Main Project Name: 50110 - Application of IDTs

Product Design Specification

Plant Name: Normanton Pilot Plant

Plant Location: Middlesbrough, North Yorkshire, England

Main Project Owner: Andrew Chown

Sub Project Name: VIM demonstrator on Azure

Sub Project Owner: Johnny Lee

Date: 11/2022 - 03/2023

Amendment Record			
Issue No.	Pages Affected	Amendment / Comments	Date
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1.1 Introduction and Background

VIM is a special and innovative melting process that provides several benefits:

- Melting, refining, alloying and casting under vacuum.
- Controlled addition of high reactive elements.
- Close tolerance achievable for various alloying elements such as Al, Ti, Nb, Zr, etc.
- Reduction of gas content (H, N, O) and removal of undesirable trace elements.

2.0 Key Objectives / Project goals

We found that work on the VIM from the nuclear industry is lucrative. Therefore, the main purpose of this subproject is to create a saleable service for Materials Processing Institute by developing a VIM demonstrator on the Azure platform.

2.1 What are the problems?

Currently, VIM data is mainly manually recorded in paperwork by operators, only part of the data enters the pilot plant PLC, and the data stored in the pilot plant PLC has no visual interface for senior supervisors who are not usually at the pilot plant to view.

2.2 What ideas do you have to solve this?

Based on what we learned from the Advanced Materials team, we devised two ideas for improving the current workflow in VIM. First, for document entities, we plan to digitize and migrate them from the local to the Azure cloud platform. Secondly, for the data in pilot plant PLC, we plan to transfer the local data to the Azure cloud platform and create a simulation demonstrator on the Azure webpage, which is convenient for users to monitor VIM data remotely.

2.3 Key milestones

Develop scope for Azure demonstrator for VIM:

- Set up a meeting with Advanced Materials team to understand requirements.
- Organize requirements and determine what needs to be done.
- Connect VIM PLC to Kepserver.
- Azure SQL database design and build up
- Create digitized documents for VIM sheets on Azure.

- Create VIM monitor mimics on the Azure platform.
- User Acceptance Testing.
- Users training & programme go live.

3.0 Scope

3.1 Requirements and Major deliverables

The main requirement for this subproject is to create a saleable service for Materials Processing Institute by developing a VIM demonstrator on the Azure platform and there will be two major deliverables, online worksheets for VIM logs and VIM monitoring simulators, both on the Azure cloud platform.

3.1.2 Who are the end users and in what setting?

The end users of this subproject will be researchers from the Advanced Materials team and operators at the Normanton Pilot Plant. Since this subproject is mainly based on current workflows, with optimization and digitization, no user training will take place. All final products will be on the Azure cloud platform.

3.1.3 Hardware

No specific hardware is required.

3.1.4 Software

Microsoft Azure cloud platform and Azure SQL database.

3.2 Constraints

3.2.1 Access requirements/limitations?

All relative users will be granted access to the Azure webpages, and it can be accessed through any browser on PC, laptop, or mobile device.

3.2.2 Technological limitations

There will be no technical limitations.

4.0 Design

4.1 Design requirements

The design requirement for this subproject is to connect the pilot plant machine to PLC or send data directly to PTC Kepware server to ensure all data is saved, then use programming code on Microsoft Azure cloud platform to get machine data from PLC or PTC Kepware server and display it on webpages.

VIM process in the pilot plant (as-is):

VIM process in the pilot plant (to-be):

4.1.1 Performance

Since the scope of this subproject is relatively small and not expected to go through a large amount of data at once, the performance of the resulting webpages can be expected to be real-time updates with little or no delay.

4.1.2 Ergonomics

The VIM operational workflow at the pilot plant will remain unchanged, except that some current document entities will be digitized from physical paper to web-based forms.

4.1.3 Environment

All workflow environments will remain the same.

4.1.4 Maintenance

Peter Walters from the Digital Technologies team will be primarily responsible for developing and maintaining the results of this subproject.

4.1.5 Costs

The extra cost of this subproject will be the monthly subscription fee for Azure SQL database attached to the main project (50110 - Application of IDTs).

The estimated monthly cost for Azure SQL database is approximately £16.48 using the standard service tier of the DTU model.

Microsoft Azure Estimate					
Your Estimate					
Service category	Service type	Custom name	Region	Description	Estimated monthly cost
Databases	Azure SQL Database		UK South	Single Database, DTU Purchase Model, Standard Tier, S0: 10 DTUs, 250 GB included storage per DB, 1 Database(s) x 730 Hours, 5 x 5 GB Long Term Retention	£16.48
Support			Support	0	£0.00
			Licensing Program	Microsoft Customer Agreement (MCA)	
			Billing Account		
			Billing Profile		
			Total	16.48011242	£0.00

(Azure SQL database pricing calculator: https://azure.microsoft.com/en-gb/pricing/calculator/?service=azure-sql-database)

4.1.6 Manufacture

There will be no physical deliverables for this subproject. All results will be displayed and stored in the Azure cloud platform.

4.1.7 Safety

All safety-related policies shall comply with the Health and Safety Regulations established by the Materials Processing Institute.

