

SGEL6000 Independent Project

DOUBLE MARKING SHEET AND COMBINED STUDENT FEEDBACK

Assessment 2 of 4

Presentation 1: Project Definition, Research and Quality Planning

2020-2021

Agreed mark

75

Student Name: Daniel Ince

Student Number 1602836

<https://youtu.be/JgY5WyBP-uc>

<https://youtu.be/ApASUSf8qlc>

Generic Assessment Criteria	Marks available	1st Marker (RD)	2nd Marker (MH)	Agreed Mark
1. Engagement with Literature Skills.				
Section 1: Engagement in research, for project background (4/5) Clear evidence of research contained that set out the background of the project. (RD) Evidence of extensive research was demonstrated (MH)	5	4	4	4
Section 5: Engagement in research, for review of solutions (4/5) Clear evidence that solutions were well researched (RD) A wide range of reliable technical sources were used. (MH)	5	4	4	4
Total	10	8	8	8
2. Knowledge and Understanding Skills				
Section 1: Project background (4/5) Clearly understood and presented (RD) Project explained as a control system upgrade for a VRU compressor (MH)	5	4	4	4
Section 3: Project risks, health and safety etc (4/5) Well presented (RD) Ethical engineering explained in some detail and a project risk chart was explained showing factors against the project success.(MH)	5	4	4	4
Response to questions 1 and 4 (7/10) Good understanding demonstrated (RD) Detailed answers provided with confidence and without hesitation (MH)	10	7	8	7
Total	20	15	16	15
3. Cognitive and Intellectual Skills				
Section 1: Problem Definition and constraints (8/10) Clearly defined (RD) Clearly defined and explained, but could have spent less time on this (MH)	10	8	8	8
Section 2: Functional Design Specification (7/10) Well presented (RD) Detailed and clear, although had to rush this part (MH)	10	8	6	7

Section 4: Test planning (7/10) Good plans in place (RD) Detailed testing plan included with success metrics, but again rushed (MH)	10	7	6	7
Response to questions 2 and 6 (4/5) Good answers given (RD) Detailed answers provided with confidence and without hesitation (MH)	5	4	4	4
Total	35	27	24	26
4. Practical Application Skills				
Section 5: Critical choice and justification of final solution (7/10) Clear decision making evidenced (RD) Detailed scoring system used to assess each solution, but only briefly discussed due to time (MH)	10	8	6	7
Section 6: Project Planning and working breakdown structure (7/10) Good information provided (RD) Detailed 4 layer WBS was devised, Gantt chart was comprehensive (MH)	10	7	8	7
Response to questions 3 and 5 (5/5) Clearly consideration given (RD) Detailed answers provided with confidence and without hesitation (MH)	5	4	5	5
Total	25	19	19	19
5. Transferable Skills for Life and Professional Practice				
All sections: Quality of the presentation slides – (5/5) Good style, clear slides (RD) Most slides were generally readable and well presented (MH)	5	5	5	5
All sections: Quality of the delivery style – (2/5) Slow to start with, did not keep to time, some necessary pauses (RD) Confidently presented, but spent far too much time on the problem and constraints. Over-ran on time and ended up rushing the last few slides.(MH)	5	2	2	2
Total	10	7	7	7
Grand Total	100	76	74	75

1602836 DI Presentation 1

by Daniel Ince

FILE	14401_DANIEL_INCE_1602836_DI_PRESENTATION_1_178787_193888297.PPTX (7.05M)		
TIME SUBMITTED	11-JAN-2021 07:11AM (UTC+0000)	WORD COUNT	1237
SUBMISSION ID	141506142	CHARACTER COUNT	7077

Vapour Recovery Unit (VRU) Control System

Project Overview, Plan and Progress

Daniel Ince

Project Background

- VRU compressors 1 & 2 are designed to **reduce** the sphere vapour line **pressure**.
- Compressors **cut in** at 4.4kg/cm² and begin **loading** up as the pressure increases.
- Multiple **safety systems** are built into the logic.
- Compressor **start procedure** must be followed for successful operation.
- Failure to control the pressure effectively results in environmental and safety concerns.



Compressor Loading

Loading procedure is designed to **increase effectiveness** of pressure reduction as process pressure increases.

Controlled through operation of cylinder **SOVs**.



