New Zealand Aluminium Smelters Limited

Participant Rolling Outage Plan

December 2014

(as approved by the System Operator)

Contents

Definitions

AUFLS	Automatic Under Frequency Load Shedding
Authority	The Electricity Authority
Code	The Electricity Industry Participation Code 2010
developing event	An event that evolves over time, e.g. as the result of a period of unseasonably low inflows to hydro catchments
EMP	The system operators Emergency Management Policy. Current version published 19th December 2011
GXP	Transpower Grid Exit Point which connects off-take loads (e.g. large industrials, distribution companies) to the national grid
GEN	Grid Emergency Notice
immediate event	An event that occurs with little or no warning, e.g. as a result of a transmission or major power station failure
NZAS	New Zealand Aluminium Smelters Limited
PROP	Participant Rolling Outage Plan (this plan)
Regulations	Electricity Governance (Security of Supply) Regulations 2008 and Electricity Governance (Security of Supply) Amendment Regulations 2009
Rolling Outages	Planned electricity disconnections spread over different parts of the electricity system at differing times to avoid prolonged outages at any one location.
SOROP	System operator rolling outage plan
Supply shortage declaration	Declaration made by the system operator under Clause 9 sub part 2 of the Code.
System Operator	Operator of the national electricity transmission grid (Transpower)
Transpower	Transpower New Zealand Limited
Transmission line	A high voltage supply line owned and operated by Transpower New Zealand Limited
TWI	Tiwai GXP (TWI2201) – NZAS point of connection to the grid

Associated documents

1. Emergency Management Policy published by the system operator on 18th December 2011
2. System operator Rolling Outage Plan - issued by the Electricity Commission on 30 September 2010
3. NZAS operational procedures

Purpose of this plan

4. Part 9 of the Electricity Industry Participation Code (the Code) relates to security of supply and includes provisions relating to the system operator rolling outage plan (SOROP) and participant rolling outage plans (PROPs).
5. This plan was written to satisfy the requirements of the Code that relate to PROPs. Clause 9.8 of the Code requires that each PROP must
   a) be consistent with the system operator rolling outage plan; and
   b) comply with the requirements specified in the notice sent under clause 9.6(2)(a); and
   c) specify the actions that the specified participant will take to achieve, or contribute to achieving, reductions in the consumption of electricity (including any target level of reduction of consumption of electricity in accordance with criteria, methodologies, and principles specified in the system operator rolling outage plan) to comply with a direction from the system operator given under clause 9.15.
6. This PROP covers the following site:

Site name	Physical location	GXP
NZAS	Tiwai Road, Invercargill	TWI2201

7. This PROP provides details of how New Zealand Aluminium Smelters (NZAS) will respond to a supply shortage declaration issued by the system operator and how the system operator (Transpower) should communicate any requests for reductions in demand.
8. This PROP provides details of the main energy saving measures that can be called on and how these are structured and implemented.

Supply shortage declaration

9. Part 9 Sub part 2 of the Code sets out how supply shortage situations will be managed.

10. Under the provisions of the Code the system operator has powers to direct outages following a supply shortage declaration. As a specified participant NZAS must comply with any direction given by the system operator following a supply shortage declaration.

11. A supply shortage declaration may apply to:

    a) All of New Zealand; or

    b) Regions specified in the declaration

12. When a supply security declaration is made NZAS must comply with a direction given by the system operator in accordance with this PROP.

13. The system operator may, at any time in the period during which a supply shortage declaration is in force, direct NZAS to contribute to achieving reductions in the consumption of electricity by implementing outages or taking any other action specified in the direction.

14. A direction may be communicated through the information system operated by the system operator.

15. The system operator will notify NZAS when a supply shortage declaration has been revoked

16. This PROP sets out the actions that NZAS will take, who is responsible for implementing the actions and how communications will be managed between NZAS and the system operator.

Background

The Electricity Authority

17. The Electricity Authority (Authority) is an independent Crown entity responsible for regulating the New Zealand electricity market. The Authority's objective is to promote competition in, reliable supply by, and the efficient operation of, the electricity industry for the long-term benefit of consumers.

18. The core functions of the Authority are to:

    a) make and administer the Electricity Industry Participation Code 2010 (Code) governing the New Zealand electricity market;
    b) undertake market-facilitation measures (such as providing education, guidelines, information, and model arrangements) and monitor the operation and effectiveness of market- facilitation measures;
    c) monitor and enforce compliance with the Code, various regulations, and the Act;
    d) proactively monitor the performance of the electricity industry in regard to competition, reliable supply and efficient operation; and
    e) contract service providers to operate the New Zealand electricity system and market in accordance with the Code

Transpower

19. Transpower is a State Owned Enterprise, tasked with owning and operating New Zealand's National Grid - the network of high voltage transmission lines and substations that transports bulk electricity from where it is generated to distribution line companies and directly (grid) connected major electricity consumers.

