

1909752

by Jordan Rees

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Word count: 839

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Introduction Vacuum Pump Control System

- Reduce energy consumption
- Save the company money
- User friendly/ease of use

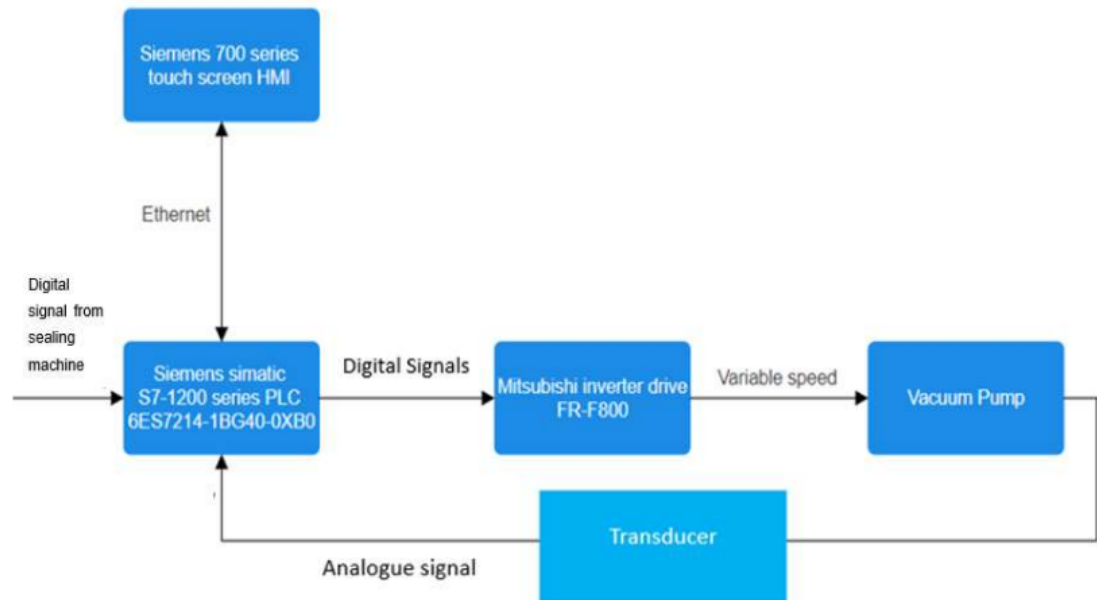
Function Design Specification

- FDS Table key:
- F=Function
- S=Safety
- M=Measurables
- P=Performance
- E=Environmental

