George Passmore
Director Business Performance
Queensland Competition Authority
Level 27, 145 Ann Street
Brisbane QLD 4000

24 June 2019

Dear George,

Aurizon Network Pty Ltd (Aurizon Network) – FY2018 Capital Expenditure Submission

As part of its assessment of Aurizon Network's FY2018 Capital Expenditure Submission (**FY2018 Capex Claim**) the Queensland Competition Authority (**QCA**) engaged AECOM to assess whether the costs attributable to the FY2018 Capex Claim were prudent and efficient in accordance with clause 2 of Schedule E of Aurizon Network's 2017 Access Undertaking (**UT5**).

Aurizon Network has now reviewed AECOM's assessment thoroughly and sought to address those key issues raised by AECOM. The purpose of this submission is to provide further information to support the $2.08m of capital expenditure incurred by Aurizon Network for QCA's approval for inclusion into the Regulatory Asset Base (**RAB**).

Aurizon Network welcomes the opportunity to discuss any queries the QCA or AECOM may have and can provide access to the relevant experts to discuss any of the points in this submission.

We have provided a version of this submission for publication along with a confidential version. Please note all appendices contained herein are to be treated as confidential.

If you have any questions in relation to this correspondence, please do not hesitate to contact Jenna Cameron on 07 3019 1123 or via email Jenna.Cameron@Aurizon.com.au

Yours sincerely,

Jon Windle
Manager Regulation
Aurizon Network

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Background

Aurizon Network has a Regulatory Asset Base (**RAB**) approved by the Queensland Competition Authority (**QCA**). Aurizon Network's 2017 Access Undertaking (**UT5**) outlines the QCA process for the review and subsequent approval of any additions to the RAB. The process for this is detailed within Schedule E of UT5.

In the financial year 1 July 2017 to 30 June 2018 (**FY2018**), Aurizon Network commissioned capital projects with a value of **$212, 786, 146** including an Interest During Construction (**IDC**) amount of $1,579,729. This capital value encompasses 58 individual projects across the Central Queensland Coal Network (**CQCN**), details of which are outlined in Appendix A – Aurizon Network's FY2018 Capital Expenditure Project List.

In compliance with UT5, on 31 October 2018 Aurizon Network submitted to the **QCA** its FY2018 Capital Expenditure Submission (**FY2018 Capex Claim**) seeking approval from the QCA of the capital expenditure for subsequent inclusion into the RAB.

On 1 September 2018 the QCA engaged AECOM, an engineering consultant, to assess whether the costs within the FY2018 Capex Claim were prudent and efficient , assessing these costs against clause 2 of Schedule E of UT5. AECOM's May 2019, Assessment of Aurizon Network's Capital Expenditure Claim (**Assessment Report**), recommended that 4 projects of the 27 projects sampled and reviewed have their cost claim completely or partially rejected. AECOM recommends a total of $2.08m, pertaining to the 4 projects, not be approved by the QCA. A summary of the recommendations are outlined in Appendix B –Summary table of AECOM's FY2018 Assessment Recommendations.

In providing this response, Aurizon Network has addressed those outstanding issues relating to the $2.08m raised in the Assessment Report and in particular sought to provide clarity about the circumstances relevant at the time of making the decision to incur the capital expenditure.

Should the QCA approve the balance of $2.08m Aurizon Network will incorporate these costs within its FY2019 RAB Roll-forward Report submission, for QCA approval.

Response to AECOM Assessment Report

IV.00154 - Autotransformer Renewal Project

Figure 1. AECOM Assessment Report – IV.00154

IV.00154 - FY17 Autotransformer Renewal Project	Review Summary	**Scope**	✓	Capital Expenditure Claim	$1.4M
		Standard	✗	Impact of findings on Claim	$1.4M
		Cost	✓	**Total accepted**	**$0.0M**

Source: AECOM, FY2018 Capital Expenditure Claim, Assessment report, page 26

Existing autotransformer sites, compliance with AS2067:2016

In 2013 Aurizon Network performed a risk assessment of 'Fire, Explosion & Oil Spillage for Existing Feeder Stations' in accordance with AS2067:2008 Substations and high voltage installations exceeding 1 kV a.c. AECOM received the risk assessment as supporting documentation for project IV.00154 Autotransformer Renewal within the FY2018 Capex Claim.

In AECOM's Assessment Report it stated that Aurizon Network's:

> *"… existing autotransformer sites have not been modified to comply with the requirements of AS2067:2016, Section 6.7 – Protection Against Fire and Explosion. The risk assessment carried out in 2013 (for feeder stations) and the 2017 report for autotransformers does not adequately address, or otherwise provide adequate justification as for not addressing, the requirements of the 2016 update of AS2067 for autotransformer sites. As such, the documentation provided by Aurizon which references these documents is not sufficient justification as for not addressing fire and explosion risk at the autotransformer sites. It is recommended that the project is rejected from the FY17/18 claim in its entirety, due to the lack of justification as for not addressing fire and explosion risk at the autotransformer sites."*[1]

Furthermore, AECOM have noted AS2067:2016 Clause 6.7.2.1 (Buildings - General) states that:

> *"Protection shall be provided against fire initiated or propagated by any part or element of high voltage installations. Our interpretation of this clause is that the PSC at this site is a building and shall be protected."*[2]

Aurizon Network does not consider AECOM's interpretation of AS2067:2016 Clause 6.7.2.1 to be correct for the reasons stated below.

1. Interpretation of AS2067:2016

Aurizon Network note Clause 6.7.1.4 Fire and Explosion Risk Management of AS2067:2016 states;

> *"Transformers insulated with either less-combustible or combustible liquids should have a firewall between them for additional protection if the separation distance specified in Clauses 6.7.4 and 6.7.5 is not met or other requirements are determined for large installations in accordance with a risk management process."*[3]

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[1] AECOM, FY18 Capital Expenditure Claim, Assessment report, page 27

[2] AECOM, FY18 Capital Expenditure Claim, Assessment report, page 28

[3] Standard AS2067:2016 Substations and high voltage installations exceeding 1 kV a.c., page 80

The term *"should"* in Clause 6.7.1.4 is defined in the 'Standardisation Guide 009: Preparation of Standards for Legislative Adoption' as a;

> *"…suggestion or recommendation that is not a requirement."*[4]

Aurizon Network's interpretation of AS2067:2016 is that installation of fire-resistant barriers is one of the *recommendations* for fire prevention and fire protection for HV installations is not a *requirement* that *must* be followed in order to conform to the Standard.

The clear intent of AS2067:2016 is that infrastructure owners are to *consider* implementing the *recommendations* given in clause 6.7 with due regard for the risks and costs. Accordingly, Aurizon Network has determined that excluding fire-resistant barriers from the scope of its FY2018 autotransformer renewals project is prudent and in accordance with AS2067:2016.

As discussed in detail within the recent risk assessments undertaken by Aurizon Network has reviewed the cost of relocating the Power Supply Cubical (**PSC**) and building a fire-resistant barrier between the two autotransformers which it estimated is approximately $120,000 per site. Aurizon Network assessed the benefit of expending additional capital ($120,000 per site) to only minimally reduce the risk scores and decided to exclude fire-resistant barrier from the scope of work. Aurizon Network considers that installation of fire-resistant barriers at these sites would be imprudent expenditure given the low-level risk scores and therefore not in the best interest of its customers.

Refer to Appendix C – Autotransformer Site Renewal – Explosion & Fire Risk for the three risk assessments and Report.

2. AECOM raised the same concern during the FY2016 Capex Claim, yet the QCA approved

AECOM has previously recommended that the QCA reject expenditure related to project: IV.00028 Autotransformer Renewal Program as part of its assessment of Aurizon Network's FY2016 Capex Claim titled AECOM Engineering Assessment of Aurizon Network's Capital Expenditure Claim. Despite this recommendation, the QCA did chose not to agree, instead approving the capital expenditure be included into the RAB. The primary reasons AECOM recommended the QCA reject capital expenditure related to program IV.00028 and Aurizon Network's response to those reasons are listed below.

2.1 Oil containment

The first concern AECOM stated in its FY2016 Assessment Report was:

> *"We note that the new autotransformers contain an additional 2,900 litres of oil. There is no evidence of any design or construction works for oil containment in the event of a failure, which would result in a significant environmental event."*[5]

In response to AECOM's concern, Aurizon Network provided to the QCA its 'Explosion Risk at Autotransformer Sites Risk Assessment Report,' whereby Aurizon Network acknowledged and identified:

> *"that six (6) of the total eight (8) autotransformer sites included in IV.00028 Autotransformer Renewal Program do not have sufficient oil containment and are therefore not compliant with the Standard."*[6]

'Table 1 - FY16 and FY17 Autotransformer Sites without Oil Containment' within Aurizon Network's response (and replicated below) detailed those sites that required the retrospective installation of oil containment equipment.