Loading	Switch Point Rising (Falling)	Pressure Switch VRU1 (VRU2)	Loading SOVs Energised VRU1 (VRU2)	Cylinders Active
0%	6.5psi (3.5psi)	PS-1577A (1677A)		
25%	6.5psi 10sec delay (3.5psi)	PS-1577A (1677A)	SOV-1578 (1678)	1 & 5
50%	10psi (7.8psi)	PS-1577B (1677B)	SOV-1578 (1678)	1 & 5
			SOV-1580 (1680)	2 & 6
75%	12.3psi (10.3psi)	PS-1577C (1677C)	SOV-1578 (1678)	1 & 5
			SOV-1579 (1679)	3 & 7 and 4 & 8
100%	15psi (13psi)	PS-1577D (1677D)	SOV-1578 (1678)	1 & 5
			SOV-1579 (1679)	3 & 7 and 4 & 8
			SOV-1580 (1680)	2 & 6

Problem Definition

The existing system is controlled through an aging **relay logic** panel that **fails often** and is responsible for numerous maintenance work requests. The proposed new installation aims to replace this with a **modern** form of **control**.

Common existing issues include:

- Poor set point control.
- Compressors not cutting out.
- Unreliable relay operation.
- Compressor selection and loading problems.



Constraints

Risk Assessment and Management of Change

The proposed upgrade is **not** a **like for like** change and so requires hazards to be identified and ranked against risk. Classified by the Risk Matrix.

To summarise, the outcome of the MOC risk assessment highlighted **three main points**:

- *Sphere vapour line **over pressure** and lifting of PSV, releasing propane gas to atmosphere.*
- *Pressure increasing past 4.7kg/cm² with **no indication** shown to highlight the increase.*
- *Compressor cut-in is reached, however it **fails to start**.*

Constraints

Risk Assessment and Management of Change

Resulting controls:

- *Cut-in of selected VRU compressor **before flare** valve operation.*
- *Expanding of **measurement range** of VRU cut-in indication to 6kg/cm² with appropriate alarms.*
- *Compressor '**failure to start**' **alarm** implemented.*

Constraints

Environment and Sustainability

- Modern components to be used with increased reliability.
- Upgrade aims to achieve proper control and reduced environmental emissions of the company.
- Equipment sourced from stores where possible.
- ATEX rated intrinsically safe equipment to be used for installation.

Constraints

COVID19

- *Company and government precautions have to be followed.*
- *Equipment and work area access is limited due to restrictions in place.*
- *Material Vendors are having supply and delivery issues.*
- *Manpower may be reduced due to isolations.*
- *Situation is constantly changing.*

Confidentiality and Ethics

- *Company sensitive information kept confidential*
- *Consideration given to where materials are sourced from.*
- *Only company approved vendors are used.*

Functional Design Specification

Functionality

The upgrade needs to **control** both VRU compressors, maintaining the correct **pressure** and preventing it from reaching the flare valve set point or higher. Should any abnormal circumstances occur, the compressors should promptly **trip**, preventing a restart until the fault has cleared and has been manually **reset**.

Functional Design Specification

Operation and Indication

Indication should be provided through use of either communication through DCS, a HMI or local annunciator panel.

Provision must also be made for an **analogue indication** of the set point controller pressures. The indication must provide operations with information of the current **running status** and any **standing trips** or alarms.

Functional Design Specification

Ergonomics

The project design is for a **prototype** workshop-based system prior to field implementation and is required to be designed to meet the field size and weight restrictions. The location is within an existing **cabinet** of 1m wide, 2m long and 1m deep. All **supplementary equipment** such as power supplies and barriers will also be stored inside.

Functional Design Specification

Reliability and Maintenance

The system must have **redundancy** and **protection** measures whilst also being designed with maintenance in mind.

The reliability of the system should be sufficient to run **continuously** for extended periods of time **uninterrupted**.

The system should not need replacement and should last the life of the business unit provided no major changes are required.

Functional Design Specification

Hardware and Standards

- Correct **failure modes** must be used on electronic transmitters, along with **NAMUR** alarm and saturation points.
- Hardware must be up to functioning in a harsh outside environment reliability.
- Intrinsically safe **ATEX rated** equipment must be used within relevant hazardous area.
- All applicable regulations, standards and company policies must be followed.

Test Planning

- Designed from the FDS, the plan aims to functionally test the system and note the performance.
- A punch list will be raised for any issues.

FDS item	Test	Expected result	Actual result	Pass (Y/N)	Amendment required
4.1.1.2, 4.1.2.4	Simulate an open circuit trip condition during healthy VRU1 compressor operation for TSHH-1569. Repeat for all VRU1 trips.	Output to VRU1 compressor immediately de-energises to shutdown equipment. VRU1 loading SOV outputs de-energise. Compressor will not start until trip made healthy again.			
	PSHH-1574	Indication for each alarm and trip must operate			
	PSLL-1571				
	PDSLL-1571				
	FAN-1 Vibration				
	LSHH-1561				

Solution Review

Three potential methods of controlling the compressors.

