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April 16 2012

Dear Mr Hall

QR Network's Electric Traction Services Draft Amending Access Undertaking

Please find **attached** a submission by Rio Tinto Coal Australia (RTCA) and its subsidiaries in relation to QR Network Pty Ltd's draft amending access undertaking (DAAU) which was submitted on 16 December 2011 and proposed changes to the pricing arrangements for electric traction services.

The Queensland Competition Authority extended the deadline for submissions from 10 February 2012 to March 9 and then to16 April 2012.

This letter is intended to accompany Rio Tinto Coal Australia's (RTCA) submission on the QR Network Draft Amending Access Undertaking (DAAU) proposing changes to the AT5 tariffs.

Since the extended submission date of March 9, RTCA has participated in discussions with QR Network and other coal producers and above-rail operators to further examine the issues and proposals contained in the DAAU. Through this process, QR Network has suggested a number of measures to address concerns with the DAAU raised by producers and at least one above-rail operator.

In RTCA's view however, the direction suggested by QR Network is based on the underlying premise that electric traction is superior to diesel traction for the Blackwater system (and the coal network in general), and the measures proposed are merely aimed at mitigating the short-term barriers to adopting electric traction. Of particular concern to RTCA is that the measures might include significant further investment in electrification which would be included in the asset base.

As outlined in our submission, RTCA is not convinced of the merits of electric traction over diesel traction and in fact believes diesel traction is likely to provide a superior long-term solution for the coal chain. QR Network's DAAU contained a number of conclusions regarding the superiority of electric traction based on QR Network analysis, but despite several attempts QR Network has been unwilling to share this analysis is sufficient detail to allow RTCA to compare with its own analysis.

Given the lack of resolution around the fundamental merits of the different traction solutions, RTCA believes that caution dictates that no change be made to the Access Undertaking until the traction issue can be resolved. RTCA intends to propose to QR Network that any further discussions at the working group level focus on addressing the traction issue rather than implementation of electric traction per se, but considers that this process is likely to require a significant effort and duration by all parties, and that any short-term solution is unlikely.

Accordingly, RTCA submits and requests that the QCA move as quickly as possible to adjudicate on the DAAU in its current form based on submissions received, without expectation of potential QR Network/industry agreement on changes to the DAAU.

Confidential parts of the submission are highlighted in yellow. We ask that these sections be redacted prior to publication by the QCA.

If you require any further information please contact Xiao Fan Zhuang on 07 3625 5197 or myself on 07 3625 5533.

[redacted]

Timothy Renwick
General Manager Infrastructure
Rio Tinto Coal Australia

16 April 2012

Submission by Rio Tinto Coal Australia to the Queensland Competition Authority: Electric traction services

1 Outline of submission

This submission is given by Rio Tinto Coal Australia (**RTCA**) and its subsidiaries in relation to QR Network Pty Ltd's (**QRN**) draft amending access undertaking (**DAAU**) submitted on 16 December 2011 in relation to electric traction services.

RTCA submits that the Queensland Competition Authority (**QCA**) should reject the DAAU in its entirety.

RTCA further submits:

(a) QRN alleges that electric trains are more efficient than diesel trains. The analysis undertaken by QRN is overly-simplistic. QRN's analysis fails to have regard to the following:

  (1) It should be noted that electric trains suffer from limitations on the number of electric trains in a section. In addition, electrification of the network is capital intensive. To meet the demands of a congested system more and more feeder stations are required. This is not in the interests of the coal system.

  (2) Real efficiency in the use of the network will be achieved by technological enhancements which are not tied to whether a train is electric or diesel. For example, shortening of headways will be achieved through trains with ECP braking. Further efficiencies will be achieved by the introduction of in-cab signalling in lieu of fixed signalling.

  (3) When accounting for the consumption of coal at the point of generation, energy consumption by modern diesel trains is more efficient than energy consumed by electric trains.

  (4) Moving Blackwater to a largely electric system will act as a barrier to entry to 'second' tier haulage operators who typically use re-engineered diesel trains.

  (5) We note that all other major commodity export rail networks in Australia (that is, the Hunter Valley and the Pilbara) are diesel systems and their headways are substantially shorter (8~16 minutes in different sections of the track in the Hunter Valley against 30 minutes in Blackwater).

(b) Producers and rail haulage operators in the Blackwater system have made long term commitments to train types in their haulage agreements based on the current pricing framework. There should not be any change to the AT5 charging framework.

(c) There is no regulatory precedent (or justification) for a fundamental change to the pricing framework part way through a regulatory period. Nor is there regulatory precedent (or justification) for:

  (1) subsidisation of electric infrastructure; or

  (2) combining the AT5 for Goonyella and Blackwater.

(d) It is not appropriate that the rail infrastructure provider seek to direct (through its pricing arrangements) the types of trains miners should employ. Miners should select their train type voluntarily and the network designed around that selection.

(e) The suggestion that an amendment to AT5 is necessary to provide guidance to WICET users is false. A number of WICET users have already committed to their haulage agreements. All WICET producers who have announced their entry into a haulage agreement have committed to diesel trains. We understand the WICET stage 1 producers have elected not to electrify the WICET balloon loop. It is therefore difficult to see how WICET users could do anything but contract diesel trains.

(f) If it were the case that electric traction was more efficient than diesel, it would not be necessary to change AT5 as proposed by QRN.

2 Background

QRN is currently undertaking a large capital investment program on the Blackwater system (please refer to the QRN flyer attached as attachment 1). Given that this capital investment is occurring in an environment of reducing demand for electric traction, the electric charges on the Blackwater system are anticipated to increase significantly.

In support of its 2009 Draft Amending Access Undertaking, QRN argued that the increase in the Blackwater AT5 tariff was inequitable and the pricing structure for electric infrastructure was inefficient. To remove the 'free rider' benefit for the Goonyella system, QRN therefore proposed combining the asset bases for the two systems and calculating a single tariff (AT5 tariff) to apply to both systems.

The QCA found it difficult to accept QRN's arguments that the changes in the Blackwater and Goonyella AT5 tariffs were so significant they could result in the stranding of new investments in the Blackwater system's electric infrastructure. QRN had separately argued that investments in electric locomotives in the Blackwater electric infrastructure were the most efficient option. Therefore, in its 2009 draft decision, the QCA concluded that as QRN had not made a convincing argument in support of a single Blackwater and Goonyella system AT5 tariff, it would reject QRN's proposal.

In response to the QCA's 2009 draft decision, QRN stated that not combining the Goonyella and Blackwater electric infrastructure tariffs would negatively impact upon network performance and efficiency in both the short and longer term.

Further, QRN argued that the single price across both systems was more appropriate because it did not: make electric consists unviable in Goonyella; threaten long-term electric investment in either system; or endanger the long-term goal of efficiency in the Blackwater system and future expansion of the Goonyella system's electric infrastructure.

In the 2010 DAAU, QRN accepted the QCA's decision stating that it would revisit the issue in the next undertaking period.

In response, the QCA reiterated its comments in the 2009 draft decision that it seems incongruous that the purchase of electric locomotives and the expansion of the electric infrastructure could be viewed as the most efficient option yet the subsequent prices be seen as threatening the viability of electric train operations.

In the 2010 draft decision (released in June 2010), the QCA accepted as reasonable QRN's decision not to amalgamate the electric infrastructure tariffs.

On 16 December 2011, QRN submitted the DAAU to the QCA for approval.