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[4] Standardisation Guide 009: Preparation of Standards for Legislative Adoption, page 6

[5] AECOM, AECOM Engineering Assessment of Aurizon Network's Capital Expenditure Claim (FY16), page 36

[6] Aurizon Network's, Capital Expenditure FY16 – Response to AECOM Engineering Assessment, page 3

Table 1. FY16 and FY17 Autotransformer Sites without Oil Containment

FY16 and FY17 Autotransformer Sites without Oil Containment		
FY16 Program	Goonyella System	Winchester AT1 – OC 30.017 km
		Black Mountain-Hatfield AT Site AT1 – GA 45.225 km
		Wotonga GA 184 km AT1
	Blackwater System	Windah AT1 – CW 55 km
		Windah AT2 – CW 55 km
		Dingo AT Site – AT1 – CW 141 km
FY17 Program	Goonyella System	Praguelands AT1 – GA 15.335 km
		Praguelands AT2 – GA 15.335 km
	Blackwater System	Crew AT1 – GG 10.060 km

Source: Aurizon Networks, Capital Expenditure FY16 – Response to AECOM Engineering Assessment, page 3

In addition, Aurizon Network confirmed that:

> *"any planned autotransformer renewal works taking place from commencement of FY2018 will incorporate the oil containment equipment requirements of the Standard."*[7]

Aurizon Network agreed with AECOM that the sites listed in Table 1 did not have sufficient oil containment and that it would carry out the rectification work at these sites on a priority basis during FY19 – FY22. Aurizon Network also committed to incorporating the oil containment equipment in future autotransformer renewal works, which is evident within the FY2018 Capex Claim.

2.2 Fire protection

The second concern AECOM stated in its FY2016 Assessment Report was:

> *"There is no evidence of design and construction works to provide fire and explosion protection in the event of a single transformer failure."*[8]

In response to AECOM's concern, Aurizon Network noted it:

> *"… has reviewed the risk of explosion and fire at remote trackside Autotransformer sites and found that it has adequately addressed the requirements of the Standard. Evidence of this review has been provided to the QCA and AECOM."*[9]

Further, Aurizon Network concluded:

> *"… that the current protection schemes in place are sufficient to manage the risk of fire and explosion. It is relevant to note that the likelihood personnel being in the vicinity of a feeder station is considerably higher than at a trackside AT site. Hence, the probability of injuring people as the result of an explosion at an AT site would be even less than that at a feeder station. This reinforces the claim that the risk assessment in [1] can be aptly applied to trackside AT sites."*[10]

On 13 October 2017, the QCA issued a decision to approve Aurizon Network's FY2016 Capex Claim. The QCA acknowledged that Aurizon Network did not agree with the assessment of IV.0028

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[7] Ibid.

[8] AECOM, AECOM Engineering Assessment of Aurizon Network's Capital Expenditure Claim (FY16), page 36

[9] Aurizon Network's, Capital Expenditure FY16 – Response to AECOM Engineering Assessment, page 2

[10] Ibid. page 5

Autotransformer Replacement project and that Aurizon Network's decision to amend the FY2016 Capex Claim *(by removing $100,000 for oil containment equipment)* was:

> *"…consistent with the QCA consultants' assessment of prudent capital expenditure."*[11]

Aurizon Network considered the fire protection concern to be resolved during the QCA's assessment of its FY2016 Capex Claim. Aurizon Network was naturally surprised to be discussing the subject with AECOM once again during the FY2018 Capex Claim review.

Instead, AECOM recommended in its FY2018 Assessment Report that:

> *"… a risk assessment is undertaken by Aurizon Network for each autotransformer site to determine the requirements for fire and explosion risk protection and then a decision be made on the prudency of standard."*[12]

With the subsequent release of AS2067:2016 and publication of AECOM's FY2018 Assessment Report Aurizon Network decided to revisit the original 'Fire and Explosion Risk Assessment' with a focus on each of the autotransformer sites: Abrrose Epala, Dingo and Balook. Each of the three risk assessments not only considered equipment damage but also considered the safety of personnel and the continuity of operations.

The risk assessments were internally conducted with four Registered Professional Engineers of Queensland (**RPEQ**) present. Risks were scored twice, firstly with the existing controls and secondly assuming proposed controls (fire-resistant barriers and less flammable insulating fluids) were implemented. Table 2 summarises the results from the risk assessment, clearly demonstrating that additional controls would not materially reduce the risk to personnel or infrastructure.

Table 2. Summary Fire and Explosion Risk Assessment

Risks Identified	1st Score - with existing controls	2nd Score - assuming proposed controls implemented
1. Catastrophic AT fault resulting in explosion and intense fire	[redacted]	[redacted]
2. Catastrophic AT fault causing infrastructure damage within the AT site which negatively impacts on operations	[redacted]	[redacted]
3. Catastrophic AT fault causing infrastructure damage external to the AT site which negatively impacts on operations	[redacted]	[redacted]
4. Voltage surge (e.g. lightning) causes catastrophic AT failure	[redacted]	[redacted]

[11] QCA's, Approval: Aurizon Network's 2015-16 capital expenditure claim, page 2

[12] AECOM, FY18 Capital Expenditure Claim, Assessment Report, page 28

These results are not surprising given that all three risk assessments concluded that:

- Aurizon Network has never experienced a catastrophic autotransformer explosion since the commencement of electrification in the CQCN.
- The autotransformer population in the CQCN has an estimated 6,300 years of accumulated operation.
- Personnel are only present trackside at an autotransformer site for approximately 0.03% of the year.

Refer to Appendix C – Autotransformer Site Renewal – Explosion & Fire Risk for the three risk assessments and Report.

The cost of relocating the Power Supply Cubical (**PSC**) and building a fire-resistant barrier between the two Autotransformers is estimated at approximately $120,000 per site. Aurizon Network assessed the benefit of expending additional capital ($120,000 per site) to only minimally reduce the risk scores and decided to exclude fire-resistant barrier from the scope of work.

Aurizon Network is confident in its decision that it has adequately addressed the requirements of AS2067:2016 for the three autotransformer sites and will continue to assess its potential risks in accordance with the standard at future autotransformer renewal sites. Aurizon Network considers that the prudency and efficiency of investing to a higher, non-mandatory standard needs to be evaluated by the QCA having regard the broader economic sustainability of the overhead power system. In this regard, and in light of other initiatives being undertaken by Aurizon Network to optimise the costs of providing access to the overhead power system, including the 2019 Electric Traction Draft Amending Access Undertaking, it would not be prudent to install fire-resistant barriers at these sites.

Aurizon Network considers the current risk assessments affirmed its decision not to install fire-resistant barriers at these sites and the capital expenditure for this project is prudent in standard.

Aurizon Network also considers that notwithstanding whether AECOM considers that autotransformer sites should be reconfigured to a higher standard this does not provide a reasonable basis to exclude the investment the autotransformer renewals from the RAB as the matters raised by AECOM are unrelated to the Standard of the autotransformers installed at replacement. The renewed transformers are also contributing to the provision of the declared service and should therefore be reflected in the price of access to the service. There are no substantial economies of scale which necessitates, nor is not a requirement of the standard, that these additional improvements being undertaken concurrently with the autotransformer renewal. Where it is deemed prudent to improve the standard of fire and explosion protection at autotransformer sites then this can be progressed as discrete capital works and evaluated for prudency and efficiency independently of the need to renew the autotransformers.

As such, Aurizon Network requests that the QCA take into consideration this information in making their final decision regarding approval of the FY2018 expenditure for IV.00154 Autotransformer Renewal Project.

