

1909752

by Jordan Rees

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Character count: 2596



Project Background Vacuum Pump Control System

Based in a meat
processing company

- Project is for a
sealing machine's
vacuum pump

Problem Definiti on

- Current system is a star delta starter which is outdated
- Runs at constant high speed which wastes energy
- Aim is to upgrade current system to a VFD controlled system

Advantages of using a VFD controlled system:

- Energy efficiency
- Extended equipment life
- Improved process control
- Reduced noise and vibration
- Soft starting
- Better process consistency

Function Design Specification

- FDS Table key:
- F=Function
- S=Safety
- M=Measureables
- P=Performance
- E=Envitomental

Criteria	Requirement
F.1	Must run in automatic and manual
F.2	Must start remotely from sealing machine
F.3	Light displays for auto, manual, start and stop
S.1	E-Stop and isolator on panel
M.1	Vacuum level and pump data displayed on HMI
E.1	Pull vacuum for demand only
E.2	Idle mode for vacuum pump
P.1	Vacuum must pull to required setpoint at least 10mbar

Project
risks

Risk
Assessment

Constraints:

- Budget of £10,000
- Change of scope

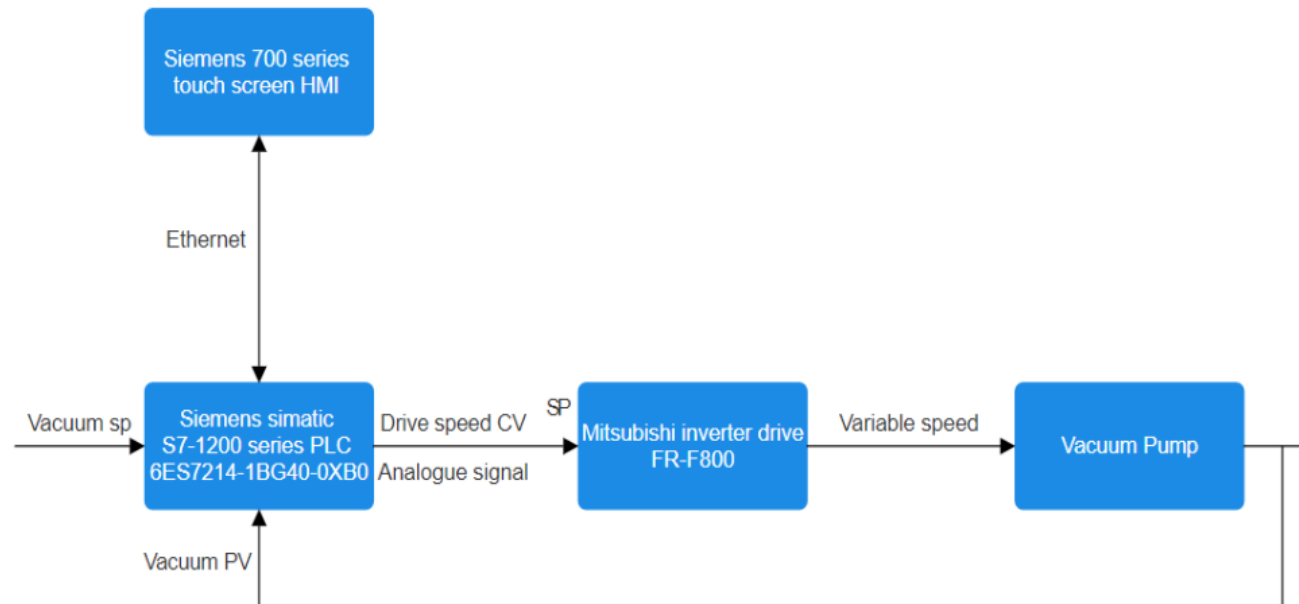
Hazard Description	Likelihood	Severity	Risk Level	Control Measures
Electrical shock during control system installation	Low	High	Medium	Follow electrical safety protocols and use proper personal protective equipment (PPE)
Noise hazards from vacuum pump operation	Medium	Moderate	Medium	Provide hearing protection for personnel working in noisy areas
Moving parts and pinch points during installation	Medium	Moderate	Medium	Ensure proper machine guarding
Control system or vacuum pump malfunction leading to process failure	Low	high	Medium	Implement regular maintenance schedules
Slips, trips, and falls during installation	Low	Medium	Low	Keep work areas clean and organized