QRN propose to amend the pricing arrangements for electric traction services in the approved 2010 access undertaking, in particular to:

(a) introduce a single network AT5 charge, combining the total costs and total forecast demand of the Blackwater and Goonyella electric networks;

(b) introduce a requirement that operators pay AT5 for at least 90% of train services that could feasibly be operated with electric trains, including services actually operated with diesel trains; and

(c) limit the revenue adjustments in a single year to be no more than 5% per annum to recoup any substantial under-recoveries of the AT5 revenue cap.

Under section 142 of the *Queensland Competition Authority Act 1997* (**QCA Act**), the QCA must consider QRN's DAAU and either approve, or refuse to approve, it.

On 21 December 2011, the QCA issued QRN with a notice of investigation, under section 146 of the QCA Act, indicating its intention to undertake an investigation into the DAAU.

The QCA has extended the deadline for submissions from interested stakeholders in response to QRN's draft amendment to 16 April 2012.

3 Rio Tinto Coal Australia and its Blackwater and Goonyella operations

RTCA is a wholly owned subsidiary of Rio Tinto Limited.

In Queensland, RTCA's operations include:

(a) Hail Creek – a 8 mtpa coking coal operation;

(b) Blair Athol / Clermont – a total of 12 mtpa mine which produces thermal coal; and

(c) Kestrel – a 5.2mtpa coking and thermal coal operation.

RTCA is a user of both the Goonyella and Blackwater systems. RTCA coal is exported through the Dalrymple Bay Coal Terminal (**DBCT**) and the Port of Gladstone (**GPC**). Coal destined for DBCT is hauled on the Goonyella system mainly using electric consists, while coal hauled to GPC is hauled using diesel consists along the Blackwater system. Table 1 below summarises the RTCA's usage of the two systems. It outlines the source mines, their respective tonnage, and distances from mine to port on each system.

[redacted]

Based on the rail operation outlined in Table 1, RCTA expects that QRN's proposed changes to the AT5 tariff will have a significant financial impact for RTCA. These impacts have been indicatively quantified in section 4.

4 Financial Impact

4.1 Overview

[redacted]

4.2 Financial impact in the current determination period

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

4.3 Long term financial impact

The Access Undertaking provides visibility of the AT5 tariff until its expiry in financial year 2012-13, however RTCA's coal assets in Central Queensland have remaining lives well in excess of this expiry. It is therefore important for RTCA to be able to assess the implications of the proposed amendments on its long term cost of hauling coal.

QRN's DAAU indicates that as part of supporting the growth in tonnage to be hauled across Goonyella and Blackwater over the coming three decades, there would be significant capital expenditure on both electric and non-electric assets. As part of forming this submission, RTCA requested that QRN provide details of the assumed forecast tonnage profile, capital expenditure, operations and maintenance expenses under their three scenarios. This information would assist RTCA in estimating the potential impact of the revised tariff structure on the long term AT5 tariff.

QRN has responded that they are unable to provide this information as it is commercially sensitive. This prevents RTCA from arriving at a fully informed conclusion as to the impact this restructure might have on its long term haulage costs.

However, it can be reasonably concluded that with additional expenditure on electric infrastructure the AT5 tariff will grow over time and not necessarily in proportion with the increased tonnage travelling across the network. As such, RTCA is potentially exposed to a higher long term increase in its coal haulage costs for infrastructure from which it does not currently utilise and may not ever utilise.

5 Assumptions made by QRN are in error

QRN's submission contends that electric trains are more efficient than diesel trains. RTCA does not believe that to be the case. QRN's submissions simply identify a narrow set of arguments in support of the case that electric trains are more efficient. Those arguments are presented in isolation and do not consider the impact of the whole of the coal chain.

RTCA submits that, when the whole coal chain is considered, including energy sources, flexibility and future innovation, electric trains are not more efficient than diesel trains.

RTCA points to the fact that major commodity export networks around Australia are not electrified (see for example the Hunter Valley and the Pilbara). RTCA contends that were the Goonyella and Blackwater system greenfield projects, electrification would not be considered today.

QRN argues that electric trains have 1.8 hr cycle time advantage over diesel trains. The 1.8 hr differential consists of 1.3 hr (73%) provisioning time and 0.5 hr (27%) "main line section run time" and "other delays". QRN says that the cycle time savings will eventually translate into:

(a) Above rail savings because less trains are required; and

(b) Below rail savings because less tracks are required.

This argument is flawed due to the following reasons:

1.3 hr provisioning time differential

a) Diesel locomotive provisioning activities are currently undertaken off the main line - this has no influence over below rail track capacity. Therefore diesel trains will not require more track investments.

b) Diesel trains do require private provisioning facilities. However the costs of this are dwarfed by substantially higher capital investments in feeder stations and associated equipment required to support electric trains.

c) On a nominal 100mtpa network – a 100% electric train network would require 33 trains and a 100% diesel train network 35 based on the 1.3 hr differential. That is a difference of only 2 trains – the scale of capex is again dwarfed by the capital required by electric trains. In addition, fleet size efficiency is an above rail economic commercial consideration, rather than a below rail consideration.

0.5 hr differential due to "section run time" and "other delays"

QRN ignores other key aspects of efficiency: headways and flexibility.

a) Headway is a crucial component of track capacity and a source of low-cost capacity increases:

(1) Electric traction complicates any reduction in headways because of the additional electrical infrastructure required (the number of electric trains under load in each electrical section) – 30 min headways in Blackwater system.

(2) This limits the potential for low-cost capacity improvements and reduces incentives for investment in flexible signalling systems to reduce headway (such as in-cab signalling).

(3) By contrast, diesel traction can achieve low headways without significant infrastructure investment (e.g. 8-16 min in Hunter Valley with a future target of 4 min).

b) Diesel trains are more flexible: diesel trains are immune to traction power outages, and are flexible in that they can be used across any systems, offering flexibility and choice to producers.

RTCA has considered recent business cases for medium and long coal system hauls. The recently publicised Hancock / GVK coal haul only contemplated diesel locomotives.

As a general trend, new mine developments are occurring further from the main line(s) and they require longer single-user spur lines. Electrification of the longer and single user spur lines will be capital intensive and is unlikely to be economic.

In addition, QRN in its DAAU pointed out that if ‘Diesel Penetration’ is greater than 20%, there will be no cycle time benefits. Thus any purported cycle time advantage of electric traction may never be realised when more and more producers choose to utilise diesel trains.

Further technical analysis of the efficiency of electric and diesel trains is set out in Attachment 2.

6 QRN’s rationale supporting its amendments are flawed

Putting aside RTCA’s concerns about whether QRN can or should be proposing the amendments now and whether therefore the QCA should even consider them on their merits, RTCA has a number of concerns relating to QRN’s rationale supporting its amendments.

These concerns are:

a) It is not obvious to RTCA that QRN’s views in respect of the “Total Cost of Ownership” (i.e. the cost of providing below and above rail services) are particularly relevant.

b) QRN’s analysis is based on the total cost of service provision including sunk costs. This is not the appropriate perspective to bring to analysing the incremental costs associated with the three alternative modes of traction: all electric, all diesel or some combination thereof. Therefore, it cannot provide a basis on which to form a view about the relative costs and efficiencies of these three scenarios. In addition, despite RTCA’s information request, QRN has not provided the information of incremental costs necessary to undertake the correct analysis.

