

1909365

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COLD BLAST
VALVES CONTROL
SYSTEM UPGRADE

MATTHEW DAVIES

INTRODUCTION - AIMS & OBJECTIVES



Control System Upgrade



Process Safety Improvement



Interlocking of valves to prevent dangerous operational occurrences to the Blast Furnace.



Budget of £40,00.



Complete by the end of April 2024

FUNCTIONAL DESIGN SPECIFICATION

Original FDS 1

FDS Item No.	Specification
1.1	Toggle switch for each valve on the front of the panel, to drive the valves open and closed.
1.2	Ammeter at bottom of the control panel to provide a visual confirmation to the operator that the valve is opening or closing indicated by its drawing current.
1.3	Key switch for CBV4 for cross-blowing activity on the front of the panel.
1.4	Override key switch on the front of the panel to bypass the control system and drive the valves open/closed from the panel alone.
1.5	Warning light for override 'enabled' on front of the panel signifying that the override key switch has been enabled and that the valves are now available to be operated without oversight from the control system. This will be an amber light labelled "Warning: Override Key Switch Enabled".
1.6	Indication lamps for each valve for open/closed. Green lamp for Open, Red lamp for closed. Located on front of the panel
1.7	Panel must be fixed on the control room wall at an ergonomic height for ease of use
1.8	Wiring must comply with BS7671 - 18th Edition Wiring Regulations
1.9	Control Panel must be rated to at least IP54 (IEC 60529 - Degree of Protection Provided by Enclosure)



Updated FDS 1

FDS Item No.	Specification
1.1	Valve positions to be illuminated on Delta V HMI. 'Closed' to illuminate valve white. 'Open' to illuminate valve green. 'Undefined' position to illuminate blue.
1.2	'Cross Blow Active' to only appear visible on HMI when cross-blowing is active.
1.3	'Override Key active system bypassed' to only appear visible on HMI when override key is enabled.
1.4	'Open' and 'Closed' Valve Permissive LEDs to illuminate on Delta V HMI. Permissive to illuminate green when active, and red when not active.
1.5	HMI to show overview of TB5 blowing to 5 Blast Furnace via CBV5 and CBV6, TB3 blowing to 3 Blast Furnace via CBV12,11,3,2 and 8. Cross-over valve to be CBV4.

A 10x3 grid of dots. The first two columns contain black dots, and the third column contains red bars.

FUNCTIONAL DESIGN SPECIFICATION

FDS 2

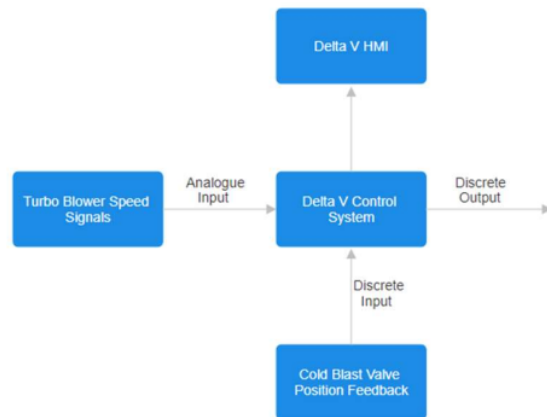
FDS Item No.	Specification
2.1	<u>T/B3 in normal operation (blowing to BF4)</u> Machine running @ minimum revs (3750 rpm): - Allow opening of CBV's 12, 11, 2 and 8 Machine running < minimum revs (<3750 rpm): - Allow closing of CBV's 12, 11, 2 and 8
2.2	<u>T/B5 in normal operation (blowing to BF5)</u> Machine running @ minimum revs (3750 rpm): - Allow opening of CBV's 5 and 6 Machine running < minimum revs (<3750 rpm): - Allow closing of CBV's 5 and 6
2.3	<u>Cross-Blowing T/D3 blowing to BF5</u> Machine running @ minimum revs (3750 rpm): - Allow opening of CBV's 12, 11, 4 and 6 Machine running < minimum revs (<3750 rpm): - Allow closing of CBV's 12, 11, 4 and 6
2.4	<u>Cross-Blowing T/B5 blowing to BF4</u> Machine running @ minimum revs (3750 rpm): - Allow opening of CBV's 5, 4, 2 and 8 Machine running < minimum revs (<3750 rpm): - Allow closing of CBV's 5, 4, 2 and 8
2.5	When Cross-Blow is active, CBV4 must NOT be permitted to close.
2.6	Programming language must be written according to IEC 61131-3 protocol.

