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Derate Analysis for SaskPower's Boundary Dam Unit 3 During the First Four Years of Operation

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Abstract

A challenge with Carbon Capture and Storage (CCS) application to coal-fired power plants is the lost capture potential due to power plant outages and derates (which limits flue gas availability to the capture island) or due to off design capture island performance. Capture operations also stop during planned shut downs of the power plant; this presents another constraint to be accommodated when applying CCS if the CO₂ is being supplied to an off-taker. Maximizing capture by reducing capture island performance losses while also satisfying outage constraints is key. As carbon capture and storage technologies seek increased deployment, not limited to electricity generating but to other industries as well, it is necessary to identify, review, and eliminate existing barriers of capture system performance. Performance evaluation is becoming increasingly important. Derate and outage analysis identifies areas of concern and provides a means for reporting performance. Such analysis helps to better understand how the process works and to identify process bottlenecks, for daily operation decisions as well as long term impacts.

The capture facility at SaskPower's Boundary Dam Unit 3 (BD3), commenced operations in October of 2014 and continues to operate today. During this approximately four and a half year operating period, the capture facility has experienced increasingly improved reliability and increased ability to operate closer to theoretical maximum capture rate as shown in Figure 1. There exists a disconnect between the installed capacity (design capacity) and achieved capacity of the capture plant. The disconnect is partly the result of the limited economic incentives to capture beyond the delivery demands of the CO₂ off-taker. Studies of the facility's operational history, which is accessible from the facilities on-line data historian, can help diagnose the main cause of capture losses- derates and outages, while also allowing engineers to analyze the derate and outage history from previous years, which aids in evaluating mitigation measures.

This paper presents and explains fundamental concepts of data analysis to improve analysis of derates and outages at SaskPower's Boundary Dam Unit 3 (BD3) by first proposing an analytic model to evaluate the power outages and derates of the coal- fired unit with carbon capture and storage application. The proposed model accounts for hourly data from the CO₂ capture plant which was extracted from the OSI Pi historian during the approximately four- and half-year operating period (October 2, 2014- March 1, 2019). The model describes how basic Excel analysis can be used to detect outage and derate problems. Data analysis included: key capture process parameters including flows, compositions, temperatures and pressures along with the maximum theoretical amount of CO₂ available for capture by the plant; and, actual amount of CO₂ capture by the plant.

Identifying causes of outages and derates is key in improving the availability of the capture facility. Process and operating improvements based on derate analysis have significantly improved the performance of the BD3 capture

facility. In fact, availability of the capture island was 94 percent in 2018. Increasing reliability of existing carbon capture facilities is key in driving the global deployment of CCS as a CO₂ mitigation strategy.

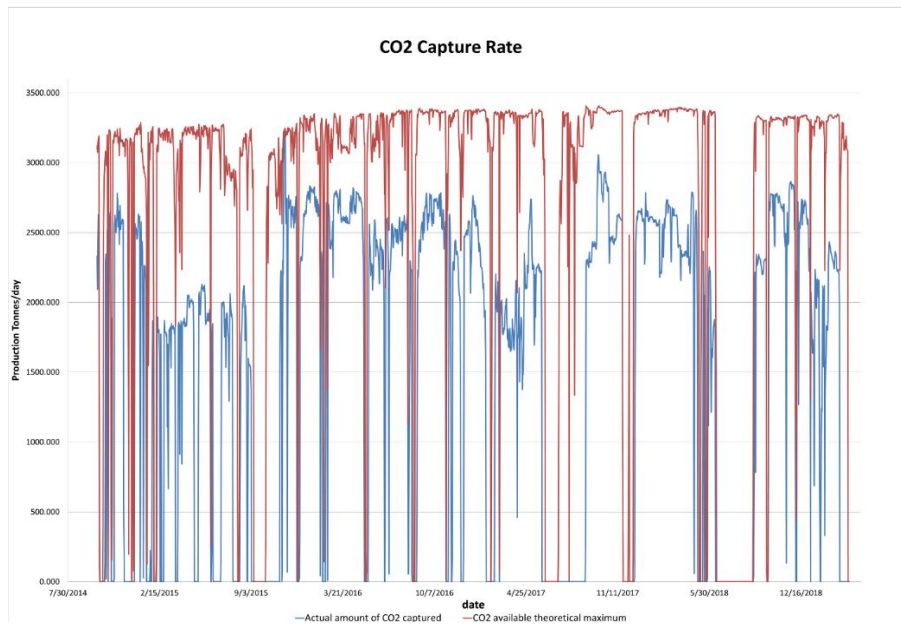


Figure 1. Comparing actual amount of CO₂ captured and available theoretical maximum CO₂ for capture

Keywords: Boundary Dam ICCS, SaskPower, Microsoft Excel Modelling, Derates analysis, Outages, Carbon capture and storage, Post combustion capture