5.0 Appendices / Drawings

5.1 VIM/Induction Furnace Trial Log Sheet

Document entity.

VIM/Induction Furnace Trial Log Sheet

TRIAL NO: 913	TIME	TEMP	SAMPLE	POWER	COMMENTS
	10:05			10KW	RV1 open/RV2 close.
HEAT NO: 913	10:27			15	Dark glow
	10:35			25	V 3.9 e-10
DATE: 12/10/2022	10:44			30	800°C
	11:00			40	
PROJECT: Consarc	11:10			60 50	
Iraing	11:19			80	
TECHNICIANS:	11:26			60	
	11:28			80	
CHARGE (kg): 34.9	11:32			60	all Melted
	11:34			off	1530 C
	11:35			50	
	11:38			60	Vac 7.2 10-2
	11:42			60	1540 C
	11:40			70	
	11:47			70	→ 1611 °C → 40 KW
	11:49			40	1610 °C
	11:50			30	1580
	11:55			35	1580 7.7 e-2 (Vaccu
	12:00			33	1584 (TC stack, consit
	:				Vaccuum 7.9 e-2

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5.2 VIM Water Record Sheet

Document entity.

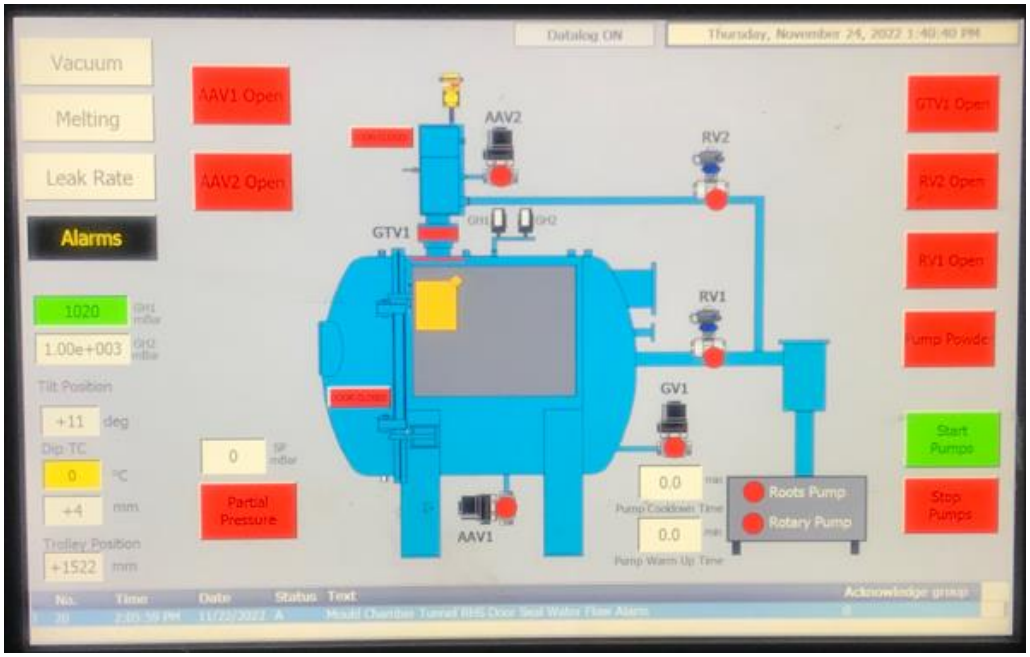
VIM WATER RECORD SHEET

TRIAL NUMBER: 913 DATE: 12/10/22

VIP	Time		Time		Time		Time		Time		Time	
GROUND LEAK CURRENT	10:20	0.01	11:05	0.000	11:05	0.000	:		:		:	
CONDUCTIVITY UNIT	:	0.01	:	0.6	:	0.6	:		:		:	
SUPPLY WATER PRESSURE	:	3 Bar	:	3.0 Bar	:	3 Bar	:	Bar	:	Bar	:	Bar
CLOSED WATER PRESSURE	:	2 Bar	:	2.0 Bar	:	2 Bar	:	Bar	:	Bar	:	Bar
INLET WATER PRESSURE (Temp)	:	20 °C	:	22 °C	:	24 ~~33~~ °C	:	°C	:	°C	:	°C
FURNACE DRAINS TEMPERATURE	:	23 °C	:	32 °C	:	33 °C	:	°C	:	°C	:	°C
MANIFOLDS	**Time**		**Time**		**Time**		**Time**		**Time**		**Time**	
CHARGER FLANGE AND CHARGER VALVE SUPPLY	:	20 °C	:	20 °C	:	22 °C	:	°C	:	°C	:	°C
MELT CHAMBER BODY 1+2 SUPPLY	:	20 °C	:	22 °C	:	24 °C	:	°C	:	°C	:	°C
MOULD CHAMBERRIGHT WALL AND REAR SUPPLY	:	2 Bar	:	2.2 Bar	:	2 Bar	:	Bar	:	Bar	:	Bar