Test Planning

Criteria	Requirement	Test description	Expected outcome	Actual outcome	Decision P/F	Evidence
F.1	Must run in automatic and manual	Press automatic and manual switch on HMI	System goes into Automatic and manual mode			
F.2	Must start remotely from sealing machine	Start pump from sealing machine when in automatic mode	System starts from sealing machine			
F.3	Light displays for auto, manual, start and stop	Run machine in correct mode and check light display	Correct light display should appear on HMI			
S.1	E-Stop and isolator on panel	Press E-stop and turn isolator on/off	E-stop pressed should stop pump from running. Isolator in off position should switch off power to panel			
M.1	Vacuum level and pump data displayed on HMI	Check vacuum level and pump data on HMI	Vacuum level and data must read +/- 5%			
E.1	Pull vacuum for demand only	Run system and check vacuum reaches setpoint	System should only reach required vacuum setpoint			
E.2	Idle mode for vacuum pump	Run machine in standby and check that pump goes into idle mode	Pump should go in idle mode			
P.1	Vacuum must pull to required setpoint at least 10mbar	Run system and check vacuum reaches setpoint	Vacuum should reach required setpoint			
P.2	Leak back after 40s must be no more than 100mbar	Run a vacuum test and check leak back after 40s of holding vacuum	Vacuum should not leak back more than 100mbar after 40s			

Solution 1

Block diagram



Advantages

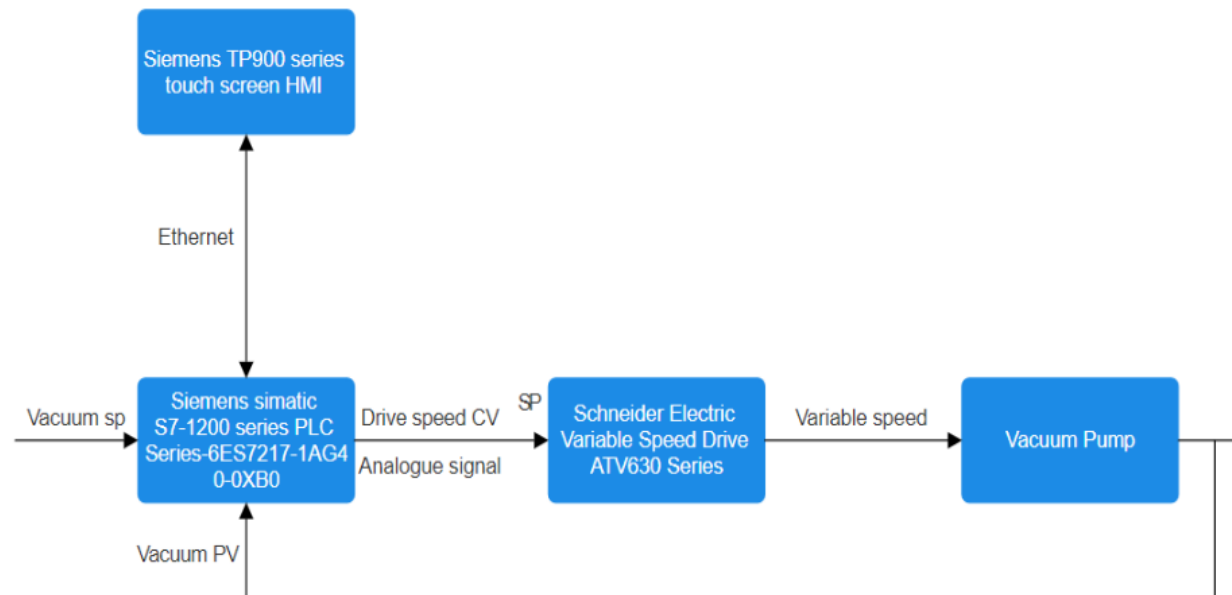
- Good compatibility between components
- Cost effective
- Ease of use/set up