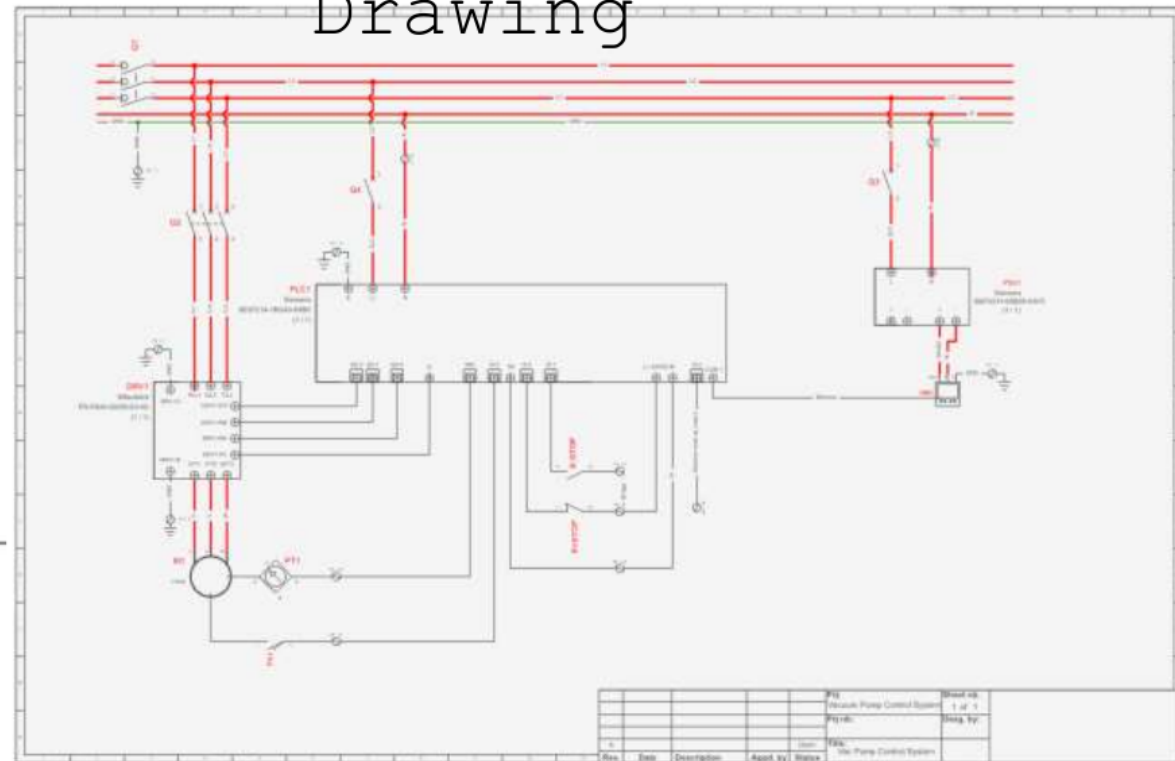
Criteria	Requirement
F.1	Start through HMI
F.2	Stop through HMI
F.3	Remote start control from machine
F.4	Manual start control from HMI
F.5	Auto start control from HMI
F.6	Start light display on HMI
F.7	Stop light Display on HMI
F.8	Auto display on HMI
F.9	Manual display on HMI
F.10	Fault light display on HMI
S.1	E-Stop on panel
S.2	Isolator on panel
M.1	Vacuum level displayed on HMI
M.2	Oil level low of pump displayed on HMI
M.3	Pump temperature displayed on HMI
E.1	Pull vacuum for demand only
E.2	Idle mode for vacuum pump after time period
P.1	System must pull vacuum to required setpoint at least 10mbar.
P.2	Leak back after 40s must be no more than 100mbar.
Budget	Is the project within budget
Timescale	Is the project within timescale