System Operator

20. As system operator, Transpower manages the real-time operation of New Zealand's electricity transmission system by matching supply (generation dispatch) with demand.

Pacific Aluminium and NZAS

21. New Zealand Aluminium Smelters Limited (NZAS) is New Zealand's only aluminium smelter and is located on Tiwai Peninsula, across the harbour of Bluff in the province of Southland.

22. NZAS is a tolling plant, producing primary aluminium in the form of ingot, billet, rolling block and t-bar products. Approximately 92 per cent of the aluminium produced at NZAS is exported.

23. Pacific Aluminium is a business unit of Rio Tinto Alcan, responsible for managing ownership interests in 4 Australasian smelters, including NZAS. Rio Tinto Alcan is one of five product groups operated by Rio Tinto, a leading international mining group.

24. Pacific Aluminium's interest in NZAS is owned by Pacific Aluminium (NZ) Limited (79.36 per cent) and by Japan's Sumitomo Chemical Company (20.64 per cent).

Security of Supply Events Covered By This Plan

25. In its Emergency Management Policy the system operator provides the steps that the system operator will take and the circumstances that will need to exist for a supply security declaration to be made. Those steps provide for a series of last resort emergency measures, which would not be implemented unless there was a significant risk that it would not be possible to meet the demand for electricity on a sustained basis.

26. The types of event likely to require the implementation of the EMP include an extended period of extremely low inflows to hydro catchments, a major asset outage that was expected to be sustained for a long period, or some combination of these events.

27. The EMP describes two categories of events that could lead the system operator to make a supply shortage declaration these are:

    - **Developing Event** – Events that evolve over time – for example as the result of a period of unseasonably low inflows to hydro catchments; and
    - **Immediate Events** –. Events that occur with little or no warning – for example as a result of a transmission or major power station failure, the impact of which are expected to extend over a period of weeks rather than days.

28. Rolling outages under a supply shortage declaration are a last resort measure the system operator may initiate, after consultation with the Authority, only if there is a shortage of electricity supply (generation) or transmission capacity if the system operator considers:

    a) that the normal operation of the wholesale market is, or will soon be, unlikely to facilitate the adjustment of supply and demand necessary to ensure that supply matches demand; and

    b) that, if planned outages are not implemented, unplanned outages are more likely than not.

Full information & partial information PROPS

29. The system operator Rolling Outage Plan sets out the following requirements for direct connect PROPs:

***Full information plans**:*

These plans must contain sufficient information for the system operator to make a decision on the most appropriate savings target for the direct-connect user. A direct-connect user's full information plan must inform the system operator about:

- the nature of the load on site;
- whether any load is used to provide other services to the electricity sector such as interruptible load;
- the extent to which different levels of savings can be achieved;
- the nature of the measures that could be implemented; and
- the cost associated with different levels of savings.

***Partial information plans**:*

These plans may contain some of the information required for full information plans. If the system operator sets a savings target for a region where there is a direct-connect user with a partial information plan, their savings target will likely be set to achieve the same percentage saving as distribution companies in that region.

What this PROP contains

30. This PROP includes procedures for managing both developing and immediate category of event.

Section	Content
Communications	Contact details for communications during a supply shortage declaration
Description of Load	A description of the NZAS load
Site response	How the site will respond to different types of event including a plan of possible savings
Coordination with the system operator	Sets out how NZAS will coordinate with the system operator
Monitoring and reporting	How NZAS will monitor and report savings made

31. This PROP contains all the information required for Partial Information Plan but will be updated to a Full Information Plan should a security of supply event be imminent.

Communications

Operational Communications

32. Depending on time of day, all urgent operational communications should, in the first instance, be made to:

During standard office hours:

Contact:	[redacted]	or	[redacted]
Phone:	[redacted]		[redacted]
Mobile:	[redacted]		[redacted]

After Hours:

Contact:	[redacted]
Phone:	[redacted]

The control room also has a dedicated TPSN line for communication directly to Transpower.

The following email address may also be used which covers the Power Supply Superintendent, Crew Leader and all RCO's:

Email: [redacted]

Note: although the above email address is a distribution list of key contacts, it should not be relied on as the sole mechanism for communication. Email communications should be tagged as 'High' importance.

