The Study, Execution and Handover to Operations of a Smelter Potline Extension at EGA Al Taweelah Smelter

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Abstract

Over the past decade, operational improvements in reduction cells process control and technology development have allowed reduction potline operators to consider various approaches to increase metal output from their assets. Amongst these approaches, the extension of an existing smelter potline by incorporating additional reduction cells can be an attractive option to maximize the usage of the existing substation equipment. While preparing an extension project, the impact of the additional cells on entire potline operation needs to be studied. A plant assessment must be conducted for all the smelter main areas including carbon plant, gas treatment center, cast house, pot feed system and other services to identify potential bottlenecks and develop strategies to carry out the construction safely and efficiently under brownfield conditions.

Since 2014, Emirates Global Aluminium (EGA) started to plan a potline extension for its Al Taweelah smelter. An integrated team formed by EGA Capital Projects and Hatch conducted a feasibility study to initiate the extension design and define innovative solutions to address the bottlenecks for all the smelter main areas. Following the feasibility study, the project execution phase was initiated in 2019 which included detailed engineering, procurement, construction, and commissioning activities. The extended sections of Potlines 1 and 2 (PL1-2) were completed and successfully energized in April and July 2021 while the extension of Potline 3 (PL3) is now nearing its energization date, with over 3 million lost time incident (LTI)-free manhours completed on the project. This article describes the joint efforts of the integrated team to incorporate an additional 66 pots at the end of the three (3) existing potlines of EGA Al Taweelah site. It provides insight about how the extension sizing was performed, the debottlenecking studies conducted for the main areas, the solutions identified to optimize some facilities, the engineering and construction challenges overcome during the project as well as the successful energization and startup of the new cells.

Keywords: Aluminium reduction technology, Potline extension, Brownfield smelter upgrade, Debottlenecking.

1. Introduction

1.1 General

The potline extension as described in this paper consists of connecting additional reduction cells in series to the existing ones at the opposite end of the rectifier transformers (non-rectifier end). The objective of this modification is to increase the production capacity of each potline in a cost-effective manner, taking advantage of spare capacity which is already built-in the reduction line and other plant areas. Given the capacity in other plant areas and especially in the substation, potline extensions are usually more cost effective than construction of a new potline.

One of the main challenges of the potline extension is that it requires relocating the existing busbar crossover between 2 potrooms to the end of the extension while keeping the busbar energized for the existing potlines. This paper explains how this challenge was overcome in the extension of Potlines 1, 2 & 3 at EGA Al Taweelah.

In planning for this project, the extension size was defined considering the capacity of the existing substation, while simultaneously optimizing and/or limiting the impact on the smelter main areas to maintain the feasibility and cost effectiveness of the project. The addition of new cells will increase the demand on other reduction areas and equipment such as: the gas treatment center, the fluorinated alumina distribution system, the compressed air system, potroom cranes and other operational equipment. It will increase the plant anode requirements, increasing demand on the carbon plant. Increased molten metal output will affect the cast house operations and molten metal transfers.

The tie-in and integration of new pots within the existing smelter systems need to be carefully engineered to minimize the impact on the operating smelter. Shutdown times, production losses and the construction activities need to be planned considering works in brownfield environment, with hazards associated to an operating smelter such as magnetic fields, molten metal, and electrical hazards. The Operations team involvement during the study, construction, and commissioning of such an extension is critical to successful outcomes and needs to be considered throughout the entire project lifecycle.

1.2 EGA Al Taweelah Extension

The EGA Al Taweelah smelter was built in two phases and is made up of Potline 1 and 2 constructed in 2009 and Potline 3 which was constructed shortly after in 2013. The three (3) potlines encompassed 1200 reduction cells prior to the extension. The extension project involves the extension of all 3 potlines, with a total of 26 pots added to potline 1 and 2 respectively and 14 pots incorporated in Potline 3. The 66 new pots will add a total of approximately 78 000 tonnes of hot metal per year.

The extension of Potlines 1 and 2 uses the same proprietary owned technology as the original potline, the DX Technology. The extension of Potline 3 uses DX+ Ultra Technology, which is an upgraded version of Potline 3 original DX+ Technology. For all potlines, the objective is to operate at the same amperage as existing reduction cells to avoid the need for an auxiliary rectifier/ booster.

The additional cells are incorporated at the non-rectifier ends of the existing buildings as shown in Figure 1 and Figure 2. The extensions incorporate 13 pots in each of the two potrooms of Potlines 1 and 2. Since only 14 pots are considered for the extension of potline 3, a single potroom building is considered to incorporate the new cells.

2. Assessment of the Impacts on Reduction Main Facilities

For a project like the extension of EGA Al Taweelah potlines to be successful, the production capacity of all the main smelter facilities needs to be assessed and adapted to support the additional cells while maintain stability and efficiency. The bottlenecks need to be identified and addressed while optimizing the capital expenditure investment.

Assessment of the potline extension impact on the reduction main areas and/or equipment such as potline substation, gas treatment center, potfeed system, and potroom equipment was performed and it was established that facilities would be suitable for the increased capacity, considering the optimized modifications as described in this document.

7. Conclusions

The extension of potline buildings to incorporate additional cells can be a very successful approach to increase the output of an aluminium smelter by taking advantage of existing assets. Innovative solutions to maximize the number of pots which can be incorporated in the shortest possible duration at the lowest possible capital cost while ensuring the safety everyone, will determine the overall success of the project.

The extension at EGA Al Taweelah encompasses the joint effort of an Integrated EGA and Hatch project team to study all the affected areas of the plant and provide engineering solutions to improve bottlenecks, reduce shut down durations, optimize the use of the available power, upgrade the existing GTCs and add flexibility to incorporate new technology to the extension. All of this was carried out while ensuring that safety is incorporated at every stage. The project has been a joint effort between the Project team, EGA Operations and EGA Technology teams who have contributed through every stage to the success of the project.

Most importantly, the integrated team of EGA and Hatch has demonstrated that this type of complex project can be delivered safely for both workers and process and ultimately deliver a strong return on investment for the owner.