Design

Block Diagram

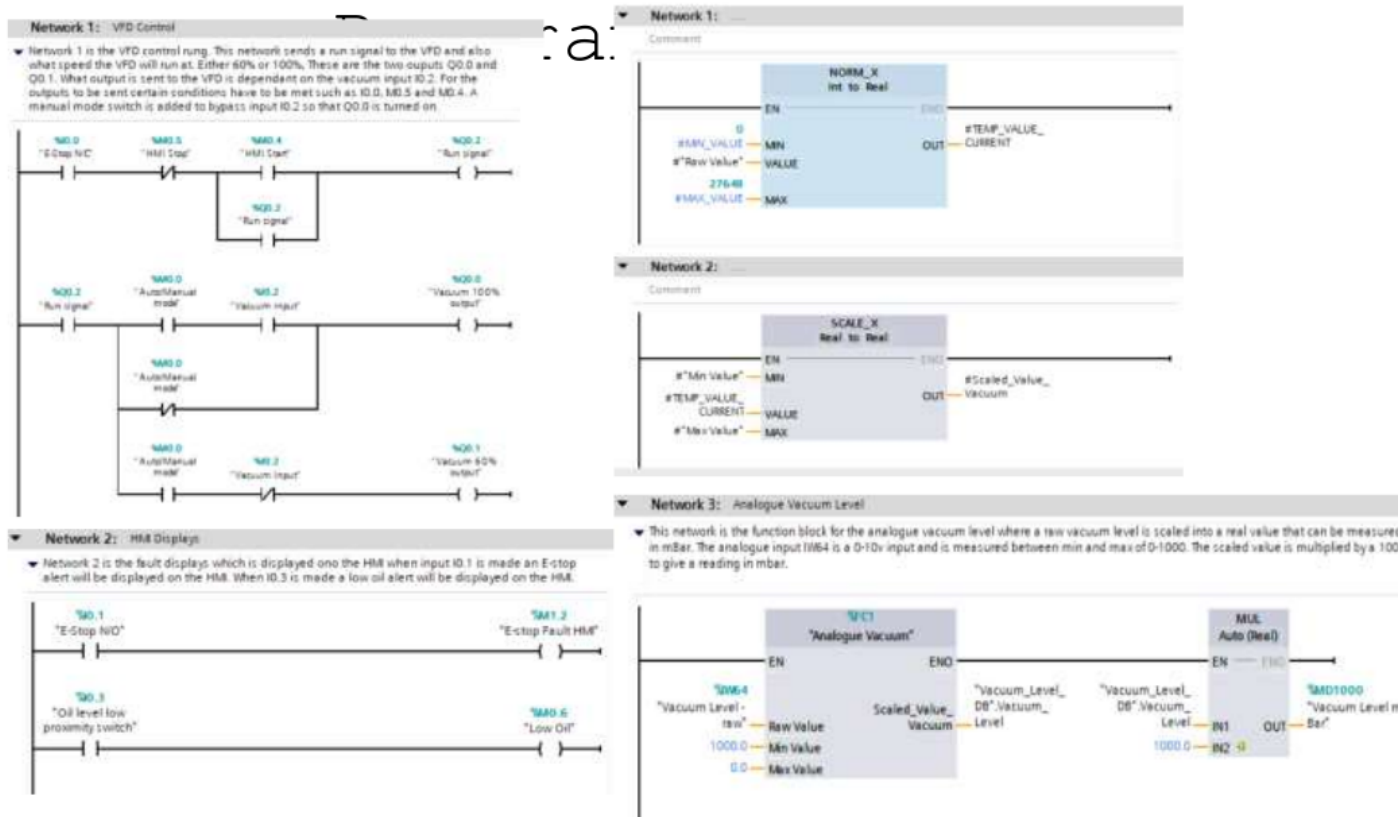


Electrical Drawing

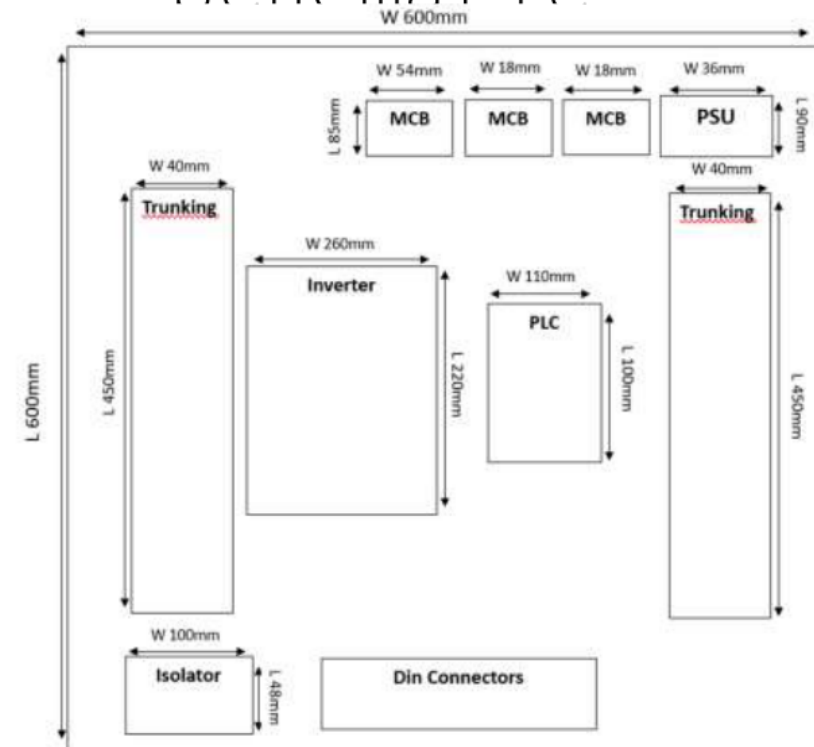


Design

PLC



Panel Schematic



Construction Phase



Testi ng

Test plan

Criteria	Requirement	Decision P/F
F.1	Start through HMI	P
F.2	Stop through HMI	P
F.3	Remote start control from machine	F
F.4	Manual start control from HMI	P
F.5	Auto start control from HMI	P
F.6	Start light display on HMI	P
F.7	Stop light Display on HMI	P
F.8	Auto display on HMI	P
F.9	Manual display on HMI	P
F.10	Fault light display on HMI	P
S.1	E-Stop on panel	P
S.2	Isolator on panel	P
M.1	Vacuum level displayed on HMI	P
M.2	Oil level low of vacuum pump displayed on HMI	P
M.3	Vacuum pump temperature displayed on HMI	F
E.1	Pull vacuum for demand only	F
