

## Final

TNG Limited: Mt Peake Scoping Study Update  
Project No. 2227

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This report has been prepared by Snowden Mining Industry Consultants ('Snowden') on behalf of TNG Limited.

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## 1 Findings

Snowden Mining Industry Consultants has updated the February 2011 Scoping Study for TNG Limited's (TNG) Mt. Peake vanadium-iron-titanium project. This update contemplates the diversion of part or all of the vanadium pentoxide ( $V_2O_5$ ) product to a ferrovanadium (FeV) plant to be constructed elsewhere. The FeV is to be sold as a separate value-added product.

Metallurgical data has been provided for use in this update by Mineral Engineering Technical Services (METS). This data has included recoveries, operating and capital costs associated with a conceptual FeV plant with a capacity to produce to be constructed (for the purposes of this study) in Darwin. Conceptually, such a plant could be constructed elsewhere, Whyalla presenting an obvious alternative.

Given the nature of the metallurgical work and financial analysis, Snowden assign a level of accuracy of  $\pm 50\%$  to this study. Any reference to "ore" is as a generic term and implies no economic significance as defined in the Australasian Code for the Reporting of Exploration Results, Mineral Resources and Ore Reserves, 2004 edition (the JORC Code).

Snowden notes that the forward price used for FeV product are speculative and do not contemplate price elasticity for this commodity. Snowden strongly recommend that a marketing study be undertaken as part of any further investigation.

Snowden further notes that the volume of material available for processing into FeV in any given period is dependent upon grade estimates derived from an Inferred resource. Assumptions relating to production and processing are therefore speculative.

### Strategy

To improve the NPV, the Scoping Study strategy<sup>1</sup> was modified to process the  $V_2O_5$  product to FeV for sale. The contemplated mining and expansion sequence remains unchanged, except for the construction of the FeV plant.

Metallurgical Scoping Study work performed by METS<sup>2</sup> provided capital and operating cost parameters for a FeV plant, based on the anticipated  $V_2O_5$  production from a 2Mtpa mining and concentrating operation. This scenario contemplates the annual production of some 4,703t of FeV throughout the life of the project, without expansion of the FeV production capacity to receive the entire  $V_2O_5$  product from a 5Mtpa mining and concentrating operation.

For this reason, after the contemplated operational expansion to 5Mtpa, the product is split, with part of the  $V_2O_5$  product being processed to FeV and part sold as  $V_2O_5$  concentrate.

In the event, the current Inferred Resource model indicates that the FeV process will consume the majority of the  $V_2O_5$  production, to the extent that the  $V_2O_5$  concentrate available for separate sale is negligible.

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<sup>1</sup> Refer Snowden project 1217 Mt Peake Scoping Study

<sup>2</sup> Refer METS report J517-000-001 B-FeV processing plant

### Technical cashflow model

For the purposes of this Update, Snowden has used the resource optimisations performed for the February Scoping Study, which are based on the 2010 Inferred Resource Model. The updated parameters produce identical pit shells to those generated in the February study, the size of the shells being limited by the dimensions of the Inferred Resource model. The size of the mining inventory is some 175Mt.

Projected product prices are the same as those advised by METS and TNG Limited for the February study, with the addition of a FeV product price.

**Table 1.1 Summary product prices**

Product	Units	Value
V <sub>2</sub> O <sub>5</sub>	\$USD/lb	8.00
Fe <sub>2</sub> O <sub>3</sub>	\$USD/mt	200.00
TiO <sub>2</sub>	\$USD/mt	155.60
FeV	\$USD/mt	50,000

The modified technical cashflow model does not take into account cost or source of capital, hedging, tax, depreciation, rehabilitation and salvage, to produce a EBITDA<sup>3</sup> cashflow and is consistent with a Scoping Study level of examination.

