iNNOVATIVE
PROCESS
UPGRADE
TECHNOLOGIES

Generic Mine Example

Coal Handling Preparation Plant

Sample Desktop Appraisal of the Suitability for a Major Throughput Step Increase + Partial Step Increase Case

REPORT

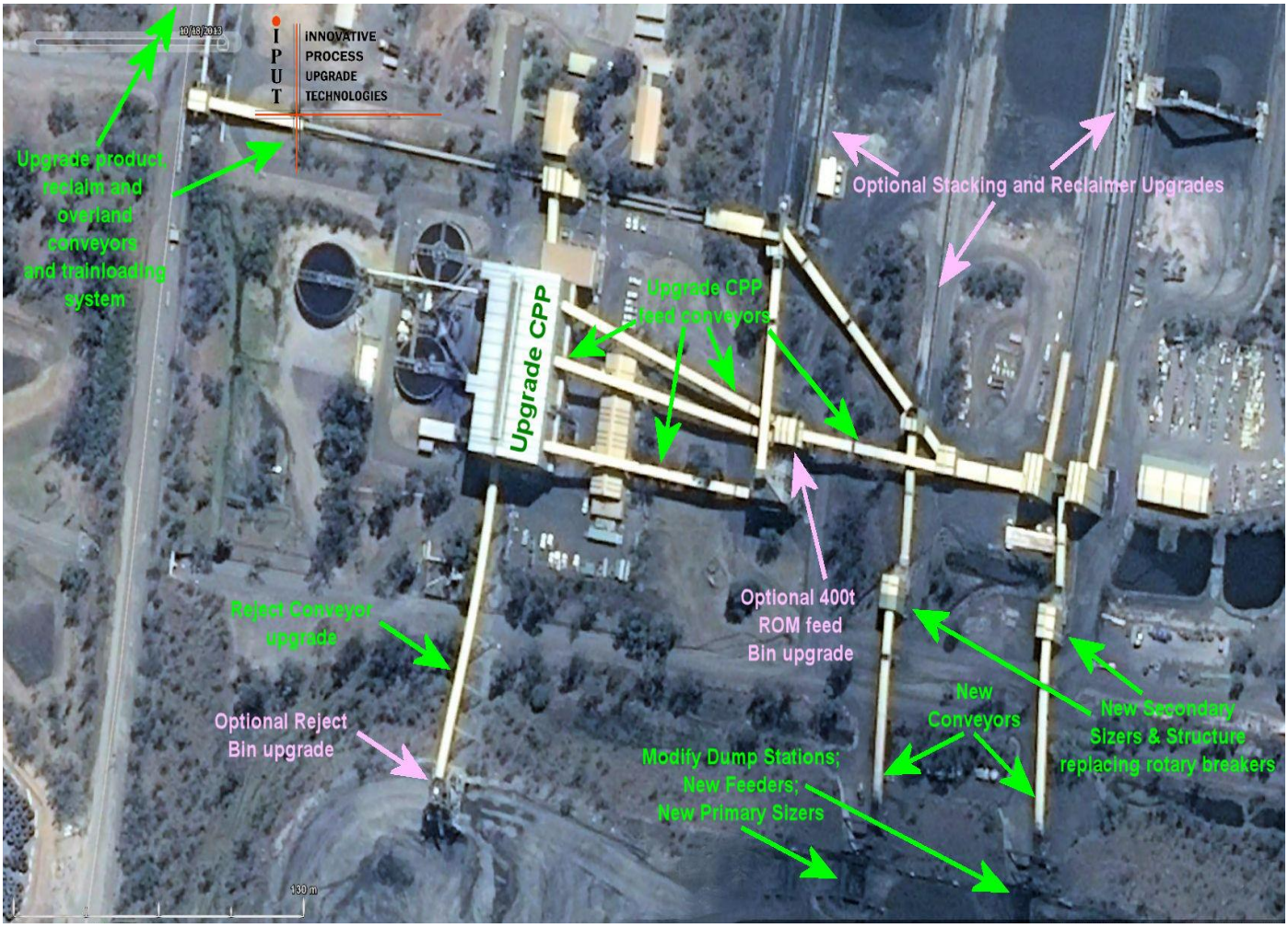

Figure 1: Illustrating the basic scope required to implement a 10Mtpa Increase at a Generic CHPP

Confidentiality

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DOCUMENT ISSUE & REVISION TRACKING:

REVISION NO	DATE	DESCRIPTION OF REVISION	Approved
0	July 2017	Initial Release for Sales Example Purposes	VS
VS – Vince Sunter; DL – David Lee; BW – Brad Wainwright			

1. EXECUTIVE SUMMARY

iPUT Pty Ltd (iPUT) have prepared a complementary desktop appraisal of a generic example client site to assess the suitability of utilising iPUT's proprietary upgrade process[1] to substantially increase throughput of a Coal Handling Preparation Plant (CHPP).