7 Regulatory certainty

7.1 The importance of regulatory certainty generally and why there should not be a fundamental change to the AT5 charge

Certainty of pricing arrangements is crucial to all participants in the coal chain.

Certainty in relation to the AT5 charge is no different. Certainty in relation to the AT5 charge:

a) Is of great importance to miners in their selection of rail haulage operators and the terms of their haulage agreements. (For example, whether the haulage agreement mandates the use of electric or diesel trains).

b) Is of great importance to haulage operators in making their fleet investment decisions. In this regard, the decision to purchase electric or diesel trains is not as simple as considering the lead times to purchase an electric or diesel locomotive. It involves decisions about crewing and maintenance which impact significantly on the time to effect a change.

Certainty is important because a decision of a miner to commit to a haulage agreement and a decision of a haulage operator to commit to invest in a fleet are long term decisions. RTCA's circumstances in this regard are highlighted below at section 5.2.

Haulage agreements are typically for terms of no less than 10 years and frequently for terms of 15 to 20 years. The decision to invest in a fleet of trains is similarly a significant investment. Each of these decisions are taken on the basis of a set of assumptions. One of the key assumptions is the AT5 charge.

The importance of providing certainty over pricing arrangements is reflected in the regulatory arrangements relating to the below rail services QRN provides. More specifically, that:

c) those services are regulated;

d) the regulation is executed through periodic reviews of the relevant access undertaking which then have a defined life; and

e) there are pricing principles (section 168A QCA Act) in place to guide the development of prices which are designed to be applied when periodic review occurs.

In contrast, the value of pricing certainty does not appear to be reflected in QRN's decision to submit its DAAU, nor is it reflected in its analysis that purports to demonstrate the merits of the QCA accepting it. More specifically, QRN's proposal appears to assume there are no costs associated with its proposal other than a need to phase in the necessary price adjustments. In practice, the submission and the changes it proposes can only create uncertainty for those proposing to make fleet investment decisions or enter into haulage agreements. That uncertainty has a real cost but it is not reflected in QRN's analysis.

RTCA submits:

f) It is not appropriate for QRN to seek to fundamentally change the AT5 charge part way through an access undertaking term. For that reason alone, the QCA should reject the DAAU.

g) RTCA, other miners and Pacific National have made long term contractual commitments on the basis of the current AT5 framework. RTCA, other miners and Pacific National will be significantly financially disadvantaged by a fundamental change to the AT5 charge. Fundamental changes to the pricing framework should be avoided and there is no justification for a change. The QCA should reject the DAAU.

h) There is no justification for the subsidisation of electric infrastructure costs or for the combining of the AT5 across Goonyella and Blackwater.

7.2 An example of how a change to the AT5 charge would be prejudicial

In 2009 RTCA, together with another mining company, successfully introduced Pacific National (**PN**) to the above rail haulage market in Queensland. The long term contractual arrangement involves dedicated diesel trains servicing Kestrel to the port of Gladstone.

The investment decision in diesel locomotives was made in 2007 based on economics of different train types and QRN's confirmation that the electrical system in Blackwater could not support AC electric traction (Siemens locomotives that PN were evaluating for the haulage) and that the necessary work to support AC traction would not be completed in time for the project start up in 2009 when RTCA's then current haulage contract expired.

The above demonstrates that RTCA made a long term commitment on the basis of:

a) Advice from QRN that it could not support AC electric traction; and

b) Based on the formulation of the AT5 charge at the time.

Changing the AT5 charge now would result in RTCA being unfairly prejudiced.

7.3 No regulatory precedent for amendment part way through a regulatory period

There is no regulatory precedent for a fundamental change to the pricing framework part way through a regulatory period.

There are two key objectives of having a defined regulatory period. The first is to provide prospective certainty in respect of the terms including the price and conditions of access to all parties. The second is to ensure the service provider has a strong financial incentive to improve its performance which can then be shared with customers in subsequent periods.

As a result, regulatory regimes typically limit the circumstances in which access undertakings can be re-opened. The circumstances usually go to instances where the original terms and conditions were set on false or misleading information, or circumstances have changed so dramatically that the existing terms and conditions are either unenforceable or would have materially adverse consequences for the ongoing provision of the relevant service in the remainder of the regulatory period.

Any other changes to the terms and conditions of access would only be contemplated where they have the consent of all relevant stakeholders; in this case, the access provider, haulage operators and those seeking haulage services. In most cases, such changes are of a minor nature and are in the interests of all stakeholders as they would typically remove distortions created by the terms and conditions that were unforseen at the time the undertaking was agreed.

RTCA notes that the QCA Act states that:

a) QRN may provide the QCA with a voluntary draft access undertaking amending the approved access undertaking (section 142(1)).

b) The QCA must consider the draft amendment and either approve or refuse to approve the amendment (section 142(2)).

c) The QCA may approve the amendment only if it considers it appropriate to do so having regard to the same matters it considered when approving the original draft access undertaking as outlined in section138(2) (section 143(3)).

d) The QCA may approve a draft access undertaking only if it considers it appropriate to do so having regard to the objects clause which promotes effective competition in upstream and downstream markets; the pricing principles outlined in section 168A and the rights of the users.

RTCA notes that the proposals made by QRN fulfil none of the conditions usually relevant to considering amendments. It has not argued that the changes are necessary to ensure ongoing service provision. It is also notable that QRN did not engage in meaningful pre-submission consultation. Instead, it is seeking to have them enforced through the regulator.

Making the changes proposed by QRN would undermine the purpose of having a regulatory period and would create a precedent that similar changes could be made to all of QRN’s prices. This again has costs in respect of investment uncertainty, which QRN’s proposal fails to acknowledge.

7.4 The use of price signals to force particular investment decisions does not have regulatory precedent

QRN's main submission in support of its amendment is that there needs to be a change in the charging framework to encourage the use of electric trains. The use of price signals to effectively force parties to invest in a particular way does not have regulatory precedent.

As is noted in QRN's submission, the use of electric trains in the Blackwater system has steadily declined over time. QRN were aware of the declining utilisation of electric trains in Blackwater in 2006. To encourage utilisation of electric trains in 2006 QRN lowered the AT5 charge in the hope that it would encourage higher utilisation of electric trains.

Despite artificially reducing the AT5 charge, the use of electric trains in Blackwater has continued to fall. In RTCA's submission, it considers that:

a) having tried to unsuccessfully encourage higher utilisation of electric trains through a lower AT5 charge, the market has made its choice and users predominantly prefer diesel trains (and have committed to contracts on that basis); and

b) it would be inappropriate to change AT5 so as to force parties to subsidise the electric assets.