1. Distributed Control System (DCS)
2. Programmable Logic Controller (PLC)
3. Trip Amplifiers and Updated Relay Logic

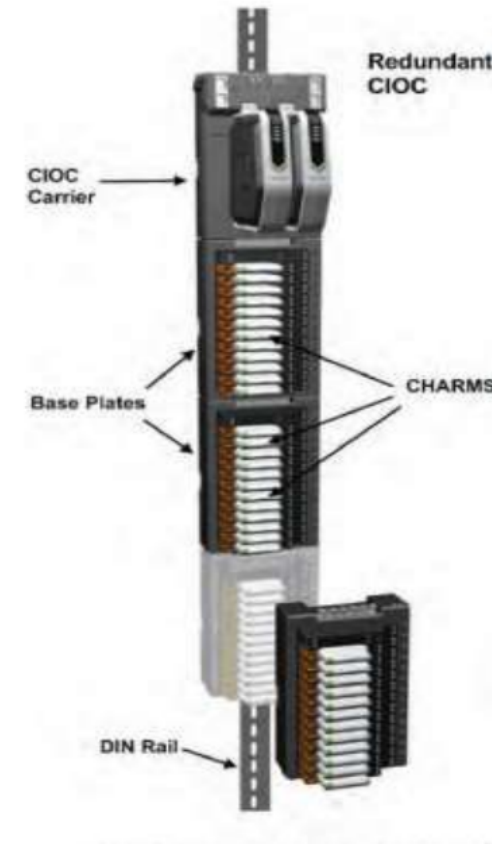
1. DCS Solution

Using the existing DeltaV infrastructure to build a controller for the system and hardwire it into place through CHARMs.

Advantages:

- Operator familiarity
- Control and trip functionality
- No programme version management required
- Visibility to operations

Cost: £17,800



: CIOC layout (Lyndon, 2020)

2. PLC Solution

The **Allen Bradley ControlLogix 5561** PLC is widely used on site in a variety of application and its reliability is proven through industrial usage.

Dual power supply and redundancy measures implemented.

Barriers to be fitted to keep system intrinsically safe.

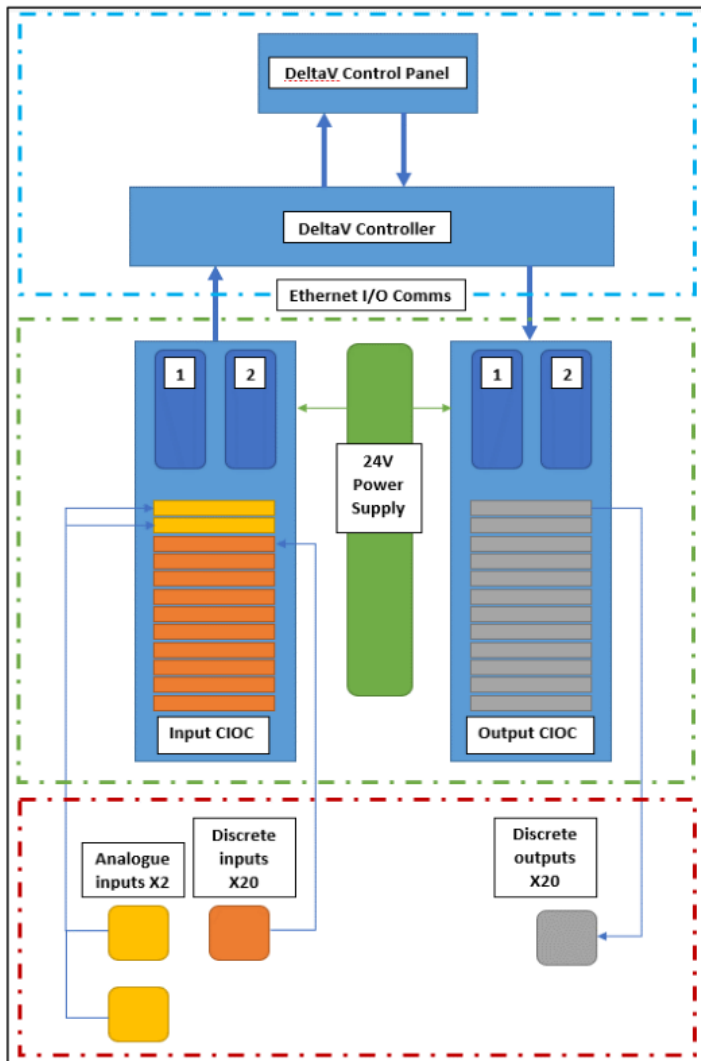
HMI/Serial link to be used for indication.