E.2	Idle mode for vacuum pump after time period	F
E.3	Power consumption test	P
P.1	System must pull vacuum to required setpoint of at least 10mbar	F
P.1/P.2	Leak back after 40s must be no more than 100mbar.	F

$$Pass Rate: \frac{14}{20} \times 100 = 70\%$$

Evaluation

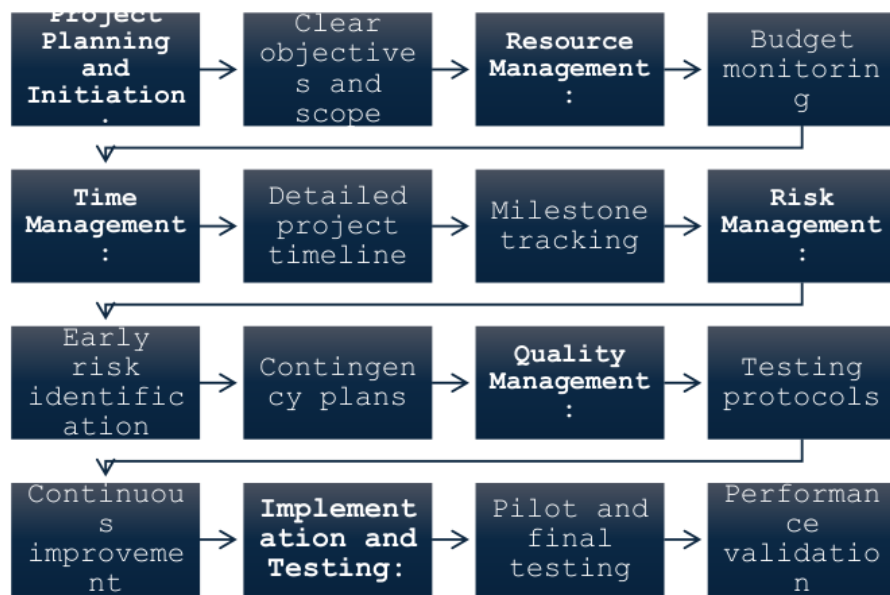
Criteria met

- System can start, stop, and change modes via HMI.
- User-friendly displays provide useful data such as vacuum level and functions.
- Emergency stops, isolators and, MCBs are operational, ensuring operator safety.

Criteria not met

- (F.3), (E.1), (P.1), (P.1/P.2): Requires connection to vacuum pump/sealing machine.
- (E.2): Timer relay installation and programming onto PLC.
- (M.3): Temperature sensor installation and programming onto PLC.