Disadvantages

- Not much room for expansion

Solution 2

Block diagram



Advantages

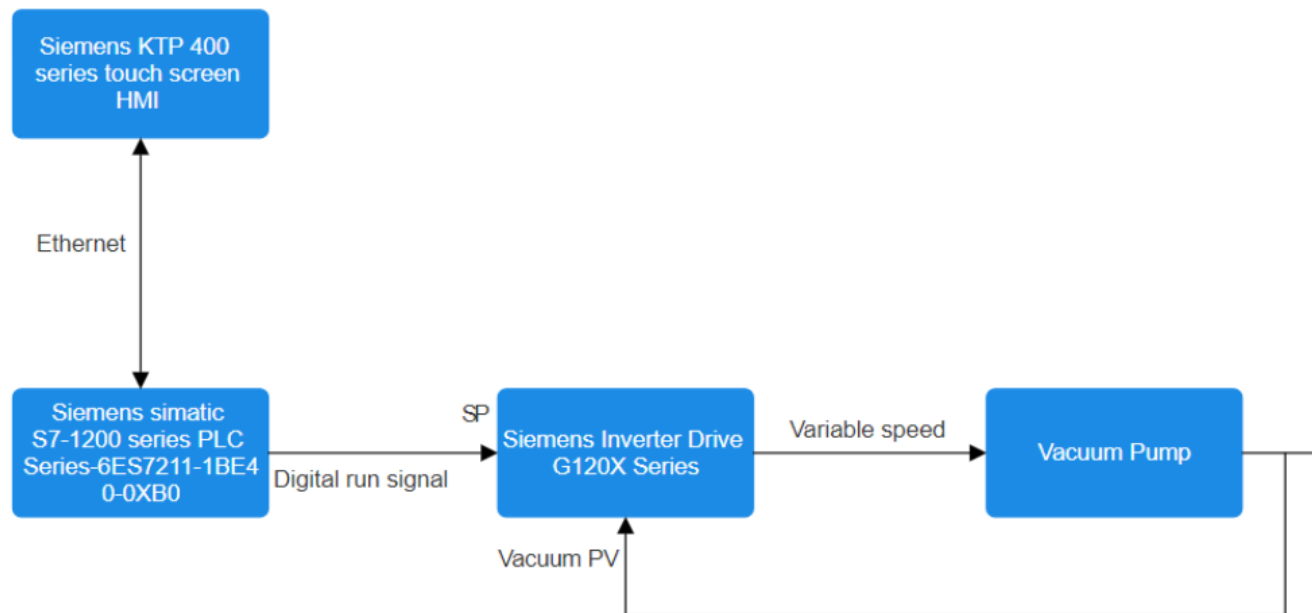
- Good performance
- Set up flexibility
- Room for expansion