Cost: £13,837

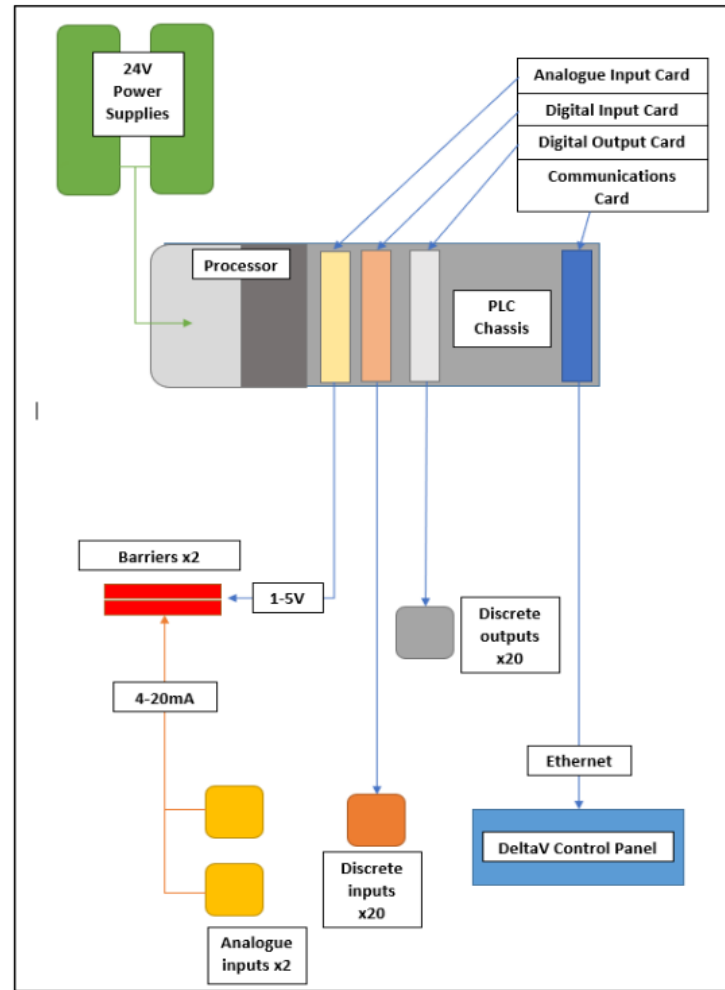
3. Trip Amplifier and Relay Solution

- Modern fault detecting relays with increased reliability from existing system.
- Circuit protection and logic reduction methods used to reduce wiring.
- New logic to be designed in a way to 'fail safe'.
- Trip amplifiers allow existing pneumatic controller to be changed out with an electronic transmitter.