Management Techniques and Planning



Task	Start date	End date	Progress	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13	Week 14	Week 15	Week 16
1-Design	08/01/2024	23/02/2024	Expected																
	08/01/2024	29/03/2024	Actual																
1.1 Control panel design	08/01/2024	19/01/2024	Expected																
	08/01/2024	26/01/2024	Actual																
1.1.1 Panel layout	08/01/2024	13/01/2024	Expected																
	08/01/2024	13/01/2024	Actual																
1.1.2 Schematic drawings	13/01/2024	18/01/2024	Expected																
	13/01/2024	25/01/2024	Actual																
1.2 Electrical design	19/01/2024	02/02/2024	Expected																
	25/01/2024	16/02/2024	Actual																
1.2.1 Electrical drawings	19/01/2024	29/01/2024	Expected																
	19/01/2024	16/02/2024	Actual																
1.2.2 Cable schedules	29/01/2024	02/02/2024	Expected																
	29/01/2024	02/02/2024	Actual																
1.3 Software design	05/02/2024	23/02/2024	Expected																
	05/02/2024	29/03/2024	Actual																
1.3.1 TIA portal	05/02/2024	16/02/2024	Expected																
	05/02/2024	26/02/2024	Actual																
1.3.2 VFD program design	19/02/2024	22/02/2024	Expected																
	05/04/2024	05/04/2024	Actual																
2-Planning	08/01/2024	08/03/2024	Expected																
	08/01/2024	05/04/2024	Actual																
2.1 Procurement planning	08/01/2024	01/03/2024	Expected																
	08/01/2024	05/04/2024	Actual																
2.2 Resource management	01/03/2024	05/03/2024	Expected																
	01/03/2024	05/03/2024	Actual																
2.3 Schedule development	05/03/2024	08/03/2024	Expected																
	05/03/2024	08/03/2024	Actual																
3-Installation	08/03/2024	16/04/2024	Expected																
	22/03/2024	19/04/2024	Actual																
3.1 Panel installation	08/03/2024	15/03/2024	Expected																
	22/03/2024	19/04/2024	Actual																
3.2 PLC configuration	15/03/2024	29/03/2024	Expected																
	29/03/2024	12/04/2024	Actual																
3.3 HMI configuration	29/03/2024	12/04/2024	Expected																
	29/03/2024	12/04/2024	Actual																
3.4 VFD configuration	05/04/2024	12/04/2024	Expected																
	05/04/2024	12/04/2024	Actual																
3.5 System testing	12/04/2024	19/04/2024	Expected																
	19/04/2024	19/04/2024	Actual																
4-Handover	19/04/2024	25/04/2024	Expected																
	Incomplete	Incomplete	Actual																
4.1 User training	19/04/2024	22/04/2024	Expected																
	Incomplete	Incomplete	Actual																
4.2 Documentation completion	22/04/2024	25/04/2024	Expected																
	22/04/2024	25/04/2024	Actual																

Conclusions and Recommendations

Conclusions

Vacuum pump control system primary objectives met

- 43.8% power consumption reduction
- Estimated yearly savings of approximately £524.12

• User Friendly Interface

Challenges and Improvements

- Incomplete criteria due to time constraints
- Continuous improvement and quality management for