IV.00321 – Sleeper Renewal Program FY2018

Figure 2. AECOM Assessment Report – IV.00321

IV.00321 - Sleeper Renewal Program FY18	Review Summary	**Scope**	✓	Capital Expenditure Claim	$6.7M
		Standard	✓	Impact of findings on Claim	$0.3M
		Cost	✗	**Total accepted**	**$6.4M**

Source: AECOM, FY2018 Capital Expenditure Claim, Assessment report, page 38

AECOM's Assessment Report stated that:

> *"The cost of work is considered to be not prudent, supported by a low level of documentation quality."*[13]

As such, AECOM recommended to the QCA:

> *"The budgeted unit cost of [redacted] per sleeper is considered to be a stretch target, as the actual cost of works incurred in FY16/17 was [redacted] per sleeper. Considering this, we have used the difference between the FY17/18 and FY16/17 unit rates to calculate the recommended cost deduction."*[14]

Furthermore, AECOM calculated:

> *"A deduction of $0.3M from the capital claim is recommended, reflecting the difference between the FY17/18 unit rates and the FY16/17 unit rates."*[15]

Aurizon Network disagree with AECOM's assessment of the quality of documentation provided in relation to IV.00321 having submitted, as an example:

- A large sample of Technical Scope Track Forms (>20) for re-sleepering sites on the Goonyella, Blackwater, Newlands and Moura systems.
- A signed Project Completion Report (10 pages)
- A large sample of Track Validation Certificates (>15)
- A large sample of Inspection Test Plans (>15)
- Integrated Possession Management Plan (>130 pages)
- Practical Completion Certificates
- Traffic Management Plans
- Contractor, REAL SPATIAL SOLUTIONS, Design Drawings (>15)

Further, the project's Investment Approval Request (**IAR**), provided to AECOM outlined the scope and unit rates as per the below tables.

13 AECOM, FY18 Capital Expenditure Claim, Assessment report, page 39
14 AECOM, FY18 Capital Expenditure Claim, Assessment report, page 38
15 AECOM, FY18 Capital Expenditure Claim, Assessment report, page 39

Table 3. FY2018 Sleeper Renewal Program (IV.00321) – Scope

	FY19 & FY20 Forecast Volume #	FY2018 Forecast (As per IAR)	FY17 Est (As per IAR)	FY16 Actual Volume	FY15 Actual Volume	FY14 Actual Volume
Scope	Total Sleeper Renewal [redacted] sleepers	Timber sleepers (total [redacted]) Concrete sleepers (total [redacted])	Timber sleepers (total [redacted]) Concrete sleepers (total [redacted])	Timber sleepers (total [redacted]) Concrete sleepers (total [redacted])	Sleepers (total [redacted])	Sleepers (total [redacted])

Source: Aurizon Network's, 'IV.00321 – Sleeper Renewal Program FY2018', IAR

Table 4. FY2018 Sleeper Renewal Program (IV.00321) – Unit Rates

	FY19 & FY20 Forecast Unit Rate #	FY2018 Forecast Unit Rate	FY17 Est Unit Rate	FY16 Actual Avg Rate	FY15 Avg Rate	FY14 Avg Rate
Unit Rate	[redacted] per concrete sleeper	[redacted] per timber sleeper [redacted] per concrete sleeper	[redacted] per timber sleeper [redacted] per concrete sleeper	[redacted] per timber sleeper [redacted] per concrete sleeper	[redacted]/KM	[redacted]/KM

Source: Aurizon Network's, 'IV.00321 – Sleeper Renewal Program FY2018', IAR

AECOM fails to account for the variability in unit rates from year to year which happens across all capital products. For example, variances in FY2018 forecast and FY2017 actual unit rates reflect a reduction in Aurizon Network's renewals capital budget associated with the regulatory uncertainty regarding the funding that would be made available following delays in finalising UT5.

The Approved WACC that was relevant to planning decisions for FY2018 was not established until December 2018 and exceeded the proposed WACC in the QCA's Draft Decision on the 2017 Access Undertaking. The regulatory risk associated with operating without an approved Rate of Return, makes making capital decisions difficult to analyse and make.

As a result of the reduction in capital available for asset replacement expenditure Aurizon Network revised the scope to the FY2018 Sleeper Renewal Program, reducing [redacted] sleepers to [redacted] sleepers.

Furthermore, AECOM stated in its FY2018 Assessment Report:

> *"Multiple mobilisations and demobilisations at various sites were required due to the scope of works at each site exceeding available timeframes, incurring additional costs over that budgeted. This has resulted in a high unit rate for works completed."*[16]

Aurizon Network's decision to reduce scope during FY2018 meant focusing on delivering a fit for purpose network at the most efficient cost for scope and risk by prioritising the extremely poor condition sleepers. Targeting the extremely poor sleepers unfortunately required additional mobilisation and demobilisation of employees and equipment to specific sites across the CQCN. It is important to understand that these sites can be thousands of kilometres apart and naturally targeting these specific sites across the CQCN mobilisation and demobilisation costs increased due to distance travelled.

To clarify, Aurizon Network reduced the scope and targeted the sleepers which were at risk of causing a derailment at specific sites across the CQCN. Renewing less sleepers meant the cost of the work resulted in a higher unit rate due to simple economies of scale, however the safety of the network is the number one priority for Aurizon Network and the focus was on managing the risks associated with extremely poor condition sleepers.

[16] AECOM, FY18 Capital Expenditure Claim, Assessment report, page 38

In assessing the prudency of scope Aurizon Network considers that the QCA (AECOM) review should evaluate whether the work that was undertaken was prudent in scope and cost, not whether an alternate scope with a lack of funding certainty should have been performed.

As such, Aurizon Network requests that the QCA take into consideration this information in their final decision on approval of the FY2018 expenditure for IV.00321 Sleeper Renewal Program FY2018.

IV.00323 – Track Upgrade FY2018

Figure 3. AECOM Assessment Report – IV.00323

IV.00323 - Track Upgrade FY18	Review Summary	**Scope**	✗	Capital Expenditure Claim	$23.4M
		Standard	✓	Impact of findings on Claim	$0.2M
		Cost	✓	**Total accepted**	**$23.3M**

Source: AECOM, FY2018 Capital Expenditure Claim, Assessment Report, page 40

AECOM deemed IV.00323 Track Upgrade FY2018 as *"not prudent in scope"* in its FY2018 Assessment Report due to the:

> *"… replacement of rail at two locations where condition information does not support the renewal of rail, and it is considered that the benefits of replacing rail on the basis of efficiency are outweighed by the loss of service life."*[17]

Furthermore, AECOM have noted:

> *"A unit rate of [redacted]/m for material rail costs has been used to calculate a recommended cost deduction of $150,000 for these two scope items, reflective of the additional costs of rerailing."*[18]

Aurizon Network disagree with AECOM's assessment and therefore recommendations regarding the renewal of rail at its two sites:

- GA Coppabella Yard DN RD 145.612-146.046km; and
- GA Coppabella-Broadlea UP RD 147.83-148.100km.

GA Coppabella Yard DN RD 145.612-146.046km

AECOM FY2018 Assessment Report stated:

> *"…the provided rail wear data indicates that the rate of wear for both rails is over 50 % less than the wear limits outlined in Civil Engineering Track Standards (CETS) Module 2 (Section 2.12.2). Based on the information provided, it is considered that the rail would have had a remaining life expectancy of approximately 10-14 years. Given this, it is considered that the benefits of replacing rail on the basis of efficiency are outweighed by the loss of service life, and the rail renewal works at this location are not considered prudent."*[19]

[17] AECOM, FY18 Capital Expenditure Claim, Assessment report, page 60

[18] AECOM, FY18 Capital Expenditure Claim, Assessment report, page 41

[19] Ibid.

To clarify, Aurizon Network replaced two, short, reverse curves (both c. R1000m) at this location for a number of reasons, outlined below:

- According to the last head wear reading (January 2018, approx. three months before the renewal) three of the four legs were only marginally under 50% of CETS limits and the fourth leg was just over 50%;
- This particular job required replacement of three glue insulated joints (GIJs). It is important to understand that welds are typically weak points in track and therefore from a track structure perspective it is deemed a lower risk and a much safer option to have fewer welds;
- If Aurizon Network had reused existing rail it would have needed to weld new GIJs to 50% worn rail which would have required an additional six taper rails and associated welds, thereby introducing unnecessary operational risk, which could lead to increased costs and supply chain impacts; and
- From a track possession perspective, replacing the existing rail with new rail at the time meant no additional track possession time was required to complete the rail upgrade later. This ultimately reduced the impact to the overall supply chain and increased throughput for customers.

Therefore, Aurizon Network considered the benefit of replacing the existing rail with new rail resulted in eliminating the requirements for an additional six taper rails; and the requirements for additional welds (from twelve to six) ultimately mitigated any unnecessary risk.