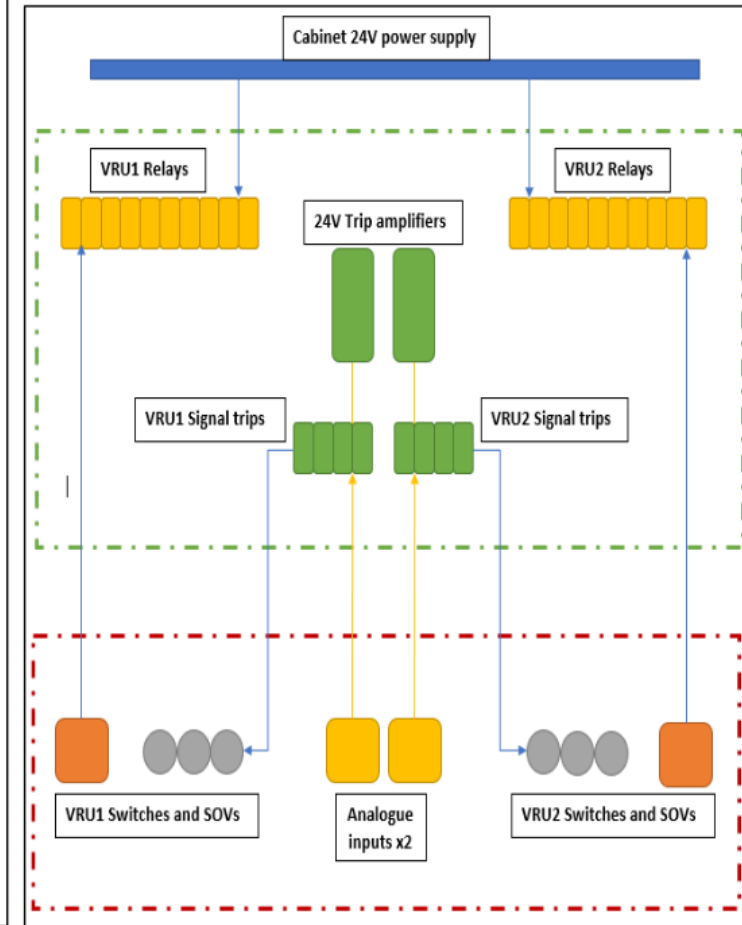
Cost: £3,344



DCS solution block diagram



PLC design block diagram



Relay and trip amplifier solution design

Choice and Justification

Strengths	Weaknesses
Merges into existing infrastructure, easily connected. Cabinet comes default fabricated from Emerson.	Very expensive. Any additional CHARMS required will quickly rack up cost.
Power supply included into cost and some CHARMS provided with quotation. Barriers not required.	Quotation does not include commissioning. Site Acceptance Test, Software documentation, cabling design or loop drawings.
System already familiar to operations and no programme version management required.	
Minimal cable marshalling required, saving labour costs.	
Preferred company standard option and replacement parts already on stores stock. Familiarity with maintenance department.	
Reliable and features a controller and CIOC redundancy system.	
Opportunities	Threats
Control and trip functionality on DCS system. System can also be SIL rated if desired.	If additional controllers are required due to lack of existing controller capacity and infrastructure. Cost will be triple.
CIOC cabinet can also be fitted in Zone 2 hazardous area locations if required.	COVID-19 company restriction and policy may prevent use of DeltaV hot rig.

DCS SWOT Analysis

Strengths	Weaknesses
Cheaper than a DCS alternative.	Company standpoint prefers usage of DCS for control where possible.
HART capability for analogue inputs.	PLC program version will need to be managed and updated.
Power supply redundancy and failsafe options.	PLC must be kept in racking room or Exd enclosure.
Separate I/O cards for each VRU to prevent common failure for both units.	
Equipment already on stores stock and familiar with maintenance department.	
Reliability proven through existing ControlLogix PLC usage already on site.	
Opportunities	Threats
Potential for expansion with additional modules	
Communication ports for either DeltaV or HMI	

PLC Solution SWOT analysis

Strengths	Weaknesses
Simple design and installation.	Inherent problems with electromechanical relays still exist.
Improves upon old method through electronic analogue input loading and relay power and fault indication.	No analogue indication or feedback to DCS or local indicator.
Very inexpensive.	Lots of wiring required taking up a lot of space within cabinet.
Opportunities	Threats
	Updated design is very similar to existing system.

Relay logic SWOT analysis

Choice and Justification

	Solution score		
Category	DCS	PLC	Relay
Reliability	9	7	4
Redundancy and protection	8	7	4
Overall cost	3	5	9
Maintenance difficulty	6	6	6
Part sourcing	5	6	3
Development	7	7	4
Testing	6	6	5
Company requirements	8	6	3
Ergonomics	8	6	4
SWOT score	4	5	-1
Total	64	61	41

Solution	DCS	PLC	Relay
Strengths (+)	6	6	3
Opportunities (+)	2	2	0
Weaknesses (-)	-2	-3	-3
Threats (-)	-2	0	-1
Total	4	5	-1

SWOT Analysis performed for each solution and score compared.

Choice and Justification

The **DCS solution** will be chosen under the following conditions:

- **Approval** is currently pending for use of the DeltaV hot rig during company COVID-19 restrictions. Having this denied will prevent use of the Emerson control software.
- Pending **availability** check of DeltaV infrastructure controller free space, failure of space availability means the budget will drastically increase.

Project Planning

Threat	Potential Consequences	Actions and Considerations
Company shutdown starting end of February for two months.	Large reduction in available man hours for project execution and construction.	Begin construction in December and allocate more manhours within this time.
COVID-19 reduces availability of manufacturer items.	Reduction in vendor stock and increased delivery times.	Order equipment a month earlier than normal, move budget to the preceding month to account for this. Company stores to be utilised where possible.
Overhead costs from other priority projects take budget from this one. (Large cogeneration project currently ongoing and TAR work are big expenses.)	Loss of budget, delay of project start date.	Begin project construction earlier than originally planned. Obtain budget approval from supervisor prior to commencing.