In 2006 in its submissions in relation to UT2 QRN noted that if it was unsuccessful in encouraging higher utilisation of electric trains in Blackwater, the appropriate outcome would be optimisation of some of the assets:

> *"It is QR's expectation that the use of electric consists in Blackwater will increase in subsequent regulatory periods.*
>
> *Given current market factors are contributing to the lower than expected utilisation of electric assets in Blackwater, QR has decided to adopt a long term perspective in resolving industry concerns with respect to Blackwater's AT5 tariff. Specifically, in the 9 June 2006 Version, QR has sculpted the depreciation profile of Blackwater's electric assets in response to the expected utilisation of the assets over the life of the assets whilst still enabling QR to recover the legitimate commercial costs of its electrification assets.*
>
> *This means QR has reduced the depreciation charged on the assets during the period of low utilisation in the 2005 regulatory period, with the expectation that as utilisation subsequently increases (in future regulatory periods), the depreciation profile will be accordingly accelerated. The main impact of this approach is to smooth the price of Blackwater's electric assets between regulatory periods.*
>
> *QR's proposal to sculpt the depreciation schedule has been specifically developed in response to industry concerns regarding the increase in the AT5 tariff over the 2005 regulatory period. QR is aware that this proposal may affect its future ability to fully recover the legitimate commercial costs of its electrification assets over the life of the assets. Such an outcome might occur if QR's expected future increase in the utilisation of Blackwater electric assets is not forthcoming in subsequently regulatory periods. Under this scenario, I acknowledge that the Blackwater's electric assets could meet the criteria in Paragraph 1.4(b) of Schedule FB, thus leading to the QCA potentially requiring a reduction in the value of the assets in the Regulatory Asset Base."*

RTCA notes that:

c) in 2006 QRN were well aware of the decline in utilisation of electric trains in Blackwater; and

d) despite the knowledge of the declining use of electric trains after 2006 QRN have continued to invest substantial sums of money in electric assets (please refer as a example to attachment 1).

RTCA submits that the risks which QRN undertook when investing in electric assets should be borne solely by QRN and not passed on to users though a substantial change in the AT5 charge.

RTCA notes that some electric infrastructure has been 'approved' by users of the Blackwater system through the CRIMP process. In this regard, RTCA comments:

e) The 'approval' is passive in that the relevant CRIMP votes were deemed approved by parties not voting against the items;

f) QRN provides limited information in the CRIMP documentation. The CRIMP documentation does not deal with threshold questions such as the demand for electric traction;

g) In reviewing CRIMP documents, users can not be expected to check the suitability of infrastructure enhancements against current demands. That is clearly QRN's role;

h) Any 'approval' through the CRIMP process does not affect the risk which QRN carries for redundant infrastructure.

Furthermore, the 2007 CRIMP document expressly acknowledged that demand for electric infrastructure was not certain and would be the subject of further consideration by QRN. In section 7.3.3 of the 2007 CRIMP document (a section titled "Commercial Dilemma") QRN stated:

> "***7.3.3 Commercial Dilemma***
>
> *The electrification decision is contingent upon the resolution of the following commercial dilemmas:*
>
> *1. QR Network Access should not further electrify the network if it cannot be sure that the operator(s) will use electric traction thereon*
>
> *2. The operators should not only buy electric if they cannot be sure that the coal network will be fully electrified*
>
> .."

The CRIMP document as quoted above, and QRN's submission to the QCA in 2006 (also quoted above) expressly acknowledge that the demand for electrification was highly uncertain. It is now fact that the demand did not exist. The resulting risk for any over investment should be borne solely by QRN and not by access holders.

The quote above also demonstrates that the CRIMP was by no means a form of mandate from users for investment in electric infrastructure.

8 Inappropriate use of regulation in light of ambiguity about traction efficiency

a) QRN's role is to provide the below rail services the market demands and to charge, as far as practical, an efficient price for the use of that service. Haulage operators and access seekers will then decide what below rail services they want. In other words, competition between the modes of traction will determine the most efficient outcome overtime and guide investment decisions in the below rail service. It is not the role of the provider to below rail services to "decide" what the most efficient outcome is and to have this imposed on the market.

b) The above is reflected in the QCA Act. The infrastructure to which the Act refers (and which QRN rely on to justify its total cost analysis) is regulated infrastructure (i.e. the below rail infrastructure). It is not the below and above rail infrastructure as QRN implies. This is evident from the fact that the Act is directed toward regulating below rail services with the effect of promoting upstream and downstream competition.

c) Certainly, QRN's views on the possible future outlook of the relative efficiencies of the modes of traction would be a relevant input into the considerations of haulage operators and seekers. Moreover, to the extent that there are material externalities caused by operating both modes of traction that are not reflected in prices, then to the extent that they can be, they should be. To the extent that this is not practical, then QRN should certainly make all parties aware of the longer term implications for below rail investment and prices, so that again haulage operators and seekers can factor that into their investment decisions.

d) QRN outlines what those externalities might be but QRN does not make a convincing case that they are material or that they could not be incorporated into prices if they were material.

9 Why a change to the AT5 charge now is of no help to WICET stage 1 users

QRN suggest that it is necessary to amend the AT5 charge part way through the current regulatory period so as to provide guidance to WICET stage 1 users:

> "*This issue is becoming critical as operators and end users are about to make decisions about whether to invest in diesel or electric locomotives for running services to WICET*."

For the following reasons, RTCA submits that QRN's justification as described above is neither accurate nor a reasonable justification for amending the Access Undertaking:

a) RTCA understands that the WICET users do not support the electrification of the Wiggins Island balloon loop. We also understand that Wiggins Island users will make their decision to contract electric or diesel trains on the basis of the current AT5 charge in the same way as any other user who is about to commit to a new haulage agreement or replacement of an existing haulage agreement. There is no need to amend the AT5 charge.

b) Any amendment to the Access Undertaking will come too late for the Wiggins Island stage 1 users. A number of Wiggins Island users have already committed to haulage agreements. Given the lead time to lock in new train consists, it is reasonable to expect that most if not all Wiggins Island users will have committed to haulage agreements by the end of the second quarter of 2012.

10 Concern about competition in the above rail market

RTCA are concerned that if AT5 charges are substantially modified in the manner suggested by QRN, QRN (as haulage operator) will have a significant advantage over PN in the Blackwater system. RTCA are further concerned that this advantage will impact on the market for haulage operation in Blackwater.

QRN's decisions in relation to traction are an example of where simple ring fencing measures may not be effective. QRN as haulage operator will clearly benefit from the proposed change to the AT5 charge.

In addition, the proposed amendments to the AT5 charge will serve to lock out potential low cost 'second tier' haulage operators. These 'second tier' haulage operators typically use re-engineered diesel trains.

11 Reservation of right to comment on QRN's draft amendments

RTCA believe that the QCA should reject the DAAU and not accept any amendment to AT5. For this reason, this submission does not address the amendments themselves.

In the event that the QCA were inclined to accept an amendment to AT5, RTCA wish to be afforded the right to make submissions on the drafting of the amendments.

12 Conclusions

RTCA submits that the QCA should reject (without any amendment) the DAAU.

RTCA considers that fundamentally electric trains are not more efficient than diesel trains.

RTCA considers that there is no justification for amending the Access Undertaking part way through a regulatory period.

RTCA considers that the amendments proposed by QRN are flawed and should not be approved at any time.

RTCA and other members of the coal chain have made long term commitments based on the current framework. It is not QRN's place (through its access charges) to force parties to chose electric or diesel trains.

Attachment 1 – QRN statements about investment in electric infrastructure

BLACKWATER POWER SYSTEM STRENGTHENING

QR National, the world's largest export coal rail transporter from mine to port, is committed to expanding the haulage capacity of the coal supply chain.

QR National Network Services is investing $195 million in a project to increase capacity and strengthen power supply on the Blackwater rail system in the Central Queensland Coal Network.

The Blackwater Power System Strengthening project will nearly double the electric capacity on the rail system that connects mines west of Rockhampton to coal-loading ports at Gladstone. The enhancements will help boost the system's coal export capacity by approximately nine million tonnes per annum.