GA Coppabella-Broadlea UP RD 147.83-148.100km

AECOM stated in its Assessment Report:

> *"No further condition information was provided for GA Coppabella-Broadlea UP RD 147.83-148.100km. Based on the sleeper condition data provided in the SPM, the sleeper renewal works are considered prudent. However, whilst requested, no condition information has been provided for the replaced rail at this location, and no condition information was contained in the SPM. As such, the rail renewal works at this location are not considered prudent."*[20]

To clarify, Aurizon upgraded the rail at the level crossing (ID3216 Private Cattle Crossing) located in Coppabella-Broadlea Section between 147.83-148-148.100km for the following reasons:

- Site walkouts for the level crossing identified derailment damaged 22t fist clip sleepers, which posed a derailment risk and could not be ignored;
- The track structure in this location are circa 1980s era; and
- The rail in this location has accumulated approximately 1,200 mgt over its life, introducing increased operational risk, which could lead to increased costs and supply chain impacts.

Therefore, Aurizon Network considered the benefits of mitigating a potential derailment risk in this location as a result of damaged fist clip sleepers and fatigued rail far outweighed the alternative to utilising the rails remaining 50% wear limits. Safety is the number one priority of Aurizon Network.

[20] AECOM, FY18 Capital Expenditure Claim, Assessment report, page 41

IV.00343 - Level Crossings Renewal Program FY2018

Figure 4. AECOM Assessment Report – IV.00343

IV.00343 - Level Crossings Renewal Program FY18	Review Summary	**Scope**	✔	Capital Expenditure Claim	$5.4M
		Standard	✔	Impact of findings on Claim	$0.2M
		Cost	✘	**Total accepted**	**$5.2M**

Source: AECOM, FY2018 Capital Expenditure Claim, Assessment report, page 44

AECOM deemed project IV.00343 Level Crossings Renewal Program prudent and efficient in scope and standard, however AECOM concluded:

> *"The cost of work is considered to be not prudent, supported by a low level of documentation quality. It is recommended that $177,766 for 'FY19 Engineering Design' included in total project costs be deferred until next year."*[21]

AECOM further concluded:

> *"The project was completed within the allowed budget of $6.3 million with a contingency of $[redacted] which was not spent. Works were completed by Aurizon Network staff and external contractors, using existing supply agreements, demonstrating prudency and efficiency of costs."*
> [22]

AECOM has contradicted itself with these two statements by stating the project is not prudent with regards to cost, yet also stating the project was completed by using existing supply agreement managed through an efficient supplier procurement method and was completed within the allowed budget and contingency remained untouched.

Aurizon Network does not consider AECOM's assessment of the prudency of the project with regards to cost as correct, nor does it agree that the costs should be deferred to the FY2019 Capex Claim.

UT5 does not specifically define whether or not *'design costs'* alone are to be claimed in the year the expenditure, however it would appear to be reasonable to include these costs within an overall project spend.

The majority of capital renewal work is performed on a continuous, rolling basis and as a result design and construction work is performed continuously. As design precedes the construction and scheduling, it is not dictated by financial years and it is highly likely that there will be situations where construction is performed in the financial year following the design. Historically, multi-year projects with different disciplines being delivered in different years, have been included within Capital Claims, which are escalated using the approve WACC at the relevant time.

[21] AECOM, FY18 Capital Expenditure Claim, Assessment report, page 43

[22] Ibid.

Appendix A – Aurizon Network's FY2018 Capital Expenditure Project List

Project Number	Project Name	Project Type	Project Discipline	Asset Type	System	Claimable Expenditure (pre-escalation)
MATERIAL PROJECTS						
IV.00049	Radio System Replacement	Capital Renewal	Systems	Network Controls	System Wide	23,351,894
IV.00323	Track Upgrade FY2018	Capital Renewal	CIVIL	Track	System Wide	23,449,382
IV.00322	Rail Renewal FY2018	Capital Renewal	CIVIL	Rail	System Wide	21,468,545
IV.00329	Structures Renewal FY2018	Capital Renewal	CIVIL	Structures	System Wide	15,054,900
IV.00344	Formation Renewal FY2018	Capital Renewal	CIVIL	Formation / Ballast	System Wide	12,236,291
IV.00364	Turnout Renewal FY2018	Capital Renewal	CIVIL	Turnouts	System Wide	11,500,392
A.04599	Havilah Culverts Upgrade	Growth	Expansion	Structures	Newlands	8,719,163
IV.00346	Package 1 FY2018 Control Systems Renewal	Capital Renewal	Systems	Network Controls	System Wide	8,223,807
IV.00347	Package 2 FY2018 Control Systems Renewal	Capital Renewal	Systems	Network Controls	System Wide	8,035,389
IV.00334	Bridge Ballast Renewal Program FY2018	Capital Renewal	CIVIL	Formation / Ballast	System Wide	7,272,262
IV.00321	Sleeper Renewal Program FY2018	Capital Renewal	CIVIL	Sleepers	System Wide	6,747,175
					Sub total	**$146,059,200**

Project Number	Project Name	Project Type	Project Discipline	Asset Type	System	Claimable Expenditure (pre-escalation)
NON-MATERIAL PROJECTS						
IV.00343	Level Crossings Renewal Program FY2018	Capital Renewal	CIVIL	Level Crossings	System Wide	5,421,998
IV.00360	Network Asset Mgt System Tranche 2	Capital Renewal	Systems	Operational Systems	System Wide	5,311,528
IV.00145	Track Upgrade FY17	Capital Renewal	CIVIL	Track	System Wide	5,145,878
IV.00437	Callide Infrastructure Upgrade	Other	CIVIL	Track	TBC	5,151,241
IV.00399	2017 Cyclone Debbie Rectification	Capital Renewal	CIVIL	Various	System Wide	4,441,745
OP.00161	FY2018 Minerva Renewals	Capital Renewal	CIVIL	Sleepers	Blackwater	3,813,799
IV.00177	Structures Renewal FY17	Capital Renewal	CIVIL	Structures	System Wide	3,618,047
IV.00384	OH Equipment Renewal FY2018	Capital Renewal	Electrical	Distribution Network	System Wide	3,461,614
IV.00270	Ethernet to Corner SCADA Upgrade FY17	Capital Renewal	Systems	Network Controls	System Wide	3,022,135
IV.00146	Sleeper Renewal FY17	Capital Renewal	CIVIL	Sleepers	System Wide	2,843,381
IV.00168	Turnout Renewal FY17	Capital Renewal	CIVIL	Turnouts	System Wide	2,685,243
IV.00294	Goonyella Supersite FY17	Capital Renewal	Systems	Network Controls	Goonyella	2,147,879
IV.00144	Rail Renewal FY17	Capital Renewal	CIVIL	Rail	System Wide	2,064,204
IV.00004	Traction Fault Locator Renewal	Capital Renewal	Electrical	Distribution Network	System Wide	1,985,507
IV.00283	Traction SCADA System	Capital Renewal	Systems	Network Controls	System Wide	2,078,916
IV.00266	Transmission Renewal FY17	Capital Renewal	Systems	Network Controls	System Wide	1,926,012
IV.00261	Telecommunications Infrastructure Renewa	Capital Renewal	Systems	Telecommunication	System Wide	1,875,684
IV.00154	FY17 Autotransformer Renewal Project	Capital Renewal	Electrical	Power Systems	System Wide	1,437,366
IV.00170	Bridge Ballast Renewals FY17	Capital Renewal	CIVIL	Formation / Ballast	System Wide	1,284,390
IV.00375	Corridor Security & Fencing FY2018	Capital Renewal	Corridor	Corridor Access	System Wide	769,726
IV.00032	FY16 Turnout Renewal Program	Capital Renewal	CIVIL	Turnouts	System Wide	717,377
A.01731	WIRP1: DINGO TO BLUFF DUPLICATION	Growth	CIVIL	Track	Blackwater	550,225
IV.00184	Network Capacity Model	Capital Renewal	Systems	Network Controls	System Wide	521,256
IV.00169	Formation Renewal FY17	Capital Renewal	CIVIL	Formation / Ballast	System Wide	459,984
IV.00040	Train Detection Renewal Program	Capital Renewal	Systems	Network Controls	Goonyella	360,580
IV.00316	Access Points Renewal Program	Capital Renewal	Corridor	Corridor Access	System Wide	308,344