Project Planning

VRU Compressor Upgrade

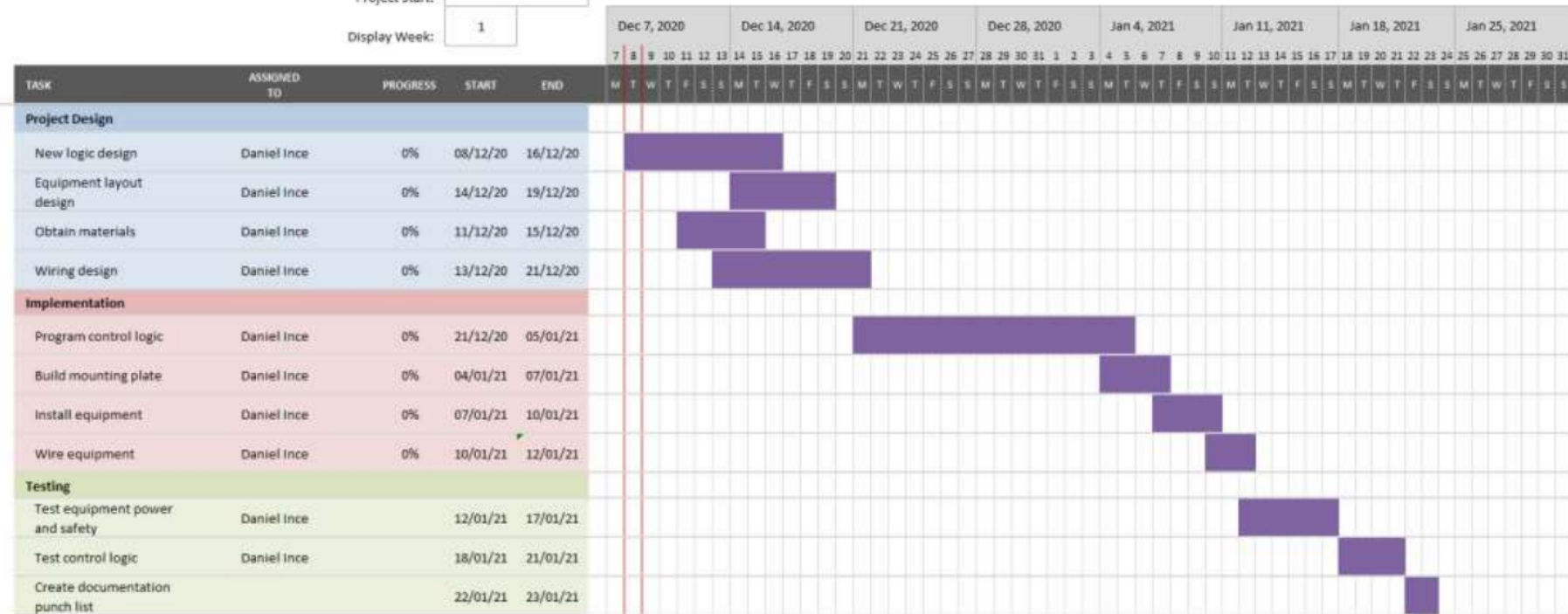
Daniel Ince

Project Start:

Tue, 12/8/2020

Display Week:

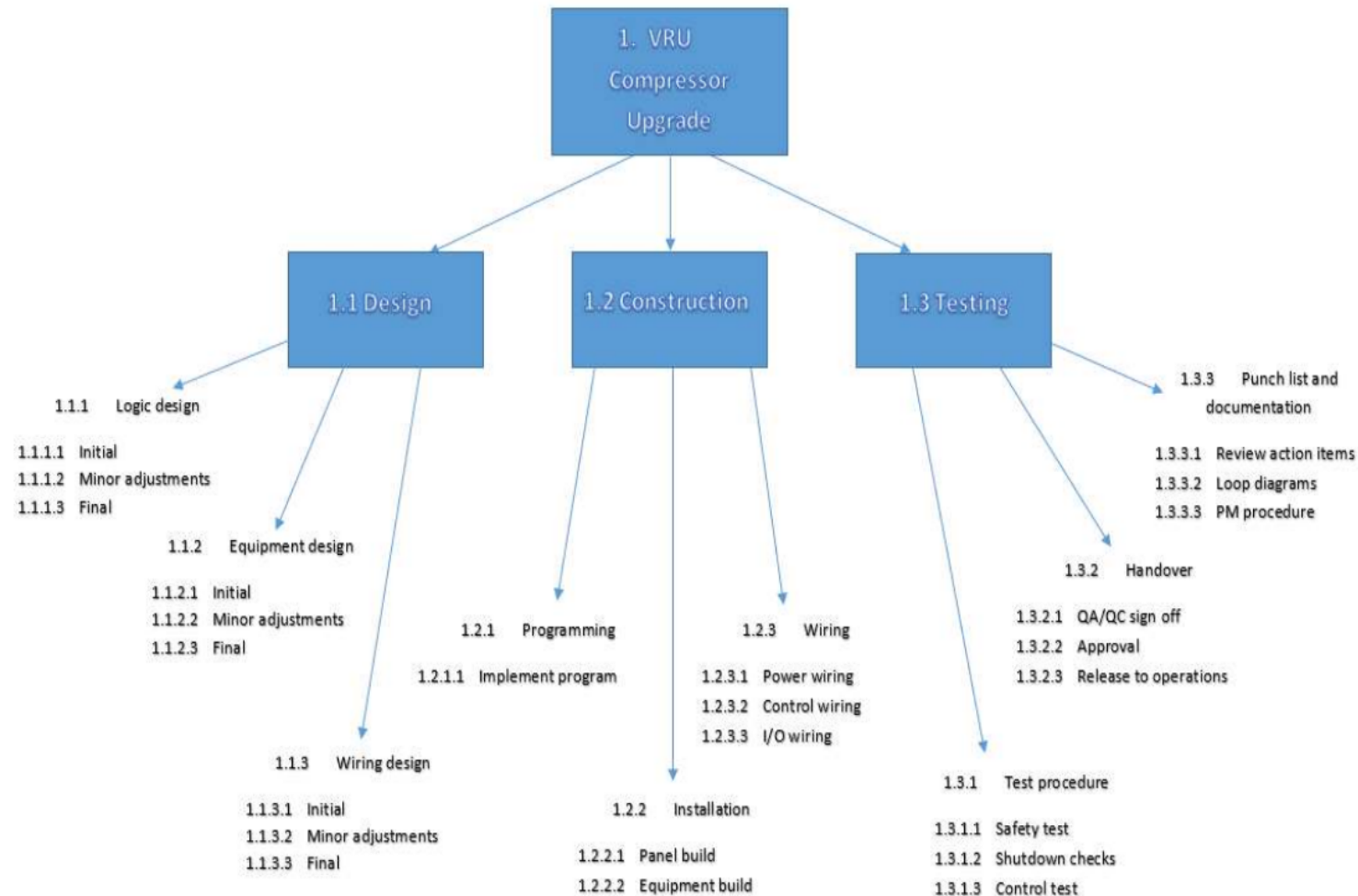
1



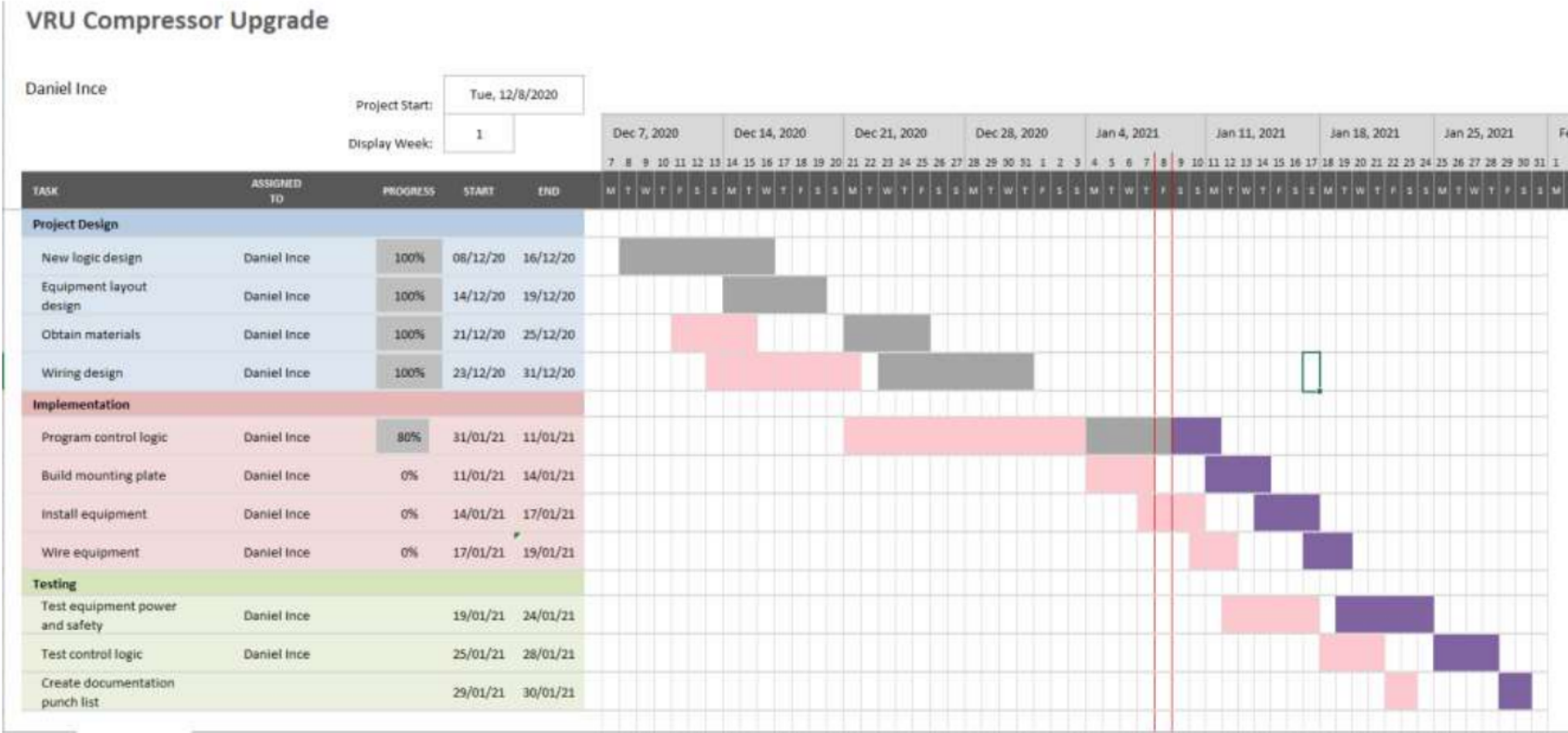
Project Planning

Description	MWO No.	Original Budget	Current Budget	Current Forecast	2020				2021				
					Sep-20	Oct-20	Nov-20	Dec-20	Jan-21	Feb-21	Mar-21	Apr-21	May-21
Construction Total	Various	£0	£0	£0									
Manhour Costs Total	Various	£6,000	£6,000	£6,000		600	750	750	750	1,050	1,050	1,050	
						600	750	1,050	1,050	1,050	750	750	
						600	750	1,050	1,050	1,050	750	750	
Materials Total	Various	£20,000	£20,000	£20,000					12,000	8,000			
								12,000	8,000				
								12,000	8,000				
Overall Total		£26,000			0	600	750	750	12,750	9,050	1,050	1,050	0
			£26,000		0	600	750	13,050	9,050	1,050	750	750	0
				£26,000	0	600	750	13,050	9,050	1,050	750	750	0
Accumulative Total					0	600	1,350	2,100	14,850	23,900	24,950	26,000	26,000
					0	600	1,350	14,400	23,450	24,500	25,250	26,000	26,000
					0	600	1,350	14,400	23,450	24,500	25,250	26,000	26,000
Original Commitment					Sep-20	Oct-20	Nov-20	Dec-20	Jan-21	Feb-21	Mar-21	Apr-21	May-21
Current Commitment					0	600	1,350	2,100	14,850	23,900	24,950	26,000	26,000
Actuals Commitment					0	600	1,350	14,400	23,450	24,500	25,250	26,000	26,000
Frozen Forecast Commitment					0	600	1,350	14,400	23,450	24,500	25,250	26,000	26,000

Work Breakdown Structure



Progress to Date



1602836 DI Presentation 1

GRADEMARK REPORT

FINAL GRADE

GENERAL COMMENTS

75/100

Instructor

PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7

PAGE 8

PAGE 9

PAGE 10

PAGE 11

PAGE 12

PAGE 13

PAGE 14
PAGE 15
PAGE 16
PAGE 17
PAGE 18
PAGE 19
PAGE 20
PAGE 21
PAGE 22
PAGE 23
PAGE 24
PAGE 25
PAGE 26
PAGE 27

GRADING FORM: NEW CSG-RUBRIC

DANIEL INCE

75

1. ENGAGEMENT WITH LITERATURE



Section 1: Engagement in research, for project background (4/5) Clear evidence of research contained that set out the background of the project. (RD) Evidence of extensive research was demonstrated (MH) Section 5: Engagement in research, for review of solutions (4/5) Clear evidence that solutions were well researched (RD) A wide range of reliable technical sources were used. (MH)