Snowden has produced two preliminary Technical Cashflow Models relating to the FeV option: the first examines the production of FeV in the context of the operation as a whole<sup>4</sup> and incorporates preliminary forecast production, recoveries and operating costs relating to V<sub>2</sub>O<sub>5</sub>, FeV, TiO<sub>2</sub> and iron oxide. The second model<sup>5</sup> examines the production, recoveries and operating costs relating to production of FeV. The difference between the two models provides an indicative measure of the overall value of FeV production.

Using a process schedule developed from the strategy outlined above, the project produces an indicative NPV of AUD\$1,585 M and an indicative IRR of 43.9% over a 24 year project life, from commencement of construction. Of this, the sale of FeV product constitutes AUD\$1,261 M, for a production of some 105,000t FeV.

Sales of iron oxide and titanium dioxide contribute some AUD\$254 M to the NPV of the project.

**Table 1.2 Preliminary technical cashflow model summary**

Measure	Units	Value
Discount rate	%	10
IRR	%	43.9
NPV	AUD\$ M	1,584.5
CASH	AUD\$ M	5,344.3
Prestrip CAPEX	AUD\$ M	17.1
2 Mtpa V <sub>2</sub> O <sub>5</sub> plant CAPEX	AUD\$ M	370.3
Expansion CAPEX	AUD\$ M	307.6
FeV plant CAPEX	AUD\$ M	43.8
Conceptual project life	Years	24.43

<sup>3</sup> Earnings Before Interest, Tax, Depreciation and Amortisation

<sup>4</sup> JEF<sub>FeV</sub>\_Model090311.xls

<sup>5</sup> 110322\_JE\_FeV\_model.xls

## 2 Introduction

TNG Limited (TNG) has requested that Snowden Mining Industry Consultants (Snowden) update the Scoping Study completed in February to contemplate the processing of  $V_2O_5$  product to produce FeV.

### 2.1 Scope of work

The current scope of work contemplates:

- a pit optimisation using economic parameters associated with FeV production
- a preliminary technical cashflow model that incorporates capital and operating costs associated with FeV production

Data relating to the capital and operating costs and process recovery of the FeV plant was taken from metallurgical scoping studies supplied by Metallurgical Engineering Technical Services (MET<sup>6</sup>S). All other data remains the same as that used in the February Scoping study.

All currency in this report is quoted in Australian dollars, unless otherwise noted and tonnes are quoted as dry tonnes. Any reference to “ore” is as a generic term and implies no economic significance as defined in the Australasian Code for the Reporting of Exploration Results, Mineral Resources and Ore Reserves, 2004 edition (the JORC Code).

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<sup>6</sup> METS assign a +/-35% level of accuracy to capital and operating cost estimates

## 3 Resource optimisation studies

### 3.1 Metallurgical parameters

Snowden has not provided metallurgical input to the Scoping Study and has relied upon advice from TNG's metallurgical consultant, METS.

The following summarises Snowden's understanding of the process and relevant costs, as applied to the FeV processing model.

#### Products

The current METS metallurgical work examines the construction of a FeV production plant, conceptually located in Darwin, that processes  $V_2O_5$  concentrate from the Mt. Peake mining and milling operation into a FeV product for sale.

The contemplated process reduces Mt. Peake  $V_2O_5$  concentrate in an electric arc furnace with the addition of lime, scrap steel and aluminium as catalyst and reactants<sup>2</sup>.

#### Throughput

The METS study<sup>2</sup> contemplates an annual ferrovanadium production of 4,703 tpa, based on the anticipated production from a 2Mtpa Mt. Peake mining and processing operation. Snowden's February Scoping Study indicates that a 5Mtpa production from Mt. Peake is more appropriate. The METS ferrovanadium study has not been updated to reflect this increased production.

However, preliminary production scheduling, based on the Inferred Resource model and appropriate recoveries, indicates that the 4,703 tpa plant will consume most of the  $V_2O_5$  concentrate produced by a 5Mtpa mining and processing operation. In this event, the negligible excess  $V_2O_5$  concentrate could be sold as such or stockpiled for processing in the FeV plant during those periods when the schedule indicates lower  $V_2O_5$  concentrate production.