A.04313	Gauge Face Lubrication Asset Renewal	Capital Renewal	CIVIL	Track	System Wide	276,873
IV.00271	UTC and DTC Upgrade Program	Capital Renewal	Systems	Signalling Equipment	System Wide	264,528
IV.00267	Asset Protection Equipment Replacement	Capital Renewal	Systems	Signalling Equipment	System Wide	238,851
IV.00171	Level Crossings FY17	Capital Renewal	CIVIL	Level Crossings	System Wide	214,462
A.02976	WIRP1: North Coast Line	Growth	CIVIL	Track	Blackwater	159,332
IV.00005	Blackwater Supersite	Capital Renewal	Systems	Network Controls	Blackwater	153,288
A.02628	COAL SYSTEM: COAL LOSS MANAGEMENT	Other	Corridor	Environmental	System Wide	125,187
IV.00046	Interlocking Renewal Program	Capital Renewal	Systems	Signalling Equipment	System Wide	92,267
IV.00359	FY16 Goonyella Flood	Capital Renewal	CIVIL	Various	Goonyella	86,001
A.03735	WIRP1: Bauhinia NORTH Upgrade	Growth	CIVIL	Track	Blackwater	64,434
A.03686	WIRP1: MOURA SYSTEM UPGRADE	Growth	CIVIL	Track	Moura	30,112
A.04357	NR Gladstone Yard Retaining Wall Upgrade	Capital Renewal	CIVIL	Structures	Blackwater	22,842
A.01552	WIRP1: WIGGINS BALLOON LOOP	Growth	CIVIL	Track	Blackwater	22,465
IV.00260	CQ Access Roads FY17	Capital Renewal	Corridor	Corridor Access	System Wide	14,561
IV.00025	NR Track Upgrade Program FY16	Capital Renewal	CIVIL	Track	System Wide	4,491
IV.00257	Minerva Renewals	Capital Renewal	CIVIL	Sleepers	Blackwater	1,107
IV.00056	Diagnostic Computer Renewal	Capital Renewal	Systems	Signalling Equipment	System Wide	-105
A.01631	WIRP1: ROCKLANDS TO STANWELL DUPLICATION	Growth	CIVIL	Track	Blackwater	-2,342
IV.00024	NR Vital Disabling Release	Capital Renewal	Systems	Network Controls	System Wide	-2,585
A.04321	Central Coal UPS Upgrade Project	Capital Renewal	Systems	Operational Systems	System Wide	-9,291
IV.00262	Power Resilience FY17	Capital Renewal	Electrical	Power Systems	Blackwater	-31,321
IV.00343	Level Crossings Renewal Program FY2018	Capital Renewal	CIVIL	Level Crossings	System Wide	5,421,998
IV.00360	Network Asset Mgt System Tranche 2	Capital Renewal	Systems	Operational Systems	System Wide	5,311,528
IV.00145	Track Upgrade FY17	Capital Renewal	CIVIL	Track	System Wide	5,145,878
					Sub total	**$65,129,218**
					TOTAL	**$211,188,417**

Appendix B – Summary table of AECOM's FY2018 Assessment Recommendations

5.0 Findings and Recommendations

5.1 Key Findings

A summary of findings in relation to the sample of projects selected for this review is presented in Table 14. It shows our assessment in relation to each major criterion and our assessment of the level of project documentation available.

Table 14 Final Assessment

Project	Prudency Assessment			Project Cost ($ million)		
	Scope	Standard	Cost	Claim	Adjust.	Accepted
A.04599 - Havilah Culverts Upgrade	✔	✔	✔	$8.72		$8.72
All Growth Projects (AUGEX)				**$8.72**		**$8.72**
IV.00004 - Traction Fault Locator Renewal	✔	✔	✔	$1.99		$1.99
IV.00049 - Radio System Replacement	✔	✔	✔	$23.35		$23.35
IV.00144 - Rail Renewal FY17	✔	✔	✔	$2.06		$2.06
IV.00145 - Track Upgrade FY17	✔	✔	✔	$5.15		$5.15
IV.00146 - Sleeper Renewal FY17	✔	✔	✔	$2.84		$2.84
IV.00154 - FY17 Autotransformer Renewal Project	✔	✘	✔	$1.44	$1.44	
IV.00168 - Turnout Renewal FY17	✔	✔	✔	$2.69		$2.69
IV.00170 - Bridge Ballast Renewals FY17	✔	✔	✔	$1.28		$1.28
IV.00261 - Telecommunications Infrastructure Renewal	✔	✔	✔	$1.88		$1.88
IV.00267 - Asset Protection Equipment Replacement	✔	✔	✔	$0.24		$0.24
IV.00270 - Ethernet to Corner SCADA Upgrade FY17	✔	✔	✔	$3.02		$3.02
IV.00283 - Traction SCADA System	✔	✔	✔	$2.08		$2.08
IV.00294 - Goonyella Supersite FY17	✔	✔	✔	$2.15		$2.15
IV.00321 - Sleeper Renewal Program FY18	✔	✔	✘	$6.75	$0.31	$6.44
IV.00322 - Rail Renewal FY18	✔	✔	✔	$21.47		$21.47
IV.00323 - Track Upgrade FY18	✘	✔	✔	$23.45	$0.15	$23.30
IV.00334 - Bridge Ballast Renewal Program FY18	✔	✔	✔	$7.27		$7.27
IV.00343 - Level Crossings Renewal Program FY18	✔	✔	✘	$5.42	$0.18	$5.24
IV.00344 - Formation Renewal FY18	✔	✔	✔	$12.24		$12.24
IV.00346 - Package 1 FY18 Control Systems Renewal	✔	✔	✔	$8.22		$8.22
IV.00347 - Package 2 FY18 Control Systems Renewal	✔	✔	✔	$8.04		$8.04
IV.00360 - Network Asset Mgt System Tranche 2	✔	✔	✔	$5.31		$5.31
IV.00364 - Turnout Renewal FY18	✔	✔	✔	$11.50		$11.50
IV.00375 - Corridor Security & Fencing FY18	✔	✔	✔	$0.77		$0.77
IV.00384 - OH Equipment Renewal FY18	✔	✔	✔	$3.46		$3.46
IV.00399 - 2017 Cyclone Debbie Rectification	✔	✔	✔	$4.44		$4.44
All Renewal Projects (REPEX)				**$168.50**	**$2.08**	**$166.43**
All Projects Reviewed				**$177.22**	**$2.08**	**$175.14**

A cost adjustment has been recommended for four projects, amounting to a total recommended adjustment of $2.08 million to the claim.[23]

[23] AECOM's Assessment of Aurizon Network's Capital Expenditure Claim (FY18), page 59

Appendix C – Autotransformer Site Renewal: Explosion and Fire Risk Assessments and Report

Trackside Autotransformer Fire Wall Assessment

20 June 2019

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Version	Issued	Details	Prepared	Reviewed	Approved
[redacted]					

Background

The Queensland Competition Authority's (QCA) consultant, AECOM, reviewed Aurizon Network's Annual Capital Expenditure Report (Capex Claim) and prepared an assessment report [3]. One of the projects AECOM identified in its assessment report as "not prudent in standard" was IV.00154- Autotransformer Renewal Project (AT renewal). AECOM stated in its report, [3] the *"project is not considered prudent in standard due to the lack of justification for not addressing fire and explosion risk at the autotransformer sites"*. AECOM recommended that the QCA reject Aurizon Network's entire capital expenditure for the project, a total of $1.4 million.

Aurizon's decision to exclude fire walls from the scope of Autotransformer site renewals was based on previous risk analysis [5] (undertaken prior to the release of AS 2067:2016) and [6]. Following the release of AECOM's report [3], Aurizon Network decided to review its decision to omit fire walls from autotransformer (AT) site renewals by undertaking new site-specific risk assessments and to form a refreshed view with due regard to AS 2067:2016.

This report is divided into three main sections:

- Interpretation of AS2067:2016
- Discussion of Aurizon's 2019 risk assessments for AT site renewals
- Discussion of AECOM's assessment report

The report finds fault with AECOM's assessment and concludes that Aurizon Network's decision to omit fire walls from the AT sties renewed under the FY18 Capex claim was a prudent one in-line with the low Risk score the hazard represents.

References

1. Standards Australia, *AS 2067:2016 Substations and high voltage installations exceeding 1 kV a.c.*, 2016
2. Queensland Government, *Work Health and Safety Act 2011*
3. AECOM, *Assessment of Aurizon Network's Capital Expenditure Claim*, 23 May 2019
4. CIGRE Working Group A2.33, *Guide for Transformer Fire Safety Practices*, June 2013

5. McKay, Ray, *Risk Analysis of Fire, Explosion & Oil Spillage for Existing Feeder Stations,* 19 December 2013

6. Nussey, Peter, *Explosion Risk at Autotransformer Sites, Risk Assessment Report*, 21 August 2017

7. Aurizon, Risk Assessments: Balook, dingo and Ambrose-Epala Autotransformer Site Renewal - Explosion & Fire Risk, 29 May 2019.