An extensive program of works has already been completed in recent years: the duplication of approximately 80 per cent of the track on the Blackwater system, providing our customers with greater-supply chain flexibility to meet growing export demand.

Work is well underway on the construction of four electrical feeder stations at Bluff, Wycarbah, Duaringa and Raglan – representing the largest electrical upgrade on the network since initial electrification in the 1980s.

Increasing the electrical capacity of the system will allow more new high-capacity electric trains to operate on the Blackwater network. The upgrades will see 33 all-electric locomotives in operation when the project is completed in mid 2012.

QR National Network Services is working with the TrackPower Alliance and energy provider Powerlink to deliver the projects.

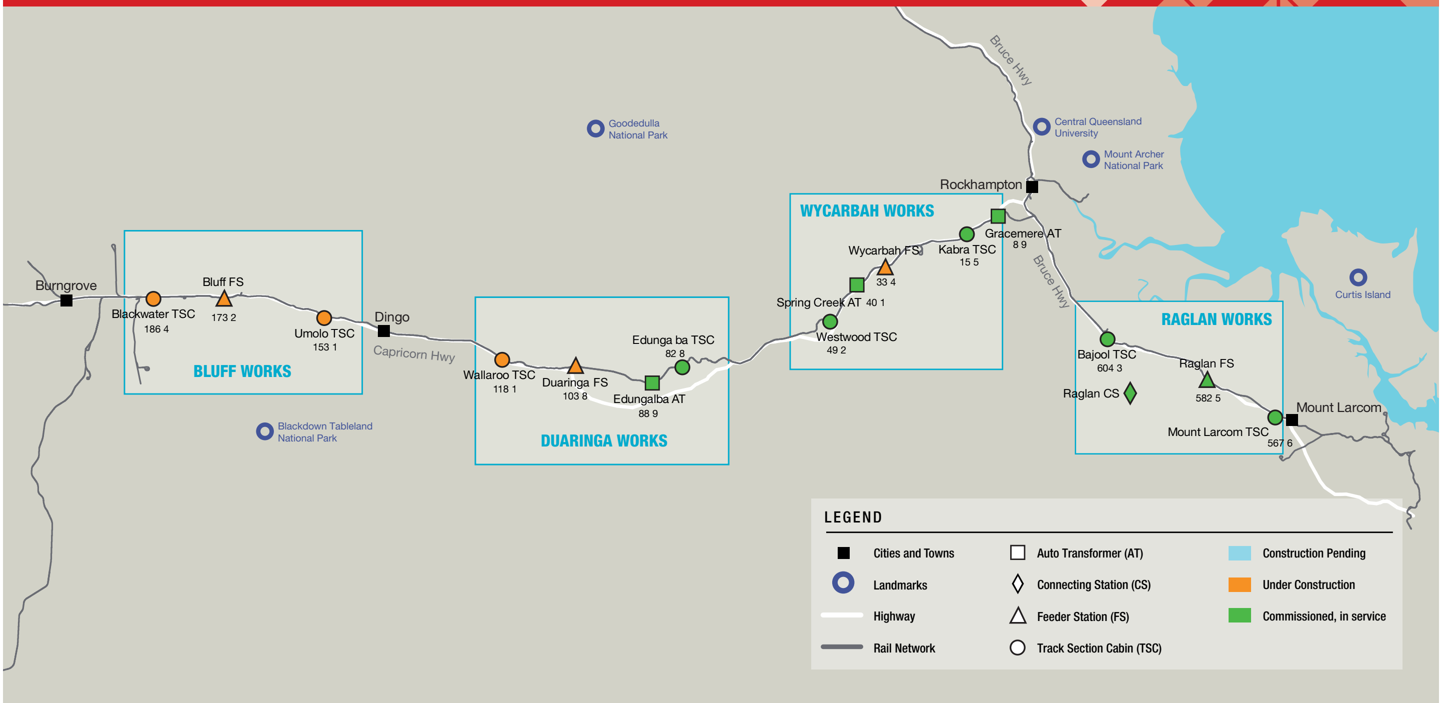
A Feeder Station is the infrastructure interface between the rail electrification and electricity authorities' high voltage power supply system to provide electrical traction power for the locomotives.

A Track Sectioning Cabin (TSC) extends the range the feeder station can provide to the electrical traction power.

QR National has a ZERO harm policy, so the safety of staff, contractors and community members is critical to all its operations, including every project undertaken as part of the Blackwater Power System Project.

QR NATIONAL

BLACKWATER POWER SYSTEM



PROJECT FACTS

Value: $195 million

Status: under construction

Completion Date: June 2012

SCOPE

- Replacing four track sectioning cabins, with new feeder stations at Wycarbah, Duaringa, Bluff and Raglan
- Installing eight new track sectioning cabins and associated new electrical equipment, between Mount Larcom and Blackwater
- Associated Powerlink transmission lines and high voltage sub stations.

BENEFITS

- Power system strengthening will support increases in electrically hauled traffic to achieve the projected 85 million tonnes of coal per year
- Increase the reliability of the existing electrical infrastructure by introducing new traction supply substations
- Improved ability to respond to electrical events such as faults and reduce the impact on the tonnage throughput.

Track Sectioning Cabin at Westwood, part of the Wycarbah works.

CONSTRUCTION TIMELINE

Oct 2011 – Jan 2012
Construction complete at Raglan

Jan – Feb 2012
Construction complete at Wycarbah and Duaringa

April 2012
Construction complete at Bluff

June 2012
All projects commissioned

For more information, please call the QR National Network Services Community Information line on 1800 033 881 or visit www.qrnational.com.au/blackwaterpowersystem

QR NATIONAL

Attachment 2 – RTCA’s technical analysis of an efficient rail network

Queensland Coal Networks Traction Efficiency (Diesel and Electric) Technical Analysis

RTCA Technical Advisor

Contents

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1 Executive summary

Rio Tinto Coal Australia (RTCA), together with independent technical assistance has undertaken a comparative efficiency analysis between electric locomotives (EL) and diesel locomotives (DEL) in the QLD coal networks. The analysis is provided in the context of a submission to the Queensland Competition Authority (QCA) in response to QR Network's Submission to QCA: Electric Access Draft Amending Access Undertaking, December 2011.

Of importance to any comparison about efficiency of one type of traction over another, is the need to take into consideration the whole of system "well to wheel" assessment, including an analysis of the source of energy, and the infrastructure and transmission/conversion losses associated with each stage of energy transfer.

EL hauled trains and DEL hauled trains offer similar efficiencies at the point of combustion (the locomotive engine, or the coal-fired power plant). However across the full "well to wheel" cycle, the DEL is 67% better.

An EL hauled service will accelerate slightly faster and hold a higher speed on long hauling grades, however DELs offer greater flexibility and ELs are constrained by overhead electric line infrastructure capacity which may limit the headways possible. Further detailed capacity and train performance modelling and comparison is necessary in order to make definitive findings in favour of one or the other.

If a system (such as Blackwater) were either 100% electric, or 100% diesel, the difference in fleet size over a theoretical 100 Mtpa operation would be in the order of 2 trains (33 electric trains are needed, vs 35 diesel trains). The capital requirements of these two trains (220 coal wagons, 9 locomotives, including spares) represents the cost of full dieselisation over electrification. This ignores the capital cost of the electrification and transmission systems from power station to locomotive pantograph.