Disadvantages

- Not cost effective
- Difficult to set up

Solution 3

Block diagram



Advantages

- Good manufacturer support

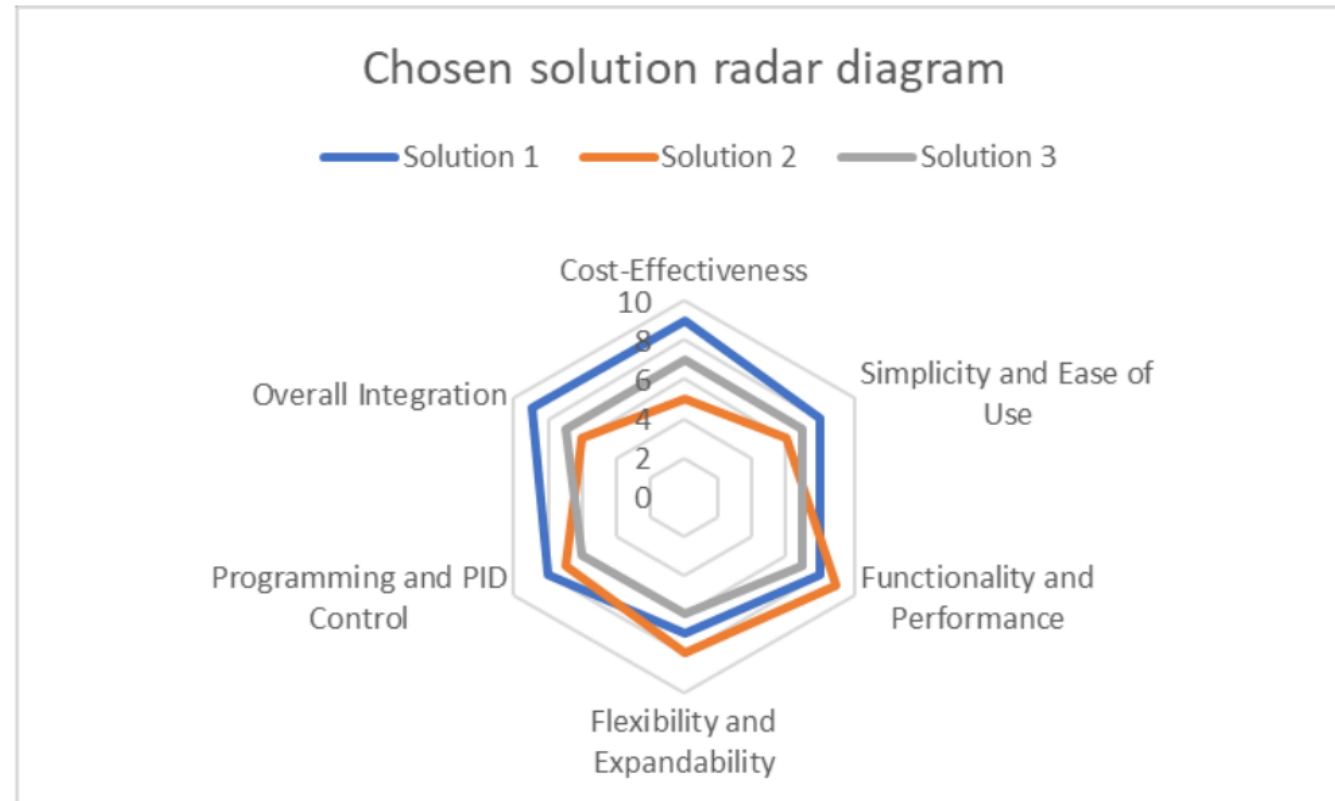
Disadvantages

- Difficult to set up
- Not much room for expansion

Chosen solution (Solution 1)

Justification of choosing solution 1

- Overall, better in most areas
- Least amount of disadvantages



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graph LR
    Root([Vacuum Pump Control System]) --- Design[Design]
    Root --- Planning[Planning]
    Root --- Installation[Installation]
    Root --- Handover[Handover]
    Design --- DesignTasks[Control panel design, Electrical design, Software Design]
    DesignTasks --- DesignSubTasks[Panel layout, Schematic drawings, Electrical drawings, Cable schedules, TIA Portal, VFD program design]
    Planning --- PlanningTasks[Procurement planning, Resource management, Schedule development]
    Installation --- InstallationTasks[Panel installation, PLC configuration, HMI configuration, VFD configuration, System testing]
    Handover --- HandoverTasks[User training, Documentation completion]
  