8. Email from Jeremy Hales to Peter Nussey, *RE: AT OOS simulations for risk assessment*, 23 May 2019

Abbreviations

Abbreviation	Meaning
AT	Autotransformer
CQCN	Central Queensland Coal Network
FY	Financial Year
PSC	Power Supply Cubicle
QCA	Queensland Competition Authority

Interpretation of AS2067:2016

AS2067:2016 [1] is the key standard which addresses fire and explosion risk in high voltage transformer installations. This standard is written to cover a broad range of installations and applications from substations embedded in populated areas to remote locations such as Aurizon's trackside AT sites. AS2067:2016 requires a risk-based approach to be used in assessing the need for firewalls. Below are some key excerpts from AS2067:2016 to illustrate this:

1. AS 2067:2016, Section 2: Fundamental Requirements

    a. Clause 2.7 **Risk Management,** calls upon the hierarchy of risk control and provides useful context and makes it quite clear that the treatment of hazards presented by high voltage electrical infrastructure should be determined by balancing the risks and available controls which can be implemented *so far as is reasonably practicable (SFAIRP)* with due consideration for the cost/risk reduction ratio.

> Nominal risk targets for hazards in HV installations, even those within levels recognized by the international safety industry as being 'safe' may not be sufficient to meet a duty of care obligation. It is, however, reasonable that all known and commonly applied precautions have been assessed, and applied so far as is reasonably practicable (SFAIRP) or as low as reasonably practicable (ALARP) where the cost/risk reduction is not grossly disproportionate. A risk target below the assessed mean risk for all other hazards across all asset classes of the enterprise could also be used to help decide when seeking further precautions for a particular hazard will no longer be required.

This approach of weighing the risk and cost of controls is consistent with the Work Health and Safety Act 2011, Subdivision 2 Clause 18 (c).

2. AS 2067:2016, Section 6: Safety Measures

   a. Clause 6.7.1.1 makes it clear that Clause 6.7 provides *recommendations* as opposed to mandatory requirements:

> **6.7 PROTECTION AGAINST FIRE AND EXPLOSION**
>
> **6.7.1 Risk**
>
> **6.7.1.1** *General*
>
> Clause 6.7 provides fire prevention and fire protection recommendations for HV installations. These recommendations provide for the safety of construction, operating and maintenance personnel, the physical integrity of plant components and the continuity of plant operations.

   In-line with 6.7.1.1 recommendations, a fire risk assessment (FRA) has been performed for each Autotransformer site installation. Furthermore, CIGRE Technical Brochure No 537 [4] was noted as a possible resource to be consulted with after the FRA was completed, if required.

AT Explosion Risk Assessment

In light of AECOM's report [3] and the release of standard AS 2067:2016 [1] Aurizon Network decided to re-assess the risks associated with fire and explosion at trackside AT sites. On 29 May 2019 three risk assessments were conducted to ascertain the risks associated with each AT site renewal in Aurizon Network's FY18 capex claim; Balook, Dingo and Ambrose-Epala AT sites. The risk assessments also identified possible additional controls. In addition, scores were determined and applied for the modified risk with these controls implemented.

Background information

The following information provided important context for the risk assessments:

1. Likelihood of AT explosion
   Since electrification of the Central Queensland Coal Network (CQCN) in the 1980s there have been an estimated 6300 years of accumulated AT operation. Aurizon Network can find no single source of anecdotal evidence or reports of any catastrophic AT explosions occurring during this time. Accordingly, the likelihood of an AT experiencing a catastrophic explosion and fire is considered to be extremely low.

2. Estimated personnel presence at trackside AT sites
   Trackside AT sites are only routinely attended for oil sampling (1 X 30 minutes per annum), visual check (1 X 30 minutes per annum) and vegetation control (4 X 30 minutes per annum)
   Total = 3 hours per annum. Normally personnel visit site in pairs.
   As a percentage of the year this equates to 3/(24*365) = 0.03% of the year that two people are present at a trackside AT site.

3. Likelihood of personnel being injured by an explosion event at a trackside AT site
   From 1 and 2 above Aurizon Network concludes that the probability of personnel being injured by the explosion of an AT at a trackside AT site is extremely low.

4. Impact on continuity of operations from the loss of one AT and a PSC at a double AT site
   Power system simulations were undertaken to assess the operational impact of having one AT

out of service at each of the following trackside AT site renewals in Aurizon Network's FY18 capex claim: Balook, Epala and Dingo. The simulation results show that there was no impact on the continuity of operations. It is important to note that even with one AT and the Power Supply Cubicle (PSC) out of service the remaining AT can continue to operate as normal.

Risk assessment outcomes

The risk assessments focused on risk to personnel, infrastructure and continuity of operations arising from the catastrophic explosion of an AT and the resulting fire. Below is a summary of the findings:

Risk to personnel

- *Risk = Consequence X Likelihood =* [redacted] *X* [redacted] = [redacted]
- *Additional controls proposed: use of less flammable insulating fluid (as suggested in [4]).*
  NB fire walls were not considered to be an effective control if a person is standing next to an AT which explodes in a position not protected by the fire wall (e.g. in front of the AT)
- *Risk (with additional controls) =* [redacted] *X* [redacted] = [redacted]
- *It is important to note that the minimum possible risk score here is 5 (moderate) because the worst-case consequence is the death of a person.*
- *Conclusion: Implementation of additional controls did not modify the risk score.*

Risk to infrastructure within AT site impacting on operations

- *Risk = Consequence X Likelihood =* [redacted] *X* [redacted] = [redacted]
- *Additional controls proposed: installation of fire-resistant barriers & use of less flammable insulating fluid*
- *Risk (with additional controls) =* [redacted] *X* [redacted] = [redacted]
- *Conclusion: Implementation of additional controls reduced the risk score by one point only.*

Risk to infrastructure external to the AT site (buildings etc) impacting on operations

- *Risk = Consequence X Likelihood =* [redacted] *X* [redacted] = [redacted]
- *Additional controls proposed: installation of fire-resistant barriers & use of less flammable insulating fluid*
- *Risk (with additional controls) =* [redacted] *X* [redacted] = [redacted]
- *It is important to note that all three of the trackside AT sites under consideration in these risk assessments are in very remote locations with no vulnerable adjacent infrastructure*
- *Conclusion: Implementation of additional controls did not modify the risk score.*
    - *NB: Depending on AT site location, this Risk score could be higher and is evaluated on a site-by-site basis.*

Discussion of AECOM's FY18 Capex Claim Assessment

In AECOM's assessment report of Aurizon Network's FY18 Capital Expenditure Claim (capex claim) [3], published on the QCA's website 27th May 2019, it was recommended to the QCA that Aurizon Network's capital expense for project IV.00154 Autotransformer Renewal Project be; *"…rejected from the FY17/18 claim in its entirety, due to the lack of justification as for not addressing fire and explosion risk at the autotransformer sites."*

There are seven key points in AECOM's assessment report. Aurizon Network has addressed each of these points below;

1. **Safety of Personnel - AECOM point 1(a)**

> **a. The emphasis on safety of personnel is increased**
>
> In section 6.7 of the 2008 version personnel safety is only mentioned twice in clause 6.7.2.(d) and 6.7.5. In the 2016 version, personnel safety is mentioned numerous times in clauses; 6.7.1.1, 6.7.1.2 and 6.7.4.2. This seems consistent with the industry's focus on safety performance and indeed aligned with Aurizon's "ZERO Harm" philosophy. The 2013 risk assessment is silent on personnel safety. We believe this should be a consideration of the risk assessment and may have an impact on the overall risk profile.

AECOM's assessment report implies that Aurizon Network has not considered the safety of personnel when determining the scope of AT site renewals. This is not correct. Aurizon recognises that these sites are unattended most of the time and therefore expose personnel to miniscule risk. However, in the risk assessments conducted on 29 May 2019 this is confirmed decisively, and it is further noted that when re-assessed with additional controls (fire resistant barriers and less flammable insulating fluid) the risk to personnel did not change. This is due to the minimal exposure of personnel and the low likelihood of an explosive event.

2. **Continuity of operations - AECOM point 1(b)**

> **b. The emphasis on continuity of operations is increased**
>
> The 2013 risk assessment is silent on the redundancy of the system, and the exposure of risk to network failure. The security of supply and redundancy need to be included in the risk
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>)M Aurizon Network FY18 Capex Review 28
> Assessment of Aurizon Network's Capital Expenditure Claim
> Commercial-in-Confidence
>
> assessment. It may well be that there is adequate redundancy in the network between feeder stations, but this needs to be assessed and evaluated. The embedded redundancy may reduce the need for additional fire protection.