ongoing success

Recommendations

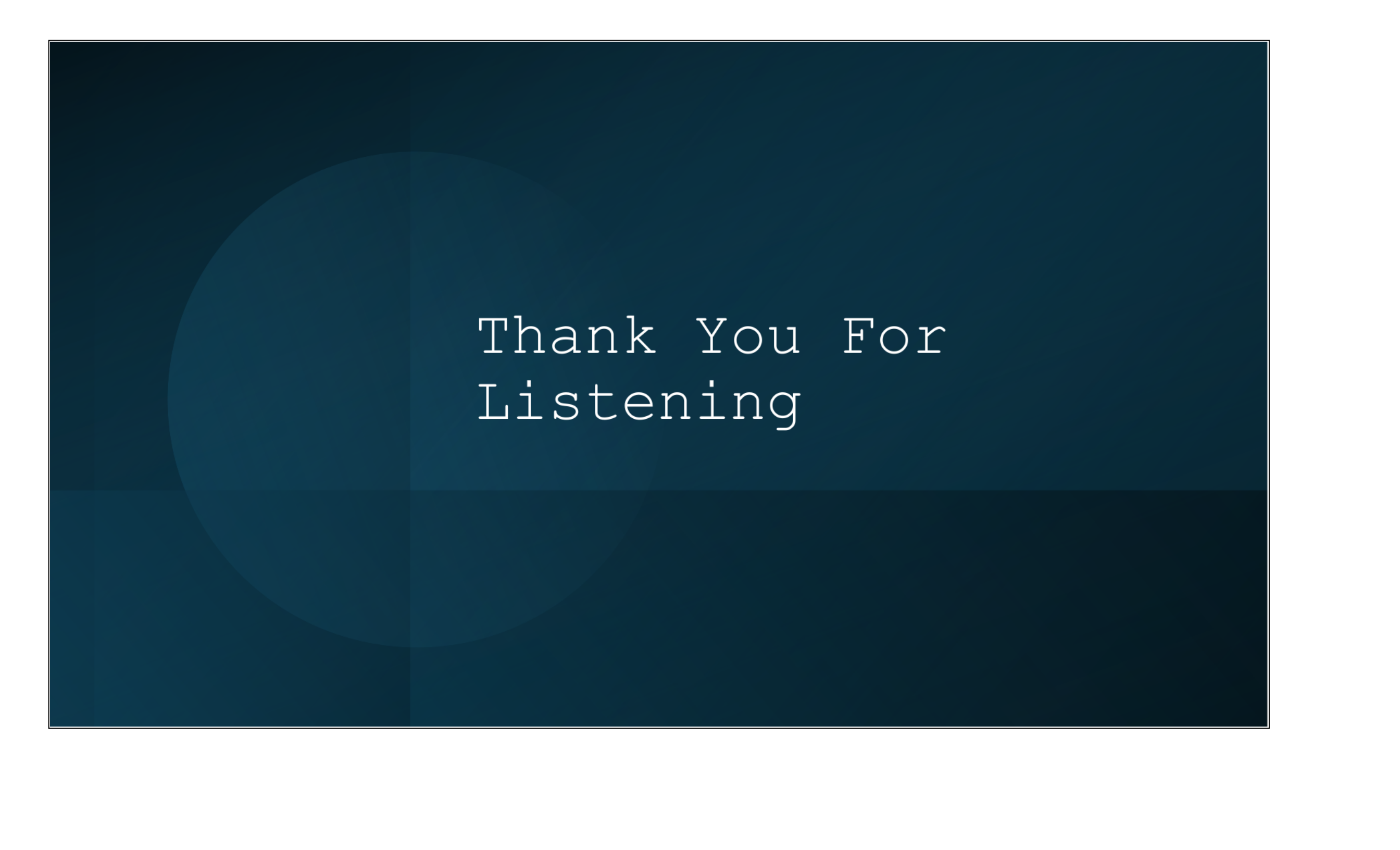
Implement System onto Vacuum Pump

- Ensure performance meets operational requirements from FDS.

Use of PID to Control Vacuum

- Central vacuum system with pressure transducers and PID control
- Larger investment for

greater energy savings



Thank You For
Listening

FINAL GRADE

GENERAL COMMENTS

75/100

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JORDAN REES

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1. ENGAGEMENT WITH LITERATURE

 NA

2. KNOWLEDGE AND UNDERSTANDING

 Project design
Very informative slides depicting the design process with detailed explanation. All discrepancies from FDS were explained in detail. A very good logical order to the design process.
Good evidence presented. (8/10)
Project implementation
A very structured implementation with good evidence on the slides. Explanation was detailed and significant points highlighted. Implementation of simulated sections of the project have been explained in detail with relevance to FDS and final outcomes.
Good explanation given. (7/10)
Response to questions

23

Good, clear and fluent. (8/10)

23/30

3. COGNITIVE AND INTELLECTUAL

- 
- Testing and analysis of results
- Test results were explained and the level of success given as a measurement value. A very realistic explanation was given with good arguments given for requirements partially or not met.
- Excellent list and analysis. (8/10)
- Critical evaluation of the project outcomes relating to FDS and constraints
- Outcomes were compared with original FDS requirements with significant points highlighted.
- Good explanation given (7/10)
- Conclusions and recommendations
- A relevant recommendation (PID) offered with good arguments for improvements drawing from a case study.
- Very good explanation given (7/10)

22

22/30

4. PRACTICAL APPLICATION

- 
- Deployment method, use of material, tools, equipment and techniques in the construction of the project.
- Project was built methodically from sourcing equipment and materials with relevance to budget

21

constraints. Technical details were explained with reference to the diagrams on the slides.
Good explanation given of methods employed. (7/10)
Quality of the final product or system
Final product consisted of the actual panel built to a good standard that included all the components sourced.
Good quality of product but no safety implemented (7/10)
Management of the design process including use of plans, costing spreadsheet
A detailed Gantt chart identified the management plan and the comparison timeline. A good explanation highlighted the issues encountered.
Very good explanation given (7/10)

21/30

5. TRANSFERABLE SKILLS



Quality of the presentation slides
Excellent slides (5/5)
Quality of the delivery style
Good and confident (4/5)

9

9/10