The generic example's site currently operates at 14Mtpa. A preliminary 24Mtpa target was requested as being beneficial to the Owner, representing an overall throughput increase of 71%.

iPUT's preliminary findings are that this specific site is suited to achieving the requested output increase with preliminary budget costing just under $70M (+/- 50%) to achieve an increase of 10Mtpa in ROM coal and 7Mtpa in product coal. This budget cost is based on a number of assumptions outlined within this report, using a 2014 cost base.

iPUT also identified other areas of interest which may result in output being in excess of the original target throughput. These areas can be explored in conjunction with direct input from the Owner's operational and marketing staff.

iPUT recommends that a detailed Concept Verification study now be carried out. This study will define precisely the changes that would be necessary to achieve the target output, and explore other avenues for further increases. The study will also establish the associated costs of the selected upgrade path, sufficient to enter into a negotiated contract for the design and construction of this upgrade. This study would take a period of 3 to 4 months to perform.

Since original submission of this report, iPUT has presented it in a meeting, submitted a plan of likely implementation stage costs (now included in this document) and attended the generic site, providing follow-up confirmation that our site inspection confirmed the viability and conclusions of this desktop report.

[1] Patented

2. BACKGROUND

The existing Generic Coal Preparation Plant (CPP) is configured as six @ 400tph modules, which a "standard" 7,000 hour operational year should produce 7,000 x 6 x 400 = 16.8Mtpa. This should be the base case. That should easily be exceeded as 7,000hrs equates to an overall availability of 80%, whereas world's best practice is closer to 90%.

On current figures of 14Mtpa the CPP is achieving 67%. The equipment that iPUT recommends for the CPP is KNOWN to be much more reliable, and achieving 85% availability as a base case for the CPP would be expected. However it is critical that the Mining and Loadout equipment can service the increased CHPP throughput. Additional information is required to understand exactly what the problems are driving the current low availability and eliminate the cause/s.

3. UPGRADE OVERVIEW

At an overview level, iPUT would expect an upgraded CHPP to perform at 85% x 365 x 24 x 125% x 6 x 400 = 22.3Mtpa ROM coal. However, from the data provided, it is clear that the generic CPP is suitable to upgrade the modules to operate in the region of 550t/hr to 650t/hr. This equates to 24.7Mtpa to 29.2Mtpa, based on a 7,500hr year. Exactly where in this range will become evident when a detailed Concept Verification study is performed.

To achieve this increased throughput primarily requires the CPP to be converted using the new enabling technology sub-resonant frequency two-mass STM screens developed by USA based General Kinematics Corporation (GK). The natural "sweet spot" upgrade path for the generic CPP is to replace all the existing screens with equivalent width STM screens having the same footprint and space envelope. This is what has been examined for this preliminary desktop review.

The CPP will also need more magnetic separators to operate at a higher density. Upgrades will be needed to DMC's, classifying and dewatering cyclones, spirals, centrifuges and pumps. Some reconfiguration of components is also required to ensure optimal feed.

The ROM system upgrade requires the rotary breakers to be replaced with a modern primary and secondary sizer system which necessitates replacement of the main ROM feed conveyors and upgrades to the CHPP feed conveyors. The rejects and product conveyors will also need to be upgraded, as will the overland conveyor and trainloading system.

The STM screens provide an increased screening reliability, consume much less energy, generate lower dynamic loads on the structure, are far stronger than existing brute force designs and easily retrofit within the same space envelope and footprint as existing screens. Product quality and yield can also be improved. By optimising the whole plant, an excellent payback period for this step change is expected. See the process overview calculation table below for a summary of upgrade scenarios and output estimates.