Snowden stress that the contemplated schedule and throughput is indicative and speculative only, being based on an Inferred Resource and preliminary metallurgical studies.

#### Process Recoveries

METS assume a ferrovanadium recovery of 93.6% for the  $V_2O_5$  concentrate feed to the electric arc furnace<sup>2</sup>. This implies an overall FeV process recovery of 82.3% in relation to the Inferred Resource.

Snowden has incorporated this recovery into the preliminary Technical Cashflow Models<sup>4,5</sup> for the FeV option to calculate an effective FeV grade-equivalent for the Inferred Resource. This grade-equivalent has been applied to the bench schedule assumptions incorporated in the Technical Cashflow Models and not to the Inferred Resource block model itself. At this stage of the investigation, Snowden considers that application of a FeV grade-equivalent to the block model is unwarranted and overly speculative.

#### Process operating costs

Process operating costs for the ferrovanadium conversion process have been advised by METS (refer **Error! Reference source not found.**) and incorporated into the Technical Cashflow Models.

METS advise that a  $\pm 35\%$  level of accuracy applies to the operating cost estimates for the FeV option.

METS estimate the operating cost for the FeV processing at \$5.36 per tonne of  $V_2O_5$  concentrate fed to the FeV plant. This cost is additional to the operating cost related to production of the  $V_2O_5$  concentrate at the Mt. Peake operation.

## 3.2 Financial aspects

The following factors were applied to both the optimisations and the technical cashflow model.

### Product prices

Snowden does not advise on metal prices and has relied on advice from METS and TNG for projected product pricing (Table 3.1).

Snowden notes that no modification has been made for the nature of any concentrate and that the  $Fe_2O_3$  price incorporates a factor for sale of at least part of the product as pigment.

Snowden cautions that future prices for FeV are conjectural, from publicly available sources and do not contemplate price elasticity for this commodity.

**Table 3.1 Summary projected product prices**

Product	Units	Value
$V_2O_5$	\$USD/lb	8.00
$Fe_2O_3$	\$USD/mt	200.00
$TiO_2$	\$USD/mt	155.60
FeV	\$USD/mt	50,000.00

### Royalty

No definitive Northern Territory Government royalty has been agreed upon for this exercise and TNG has agreed that a royalty allowance of 2.5%/t plant feed be applied to all exercises.

### Exchange rate

TNG has agreed to the use of an exchange rate of 0.85US\$ = 1\$AUD.

### Discount rate

TNG has agreed to the use of a discount rate of 10%.



## 4 Technical cashflow model

Snowden has prepared two preliminary Technical Cashflow Models to examine the effect of FeV production on the overall project:

- i. the first model examines the production of FeV in the context of the operation as a whole<sup>7</sup> and incorporates preliminary forecast production, recoveries and operating costs relating to V<sub>2</sub>O<sub>5</sub>, FeV, TiO<sub>2</sub> and iron oxide.
- ii. the second model<sup>8</sup> examines the production, recoveries and operating costs relating to production of FeV as a sole product.

The difference between the two models provides an indicative measure of the overall value of FeV production.

Neither model accounts for cost or source of capital, hedging, tax and depreciation. Similarly, no provision has been made for salvage or mine closure costs. This is consistent with a Scoping Study level of accuracy. The models return a raw NPV and IRR based on a 10% discount rate and has been optimised for these factors.

### 4.1 Preliminary capital estimate

For both Technical Cashflow Models, Snowden has taken the preliminary capital estimates for the Mt. Peake operation from the February Scoping Study and added METS capital estimates for the FeV processing plant (Table 4.1).

METS have advised that a  $\pm 35\%$  order of accuracy applies to the Capex estimate.