Aurizon Network has confirmed by power systems simulations that continuity of operations can be maintained with one AT out of service at each of the three sites renewed under the FY18 Capex claim.

3. **Protection of buildings - AECOM point 1(c)**

c. The protection of buildings is required

AS2067:2016 Clause 6.7.2.1 (Buildings - General) states that *"Protection shall be provided against fire initiated or propagated by any part or element of high voltage installations".*

Our interpretation of this clause is that the Power Supply Cubicle (PSC) at this site is a building and shall be protected.

As already noted, the entirety of AS2067:2016 Clause 6.7 provides *recommendations* rather than mandatory requirements. In view of this and the comments above regarding Continuity of Operations, Aurizon, using SFAIRP principles has found that the cost/risk reduction to protect the PSC buildings is grossly disproportionate at these sites would not be prudent.

4. **Protection requirements decided by operator/owner - AECOM point 1(d)**

d. Protection requirements decided by operator/owner

Clause 6.7.13 from the previous 2008 (Amended 2010) version of AS2076 allowed the network operator or owner to determine their own fire protection requirements. This clause no longer exists in the 2016 version. This was a clause relied on in section 1.8 of the 2013 risk assessment.

AS2067:2016 calls for the infrastructure owner to take a holistic risk-based approach in assessment. Aurizon has now undertaken new site-specific risk assessments for the AT sites assessed by AECOM in FY18 Capex claim.

5. **Standard AS/NZS 3931:1998 withdrawn - AECOM point 1(e)**

e. Standard AS/NZS 3931:1998 withdrawn

AS/NZS 3931:1998 "Risk analysis of technological systems - Application guide" as quoted frequently in the 2013 risk assessment document has since been withdrawn, and not replaced. The current AS2067:2016 now refers to AS/NZS ISO 31000.

While we do not disagree with the use of event tree analysis described in AS3931 and as documented in the 2013 document, the risk assessment needs to consider a wider range of consequences such as personnel safety, and continuity of operations, not only equipment damage.

Aurizon Network has now undertaken new site-specific risk assessments for each of the AT sites assessed by AECOM in its FY18 capex claim.

6. **Lightning arrestor - AECOM point 2(a)**

a. Lightning arrestor

The 2017 report is silent on whether the risk control of a lightning arrestor is applicable to the Autotransformer. There is not enough information to determine if lightning arrestors are installed at the Autotransformer sites. If not, then this risk control cannot be claimed, and this needs to be reflected in the risk assessment and may have an impact on the overall risk profile.

Aurizon Network's specification, 'SAF/SPC/5175/ELE/NET High Voltage Electric Traction System Construction and Commissioning' clearly states that surge arrestors are installed at all trackside AT sites. This requirement is specified below.

9.5.14 Surge Diverters (Lightning Arrestors)

1. Surge diverters must be provided as shown on the drawings at Feeder Stations, Track Sectioning Cabins, Autotransformers and Auxiliary Supply Transformers.
2. Surge diverters must be located either on the structure supporting the transformer to be protected or on the adjacent structure supporting associated OHLE for pad mounted transformers. Surge diverters must be mounted vertically, and must be earthed and bonded to the traction rail or earth grid as indicated in the design documentation. All installation work must be in accordance with best industry practice, the requirements of Aurizon design documentation and the manufacturers' installation requirements to ensure a good earthing path is present.
3. The location of the surge diverter must be as shown on the relevant switching data sheet or switching cross section drawing.

7. **Mechanical Trip Signals – AECOM point 2(b)**

b. Mechanical Trip Signals

There is not enough information to demonstrate proven reliability of the Fault Locators to be an effective risk control to avoid ignition of an explosion. In a separate capital funding request labelled *'CFR Traction Fault Locator Renewals'* dated (19 September 2014), fault locators have previously been proven to be unreliable to provide exact fault location and to relay the Autotransformer Mechanical Trip Signals back to the Feeder Station for fast clearing of the supply feeding the autotransformer fault.

For the recently renewed fault locators, we have seen test documentation to indicate correct operation of the mechanical trip function, however we have not seen timing tests to prove that the trip function operates within the required tripping time. If the Fault Locators are not reliable, then this risk control cannot be claimed, and this needs to be reflected in the risk assessment and may have an impact on the overall risk profile.

The ability of the Traction Fault Locators to relay mechanical trip signals to traction substations is seen as a backup protection function. The protection system is designed so that any severe internal AT fault would be detected by the primary track feeder protection relays. If the primary protection failed to operate the Fault Locator would serve as this backup to arrest the source of ignition of a fire by tripping the relevant circuit breakers. Furthermore, it should be noted that the telecommunications system that this protection runs on, is a highly available carrier-grade PDH system. Such systems have long been used for tele-protection purposes and adhere to IEC 60834 requirements. On this basis Aurizon Network is justified in claiming that the Fault Locators provide a valid backup risk control for fire at trackside AT sites.

Conclusions

This report concludes as follows:

1. AS2067:2016 does not mandate the installation of fire-resistant barriers at Aurizon Network's trackside AT sites and furthermore requires the infrastructure owner to take a holistic risk-based approach in assessment.

2. Implementation of additional controls was assessed and found to be ineffective in reducing the risk to personnel, and only marginally effective in reducing the risk to infrastructure.

3. Aurizon Network cannot justify the incremental cost of installing fire-resistant barriers (grossly disproportionate in this scenario) at the AT sites under consideration because the resulting reduction in risk is marginal.

4. The seven areas of concern raised by AECOM in their assessment of the FY18 Capex claim have been adequately addressed by Aurizon Network.

Recommendations

It is recommended that Aurizon Network challenge AECOM's assessment that Aurizon Network was not prudent in standard due to omitting the installation of fire-resistant barriers in project IV.00154-Autotransformer Renewal Project.

It is recommended that Aurizon request the QCA to reconsider AECOM's advice and accept Aurizon's reasoning that the entire $1.4 million worth of capital expenditure for the project be added into the Regulatory Asset Base (RAB), in accordance with clause 2 of Schedule E of UT5.

Appendix 1 Risk Assessment: Balook Autotransformer Site Renewal - Explosion & Fire Risk

Assessment Title: Balook Autotransformer Site Renewal - Explosion & Fire Risk

Note 1: *The original of this document, duly signed by the treatment owner and authorising officer, is held by the Document Controller within related business area.*

1. REFERENCE DOCUMENTS

The following sources of reference material have been used to develop this document:

Reference No.	Document Title
04-PRI-014	SHE Risk Management

Aurizon's Five Safety Principles

1. Safety is the core Aurizon value
2. All injuries can be prevented
3. Management is accountable for creating and maintaining a safe workplace
4. We are ALL responsible for preventing injuries
5. Working safely is a condition of employment

2. RISK ASSESSMENT CONTEXT

Risk Assessment Forum – Location	
Risk Context Summary	In AECOM's Assessment Report of Aurizon Network's FY18 Capital Expenditure Claim (Capex Claim), published on the Queensland Competition Authority's (QCA) website 27th May 2019, it was recommended to the QCA that Aurizon's Capital Expense for project IV.00154 Autotransformer Renewals be *"…rejected from the FY17/18 claim in its entirety, due to the lack of justification as for not addressing fire and explosion risk at the autotransformer sites."* Therefore, AECOM deemed the project as not prudent in scope because it did not adequately address the requirements of AS2067:2016 in respect of fire and explosion protection. An earlier analysis undertaken by Aurizon Network in 2013 titled; '*Risk Analysis of Fire, Explosion & Oil Spillage for Existing Feeder Stations, V.03.4900.373'*, considered fire and explosion risks at Feeder Stations rather than trackside autotransformer (AT) sites. At the time of the risk assessment AS2067:2008 was the current standard. AECOM also recommended in its assessment report; *"that a risk assessment is undertaken by Aurizon Network for each autotransformer site to determine the requirements for fire and explosion risk protection and then a decision be made on the prudency of standard."* With the subsequent release of AS2067:2016 Aurizon Network has decided to revisit the fire and explosion risks with a focus on the three trackside AT sites (Balook, Dingo and Ambrose-Epala).