Other equipment may possibly require upgrading, but their costs have not been included at this stage as they will be the subject of detailed discussion and review in the feasibility stage. We currently believe that these items are not essential to achieve the throughput increase.

iPUT makes this technology available on a total system upgrade basis from ROM stockpile to trainloader. It is proposed that the upgrade works proceed sequentially in logical stages to minimise impact on production and cash flow. Initially it is proposed to upgrade two modules, then to upgrade two more and one ROM feed line, followed by the final two modules and remaining ROM feed line.

Generic CHPP Step Change Throughput Increase Suitability Review

INNOVATIVE PROCESS UPGRADE TECHNOLOGIES

Process Overview Calculations

Assumptions

Maximum Possible Annual Operating (365*24):	8,760	Hours
Current ROM Feed Available:	14,000,000	Tonnes
Target ROM Feed Preferred for Step Change:	24,000,000	Tonnes (=71.4% increase)

Row	Description	Unit	Existing Plant	After +25% Upgrade	After +10Mt Upgrade	Achievable Range: After 550t/h Upgrade	Achievable Range: After 650t/h Upgrade	Comments
1	Qty Modules	ea	6	6	6	6	6	
2	Coal Feed rate per module	t/h	400	500	538	550	650	
3	CHPP ROM Coal Feed rate	t/h	2,400	3,000	3,228	3,300	3,900	to dump station
4	Increase on existing design output	%	0.0%	25.0%	34.5%	37.5%	62.5%	
5	Assumed operational utilisation	%	80%	85%	85%	85%	85%	increased reliability
6	Annual operational running time	hrs	7,008	7,446	7,446	7,446	7,446	
7	ROM feed capacity pa @85% Availability	t	16,819,200	22,338,000	24,035,688	24,571,800	29,039,400	
8	Actual Raw coal feed available pa	t	14,000,000	22,338,000	24,035,688	24,571,800	29,039,400	
9	Product coal produced pa @ avg 82% yield*	t	11,480,000	18,317,160	19,709,264	20,148,876	23,812,308	
10	Product coal produced pa @ avg 70% yield*	t	9,800,000	15,636,600	16,824,982	17,200,260	20,327,580	
11	Actual operational utilisation req'd	%	66.6%	85.0%	85.0%	85.0%	85.0%	Beyond 85% / 7,500 hrs is a stretch target needing post upgrade work to achieve
12	Annual operational running time req'd	hrs	5,833	7,446	7,446	7,446	7,446	

* Actual results depend on seam geology

Achievable Range

4. THROUGHPUT INCREASE – IMPLEMENTATION OVERVIEW

4.1 Essential Plant Upgrade Requirements

The proposed upgrade is based on modifying the existing generic CPP to enable it to process 24Mtpa of ROM Coal which is an increase of 10 Mtpa of ROM Coal and additional 7 Mtpa of product coal. To achieve this outcome the following modifications are anticipated.

4.1.1 Raw coal handling

The following general scope will be required:

a) Remove lower section of each dump hopper through to and including the rotary breakers.

b) Install a feeder and associated steelwork and access under each dump hopper to feed new Primary sizers which will reduce the nominally -1,000mm feed to -300mm. Feed rate will be between 1,650 and 2,000 t/h.

c) The Primary sizers will discharge onto new elevating conveyors which will elevate the -300mm coal up to the new Secondary Sizer Station.

d) The new Secondary Sizer stations will reduce the -300mm feed down to -100mm sizing and this will then discharge onto the existing Roller Screen/ Tertiary Sizer feed belts.

e) The conveyors and plant feed system will be speed up / modified to be able to handle the new 3,300 to 4,000 t/hr plant feed capacity.

