

## SUSTAINING CAPITAL OF ALUMINA REFINERY PROJECTS – IMPORTANT BUT UNLOVED

Peter-Hans ter Weer<sup>1</sup>

<sup>1</sup>TWS Services and Advice, Imkerweg 5, 1272 EB Huizen, The Netherlands; [twsservices@tiscali.nl](mailto:twsservices@tiscali.nl) or [www.twsservices.eu](http://www.twsservices.eu)

Keywords: Alumina Refinery Opex, Alumina Operating Cost, Sustaining Capital Cost, Sustaining Capex, Susex

### Abstract

Sustaining capital cost / expenditure, abbreviated as sustaining capex or Susex, is a project cost item which is sometimes forgotten and often disliked. To many it is unknown, and it may be (partly) hidden in other operating cost items. The relation – and the difference – with repair and maintenance costs is not always clear and may inadvertently lead to incomplete cost estimates.

This paper explores several facets of sustaining capital and aims at clarifying some of these issues for alumina refinery projects.

### Overview – Section 2

#### Sustaining Capital – General & Ala Refinery Project (2.1)

Sustaining capital expenditure (“Susex”) in general refers to expenditure related to capital asset additions, replacements or improvements required to maintain/sustain existing assets. Required investments covered under Susex contribute to ensuring that the operation’s overall reliability is maintained at the existing production level and that all (existing and new) reliability, legislative, regulatory, environmental and safety requirements are met. Considered from an economic perspective: Susex does not generate additional revenues. Drivers of Susex include:

- Reliability and risk mitigation which includes but is not limited to life extensions, end of life replacements, and system reinforcements (designed and implemented to meet existing and new requirements)
- Regulatory compliance
- Health, Safety & Environment compliance and improvements
- Social requirements
- Product market requirements.

Summarizing: for an alumina refinery project Susex is the ongoing capital expenditure required to avoid the eventual discontinuation of the operation, to maintain its production level, its product at target quality and to maintain Health Safety and Environment (HSE) on target / in compliance. It covers items such as:

- Replacing worn out equipment, and major equipment repair<sup>1</sup>
- Developing bauxite residue (“red mud”) disposal areas
- Repair of facility structures
- Investments to meet (existing and new) HSE requirements
- Investments to meet (existing and new) alumina product quality standards
- Investments to meet social obligations.

Often an alumina refinery project includes other project elements such as a Bauxite mine and Infrastructure (port, railway, roads, personnel housing, etc). In that case most of the above items apply also to the additional project elements, and supplementary Susex items may include (but are not necessarily limited to):

- Mine mobile equipment replacement

- Mine fleet expansion to maintain plant throughput capacity (if applicable)
- Resettlement costs of local communities (if applicable)
- Port dredging (if applicable)
- Railway rolling stock and locomotive replacement (if applicable).

#### Operation Closure Costs (2.2)

In the development of greenfield alumina refinery projects, ordinarily an allowance is included in the financial model, covering the costs of closure of the operation, and the costs of rehabilitation of the affected mine lease and refinery proper areas at the end of mine life. Mine area rehabilitation is normally a progressive process, but final closure of the operational residue area and the refinery site itself will require expenditure at the end of life.

After operation closure, port and housing facilities and any other usable infrastructure are sometimes handed over to the country’s government without further expense. Operation closure costs are not included in this paper’s Susex cost.

#### Difference with Repair & Maintenance Costs (2.3)

The principle difference between Susex and Repair and Maintenance (R&M) costs (including materials and contractors) as included in the alumina refinery cash operating cost is that Susex is depreciated (spread) over a period of time while R&M costs are expensed, i.e. form part of a plant’s cash operating costs (Opex).

However when comparing Susex between different projects, elements of Repair and Maintenance costs should be considered as well because plants do not always use the same basis for these two cost items (refer section 5).

### Sustaining Capital Cost Values – Section 3

The actual Susex of a project depends on aspects such as its location, age, technologies used, operational and maintenance methods, infrastructure, production capacity, etc. It should also be remembered that due to its nature actual Susex values may vary (significantly) from year to year, oscillating around a long term average.