It should be noted that only operational communications directly related to a Supply Shortage event should be made to the NZAS Superintendent Power Supply in the first instance during working hours or the Duty RCO after normal working hours.

The Power Supply Crew Leader or designated RCO will communicate with the system operator for operational communications using the following details:

Transpower National Control Centre
Energy Desk Duty 0800 535 123
Security Desk Duty 0800 488 500

Hamilton Co-ordination Centre
Fax (07) 843 7176

Wellington Co-ordination Centre
Fax (04) 496 9109

Supply Shortage & Media Communications

Communications from the system operator about a *supply shortage declaration* should be made to:

Primary Contact:	
Phone:	
Mobile:	
Email:	
Secondary Contact:	
Phone:	
Mobile:	
Email:	

The NZAS person responsible for reporting to the system operator on *performance against savings targets* is:

Contact:	
Phone:	
Mobile:	
Email:	

The person who the system operator should notify for *revocation of the shortage declaration* is:

Primary Contact:	
Phone:	
Mobile:	
Email:	
Secondary Contact:	
Phone:	
Mobile:	
Email:	

Note: although the email address specified above is a distribution list of key contacts for NZAS' commercial related energy matters, it should not be relied on as the sole mechanism for communication. Email communications should be tagged as 'High' importance.

These people will communicate with the system operator for administration and reporting against targets using the following details:

System Operator
Transpower
Level 7
Transpower House
96 The Terrace
PO Box 1021
Wellington

Telephone: (04) 495 7000
Fax: (04) 495 7100

The NZAS person who is responsible for communicating with the media (if required) is:

Contact: [redacted]
Phone: [redacted]
Mobile: [redacted]

Description of Site Load & Smelting Process

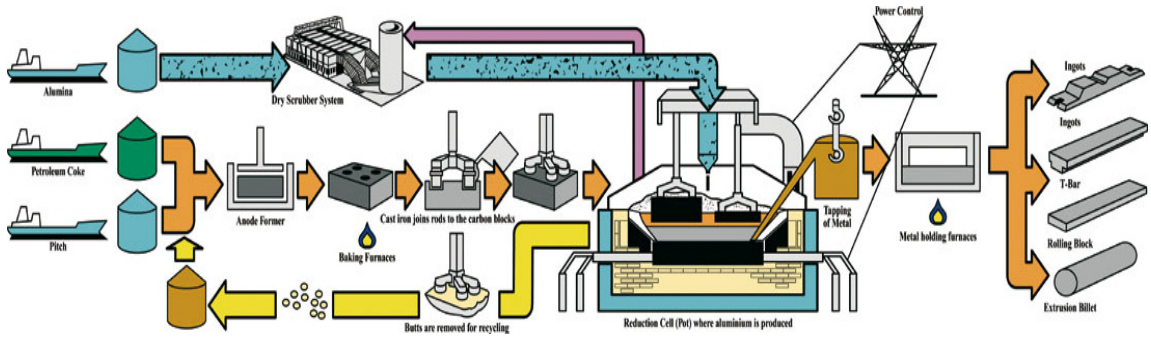
33. Installed capacity at the smelter currently consists of 3 reduction lines of Kaiser P69 technology cells, with 208 cells per line (i.e. 624 total), and one quarter line of 48 CD200 technology cells (not currently operational[1]).

34. For the purpose of this document, it should be assumed that NZAS will be operating with a baseload production capacity across reduction lines 1-3 to ensure the current contract volume of 572 MW is consumed. This results in a small amount of idle capacity across reduction lines 1-3 (approx. 8 MW worth).

35. Approximately 97% of the operating load is consumed by the 3 reduction lines as part of the aluminium smelting process (Hall-Héroult process). The remainder is used for site works feeder (auxiliary) power for lighting, extraction fans, compressed air, etc.

36. Metal production at the assumed baseload production capacity is approximately 330,000 tonnes per annum.

37. The below diagram represents the aluminium smelting process:



38. The smelting process is an electro-chemical process which uses continuous electrical energy to separate the aluminium metal from its oxide alumina. This occurs in reduction cells, which are large, steel, carbon lined furnaces. Alumina is fed into the cells where it is dissolved in molten cryolite (a liquid which dissolves alumina and conducts electricity at 960°C). Electricity is introduced into each cell via carbon anodes. All reduction cells are connected in a series by an aluminium busbar, which carries electrical current to the cells within each reduction line.