**Table 4.1 FeV plant capacity capital cost estimate**<sup>Error! Bookmark not defined.</sup>

Area	A\$ Million
<b>Direct cost</b>	
Ferrovandium plant	28.8
<b>Direct cost sub-total</b>	<b>28.8</b>
<b>Indirect cost</b>	
Field indirects	3.5
EPCM	4.3
Vendor reps	0.2
Capital spares	0.7
Commissioning spares	0.2
Insurance	0.4
<b>Indirect cost sub-total</b>	<b>9.3</b>
<b>Total cost</b>	
Contingency	5.7
<b>Grand total</b>	<b>43.8</b>

### 4.2 Preliminary technical cashflow model results

At a 10% discount rate, the preliminary technical cashflow model indicates an internal rate of return (IRR) of 43.9%, for an NPV of \$1584.5 M (refer Table 4.2).

Of this NPV, \$1584.3M is contributed by FeV production and sales.

<sup>7</sup> JEF<sub>FeV</sub>\_Model090311.xls

<sup>8</sup> 110322\_JE\_FeV\_model.xls

The indicative mine life associated with this scenario is around 24 years from commencement of development.

**Table 4.2 Preliminary technical cashflow model results**

Measure	Units	Value
Discount rate	%	10
IRR	%	43.9
NPV	AUD\$ M	1,584.5
CASH	AUD\$ M	5,344.3
<b>FeV Contribution</b>		
NPV	AUD\$ M	1,261.1
CASH	AUD\$ M	3,423.5
Conceptual operation life	Years	23.63

## 5 Project risks

Snowden comments on the following risks associated with a Scoping Study level mining inventory and technical cashflow model:

- The parameters used to assess the Mt. Peake FeV project viability have been based on limited data.
- The economic evaluation is preliminary and based on an Inferred Mineral Resource and preliminary economic assumptions.
- Metallurgical assumptions relating to FeV production is at a conceptual level.
- The metallurgical capital and operating costs are preliminary and there is a high risk that these will change. If these costs increase significantly, this may present a risk to the project economics.
- The project has the potential to supply a significant proportion of current world ferrovanadium requirements, affecting FeV price elasticity.
- Approvals, leases and required licences may be slow to acquire and transport of the product may be subject to stringent environmental restrictions.
- Snowden understands the price of ferrovanadium is susceptible to market fluctuations and considers that the project operating cashflow is very susceptible to the prevailing ferrovanadium price in this study.

## 6 Conclusions and recommendations

### 6.1 Conclusions

Snowden has used the results of the February Mt. Peake Scoping Study to conduct Scoping Study-level to construct a Technical Cashflow Model for the production of ferrovanadium. This exercise contemplates the annual production of 4,703t of FeV from Mt. Peake V<sub>2</sub>O<sub>5</sub> concentrate at an arc-furnace reduction plant, conceptually constructed in Darwin. Process recoveries, operating and capital costs have been estimated by TNG's metallurgical consultants, METS.

Product prices have been advised by METS and TNG Limited.

#### Capital and operating costs

METS has estimated capital cost and operating costs for a FeV plant at \$43.8 M and \$5.63/t concentrate feed, respectively.

#### Technical cashflow model

The preliminary technical cashflow model is rudimentary and does not take into account cost or source of capital, hedging, tax, depreciation, rehabilitation and salvage. The project produces an indicative NPV of AUD\$1,584.5 M and an indicative IRR of 43.9%.

**Table 6.1 Preliminary technical cashflow model summary**

Measure	Units	Value
IRR	%	43.9
NPV	\$ M	1,584.5

### 6.2 Recommendations

- Snowden recommends that TNG Limited seeks specialist advice on projected ferrovanadium price and demand.
- Further process recovery research and confirmation of process flows should be undertaken to improve the level of accuracy from a Scoping Study level.
- The process capital and operating cost needs to be further developed.
- The financial analysis will need to be developed to consider royalty, tax and depreciation. Indicative royalties should be sourced from the Northern Territory Government Treasury Department.

## 7 References

METS 2011. *J517-000-001 B-FeV processing plant* (unpubl. internal report, project 459 for TNG Limited)

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