FDS 3

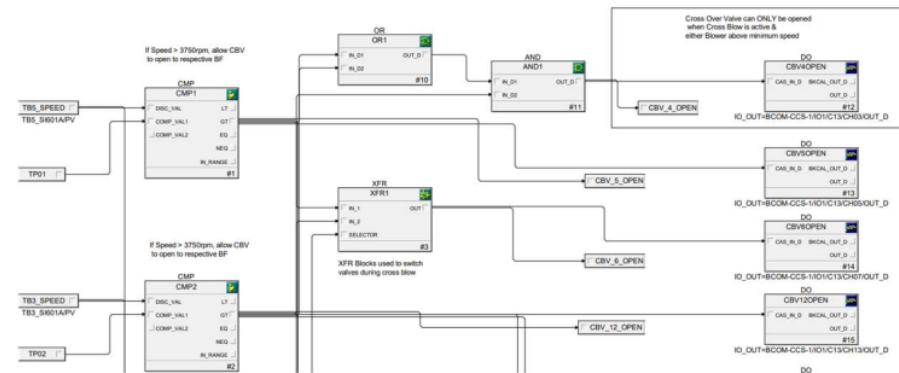
FDS Item No.	Specification
3.1	The project spend must not exceed the budget set of £40,000
3.2	Project must be implemented by the end of April 2024.