Table I – Typical Susex Range and Value

Project Element	Sustaining Capex, \$/tA	
	Indicative Range	Typical Value
Bauxite Mine	2.5-5.5	~3.5
Infrastructure	1.5-3.5	~2.5
Alumina Refinery	6-12	~8
Total	10-21	~14

The Susex numbers in Table I are based on available global historical data and include typical Bauxite Mine and Alumina Refinery Susex values and ranges (for both low and high

<sup>1</sup> Mobile equipment, communication, control and IT systems, mills, tanks, filters, boilers, etc

temperature digestion plants) for existing bauxite and alumina projects, and Infrastructure values based on greenfield data.

The approach used in this paper to reconcile an alumina refinery's Susex is based on the underlying capex build-up and the lifetime of its components as shown in Table II.

The table illustrates that, based on typical values for refinery capex and lifetime of equipment and structures, a typical annual long-term alumina refinery Susex value may be derived (8.7 \$/tA) which is reasonably in line with the actual typical value as shown in Table I (~8 \$/tA).

Table II – Alumina Refinery Sustaining Capex Build-up

Alumina Refinery	Typical Greenfield Capex Values, \$/Annual tA		Lifetime, Years		Calculated Annual Long Term Susex				
					Greenfield Project Basis				Mature Portfolio Basis <sup>④</sup>
Capex Element	Indicative Range	Typical Value	Indicative Range <sup>⑤</sup>	Typical	Indicative Range, \$/tA	Typical, \$/tA	% of Direct, Total Capex (Range)	% of Direct, Total Capex (Typical)	% of Direct, Total Capex (Range)
Equipment		150	40-60	50	2.5-4	3			
Commodities <sup>①</sup> / Structures		370	60-70	65	5-6.5	5.7			
Direct Capex		520			7.5-10.5	8.7	1.4-2	1.7	2.8-4
Indir. Capex <sup>②</sup>		480							
Total Capex	850-1,400 <sup>③</sup>	1,000					0.8-1.1	0.9	1.6-2.2

① Structural Steel, Concrete, piping, wire and cable, raceway (cable trays), Instrumentation, Electrical Equipment, Earthworks, etc

② Freight, EPCM, temporary construction support, commissioning, insurance, owner's engineering, etc.

③ Dependent on production capacity, location, bauxite quality, technologies, etc

④ A portfolio with (Bauxite and) Alumina projects which on average are midway their lifetime

⑤ Refer for instance [1]

The indicative range derived this way (7.5-10.5 \$/tA), although being narrower than the actual range, refer Table I (6-12 \$/tA), is not inconsistent as it falls completely within the range of Table I.

#### Sustaining Capital – Industry Majors – Section 4

To provide a context for the numbers in section 3, Susex values in relation to Properties, Plant and Equipment (P, P & E) of Alcoa [1], Hydro [2], and Rio Tinto [3] have been compared for the years 2013 and 2014 based on their respective annual reports. The result is shown in Table IV.

Land and land rights (Alcoa, Hydro) and Mining properties and leases (Rio Tinto) have been excluded from P, P & E in this comparison under the assumption that no sustaining capital has been spent on these items. Construction Work-in-Progress, respectively Capital Works in Progress (WIP, Alcoa, respectively Rio Tinto) and Plant under Construction (PUC, Hydro) are separately indicated. These are excluded in the calculation of Susex as percentage of P, P & E under the assumption that they have not (yet) required sustaining capital expenditure.

When interpreting the numbers of Table IV it should be realized that Alcoa, Hydro and Rio Tinto differ significantly in many respects such as scale (2014 Revenue: Alcoa ~24BUS\$; Hydro ~12.5 BUS\$; Rio Tinto ~48 BUS\$) and business focus (Alcoa 2014, an integrated Aluminium company with significant downstream activities: Alumina + Primary Metal ~43% of Revenue; Hydro 2014, an integrated aluminium company with limited downstream and other activities: Bauxite & Alumina + Primary Metal + Metal Markets ~69% of Revenue; Rio Tinto 2014, a major mining company (iron ore, copper, diamonds) with integrated aluminium activities: Rio Tinto Alcan ~25% of Revenue).

The differences between these industry majors are reflected in the range of Susex as percentage of P, P & E on "at cost" basis (2.2-

3.8%) and to a lesser extent on "net of depreciation" basis (5.0-6.5%). Table III provides a comparison of the results.

