Power Supply Outages to Cells in Aluminium Smelters

Anthony Kjar
Managing Director, Gibson Crest Pty Ltd
Corresponding author: arkjar@bigpond.com

Abstract

The need for the reliability of power supply to the cells in the aluminium reduction process is well known. However, there was a peak of outages in the period 2008 to 2011 coinciding with the start up of new large smelters and the reliability of supply to Western smelters is still not improving. Readily available data over the last fifteen years is provided. This data is used to develop a high level root cause analysis, which is used to provide suggestions for a way forward.

Keywords: Reliability of power supply to aluminium reduction cells; power interruptions to smelters; root cause analysis.

1. Introduction

Unlike data that is systematically collected on the reliability of power station by the Electrical Research Institute [1], there is little analysis of power outages in aluminium smelters. Nevertheless, the need for reliability is well known, particularly for outages greater than two hours when modern cells start to freeze and restart becomes problematic. Some outages can cost up to hundreds of millions of dollars.

This paper builds on previous papers [2] to [6]. A comprehensive, but not necessarily complete, list of outages has been compiled and analyzed. While not necessarily totally accurate, enough examples are available to give a reasonable picture. Any feedback would be appreciated. All smelters, excluding China, are included in the analysis. China is only excluded as the data is not readily available and can be confusing with many more stops and starts to fit power availability and market conditions.

2. History

A history of fifty outages including a few near misses over the last fifteen years are listed in Table 1, with references listed from [7] to [45]. A history of outages by year is shown in Figure 1, separated into Larger (> 500 000 tpy) and Smaller smelters.

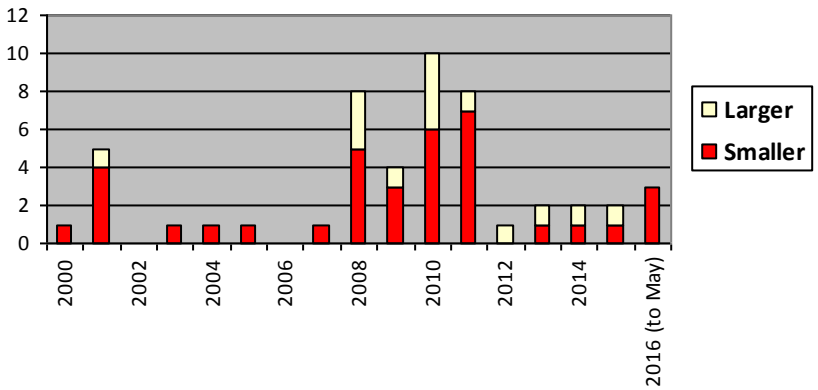

Figure 1. History of power outages by year.

Table 1 – Source of power outage in last 15 years

			A – Initial Location			B – Equipment or system							C – Type or event				D – Equipment Age			Comment
Plant	**Ref**	**Date**	1 Plant or Main Switch Yard	2 On Site Power Station	3 Grid or offsite PS	1 Bus Bar	2 Rect-ifier	3 Trans-former	4 Switch Yard	5 Trans-mission line	Cells	6 Other circuit break protect equip. DNS Tube leaks. Earth faults. Flood	1 Fire/ Elect/ Flash over	2 Mech	3 Light-ning	4 Failed Protection Poor Response Poor Procedures Poor Design Other	1 0-5 y	2 5-25y	3 Old >25 y	0 >5000 000tpy xx two outages x one outage DNS :Did not start
2000																				
Mt Holly	3	10/3	x			x							x					x		Bus bar failure
2001																				
St Jean-M	7	14/2	x								x		x					x		Basement Thermite
Albras	3,8	1/6			x						x					x			x	Power shortage
Hillside	3	14/9			xo							xo				xo			xo	Air compressor dns
Warrick	9,10	5/12		xx								xx				xx			xx	Unreliable equipment
2002																				
2003																				
Alumar	3,11	18/7	x				x						x					x		2 rectifier failures
2004																				
Ormet	12	Nov	x								x			x					x	Labour strike
2005																				
Korba	13	2005		x								x				x	x			PS shut. Inexperience
2006																				
2007																				
2007																				
Alcoa Ten	14	16/4	xo						xo						xo			xo		Lightning,Power line broken
2008																				
Portland	15	18/6			x					x				x				x		Broken 500kV line
Anglesey	3	12/6	x					x					x						x	132 kV transformer
Dubal	3,16	2/11		x								x				x		xo		Thermal overload
NZAS	3	9/11			x			x					x					x		Transformer failure
Korba	17	22/11	x									x	x				x			Overload/Breaker failure
Korba	17	2007	x								x			x			x			Power surge/Metal leak
Korba	17	2007/ 9		xx+o								xx+o				xx+o	xx+o			Boiler tube failures Some near misses

In addition, particular vigilance is required to develop, record, organize appropriate management structures, train and then audit the startup, shutdown and restart major electrical and equipment circuits.

Further check lists are outlined in [6].

4. Conclusions

Power outages (and also major safety accidents) should be reducing in the future, and each company maintaining meaningful databases of typical root causes is difficult due to a limited sample size. The various aluminum associations have stopped out of this field.

It would be useful for all producers if each company published its own high level root causes in their press releases and or annual reports. This would allow easier analysis and encourage improvement so as to be more competitive than other metals.

This paper outlines the importance of a focus on system design, maintenance, organization and smelter management and audit both for processes under direct as well as indirect control.

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