DESIGN DETAILS

Block Diagram

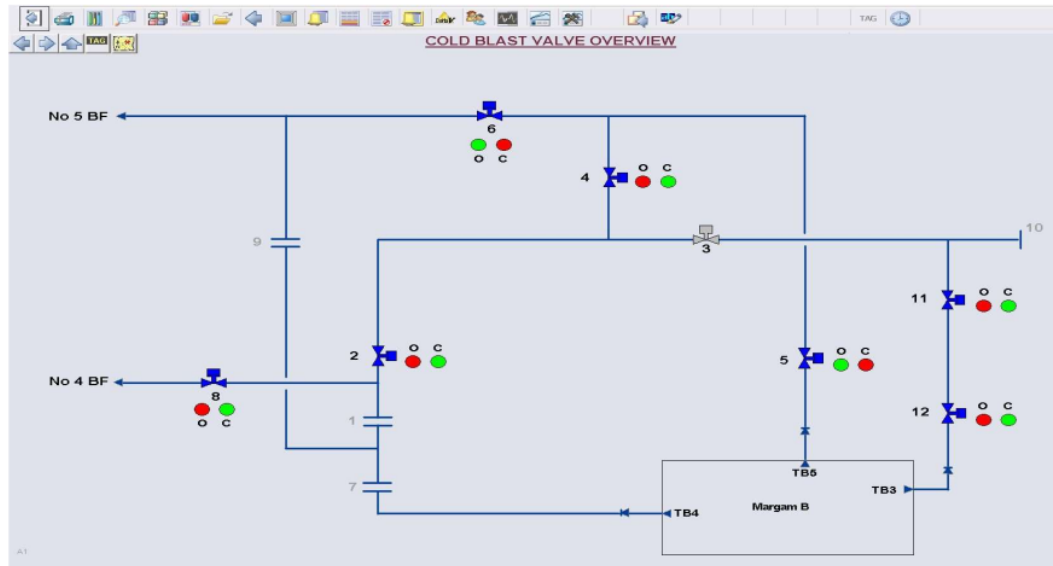


PLC Program



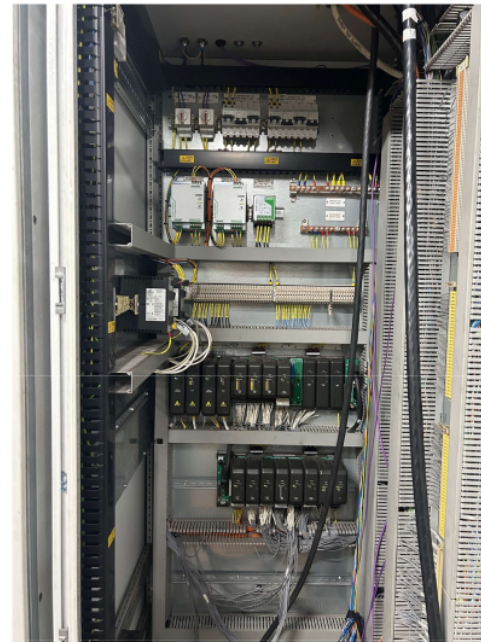
DESIGN DETAILS

Delta V HMI Screen



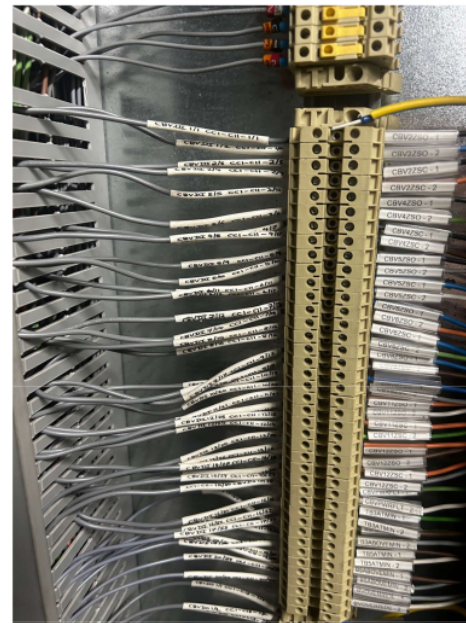
CONSTRUCTION

The DeltaV Panel where the cards and controller are installed.



CONSTRUCTION

Terminal rail for connection of field wiring to internal panel wiring to the DO and DI cards.



TESTING

Test	FDS Item No.	Item	Test	Expected Outcome	Pass/Fail
1	1.1	Valve Position Indication On HMI	Force the open and closed values of all CBVs Digital Inputs to monitor indication:	Valves should illuminate green for open and white for closed on the DeltaV HMI.	Pass
2	1.2	Cross-Blow Active on HMI	Force the 'Cross-Blow Active' signal on DeltaV	Message 'Cross Blow Active' to only appear on HMI when signal is active.	Pass
3	1.3	Override Active on HMI	Force the 'override' signal on DeltaV	'Override Key Active System Bypassed' message to appear only when signal is active.	Pass
4	1.4	Open and Closed Permissive LEDs on HMI	Force THE Open and Closed Permissive LEDs on DeltaV.	Open and Closed Permissive LEDs on DeltaV HMI should illuminate green when active and red when inactive.	Pass

- 4 x HMI Tests = 100% pass rate



TESTING

6	2.1	TB3 (Cross-Blow inactive) control system	With loop injector, simulate machine @ <3750 rpm and monitor which valves are permitted to open/close.	@ < 3750 rpm CBV's 12, 11, 2 and 8 should be allowed to close and CBV4 not allowed to open.	Pass
7	2.2	TB5 (Cross-Blow inactive) control system	With loop injector, simulate machine @3750rpm and monitor which valves are permitted to open/close.	@ 3750rpm, CBV 5 and 6 should be allowed to open and CBV4 not allowed to open.	Pass
8	2.2	TB5 (Cross-Blow inactive) control system	With loop injector, simulate machine <3750rpm and monitor which valves are permitted to open/close.	@ < 3750 rpm CBV 5 and 6 should be allowed to close and CBV4 not allowed to open.	Pass
9	2.3	TB3 (Cross-Blow active) control system	Simulate machine in cross-blow operation and with loop injector, simulate machine @ 3750 rpm and monitor which valves are permitted to open/close.	@ 3750rpm, CBV 12, 11, 4 and 6 should be allowed to open. CBV 2 and 5 should not be allowed to open.	Pass

- 7 x Control System interlocking tests
= 100% pass rate



EVALUATION

- Program met all testing requirements and FDS functionalities.
- Massive savings on budget due to not implementing fully (£986.41 total spend).
- Accurate documentation = seamless installation.
- Solution found for issue around unavailability of German engineers.