[1] reduction line 4 (approx. 50 MW) is has been out of circuit since April 2012

39. Typical electrical loadings per reduction line at baseload production capacity are given below:

	Line 1	**Line 2**	**Line 3**	**Line 4**
Power AC MW	189	189	190	n/a
DC Voltage (V)	930	930	940	n/a
DC Amperage (A)	200,000	200,000	198,000	n/a

Each reduction line is controlled by a computer based, customised control system.

40. The smelter's contractual electricity arrangements with Meridian Energy for 572 MW are unique in New Zealand's electricity market, and it is important to consider when contemplating any reductions in loading.

41. The contract for 572 MW is a Contract for Difference, with a requirement to maintain consumption levels. Any sustained reduction initiated under this PROP that would result in the site electrical load falling below the minimum consumption level will require cooperation between NZAS and Meridian Energy.

42. NZAS, as a market participant, purchases all power directly from the NZ wholesale electricity market. Any amount of non-contract spot power purchased is dependent upon any hedge contracts NZAS has in place at any point in time, the wholesale spot rate and physical production capacity. Should NZAS be operating above 572 MW, load reductions above this amount could be made by NZAS without recourse under the baseload agreement with Meridian Energy.

43. At certain times a reduction line has been made available to the market (via the system operator) for under frequency load shedding. This has been afforded on both an automatic and manual response basis.

44. The site also responds to grid emergency notices from the system operator.

45. This plan assumes that NZAS has a single reduction line permanently armed for Automatic Under frequency Load Shedding (AUFLS) and that this, or any other SPS arrangements NZAS may have in place, can also be included in the planned savings in this PROP.

How The Site Will Respond To Different Types Of Event

46. The system operator is responsible for making a supply shortage declaration and for directing NZAS to implement rolling outage savings. Communication of such a direction to NZAS to reduce demand should be given to the following person.

Contact:	[redacted]
Phone:	[redacted]
Mobile:	[redacted]

If unable to be contacted, then contact:

Contact:	[redacted]
Phone:	[redacted]
Mobile:	[redacted]

47. The above person(s) has the authority to make demand reductions and is responsible for coordinating emergency demand response at NZAS and communicating with the system operator when a directive is in force.

48. Any load that has already been reduced due to a Grid Emergency notification will be considered to have contributed towards the requested savings under a Directive.

49. Any load that has been dispatched as under frequency reserves will not be considered to have contributed towards the requested savings under a Directive. NZAS will consider withdrawing any under frequency reserves offers at the time when a savings directive is in force.

50. Following receipt of a Directive NZAS will, as soon as reasonably possible, issue a directive to all staff to reduce all discretionary electricity use. Discretionary means electricity use that does not impact on production, the health and safety of people and site security.

51. If further reductions are necessary to meet the Directive NZAS will implement the savings plan set out in the following section.

Savings Plan

52. When a Directive is received it is likely that that NZAS load will have been reduced in response to high wholesale electricity spot prices. If the required percentage savings has already been achieved through reductions in response to spot prices or for other energy conservation measures no further savings are to be made.

53. If the NZAS loading has not already responded to spot prices and further reductions are required to meet the system operator's directive then the following plan will be followed.

Immediate Event

54. If an immediate load reduction is required under a Directive, the power taken could be ramped down by up to 30 MW of the pre-reduction loading[2]. This position can be sustained for a maximum of 2 hours, with no more than one reduction event of this type taking place in 7 days. This is due to the impact on cell heat balance and process efficiency of such an event. Increased frequency of load reduction events could lead to a significant increase in cell failures and outage costs.

55. Duration and frequency of the load reduction is an issue as the longer cells operate on reduced load, the greater the impact the process stability and process recovery time, and hence the production penalty becomes significantly higher.

56. The likely costs of making this reduction would be:

    a) increased anode consumption during the recovery period

    b) shortened life of the cells

    c) lost production through load reduction and subsequent process instability (i.e. reduced power efficiency)

    d) additional spot power cost: after the event, increased power consumption above the pre-event loading will be temporarily required to recover process heat balance. The amount required for a load reduction specified in point 54 could be up to 5 MW for 6 hours after the event. This additional power does not produce aluminium.

    An estimate of the likely cost of the above for a 2 hour reduction of 30 MW is dependent on the prevailing London Metal Exchange (LME) price, US exchange rate, and the cost of the power purchased for post-event heat recovery. Given this variability, costs will not be provided in this plan but consideration will be given to providing costs if a security of supply event is imminent and/or declared.

57. For a short term immediate event noted in point 54, the load reduction would be obtained through amperage reductions across the operating lines. How this reduction is managed on each line (i.e. which reduction lines are used and the load reduction quantity per line) will be at the discretion of NZAS as it will depend on reduction line operating conditions at the time of such an event.

