Development, Testing and Deployment of the METRICS Pot Control System

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Abstract

TRIMET Aluminium SE operates six different smelter technologies, all of which are facing the obsolescence of their respective process control systems. After analysing the solutions available on the market, TRIMET decided to develop its own system, METRICS®, in order to retain its core business know-how and to be able to adapt quickly to new challenges in an ever-changing industry landscape.

This paper gives a brief history of the project scope and shows how some of the features of METRICS® helped to speed up the development and encourage innovation: off-the-shelf hardware, model-based design, automated testing, continuous integration, and deployment.

It also gives an overview of the rollout in our German plants: the Essen aluminium smelter was the cradle of the first trials and its first potline with 120 pots is being commissioned. The Voerde aluminium smelter completed the hardware rollout last year, while two thirds of its production were down due to the energy crisis, and restarted its pots in early 2024 using METRICS®.

Keywords: Process control system, Model-based design, Continuous integration, Continuous deployment, Power modulation.

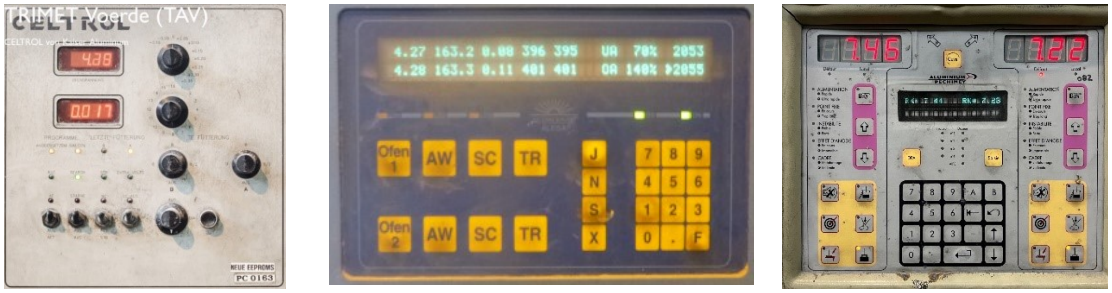
1. Project History and Challenges

TRIMET Aluminium SE operates a patchwork of six different pot technologies within its four smelters in Essen, Hamburg, Voerde in Germany, and Saint-Jean-de-Maurienne in France, see Table 1.

Three different Process Control Systems (PCS) were in use: Kaiser Aluminium's CELTROL for the 188 pots in Voerde, as well as an updated and not compatible version CELTROL CX for the 270 pots in Hamburg, Alesa's BLUEBOX for the 360 pots in Essen, and Rio Tinto Aluminium Pechiney's ALPSYS for the 180 pots in Saint-Jean-de-Maurienne. Figure 1 shows the associated pot controllers.

Table 1. Technologies operated by TRIMET and associated PCS.

Site	Pot Technology		PCS	# Pots
Essen (TAE)	Alusuisse EPT14	PB End-to-End	BLUEBOX	240
	Alusuisse EPT17	PB End-to-End		120
Voerde (TAV)	Kaiser P69	PB Side-by-Side	CELTROL	188
Hamburg (THH)	Reynolds	PB Side-by-Side	CELTROL CX	270
Saint-Jean (TAF)	Pechiney AP18	PB Side-by-Side	ALPSYS	60
	Pechiney AP30	PB Side-by-Side		120
			Total	998



CELTROL BLUEBOX ALPSYS

Figure 1. Pot controllers used in TRIMET smelters.

ALPSYS, which was installed in St-Jean-de-Maurienne in 2003, was the latest PCS within TRIMET. With a service life of 20 to more than 30 years, all TRIMET PCS were facing hardware and software obsolescence and needed to be replaced. CELTROL was discontinued in the early 1990s, while BLUEBOX was discontinued in the 2010s and some functions were integrated in ALPSYS.

It was time for TRIMET to standardize its PCS across the four smelters, to meet existing and future process control challenges: flexible control mechanisms to adapt to fluctuating power supply, virtual battery [4] and potentially CO_2-free aluminium production.

While the solutions available on the market offered proven results and reassuring support, they did not fully meet expectations in terms of costs and ability to implement our own process control ideas, as proprietary hardware and/or software hindered our ability to innovate.

This led TRIMET to make the challenging decision to develop its own PCS, METRICS®, with some key expectations derived from our experience in using previous PCS.

The first was to use a standard Programmable Logic Controller (PLC) to facilitate maintenance and reduce costs. This choice has already been made by others [3] and aims to avoid as much as possible the difficulties encountered with proprietary, outdated hardware and software.

The second was to be able to adapt to the huge diversity of the existing pot technologies. The goal was to develop a generic PCS that could be configured for all the different types of equipment found in the four smelters. From centre bar breaker to the desired number of point feeders, pneumatic or electric beam motors, beam position sensors, bath sensors, shell heat exchangers and other custom developments.

Thirdly, to develop an intuitive Human-Machine Interface (HMI) to facilitate the operator's interaction with the system, allow field observations and feedback, and facilitate training.
Finally, the development framework should be efficient and allow for extensive automated testing to speed up innovation.

TRIMET is committed to further developing its PCS to drive innovation and meet the challenges of power modulation and low carbon operation.

7. References

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