4.1.2 Coal Preparation Plant

The six modules in the plant will modified so they can each handle between 550t/hr and 650t/hr. Initial calculations indicate that the following general scope will be required:

a) Double the amount of Magnetic Separators and replace dilute medium pumps so the Plant can operate at a higher density for better yield.

b) Modify the existing Primary Classifying Cyclones – replace with larger or increase number.

c) Modify the Fine Product Dewatering Cyclones – replace with larger or increase number.

d) Install additional spirals and modify cyclone/spiral installation so that the classifying Cyclones discharge directly to the spirals.

e) Replace the existing DMC's with larger ones to handle the additional feed.

f) Replace all the existing screens with STM Screens to fit in the same footprint including feed and discharge chutes and underflow launders.

g) Speed up the reject belt to handle the additional tonnage.

h) Double the amount of Centrifuges and reposition the existing for increased capacity and provide trouser leg feed chutes and throttling gates for even distribution of feed.

i) Remove fine coal centrifuges

j) Increase the height of the Classifying Cyclone feed Sumps and upgrade pumps to suit.

k) Upgrade DMC feed pump drives for the increased volume and higher density.

l) Upgrade Tailings system for increased volume of tailings.

4.1.3 Product Handling

The following general scope will be required:

a) Upgrade Product Conveyors to handle the additional capacity.
b) Optimise the capacity of the overland conveyor.
c) Upgrade Rail loading capacity.

4.1.4 Electricals

The new screens will use less power but conveyor upgrades will consume much or all of this. As long as incoming HV (High Voltage) supply to the site is sufficient, reallocating and replacing breakers within the existing the generic CPP MCC facilities is likely to achieve the required results.

The new screens and CPP circuit changes will necessitate considerable additional IO to the plant PLC and SCADA systems. The availability issues currently being experienced and forward management of the facility will also benefit greatly from detailed historical datalogging capacity built in.

At this stage, an allowance based on previous experience has been made to cover the above work.

4.1.5 Optional Plant Upgrade Requirements

There are a number of areas that may require upgrading that have not been considered in detail in this initial appraisal. These will be the subject of detailed discussion and review in the Concept Verification stage. The rejects bin is likely to require a high flow outlet to reduce cycle times and maximise truck payloads. iPUT have fitted our proprietary design high flow gates to several Hunter Valley Mines. The stockpile and reclaim systems will also be reviewed in the context of plant direct feeding and overview operational stability requirements.

4.2 Budget Pricing

All pricing excludes GST. This pricing is derived in a detailed spreadsheet based on iPUT's expert judgement for the type and nature of works to be performed, and including assumptions about inclusions and exclusions as are generally outlined herein, using a 2014 cost base.

Description	+10Mtpa Budget Price ($M)	+5Mtpa Budget Price ($M)
In-pit crush & 5km Overland	Not considered	$40.5
CHPP Raw Coal Handling	$17.6	$5.5
CPP Upgrade	$27.3	$13.6
Product Handling	$15.2	Not in 1st stage
Electricals	$9.1	$7.8
Estimate TOTAL:	**$69.2**	**$67.4**

GST is excluded from all pricing.

4.3 Improvement in Product Yield and Quality

The upgrade would offer the potential to improve product yield, but with a commensurate increase in ash and reduction in energy, by operating the dense media section of the plant at higher cut points and by including the more marginal material in the fines section. A brief evaluation of the bore core data indicates that there could be between 0.5% and 2% improvement.

This is an estimate based on experience, and we would need to look at the current actual performance of the plant as well as the theoretical based on the bore core data and assumed process performance. So experience tells us this outcome is likely, but it is quite a body of work to develop the details to ensure that it happens.

4.4 Staged Upgrade Sequence

It is proposed that a staged sequence of upgrades will enable the desired throughput of 24Mtpa to be progressively achieved with one Module being down at any one time for planned maintenance during day shift, leading to significantly lower overall costs. In the detailed review we would also look at further splitting the first two stages outlined below so that a higher throughput can be maintained during the Project Execution stage.

4.4.1 Stage One

Upgrade first two modules. Capacity of plant will be limited to 1,600 t/hr during this work which is expected to take 12 weeks on site. Capacity of plant on completion will be 2,400t/hr due to the limitations of the Raw Coal System. Cost of this stage $17.4M.

4.4.2 Stage Two

Upgrade third and fourth modules and upgrade one line of the Raw Coal System. Capacity of plant will be limited to 1,200t/hr during these works due to limitations of the existing Raw Coal System and are expected to take 12 weeks on site. Capacity of plant on completion will be 3,450t/hr. 25.6Mtpa . Cost of this stage $20.1M.

