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

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Abstract

Currently carbon capture and storage technologies have been applied to two industrial scale facilities worldwide – SaskPower's ICCS Project and W.A. Parish's Petra Nova Project. As carbon capture and storage technologies seek to progress to other industries it is necessary to identify, review, and eliminate existing barriers of power plant performance. Performance evaluation is becoming increasingly important. *Derate and Outage Analysis* are areas of concern and a means for reporting performance. Such analyses help to better understand how the process works and to meet the needs of industry.

This paper presents and explains fundamental concepts of data analysis to improve estimators of derates and outages at the Boundary's Dam Unit #3. It describes how basic Excel analysis can be used to detect outage and derate problems. These concepts were developed by the International CCS Knowledge Centre together with SaskPower experts to identify and review the processes, tools and techniques for measuring performance and estimate outage, derate and

thresholds of Boundary Dam Unit #3 power station - the world's first commercial scale integrated Carbon Capture and storage project.

Analysis procedures were as follows:

1) Capture Plant Capacity Availability Factors were estimated. Flue gas flow (available feedstock) was calculated using PI System data. From this data and the boiler steam output data the theoretical amount of CO_2 lb/hr available for capture was determined. Assuming a fully operational capture island 90% of the produced CO_2 would be captured.
2) Hourly and averaged daily data from the CO_2 capture plant was extracted from the PI System during the three years period (October 2nd, 2014- October 1st,2017). Daily status reports of BD3 were analysed to determine the occurrence of the outages. Once known the outages were reflected onto the PI data. Data analysis included flue gas flow estimation, CO_2 mol fraction, CO_2 emissions, maximum theoretical amount of CO_2 captured by the plant and actual amount of CO_2 capture by the plant. This database was used to determine the lost generation through either outages and derate due to flue gas availability and boiler performance issues.
3) The ratio of actual to theoretical maximum amount of CO_2 captured was calculated. This value was presented as a fraction of the maximum possible amount of CO_2 it could have captured at maximum operating capacity.
4) The numbers were correlated between steam flow and the amount of flue gas flow generated.

Furthermore, data collection and analysis was extended to include maximum amine capacity calculated based on amine available for CO_2 capture and volumetric flow of the lean amine. The impacts of high SO_2 slip, foaming and plugging were also screened for using PI data. Results indicate high SO_2 slip, foaming and plugging continue to be the leading CO_2 capture unit concerns.

Compressor performance and dehydration capacity is a significant cause outage delays, and outage delays, this is due to issues with restarting the compressor after long shutdown periods. An annual evaluation of the deposition-based outages and derate did not show a clear trend. In

fact, the coal quality-based outages and derates is not stable and controlled over the three-year period. Around 80% of the actual derate can be explained via the spreadsheet.

System analysis including derate and outage evaluations, reduces problems by describing threshold assumptions, and improvements which can help to gather more outage and derate related information. Overall analysis showed that early identification of operation abnormalities can prevent unnecessary tripping. This in turn reduces the amount of time that the unit is out of service and can facilitate ease of planning for maintenance outages. The analysis, if implemented, could save on operational costs.

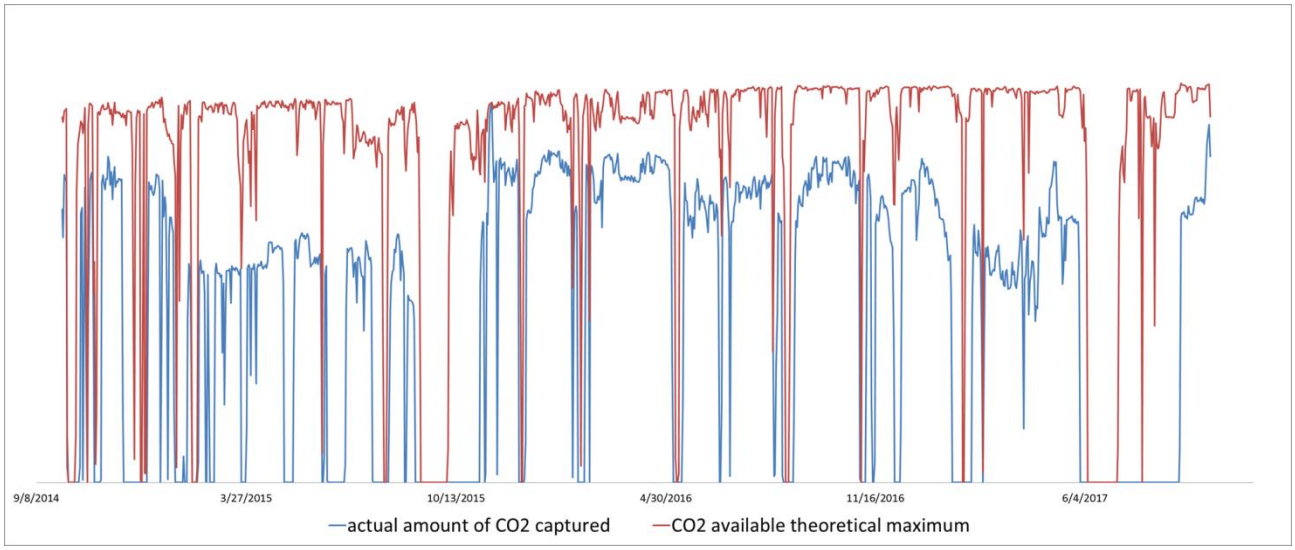

Figure 1. Comparing actual amount of CO_2 captured and available theoretical maximum CO_2 for capture