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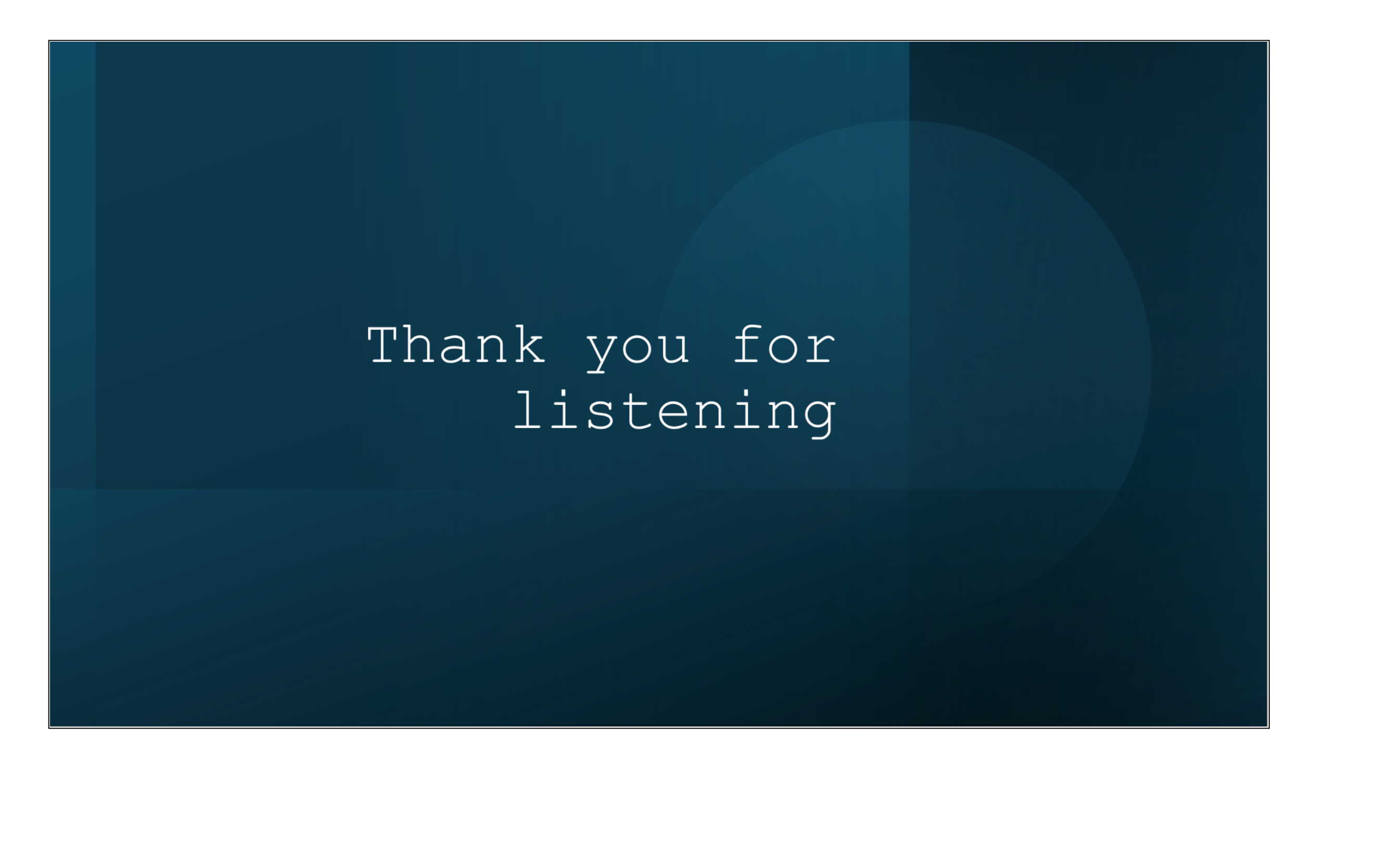
Vacuum Pump Control System

- Design**
 - Control panel design
 - Panel layout
 - Schematic drawings
 - Electrical design
 - Electrical drawings
 - Cable schedules
 - Software Design
 - TIA Portal
 - VFD program design
- Planning**
 - Procurement planning
 - Resource management
 - Schedule development
- Installation**
 - Panel installation
 - PLC configuration
 - HMI configuration
 - VFD configuration
 - System testing
- Handover**
 - User training
 - Documentation completion

[illegible]

Progress made to date

[illegible]



Thank you for
listening

FINAL GRADE

GENERAL COMMENTS

66/100

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GRADING FORM: NEW CSG-RUBRIC

JORDAN REES

66

1. ENGAGEMENT WITH LITERATURE

 NA

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2. KNOWLEDGE AND UNDERSTANDING

 Project background and problem definition (6/10)
Project constraints, risks, health and safety (6/10)
Response to questions (6/10)

18

3. COGNITIVE AND INTELLECTUAL



Functional Design Specification (7/10)
Test planning (7/10)
Project Planning and management methods (6/10)

20

4. PRACTICAL APPLICATION



Review of Solutions (6/10)
Justification of final solution (7/10)

13

5. TRANSFERABLE SKILLS



Quality of the presentation slides (7/10)
Quality of the delivery style (8/10)

15