[2] assumes NZAS is operating at baseload operating capacity

58. Where savings under an immediate event directive require a longer than 2 hour period sufficient to justify the cost, time and safety risks and cell loss risks associated with the cell restoration process, the options considered will be the same as for developing events below.

Developing Event

59. The majority of the loading reductions would be undertaken on reduction lines 1 and 2, with reduction line 3 providing minor reductions to support if required. Reductions will be achieved through a combination of one or more of the following:

    a) removal of selected cells

    b) reduced loading across one or more reduction line.

60. The costs incurred due to a load reduction would be dependent on what commercial arrangements NZAS has in place at the time and the flexibility to suspend or terminate these arrangements.

61. Load reduction for a developing event would typically take the following form. In the first instance, cells that fail as part of routine operation would not be returned to circuit. Where possible NZAS would then remove cells that have the highest probability of successful restart. Then a concentrated group of cells on reduction line 1 and/or 2 would be removed from operation. Minor amperage reductions could also be used across all reduction lines to supplement the total load reduction.

62. Indicative savings plans for various levels of savings and duration are provided in the tables below.

5, 10% and 15% Weekly MWh savings plan

Mechanism	**Expected demand (MW)**	**Expected pre-savings weekly energy (GWh)**	**Target weekly savings (GWh)**	**Expected weekly savings (%)**
Removal of selected cells and/or reduction line loading. Majority of reduction from reduction lines 1 and 2	572	96	5	5%
	572	96	10	10%
	572	96	14	15%

Total GWh saved

	5%	10%	15%
1 Week	5	10	14
2 Weeks	10	19	29
3 Weeks	14	29	43
4 Weeks	19	38	58
5 Weeks	24	48	72
6 Weeks	29	58	87
7 Weeks	34	67	101
8 Weeks	38	77	115

63. The cost of savings has two main components
    1. costs attributed to the required savings; and
    2. costs attributed to the restoration of production.

64. The costs attributed to restoration are due to the incremental nature of restoration of production cells. Experience in managing past events has shown that cell restoration can take place at a rate of approximately 10 per week, depending on the condition of the cells removed and the lead time given prior to removal. It can be seen from the table below that the number of cells required to be withdrawn from production for various levels of weekly savings will be in excess of 10. Therefore, the restoration time will be several weeks, which increased up to several months as more savings are mandated.

MW per cell		0.9		
MWh per cell per week		153		
GWh per cell per week		0.15		
Full Site Load	MW	572		
Savings		**5%**	**10%**	**15%**
MW to be Saved		28.6	57.2	85.9
GWh to be Saved per week		4.8	9.6	14.4
Cells off line to achieve weekly saving		32	63	95
Restoration Capability - cell per week		10		
Restoration Duration (weeks)		3	6	10
Estimated Production lost during restoration (GWh)		8	30	69

65. A prolonged reduction of NZAS loading below the contractual amount of 572 MW requires cooperation between NZAS and Meridian Energy. This is needed to meet both contractual and practical requirements. No allowance has been made to cover potential contract penalties that may be incurred.

Coordination with the System Operator

66. Communications from the system operator for coordination of NZAS operations will be made in the first instance to the NZAS Power Supply Control Room. This communication will be made by telephone.

Contact: [redacted]
[redacted]
Phone: [redacted]

If unable to be contacted, then during standard office hours contact:

Contact: [redacted] or [redacted]
Phone: [redacted] [redacted]
Mobile: [redacted] [redacted]

NZAS has existing procedures in place which covers the co-ordination between the NZAS Power Supply Control Room Operator and the System Operator regarding load reduction and restoration.

67. In the event that a Grid Emergency is coincident with a request for savings under this PROP it is assumed that the Grid Emergency requirements made by the system operator will take precedence over this PROP savings plan. The level of savings available under this PROP will, therefore, be reduced by the level of any load reductions made in response to a Grid Emergency.

68. Once a Grid Emergency has ceased the load savings under this PROP savings plan will be recommenced.

Monitoring and Reporting

69. Monitoring and reporting for operational purposes will be to the system operator.

70. Monitoring and reporting for compliance will be with the system operator.

71. For major loads, NZAS internal SCADA data will be used to produce daily or weekly reports of savings achieved.

72. For unmetered loads, savings will be calculated by comparison with an average energy consumption profile and the observed actual loading reductions for during a Supply Shortage event.

73. Monitoring and reporting is the responsibility of Manager Commercial Services (refer Communications section).

74. If required, reporting to the Authority will be undertaken as requested.