Of importance is the issue of headways in the efficiency discussion, and the role technology plays in enabling step changes in capacity. QR Network is relying on electrification as its preferred source of traction energy, which ties step changes in capacity to expensive infrastructure installations, and limits incentive to invest in flexible future safeworking systems such as "In Cab Signalling" and "Moving Block".

The issue of electrification may present a barrier to entry to a 2nd Tier operator, who relies on lower cost locomotive technologies and non-mainstream solutions to locomotive engine use. The market for diesel locomotive technology is broad enough to be competitive, which incentivises investment in improvements and technology. Narrow gauge electric locomotives are currently supplied by one dominant producer; Siemens.

A low cost operator, seeking to provide diesel powered services to a producer with deposits across two systems, will be only able to compete in the non-electrified territory. The alternative is to pay (pass through to the producer) a premium for using the diesel locomotives in the electrified territory, potentially eliminating the low cost advantage and option for the producer who is left with the choice of the two incumbent above rail operators. The AT5 tariff proposal may have the effect of constraining above rail competition.

Finally, QR Network applies a transit time multiplier to absorb variation in the system and create cycle time recovery and certainty. The effect of the multiplier is to artificially inflate the system assumed cycle to each producer, which has the effect of inflating the required number of trains to complete the contracted tonnage haulage task. Whilst this applies to diesel and electric trains, the issue remains that there is a single facet argument in the application which ignores a whole range of other factors that if addressed offer system efficiency gains to benefit all producers.

2 Purpose

The purpose of this document is to provide technical information and advice relating to train operations and traction systems in the Queensland coal network.

This document articulates the findings of research and analysis into the relative efficiency of electric traction and diesel traction, and explains relevant rail industry terminology.

3 Introduction

The basis for a claim of traction type efficiency needs to be based on a whole of system, “wheel to well” value chain and externalities assessment that captures the peripheral issues associated with how the equipment is used. To simply argue that electric traction is more efficient based on a cycle time and energy use comparison is overly simplistic and ignores the adjacent spaces of capacity utilisation and the way the whole system interacts to deliver efficiency.

How QRN Network enables the efficient use of available pathing is as important, if not more important than influencing a specific traction choice to rail operators. It matters little if an electric locomotive is faster over the network, if the queuing associated with accessing port facilities negates the transit time advantages of electric traction over diesel.

This paper identifies some of the technical train operations elements that haven’t been considered in the QR Network Submission to the QCA for Electric Access Draft Amending Access Undertaking.

4 Industry Terminology

Some discussion is required to explain the way locomotives use energy to effect forward motion.

As a locomotive hauls a given mass and length of train over a section of track, it is affected by a range of factors working to resist motion; rolling resistance, rotational inertia, curve resistance, air resistance, to name a few. A locomotive is tasked to apply tractive effort to overcome these forces and enable motion.

4.1 Tractive Effort

Tractive effort is the physical exertion applied at the wheel rail interface to effect motion. It is the combination of vehicle mass expressed in downward force (or axle load), friction (as a co-efficient), adhesion (how the locomotive optimises wheel to rail contact) and the rotational force of the wheel to take advantage of the available friction between rail head and wheel tread.

An electric locomotive in the Goonyella and Blackwater system (assuming like for like AC traction systems) will have an advantage over a diesel locomotive due to the higher mass and available power of the electric system. In other words, the electric locomotive, due to its higher mass can use more of the power for rotational force until the wheel exhibits signs of losing adhesion. In addition, the electric locomotive is geared for a lower top speed (80KPH vs 100KPH), which further enhances the ability of the locomotive to apply torque to the interface at more effective speeds.

4.2 Adhesion

Adhesion is how the locomotive systems sense how the rotational force is being applied at the wheel/rail interface, and ensures a constant as possible maximum transfer of energy into forward movement. Adhesion is enhanced by electronics that make minute and frequent adjustments to tractive forces, and which apply traction assistance, including using sand injected at the interface to arrest slippage.

4.3 Starting Traction

Starting Tractive Effort is the maximum traction a locomotive can apply for short periods of time. The mode uses the most available power and traction possible with the adhesion available (driven by the friction co-efficient), and is used to “lift” a train from start. A locomotive load table, which articulates the minimum number of locomotives on a train for a route, is designed to ensure that a train stopped on the steepest grade, with the whole train mass on the grade, can lift from a stopped condition and reach balance speed.

4.4 Continuous Tractive Effort (Balance Speed)

Continuous tractive effort is the maximum traction a locomotive can apply for extended periods of time. The Traction system can keep the traction motors at a temperature that is sustainable so as to ensure the system doesn’t incur damage from the high energy flowing through the system. The balance speed, is the speed at which the continuous tractive effort locomotive is balanced against the resistance of the train.

4.5 Cycle Time

Cycle time is derived from the sum of the activity dwells, and transit times associated with a complete point to mine, to port and back to point “cycle”. The loading and unloading times for a DEL train, and an EL train will be the same. The variables in the comparison are the transit times, starting times and the provisioning demands. The activities required to support a DEL cycle are provisioning (fuel, sand, water, coolant), changing Train crews, and cleaning the driving cab. The activities for an Electric locomotive hauled train are similar, with the exception of the requirement to add fuel, lubricant and coolant. A diesel locomotive hauled train will nominally require an additional 60 minutes to 120 minutes for provisioning compared to an EL hauled train.

5 Analysis

The analysis seeks to determine the specific traction and efficiency related differences between electric and diesel locomotive choices. Of note, is the reliance that QR network places on the cycle time advantages of the electric hauled trains. The single facet approach to the efficiency discussion ignores a significant amount of relevant information pertaining to the economic decision a producer makes, including whether or not the available traction choices are best for whole of industry.

This section seeks to unlock and begin discussions regarding many of the issues that influence the traction choices and options an above rail operator will be faced with when analysing the best haulage equipment for the task.