4.4.3 Stage Three

Upgrade the final two modules and upgrade the remaining Raw Coal line and Product Handling. Capacity of plant will be limited to 1,650t/hr during these works which are expected to take 12 weeks on site. During these works an outage of 2 weeks for the Overland Conveyor may be required which would mean a campaign of trucking coal to the rail loader stockpiles may be required using privately owned roads. Capacity of plant on completion will be between 3,300 and 3,900 t/h. There would be the potential to process 29 Mtpa at utilisation of around 88%. The limitation of this upgrade is likely to be the raw coal Receival and crushing system with a limit of 24Mtpa. Cost of this stage $31.7M.

5. SUBSEQUENT STEPS / MOVING FORWARD

With the provision of this report, iPUT's commitment to provide a complementary desktop appraisal of the suitability of the generic site has been completed. This desktop review has explored the suitability of the iPUT Step-Change technology to provide an improvement of throughput for the generic CHPP.

The initial review has identified that a significant increase can be achieved meeting or even exceeding the target level of 24Mtpa. A detailed Concept Verification study is necessary to properly identify and quantify with more accuracy the scope and budget for the upgrade.

iPUT has the capability, capacity and are prepared to perform this study. We anticipate that it would take 3 to 4 months and include evaluation of the physical plant plus direct involvement of the Owner's key staff to ensure relevant aspects are covered. A schedule of rates is appropriate to undertake the preliminary work to an agreed scope, carrying through until such time as fixed pricing can be agreed to Design and Construct each Proposed Upgrade Stage.

5.1 Concept Validation Study

GST is excluded from all pricing. This document originally based on mid-2014 pricing.

	Description	Estimated Cost
I.	Site Visit (4 persons) – one day	$8,500
II.	Three-day review info, verify thoughts, interact with the Owner personnel, involve GK design team, etc	$22,500
III.	Review of structural and site layout consequences of upgrade project – five days	$20,000
IV.	One-day team review workshop including the Owner	$8,000
V.	Four days to do further investigations, write up estimate and relatively detailed scope of work including schedule and outage plan	$40,000
VI.	One-day presentation of report to the Owner	$8,000
VII.	Estimated Expenses (excludes airfares and travelling time if needed)	$1,000
Estimated Total (excluding the Owner's costs)		**$108,000**
• **Duration: Four weeks depending on meeting schedules & interactions with the Owner** • **All costs exclude GST and expenses which are charged at cost** • **Invoiced at end of Item VI** • **Invoices to be paid net 14 days from invoice date**		

5.2 Scope Finalisation Study

GST is excluded from all pricing. This document originally based on mid-2014 pricing.

	Description	Estimated Cost
a.	Scoping and measuring site visit with process, structural, operational experts – two days	$30,000
b.	Produce detailed equipment lists and layout drawings and constructability plan –two weeks	$50,000
c.	Detailed structural review – structural review and analysis of facility to define what needs to be upgraded if at all – two weeks	$20,000
d.	Detailed electrical review – two weeks	$20,000
e.	Produce process flow and block schematics and diagrams to define the project – three weeks	$50,000
f.	Project schedule to minimize down-time plus meet production requirements – one week	$15,000
g.	Draft Scope Finalisation Study report which brings everything together including detailed project budget – three weeks	$75,000
h.	Presentation to the Owner and finalisation of Report – one week	$20,000
i.	Estimated Expenses (excludes airfares and travelling time if needed)	$5,000
Estimated Total (excluding the Owner's costs)		**$285,000**

- **Duration: Six - nine weeks depending on meeting schedules & interactions with the Owner**
- **All costs exclude GST and expenses which are charged at cost**
- **25% Invoiced at commencement, 50% invoiced at completion of item e. balance at completion of item h.**
- **Invoices to be paid net 14 days from invoice date**

5.3 Schedule of Resource Hourly Rates

GST is excluded from all pricing, as at mid-2014 pricing.

Resource Description	Price / hr
Engineer (Executive)	**$275.00**
Engineer (Principal)	**$250.00**
Engineer (Senior Process, Mechanical, Struct/ Civil)	**$230.00**
Engineer (Senior Electrical)	**$210.00**
Senior 3D Designer	**$200.00**
Design Draftsperson	**$130.00**
Document Controller/ Administration Assistant	**$80.00**
Flat Day Rates (day shift) based on 10hrs work	
Travel Rates lesser of 70% x day rate or actual hrs x 80%	
Incidentals and direct costs at cost plus 15%	