RRP Electrical Architecture Templates

Purpose: The goal is to create a repeatable system that helps technicians quickly understand:

- Power flow
- Control logic
- System dependencies
- Safety interlocks
- Communication architecture
- Failure points
- Diagnostic access

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Template 1 — Master Electrical Architecture Overview

Machine Information

Item	Information	Item	Information
Machine Model		Network Type	
Serial Number Range		Revision Level	
Electrical System Voltage		Document Number	
Hydraulic System Type		Date	
PLC/Controller Type			

Major Electrical Subsystems

Subsystem	Function	Voltage	Controller
Battery/Charging	Primary power source	24VDC	N/A
Power Distribution	Protected power routing	24VDC	PDM
Engine Controls	Engine management	24VDC	ECU
Hydraulic Controls	Valve control	24VDC	PLC
Operator Controls	User interface	24VDC	HMI
Lighting	Illumination/safety	24VDC	BCM
Vision System	Cameras/guidance	24VDC/PoE	Vision Controller
Safety System	Interlocks/E-stop	24VDC	Safety Relay
Communication	CAN/Ethernet	Variable	Gateway

High-Level Power Flow

```
Battery Bank
    ↓
Master Disconnect
    ↓
Main Protection Breaker
    ↓
Power Distribution Module
    ↓
Subsystem Distribution
    ├── PLC Power
    ├── ECU Power
    ├── HMI Power
    ├── Sensor Power
    ├── Vision System
    ├── Hydraulic Solenoids
    └── Lighting
```

Template 2 — Power Distribution Architecture

Main Power Distribution Sheet

Primary Power Source

Item	Specification
Battery Voltage	
Battery Capacity	
Charging Voltage	
Alternator Output	
Main Ground Location	
Main Disconnect Type	

Main Circuit Protection

Circuit	Protection Type	Rating	Feeds
Main Feed	Breaker		
PLC Supply	Fuse		
Lighting	Fuse		
Hydraulic Controls	Fuse		
Vision System	Fuse		
HMI	Fuse		

Power Distribution Layout

```
24V Battery
   ↓
Master Disconnect
   ↓
250A Main Breaker
   ↓
Power Distribution Module
   ├── 40A PLC Supply
   ├── 30A Hydraulic Controls
   ├── 15A Vision System
   ├── 20A Lighting
   ├── 10A HMI
   └── 15A Auxiliary Systems
```

Voltage Verification Table

Test Point	Nominal Voltage	Minimum	Maximum	Loaded Voltage
Battery	24VDC	22V	28V	
PLC Supply	24VDC	21.6V	28.8V	
Sensor Supply	5VDC	4.8V	5.2V	
Camera Supply	24VDC	22V	28V	
Solenoid Supply	24VDC	20V	28V	

Template 3 — Grounding Architecture

Grounding System Layout

Primary Grounds

Ground Point	Function	Location	Resistance Max
G1	Main chassis ground		
G2	PLC ground		
G3	Sensor ground		
G4	Vision system ground		
G5	Hydraulic control ground		

Ground Distribution Diagram

```
Battery Negative
    ↓
Main Chassis Ground
    ├── Engine Ground
    ├── PLC Ground
    ├── Sensor Ground
    ├── Camera Ground
    ├── Lighting Ground
    └── Hydraulic Control Ground
```

Ground Verification Checklist

Verification Item	Pass/Fail	Notes
No paint under lug		
No corrosion		
Proper torque		
Voltage drop acceptable		
Shield drains intact		

Template 4 — PLC/ Control Architecture

Controller Information

Item	Information
PLC Manufacturer	
PLC Model	
Software Version	
Firmware Version	
Input Count	
Output Count	
Communication Type	

PLC Power Requirements

Parameter	Specification
Nominal Voltage	
Minimum Voltage	
Maximum Voltage	
Current Draw	
Fuse Rating	

Input Architecture

Input	Source Device	Signal Type	Normal State
Start Switch	Operator panel	Digital	Open
E-stop	Safety system	Digital	Closed
Pressure Sensor	Hydraulic system	Analog	Variable
Limit Switch	Mechanical system	Digital	Open
Vision Input	Camera system	Ethernet	Active

Output Architecture

Output	Controlled Device	Voltage	Function
O1	Hydraulic Relay	24VDC	Enable hydraulics
O2	Solenoid Valve	24VDC	Extend cylinder
O3	Warning Light	24VDC	Fault indication
O4	Cooling Fan	24VDC	Thermal management

Control Logic Sequence

```
Operator Command
      ↓
Input Verification
      ↓
Safety Interlock Check
      ↓
PLC Logic Processing
      ↓
Output Activation
      ↓
Hydraulic/Electrical Action
      ↓
Feedback Confirmation
      ↓
Fault Monitoring
```