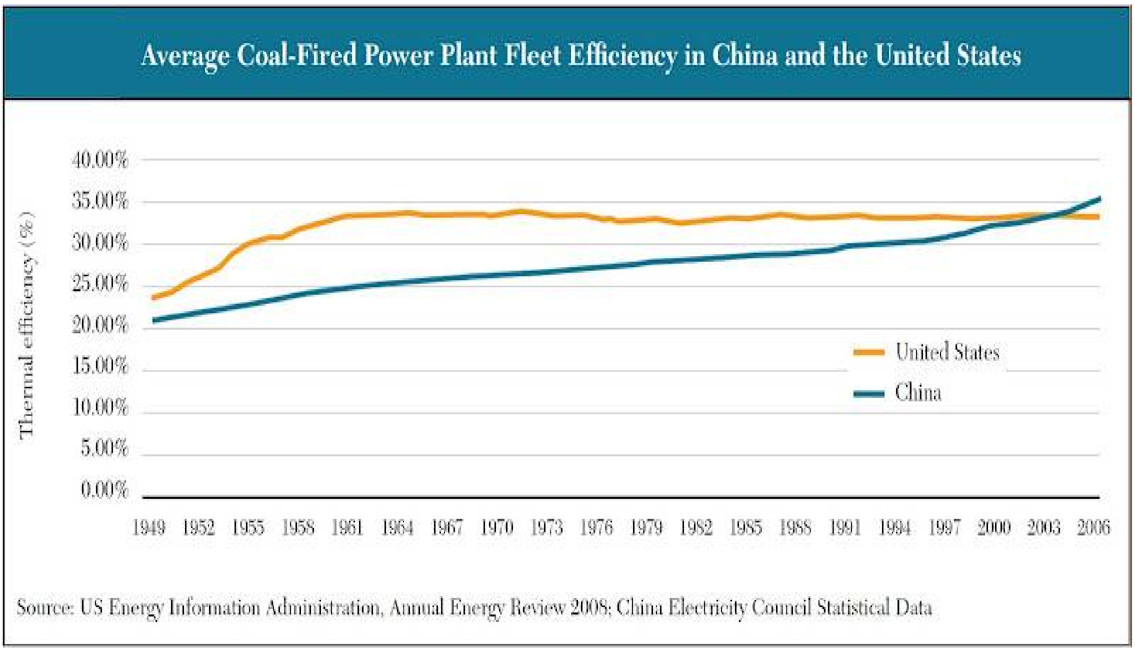
5.1 Efficiency

A train, hauled by either 4 diesel locomotives or 3 electric locomotives will use roughly the same energy to overcome the resistance to motion of the train. To obtain high speed more quickly and maintain a higher balance speed, and hence reduce transit times, the electric train will use the same energy in a different way, essentially achieving higher speeds on slower sections of the network, and accelerating at a higher rate to achieve road speed. The QR Network submission notes this and relies on the resulting cycle benefits as the underpinning argument for Electric traction over diesel traction.

(a) Thermal Efficiency

The efficiency discussion presented in QR Network's submission ignores the energy loss at the point of combustion – in the cylinder of a diesel engine (approx. 35% thermal efficiency between combustion and traction movement) and from the point of combustion of coal in a coal-fired power station to electricity (can be as low as 30% but for this discussion assume 35%). Without a whole of system "well to wheel" assessment, the discussion about efficient traction choice is incomplete.

The graph below presents the average coal-fired power plant efficiency in China and the US.



The average modern diesel locomotive, using contemporary induction systems and with computer sensed and controlled combustion processes, realises losses of approx. 52% at the point of combustion (or is 48% efficient), with ancillary systems accounting for up to a further 15%[1,2].

To assess the "well to wheel" performance of DEL and EL the table below details the transfer of 100 units of energy from the base fuels of diesel and coal. Energy is expressed as Units and each category shows the energy used.

Consumption/loss (units)	**DEL (well to wheel)**	**EL Contact wire**	**EL (well to wheel)**
Avail at Source	100	100	100

[1] http://www.internationalsteam.co.uk/trains/newsteam/modern50.htm

[2] Stodolsky, F., 2002, Railroad and Locomotive Technology Roadmap, Centre for Transportation Research, Energy Systems Division, Argonne National Laboratory, P15.

Point of energy conversion	52	N/A	65
At Contact Wire (transmission costs)	N/A	100	7
System and Conversion	5	10	2
Accessories and Peripherals	3	10	2
Loss (heat, sound, other kinetic)	5	9	3
Available to Wheels	35	71	21

For the DEL locomotive, from fuel tank to wheel the available power is 35%. Using power available to the electric locomotive, at the contact wire (100 Units), subtracting loss through use of peripherals (compressors, lighting, and other system needs), conversion and transformation loss, the residual power converted to kinetic energy is approx. 71%, which is applied at the wheels. So the DEL, on face value is roughly half as efficient as an EL.

The third column contemplates the complete “well to wheel” cycle for the EL, and paints a completely different picture. At the point of conversion of coal calorific content to energy, approximately 65% is lost between combustion and rotational force in the turbine. Making an allowance for energy loss in long distance transmission and transformation, as little as 28% of the original 100 Units is likely to be available at the contact wire. The resulting comparison finds the DEL almost 67% in front.

The last point to make in this discussion relates to how the externalities are treated. In an efficiency debate, externalities can’t be ignored, at least not to the extent that it is ignored in the QRN Network submission. Modern locomotives using modern emission control systems emit a cleaner exhaust to atmosphere than a black coal fired power station. In addition, the transmission lines and towers, with the associated land clearing and vegetation removal impacts for electrification systems can’t be ignored. The discussion in the QRN Network submission is quite narrow.

5.2 How QRN Network Addresses Cycle Efficiency

When calculating a cycle time, QRN Network applies a transit time multiplier (known as Below Trail Transit Time, BRTT) to the sum of section run times in systems, to make allowancefor variation in coal chain components. For example, a cycle time for a train to service Dalrymple Bay Coal Terminal from RTCA’s Blair Athol mine loadout, is calculated on the raw section run times, and a factor of 30% added to account for these above rail inefficiencies. The effect of this is to increase the capital allocation of trains and associated equipment to service the haul by 30%.

Because there are more trains than are needed in the system, trains dwell at locations like Coppabella and Jilalan waiting for a path or queuing for access to port unloaders. It effectively creates an artificial queue for capacity (too many trains, for the right amount of unloaders), which requires artificially high holding and queuing roads, or inefficient use of the network. There are no incentives to an operator to manage variation and improve efficiency; rather there is an artificially high capital allocation from the operator to the producer.

The cycle multiplier and resulting system inefficiency works to mitigate any performance advantages of EL over DEL. Anecdotal estimates of queuing at Coppabella east to Jilalan range in the order of 2 hours to 4 hours, suggesting there is an over-allocation of capital in the system, including locomotives. It becomes difficult to run an argument that EL trains and their higher speeds are more efficient if the trains are queuing anyway – the benefits are never realised.

5.3 Fleet Differential (Impact of DEL/EL Differential on Fleet size – cycle time impacts)

The information in the QR network submission refers to diesel v electric cycle time differentials as the basis for an operational efficiency discussion. RTCA has used a theoretical 100 Mtpa system throughput to calculate the raw fleet size required by either locomotive type. On raw cycle times (no multiplier applied), and based on the theoretical cycle used in the QRN Network submission on a nominal 100 million tonne task, the difference in cycle time dictates that a 100% DEL fleet will need 35 physical trains and a 100% EL Fleet will need 33 trains. Assuming the system will always be 80% electric locomotives due to the existing operators running a DEL fleet, the difference over the remaining 20 Mtpa is less than ½ a train.

5.4 Headways

This section discusses the issues and dynamics that affect the calculation of headways – the safe distances between trains on trunk lines, which are generally duplicated, and in some cases triplicated.

(a) Electronically Controlled Pneumatic (ECP) Braking and Headways

Headways are a function of speed, signal sighting distances (how early a driver can visually pick up a signal indication), the braking capability of the trains (how quickly a train can react to a stop signal), and a safety overlap (an overshooting distance to ensure a train cannot collide with a train in front). These distances combined, create a headway that is then applied to calculate the physical number of trains that can pass a given point each hour.

Traditionally, trains use a brake pipe signal, a reduction in air pressure, to trigger a brake application in each wagon. These are commonly referred to as pneumatically braked trains. The air signal takes time to propagate the length of the train, and trigger the brake application in each wagon. A typical loaded Goonyella train will have a stopping distance from 60 KPH of up to 1.4 KMs.

ECP braking is electronic. The driver applies the brakes and each wagon responds almost instantly. This enables an ECP train to stop up to 40% shorter than an equivalent pneumatically braked train[3].

