

#### Priority 1 (Critical - Red):

- Explosion sensor activation
- Temperature > 185°C
- Motor failure
- Safety system fault

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### Priority 2 (High - Orange):

- Temperature deviation > 10°C
- Pressure deviation > 20%
- Moisture out of spec
- Level alarms

### Priority 3 (Medium - Yellow):

- Equipment warning
- Maintenance due
- Efficiency drop

## 5. ADDITIONAL CONTROL STRATEGIES

### 5.1. ENERGY OPTIMIZATION

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IF Condensate temperature (TT-C104) < 85°C THEN

Adjust steam trap operation



Optimize heat recovery

ENDIF

Fan speed optimization based on:

- Pressure drop across system (PT-102 to PT-103)
- Product moisture content
- Energy consumption

### 5.2. PRODUCT QUALITY ASSURANCE

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text

Continuous monitoring:

- Moisture consistency (MT-101 trend)
- Temperature profile (TT-101, TT-102, TT-103)
- Residence time calculation
- Product throughput rate

### 5.3. PREVENTIVE MAINTENANCE TRIGGERS

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Vibration monitoring (VT-V6515):

- IF > 4.5 mm/s THEN Warning
- IF > 7.0 mm/s THEN Alarm + Schedule maintenance

Bearing temperature (TT-V6515C/D):

- IF > 85°C THEN Investigate
- IF > 95°C THEN Schedule maintenance

## 6. CONTROL SYSTEM ARCHITECTURE



### 6.1. HARDWARE CONFIGURATION

PLC System:

- Redundant processors
- Distributed I/O stations
- Safety PLC for ESD functions

Field Devices:

- 4-20mA analog signals (majority)

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- Digital inputs for status/interlocks
- Profibus/Profinet for smart devices

#### Human-Machine Interface:

- Redundant operator stations
- Engineering workstation
- Mobile access for maintenance

## 6.2. COMMUNICATION PROTOCOLS

- MODBUS TCP/IP for PLC to DCS
- PROFINET for field devices
- OPC UA for data historian
- Wireless for mobile devices



## 7. IMPLEMENTATION PRIORITY

### PHASE 1 (Immediate - Safety):

1. ESD system implementation
2. Temperature safety interlocks
3. Door safety interlocks

### PHASE 2 (Short-term - Basic Control):

1. Moisture-temperature cascade control
2. Basic sequence control

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### 3. Critical parameter monitoring

#### **PHASE 3 (Medium-term - Optimization):**

1. Advanced control algorithms
2. Energy optimization
3. Predictive maintenance

#### **PHASE 4 (Long-term - Integration):**

1. Full plant integration
2. Advanced analytics
3. Remote monitoring

## **8. KEY PERFORMANCE INDICATORS**

text

1. Product Moisture Consistency:  $\pm 0.5\%$
2. Energy Consumption:  $\leq 0.608$  ton steam/ton product
3. System Availability:  $> 98\%$
4. Safety Incident Rate: 0
5. Maintenance Cost:  $< 2\%$  of CAPEX annually

This comprehensive control strategy ensures safe, efficient, and reliable operation of your modified starch drying system while meeting all your specified requirements and incorporating industry best practices.