MANAGEMENT AND PLANNING

Task name	Start date	End date	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 - Planned	06/01/2024	16/02/2024																
1 - DESIGN - Actual																		
1.1 - Control Panel Design - Planned	06/01/2024	19/01/2024																
1.1 - Control Panel Design - Actual																		
1.1.1 - Schematic Drawings - Planned	06/01/2024	12/01/2024																
1.1.1 - Schematic Drawings - Actual																		
1.1.2 - Print of panel layout - Planned	18/01/2024	19/01/2024																
1.1.2 - Print of panel layout - Actual																		
1.2 - Software Design - Planned	22/01/2024	02/02/2024																
1.2 - Software Design - Actual																		
1.3 - Electrical Design - Planned	05/02/2024	16/02/2024																
1.3 - Electrical Design - Actual																		
2.1 - Cable Schedules - Planned	05/02/2024	09/02/2024																
2.1 - Cable Schedules - Actual																		
2.2 - Termination Schedules - Planned	11/02/2024	16/02/2024																
2.2 - Termination Schedules - Actual																		
2 - Planning - Planned	19/02/2024	01/03/2024																
2 - Planning - Actual																		
2.1 - Procurement of Materials - Planned	19/02/2024	23/02/2024																
2.1 - Procurement of Materials - Actual																		
2.2 - Procurement of contracting labour - Planned	26/02/2024	01/03/2024																
2.2 - Procurement of contracting labour - Actual																		
3 - Installation - Planned	04/03/2024	15/04/2024																
3 - Installation - Actual																		
3.1 - Factory Acceptance Test - Planned	04/03/2024	05/03/2024																
3.1 - Factory Acceptance Test - Actual																		
3.2 - Site Acceptance Test - Planned	11/03/2024	15/03/2024																
3.2 - Site Acceptance Test - Actual																		
3.3 - Electrical Cabling Installation - Planned	11/03/2024	22/03/2024																
3.3 - Electrical Cabling Installation - Actual																		
3.4 - Delta V Software programming - Planned	29/01/2024	16/02/2024																
3.4 - Delta V Software programming - Actual																		
3.5 - Commissioning of full system - Planned	08/04/2024	12/04/2024																
3.5 - Commissioning of full system - Actual																		
4 - Handover - Planned	15/04/2024	29/04/2024																
4 - Handover - Actual																		

- Initial Risk Assessment and POWRA's done every time site was attended.
- No MoC required.
- SAP for work scheduling



CONCLUSION AND RECOMMENDATIONS

- Achieved everything required in new FDS.
- Potential for scalability.
- Internal and ethical sourcing kept expenditure low.
- Recommend similar upgrades around site, to remove stand-alone PLC use.
- Recommend to use DeltaV for the operation of valves, to eliminate control panel.



Thank you for listening.
Any questions?



FINAL GRADE

GENERAL COMMENTS

72/100

PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7

PAGE 8

PAGE 9

PAGE 10

GRADING FORM: NEW CSG-RUBRIC

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72

1. ENGAGEMENT WITH LITERATURE

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2. KNOWLEDGE AND UNDERSTANDING

 Project design
Good slide quality and explanations of necessary changes to original FDS.
Explanations were clear and confident. FDS requirements were mostly
achieved and discrepancies were explained. Good reference to the

21

simulated test process.

Very good evidence presented. (7/10)

Project implementation

Implementation was explained in good logical order with ref to slides.

Relevance to the industrial process was highlighted with good knowledge demonstrated.

Very good explanation given. (7/10)

Response to questions

Very good explanations. (7/10)

21/30

3. COGNITIVE AND INTELLECTUAL



Testing and analysis of results

Good evidence on slides with HMI screenshots and table of results.

Explanations were clear and confident. Good argument for simulated testing and relevance to FDS.

Good list and analysis. (7/10)

Critical evaluation of the project outcomes relating to FDS and constraints

Outcomes were discussed and discrepancies explained with relevance to sim testing carried out.

Good explanation given (7/10)

Conclusions and recommendations

Conclusion indicated the extent of success with regard to FDS and

21

relevant recommendations were discussed.
Good explanation given (7/10)

21/30

4. PRACTICAL APPLICATION



Deployment method, use of material, tools, equipment and techniques in the construction of the project.

This area showed initiative and DELTA V operation was explained with remote io. Project was developed methodically with focus shown to FDS requirements.

Good explanation given of methods employed. (7/10)

Quality of the final product or system

System was created and tested. The outcomes have been met through simulated testing and relevance has been explained

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.

Good explanation given (7/10)

21/30

21

5. TRANSFERABLE SKILLS



Quality of the presentation slides

Excellent slides (5/5)

Quality of the delivery style

Good but sometimes hesitant (4/5)

9/10

9