INLET MANIFOLD (DUPLEX FILTER) SOUTH GAUGE	:	2.1 Bar	:	2.0 Bar	:	2 Bar	:	Bar	:	Bar	:	Bar
INLET MANIFOLD (DUPLEX FILTER) NORTH GAUGE	:	2.1 Bar	:	2.2 Bar	:	~~1.2~~ 2 Bar	:	Bar	:	Bar	:	Bar
GX5450/4200 VACUUM PUMP RETURN	:	0.25 Bar	:	0.3 ~~4.2~~ Bar	:	2.2 Bar	:	Bar	:	Bar	:	Bar
MOULD CHAMBER RIGHT WALL AND REAR RETURN	:	0.4 Bar	:	0.4 Bar	:	2.0 Bar	:	Bar	:	Bar	:	Bar
CHARGER FLANGE AND CHARGER VALVE RETURN	:	24 °C	:	26 °C	:	28 °C	:	°C	:	°C	:	°C
MELT CHAMBER BODY 1+2 RETURN	:	18 °C	:	19 °C	:	20 °C	:	°C	:	°C	:	°C
SITE GLASSES	**Time**	**Flow/ Set Point**	**Time**	**Flow/ Set Point**	**Time**	**Flow/ Set Point**	**Time**	**Flow/ Set Point**	**Time**	**Flow/ Set Point**	**Time**	**Flow/ Set Point**
CHARGER FLANGE AND CHARGER VALVE RETURN	:	218	:	219	:	219	:	/	:	/	:	/
GX5450/4200 VACUUM PUMP RETURN	:	216	:	~~215~~	:	214	:	/	:	/	:	/
MELT CHAMBER DOOR RETURN	:	216	:	214	:	215	:	/	:	/	:	/
MELT CHAMBER BODY 1 RETURN	:	218	:	216	:	215	:	/	:	/	:	/
MELT CHAMBER BODY 2 RETURN	:	217	:	217	:	215	:	/	:	/	:	/
MOULD DOOR RETURN	:	215	:	215	:	216	:	/	:	/	:	/
MOULD CHAMBER LEFT WALL AND DOOR SEAL RETURN	:	117	:	117	:	214	:	/	:	/	:	/
MOULD CHAMBER RIGHT WALL AND REAR RETURN	:	114	:	113	:	217	:	/	:	/	:	/
MELT CHAMBER REAR RETURN	:	/	:	/	:	113	:	/	:	/	:	/

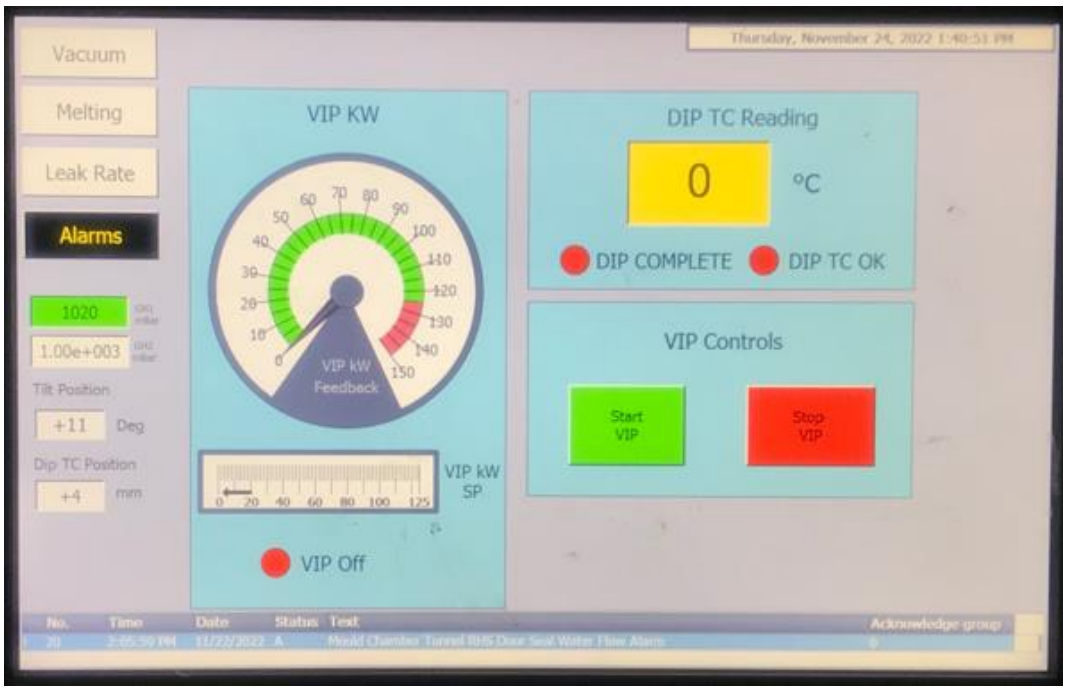
5.3 Melt Station Panel (VIM monitor) - Vacuum

System diagram.



5.4 Melt Station Panel (VIM monitor) - Melting

System diagram.



5.4 Melt Station Panel (VIM monitor) - Leak Rate

System diagram.

5.4 Melt Station Panel (VIM monitor) - Alarms

System diagram.