Table III – Susex Comparison

Alumina Refinery Sustaining Capex					
	Indic. Range \$/tA	Typ. Value \$/tA	% of Total Capex (typ.)	% of Total Capex greenf. / "at cost" (range)	% of Total Capex mature / net of deprec. (range)
Actual (Table I)	6-12	8			
Calculated (Table II)	7.5-10.5	8.7	0.9	0.8-1.1	1.6-2.2
Industry Majors 2013-2014 (Table IV)				2.2-3.8	5.0-6.5

Noticeable from this table is that the range of Susex as percentage of P, P & E both on "at cost" as well as on "net of depreciation" basis is a factor 2-4 times larger as reported in the annual reports of Alcoa, Hydro, and Rio Tinto than it is as derived in section 3. However due to the availability of only limited detail information on Susex provided in annual reports and presentations in general, and on alumina refinery operations in particular it is difficult to reconcile this difference.

Table IV – Years 2013 and 2014 Sustaining Capex of Alcoa, Hydro and Rio Tinto in relation to their Properties, Plant & Equipment

(Numbers based on 2014 Annual Reports)	ALCOA				HYDRO				RIO TINTO			
	2014		2013		2014		2013		2014		2013	
	MU\$	As % of Cost	MU\$	As % of Cost	MNOK	As % of Cost	MNOK	As % of Cost	MU\$	As % of Cost	MU\$	As % of Cost
Properties, Plant, and Equipment (excl. Land and Mining Properties & Leases), at cost	33,503	100%	34,660	100%	102,856	100%	96,199	100%	80,680	100%	79,757	100%
Accumulated Depreciation, depletion, and amortization	-19,091	-57%	-19,227	-55%	-50,757	-49%	-47,274	-49%	-33,785	-42%	-33,881	-42%
Sub Total	14,412	43%	15,433	45%	52,099	51%	48,925	51%	46,895	58%	45,876	58%
Construction Work in Progress / Plant under Construction (WIP/PUC)	1,466	4%	1,567	5%	2,687	3%	3,020	3%	9,885	12%	14,071	18%
Properties, Plant, and Equipment, Net	15,878	47%	17,000	49%	54,786	53%	51,945	54%	56,780	70%	59,947	75%
Sustaining Capital	735		770		3,300		2,700		2,700		3,000	
Sustaining Capex as % of "P & E, at Cost" Value, excl. WIP/PUC	2.2%		2.2%		3.2%		2.8%		3.3%		3.8%	
Sustaining Capex as % of "P & E, Net" Value, excl. WIP/PUC	5.1%		5.0%		6.3%		5.5%		5.8%		6.5%	

### Relationship between Susex and Maintenance Materials & Contract Services – Section 5

The following aspect may explain at least part of the discrepancy found in Table III above. To properly compare Susex values between projects, costs of “Maintenance Supplies/Materials” and “Contract Services” in an operation’s operating cost should also be taken into account, because some operations account for maintenance project costs under these headings rather than under Susex. The same could well apply to the collection of operations reported on in an annual report.

Available information of existing operating alumina refineries (both low and high temperature digestion) indicates a range of 18-30 US\$/tA for the total of [Susex + Maintenance Materials + Contract Services].

### Conclusions – Section 6

The actual typical Susex value (~8 US\$/tA) and range (6-12 US\$/tA) for an alumina refinery project can be reconciled reasonably well by using an approach based on the underlying capex build-up and lifetimes of major capex elements.

The discrepancy between the range of Susex as percentage of Property, Plant & Equipment both on “at cost” as well as on “net of depreciation” basis in the annual reports of some of the industry majors (2.2-3.8%, respectively 5.0-6.5%) and the equivalent ranges arrived at by using the earlier mentioned approach (0.8-1.1%, respectively 1.6-2.2%) cannot easily be resolved.

When comparing Susex values between operations, costs of “Maintenance Supplies/Materials” and “Contract Services” should be taken into account: for alumina refinery projects the sum of Susex plus these two items ranges between 18-30 US\$/tA.

### References

1. Alcoa Annual Report 2014 “Transforming”
2. Hydro Annual Report 2014 “Better Bigger Greener”
3. Rio Tinto Annual Report 2014 “Delivering sustainable shareholder returns”