Template 5 — Sensor Architecture

Sensor Inventory

Sensor	Type	Voltage	Signal Type	Function
Pressure Sensor	Analog	5VDC	0-5V	Hydraulic pressure
Temperature Sensor	RTD	24VDC	Resistance	Oil temperature
Proximity Sensor	Digital	24VDC	PNP	Position detection
Encoder	Incremental	24VDC	Pulse	Speed/position
Camera	Ethernet	PoE	Video	Vision guidance

Sensor Power Architecture

```
24VDC Supply
    ↓
Sensor Power Distribution
    ├── Pressure Sensors
    ├── Proximity Sensors
    ├── Encoders
    ├── Temperature Sensors
    └── Vision System
```

Sensor Validation Table

Sensor	Expected Reading	Test Method	Failure Symptoms
Pressure Sensor	0.5–4.5V	Multimeter	False pressure faults
Proximity Sensor	Switching	LED/meter	Missed detection
Encoder	Pulse output	Scope	Position loss
Camera	Live image	HMI	Auto mode disabled

Template 6 — Can Bus / Network Architecture

Network Overview

Network	Type	Baud Rate	Function
CAN1	J1939	250 kbps	Engine controls
CAN2	CANopen	500 kbps	Hydraulic controls
Ethernet	TCP/IP	100 Mbps	Vision system

Network Node Inventory

Node ID	Device	Power Source	Terminated
01	Engine ECU	Fuse F1	Yes
02	PLC	Fuse F2	No
03	Vision Processor	Fuse F3	No
04	HMI	Fuse F4	Yes

CAN Architecture Diagram

```
120Ω Terminator
       ↓
ECU ——— PLC ——— HMI ——— Vision Controller
       ↑
120Ω Terminator
```

Network Diagnostic Standards

Parameter	Expected Value
CAN Resistance	60 Ohms
CAN High	~2.5–3.5V
CAN Low	~2.5–1.5V
Shield Continuity	Verified
Packet Errors	Minimal

Template 7 — Safety System Architecture

Safety System Inventory

Device	Type	Function	Fail State
E-stop	Pushbutton	Emergency shutdown	Machine disabled
Guard Switch	Interlock	Prevent unsafe access	Machine inhibited
Safety Relay	Redundant relay	Safety monitoring	Outputs off
Pressure Switch	Safety limit	Overpressure protection	Hydraulic shutdown

Safety Logic Flow

```
Safety Input Active?
        ↓
YES → Safety Relay Energized
        ↓
PLC Safety Status TRUE
        ↓
Machine Operation Enabled

NO → Machine Inhibited
```

Safety Verification Checklist

Verification	Pass/Fail	Notes
E-stop functional		
Guard switches aligned		
Safety relay operational		
Safe shutdown verified		
Fault reset verified		

Template 8 — Vision System Architecture

Vision System Components

Component	Function	Voltage	Communication
Camera	Image capture	PoE/24VDC	Ethernet
Vision Processor	Image analysis	24VDC	Ethernet
HMI Display	Operator interface	24VDC	Ethernet
PLC Integration	Machine logic	24VDC	Ethernet/CAN

Vision Data Flow

```
Camera
   ↓
Vision Processor
   ↓
Object Detection / Alignment
   ↓
PLC Decision Logic
   ↓
Machine Action
   ↓
Operator Display
```

Vision Failure Effects Matrix

Failure	Machine Result
Camera offline	Loss of visibility
Vision processor fault	Auto mode disabled
Ethernet failure	No communication
Lighting failure	Poor target detection
Calibration loss	Misalignment

Template 9 — Hydraulic Electrical Integration

Electro-Hydraulic Architecture

Electrical Device	Hydraulic Function	Feedback Method
Solenoid Valve	Cylinder extension	Position sensor
Pressure Switch	Pressure confirmation	PLC input
Proportional Valve	Speed control	Analog feedback
Pump Relay	Pump enable	Pressure verification

Functional Sequence

```
Operator Command
      ↓
PLC Output Energized
      ↓
Relay Activated
      ↓
Solenoid Energized
      ↓
Valve Shifts
      ↓
Hydraulic Flow Directed
      ↓
Actuator Movement
      ↓
Feedback Confirmed
```

Template 10 — Diagnostic Access Architecture

Diagnostic Ports

Port	Type	Function	Location
D1	CAN	Network diagnostics	Electrical cabinet
D2	Ethernet	Vision/PLC diagnostics	Control panel
D3	USB	Controller programming	PLC enclosure
D4	Pressure Port	Hydraulic diagnostics	Valve manifold

Service Access Requirements

Item	Requirement
Laptop software	
CAN analyzer	
Network analyzer	
Calibration tools	
Service passwords	

Template 11 — Failure Mode Architecture

Failure Dependency Matrix

Failed Component	Upstream Dependency	Downstream Effect
PLC Power	Main breaker	Machine dead
CAN Node	Network integrity	Communication faults
Sensor Supply	5V reference	False readings
Vision Processor	Ethernet network	Auto mode disabled
Ground Connection	Chassis continuity	Intermittent failures