An ECP-braked train is able to stop far more efficiently than a pneumatically braked train, which gives it a potential headway advantage. Therefore ECP braking and the effect it has on stopping distances has the potential to reduce headways and contribute to improved capacity utilisation. QRN currently does

[3] KNORR-BREMSEY, Informer, edition 20, July 2008. Port headland iron ore train, 2.5 KMS in length, 200 wagons loaded to 140 tonne net loads.

not operate trains with ECP braking, while Pacific National does (100% in Queensland).

(b) Signalling and Innovation

To reduce headways there is opportunity for improvement with changing the signalling system to firstly In-Cab signalling (where the driver always knows what his limit of authority is thus changing the sighting distance constant in the equation) then to “Moving Block”; a form of in cab signalling that looks at the back of the train in front and the safe separation distance, instead of a fixed point on the geography. With ECP braking, In-cab signalling then Moving Block, the headway constraints are limited only by the safe braking distance of the train and a safety overlap. Moving Block can apply in duplicated and single line sections of track.

(c) Electrification Neutral Sections and Headways

The electrified overhead line system is separated into sections of certain lengths for a planned density of traffic, generally accounting for the maximum number of electric locomotives that under power can draw electricity from that section. Diesel trains have no such constraint, and are able to operate to the headway limits of the signalling sections. As an example of what can be achieved, consider the Hunter Valley system, headway targets on the trunk between Muswellbrook and the port have been reduced to eight minutes[4].

Headways on the Blackwater system are currently 30 minutes governed by the overhead line capacity. The (theoretical) headway limit is currently 25 minutes governed by the signalled section between Edungalva and Tunnel[5]. This means diesel trains can achieve 25 minute headways, where an electric train followed by another electric train is restricted to 30 minutes.

To increase the traffic density of electric trains by reducing headways, additional electric feeder stations are required to split existing sections.

In a fully electric systems such as Goonyella, it is possible that electrification itself becomes a capacity constraint due to the inherent capacity of the feeder sections. Step capacity changes realisable from contemporary advances in train separation technology are irrelevant if the overhead equipment required becomes prohibitively expensive to install. QRN has assessed the electrification issue for the expansion plans in Blackwater, and make reference to the flexibility advantages of diesel over electrification given the power supply constraints. Reference is made to this in the QRN Network Working Paper 4.6 – Rationale for Electric Traction System Upgrade, 2009.

> “…Offsetting this is the greater flexibility of diesel traction, with power supply limitations not applicable.” P.11.

The Working Paper goes on to explain how the Blackwater system is limited by the number of electric hauled trains in any feeder section;

> “The major capacity design limitation is for a maximum of 2 loaded trains in any electrical section.” P.12.

The paper goes further to explain that the programmed upgrades to the Blackwater electrification will result in more capacity, however within the same limitations of two loaded trains in any feeder section. Each feeder section is shortened by installing a new feeder halfway along the section, thus allowing a doubling of the capacity. The problem with this approach is that the expansion path cost becomes exponential.

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[4] 2011-2020 Hunter Valley Corridor Capacity Strategy Consultation Document, ARTC Ltd March 2011.

[5] Derived from Blackwater System Information Pack, Issue 3.0 November 2008.

5.5 Low Cost Operators – Potential Barriers to Entry

Low cost operators entering into the market are generally considered “2nd Tier” operators. They typically use locomotives that are re-engineered, or are fitted with alternative power assemblies, such as modular engine packages, or multiple engines. Low cost operators avoid high Capex machinery, the category that Electric locomotives and existing narrow gauge locomotives fall into. Even if a low cost operator can demonstrate similar or superior cycle times and transit times to an electric locomotive (for example by using an additional locomotive), to service a producer in the electrified system the operator will pay a premium to haul in that market and lose the advantage of the low cost capital base.

The AT5 approach represents a premium to a low cost operator, which may inadvertently present a barrier to entry. Should a producer have deposits in Moura system, and deposits in an electrified system, it prevents a low cost operator from eliciting economies of scale from a homogenous fleet of locomotives and system interoperability.

6 Findings

6.1 Energy Source

Considering energy use efficiency from the reference point of combustion (coal and diesel), diesel locomotives are far more efficient (35% vs. 21%) at making energy available for traction at the wheels.

6.2 Cycle Time

Electric Locomotives have a cycle time advantage over Diesel Locomotives, the bulk of which is represented by the need to stop a diesel locomotive to refuel at specific intervals. However, because this occurs “off-network”, the transit time difference is narrowed to discussions about traction power and balance speed differentials.

6.3 Cycle Time Multiplier Effect on Efficiency

QR Network applies a transit time multiplier to absorb variation in the system and create cycle time recovery and certainty. The effect of the multiplier is to artificially inflate the system assumed cycle to each producer, which has the effect of inflating the required number of trains to complete the contracted tonnage haulage task. Whilst this applies to diesel and electric trains, the issue remains that there is a single facet argument in the application which ignores a whole range of other factors that if addressed offer system efficiency gains to benefit all producers.

6.4 Impact of Queuing

ELs have a higher tractive power and higher balance speed compared with an equivalent DEL train, which provides for a higher haul speed over ruling grades and faster acceleration. These advantages, however, are only ever realised when queuing times for port and or mine access is reduced to below the differential. In other words, unless the port queuing average dwell is reduced to less than the time lost by the lower balance speeds and acceleration of the diesel train, the advantage is never realised. Simply put; travelling to the end of the queue faster simply means more time in the queue.

6.5 Flexibility

Diesel locomotives have a flexibility advantage in that they can be used across electrified and non-electrified systems, and with recent advances in thermal efficiency and emissions control, can be considered in the “greener” alternative when other externalities for electricity generation are considered.

6.6 Limitations of Electrified Traction Systems

Electrified sections of track limit the number of electric locomotives hauling loaded trains, by virtue of the electrical system harmonics and feedback. The density of electric trains in a system is a function of the capacity of each feeder station, and expansions of system capacity rely on additional feeder stations and associated transmission infrastructure. Diesel locomotives system density is limited by the headways imposed by the signalling system

6.7 Future Innovation and Advances in Signalling Technology

As previously mentioned, diesel locomotives are limited by headways associated by the signalling system. Advances in signalling systems and the expected eventual availability of “moving block” safe working systems will result in significantly reduced and flexible headways with the elimination of fixed signals. Electric traction infrastructure will continue to limit the number of trains within an electrified feeder section. Reducing headways requires increasing the feeder sections, with the additional infrastructure costs and transmission systems.

6.8 Low Cost Operators – Barriers to Entry

“2nd Tier”, or low cost operators typically use locomotives that are re-engineered, or are fitted with alternative power assemblies, such as modular engine packages, or multiple engines. Low cost operators seek competitive advantage through sourcing low capital machinery for the task. To service a producer in the electrified system, a low cost operator will still pay an AT5 premium to haul in that market and lose the advantage of the low cost capital base – an effective elimination of the competitive advantage.

6.9 Effects of System Contingency

Arguments pointing to a technical superiority of one traction type over another to underpin a system efficiency position are only valid if the system can, or conceivably will be able to into the asset’s viable future, take advantage of the superiority. The current manner by which QRN Network allocates capacity to a haul, calculates cycle times and offers capacity to an operator undermines its own efforts to optimise and therefore utilise capacity more efficiently.

7 Conclusion

The submission by QRN Network to vary the treatment of AT5 is a comprehensive document with a narrow focus on efficiency to the extent that there are many, important considerations regarding relative efficiency between locomotive choices. The paper illuminates a range of central and peripheral factors which also contribute to the efficiency discussion.