8

2. KNOWLEDGE AND UNDERSTANDING



Section 1: Project background (4/5) Clearly understood and presented (RD) Project explained as a control system upgrade for a VRU compressor (MH) Section 3: Project risks, health and safety etc (4/5) Well presented (RD) Ethical engineering explained in some detail and a project risk chart was explained showing factors against the project success.(MH) Response to questions 1 and 4 (7/10) Good understanding demonstrated (RD) Detailed answers provided with confidence and without hesitation (MH)

15

3. COGNITIVE AND INTELLECTUAL



Section 1: Problem Definition and constraints (8/10) Clearly defined (RD) Clearly defined and explained, but could have spent less time on this (MH) Section 2: Functional Design Specification (7/10) Well presented (RD) Detailed and clear, although had to rush this part (MH) Section 4: Test planning (7/10) Good plans in place (RD) Detailed testing plan included with success metrics, but

26

again rushed (MH) Response to questions 2 and 6 (4/5) Good answers given (RD) Detailed answers provided with confidence and without hesitation (MH)

4. PRACTICAL APPLICATION

 Section 5: Critical choice and justification of final solution (7/10) Clear decision making evidenced (RD) Detailed scoring system used to assess each solution, but only briefly discussed due to time (MH) Section 6: Project Planning and working breakdown structure (7/10) Good information provided (RD) Detailed 4 layer WBS was devised, Gantt chart was comprehensive (MH) Response to questions 3 and 5 (5/5) Clearly consideration given (RD) Detailed answers provided with confidence and without hesitation (MH)

19

5. TRANSFERABLE SKILLS

 All sections: Quality of the presentation slides – (5/5) Good style, clear slides (RD) Most slides were generally readable and well presented (MH) All sections: Quality of the delivery style – (2/5) Slow to start with, did not keep to time, some unnecessary pauses (RD) Confidently presented, but spent far too much time on the problem and constraints. Over-ran on time and ended up rushing the last few slides.(MH)

7