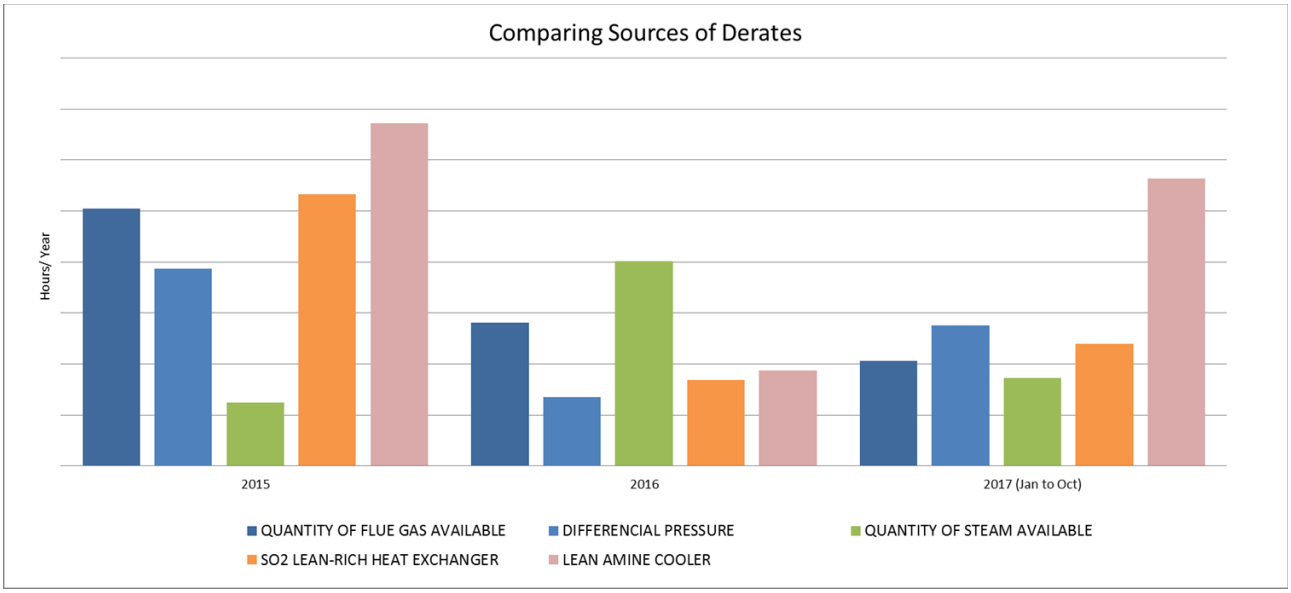

Figure 2. Comparing sources of derates

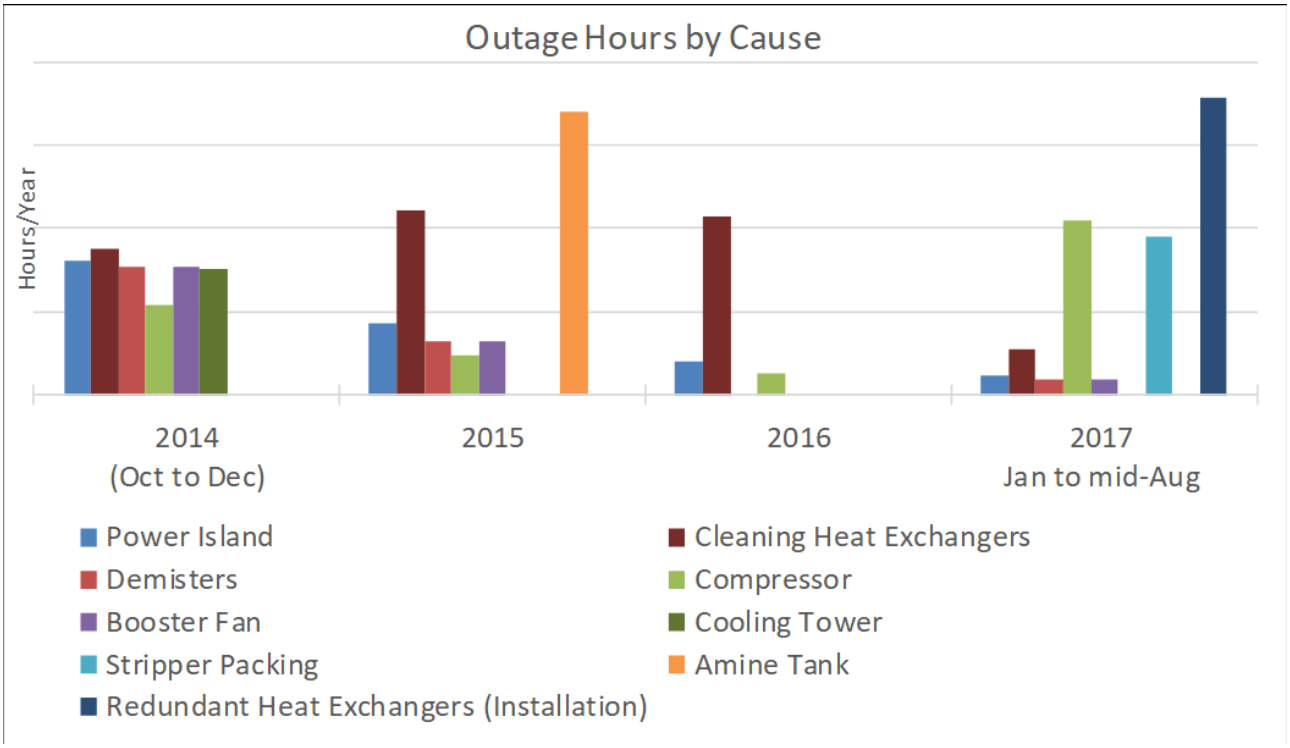

Figure 3. Comparing outage hours by cause