Facilitator: [redacted]	
Attendees at risk assessment meeting:	**Consultation:**
[redacted]	[redacted]

3. SHE RISK ASSESSMENT (CONDUCTED IN ACCORDANCE WITH 04-PRI-014 – SHE RISK MANAGEMENT)

- When conducting the SHE Risk Assessment, consideration should be given to the related business area Hazard and Risk Inventory to identify any Hazards/Safety Risks that have been previously approved by the relevant Level of Authority required by 04-PRI-014.
- Refer to 04-PRI-014 SHE Risk Management for determining the level of risk and authorisation. **See section 6.3 and 6.4 below**.
- The effectiveness of the implementation of all Control Measures shall be categorised in accordance with the criteria in **section 6.1 below.**
- Control selection and justification shall be evaluated using the guidelines in **section 6.2 below.**

SAFETY RISK ASSESSMENT		
CEO Enterprise/ Group Executive:	[redacted]	**Risk Assessment Context: (Detailed)** In AECOM's Assessment Report of Aurizon Network's FY18 Capital Expenditure Claim (Capex Claim), published on the Queensland Competition Authority's (QCA) website 27th May 2019, it was recommended to the QCA that Aurizon's Capital Expense for project IV.00154 Autotransformer Renewals be "…rejected from the FY17/18 claim in its entirety, due to the lack of justification as for not addressing fire and explosion risk at the autotransformer sites." Therefore, AECOM deemed the project as not prudent in scope because it did not adequately address the requirements of AS2067:2016 in respect of fire and explosion protection. An earlier analysis undertaken by Aurizon Network in 2013 titled; 'Risk Analysis of Fire, Explosion & Oil Spillage for Existing Feeder Stations, V.03.4900.373', considered fire and explosion risks at Feeder Stations rather than trackside autotransformer (AT) sites. At the time of the risk assessment AS2067:2008 was the current standard. AECOM also recommended in its assessment report; "that a risk assessment is undertaken by Aurizon Network for each autotransformer site to determine the requirements for fire and explosion risk protection and then a decision be made on the prudency of standard." With the subsequent release of AS2067:2016 Aurizon Network has decided to revisit the fire and explosion risks with a focus on the three trackside AT sites.
Head/GM Portfolio:	[redacted]	
Assessment Owner:	[redacted]	
Developed By:	[redacted]	
Authorisation and Date:	_____ __/__/20__	

1. IDENTIFY AND DESCRIBE			2. ASSESS AND EVALUATE					3. CONTROL AND MONITOR		
Risk No.	List Activity or Aspect and **Hazard** - e.g. What is it that has potential to cause harm?	**Risk** What is the risk associated with the hazard? **(The Risk Of)+(Due To)+ (Resulting In)**	**Existing Controls** What existing precautionary controls do I currently have in place and how effective are they? Confirm the Hierarchy of Control (HOC) and justify **Consider the following in order:** 1. Regulations 2. Codes of Practice 3. International / Australian or Industry Standard	**Justifications** Explain why this arrangement of controls was chosen. (also see **Section 6.2** below)	**Risk Evaluation** C	L	Level of Risk Extreme High Moderate Low	**Proposed Controls** Are there additional precautionary controls options I can apply to minimise the risk? (Apply the proposed Hierarchy of Control and justify)	**Justifications** Explain why this arrangement of controls was chosen. (also see **Section 6.2** below)	**Accountable Officer** Who will implement the proposed controls?	**Due Date** When are the proposed controls due?	**Date for next review** To monitor control effectiveness.

1	***Catastrophic AT fault resulting in explosion and intense fire***	*Risk of an AT tank rupturing* *Due to a mechanical failure of the AT* *Resulting in an explosion and the distribution of burning oil which has the potential to cause serious injury or fatality*	**Elimination* **Substitution* **Isolation* **Engineering* - *Robust design (e.g. type test requirements in Spec includes 10 X short circuit tests)* - *Oil bunding* - *Primary track feeder protection & secondary protection functions (e.g. Fault Locator)* **Administration* - *ECO Control room instructions* - *SWMS* - *ECOs and NPs are trained to ensure site staff move to a position of safety prior to energising a transformer* **PPE*	*A robust design is specified because the service conditions for an AT include frequent short circuit faults. The ATs are designed for these conditions.* *Calculated personnel exposure is approx. 3hrs per year X 2 persons (see background notes below)*	[redacted]	[redacted]	• *Use of less flammable insulating fluids* *<u>Risk Score assuming proposed controls are implemented</u>* *Consequence =* *Likelihood =* *Risk Score =*				
2	***Catastrophic AT fault causing infrastructure damage <u>within</u> the AT site which negatively impacts on operations***	*Risk of a negative impact on train operations* *Due to a catastrophic explosion of an AT* *Resulting in one of the two ATs at an AT site and the associated PSC being destroyed*	**Elimination* **Substitution* **Isolation* **Engineering* - *Oil bunding* - *Redundancy of ATs* - *Primary track feeder protection & secondary protection functions (e.g. Fault Locator)* **Administration* - *Emergency response procedures* **PPE*				• *Installation of Fire Resistant Barriers* • *Use of less flammable insulating fluids* *<u>Risk Score assuming proposed controls are implemented</u>* *Consequence =* *Likelihood =* *Risk Score =*				
3	***Catastrophic AT fault causing infrastructure damage <u>external to</u> the AT site which negatively impacts on operations***	*Risk of a negative impact on train operations* *Due to a catastrophic explosion of an AT* *Resulting in damage to the track or other adjacent infrastructure*	**Elimination* **Substitution* **Isolation* *- Remote location of site* **Engineering* - *Oil bunding* - *Primary track feeder protection & secondary protection functions (e.g. Fault Locator)* **Administration* **PPE*	*The Balook AT site is 'remote' from adjacent infrastructure. See background notes below.*			• *Installation of Fire Resistant Barriers* • *Use of less flammable insulating fluids* *<u>Risk Score assuming proposed controls are implemented</u>* *Consequence =* *Likelihood =* *Risk Score =*				
4	***Voltage surge (e.g. lightning) causes catastrophic AT failure***	*Risk of an AT tank rupturing* *Due to a severe voltage surge (e.g. lightning strike to OHL)* *Resulting in an AT explosion and the distribution of burning oil*	**Elimination* **Substitution* **Isolation* **Engineering* - *Lightning rods and surge arrestors on adjacent masts (refer SAF/SPC/5175/ELE/NET Section 9.5.14)* - *Primary track feeder protection & secondary protection functions (e.g. Fault Locator)* **Administration* **PPE*							

4. RISK ASSESSMENT AUTHORISATION

Prepared by: [redacted]

I hereby accept and endorse the results of the assessments in so far as they relate to my respective area of accountability and responsibility. I have duly escalated the approval of any treatments not within my authority or delegations.

I hereby agree to undertake those activities and responsibilities that have been designated to me in the above risk assessment.

Note: The SHE risk assessments above meet the defined requirements in 04-PRI-014 and subsequently contributes to satisfying the related risk management and legal obligations.

Treatment Owner Endorsement

Endorsed by: _____

Position: _____

Date: _____

Endorsed by: _____

Position: _____

Date: _____

Endorsed by: _____

Position: _____

Date: _____

Endorsed by: _____

Position: _____

Date: _____

I am satisfied this risk assessment has been conducted in accordance with 04-PRI-014, and that the deliberations and findings reflect the scope and intent of the risk assessment.

Note: *This assessment finds that the relevant legal obligations to manage SHE risk will be met via application of the stated hierarchy of controls and any additional actions, including monitoring as defined in this risk assessment.*

Authorised by: _____

Position: _____

Date: _____

5. REVISION STATUS

VERSION	*DATE*	*DESCRIPTION*	*Author*

6. RELATED INFORMATION

6.1 CONTROL EFFECTIVENESS

CONTROL EFFECTIVENESS		
FE	**Fully Effective**	Nothing more to be done except review and monitor the existing controls. Controls are well designed for the risk, address the root cause and Management believes that they are effective and reliable.
SE	**Substantially Effective**	Most controls are designed correctly and are in place and effective. Some more work to be done to improve effectiveness or, the accountable person/s have some reservations about operational effectiveness and reliability.
PE	**Partially Effective**	While design of controls may be largely correct in that they treat most of the root causes of the risk they are not currently very effective or, some of the controls do not seem correctly designed in that they do not treat the root causes, those that are correctly designed are operating effectively.
LI	**Largely Ineffective**	Significant controls gaps. Either controls do not treat root causes, or they do not operate at all effectively.
TI	**None or Totally ineffective**	Virtually no credible control. Management has no confidence that any degree of control is being achieved due to poor control design and/or very limited operational effectiveness.

6.2 CONTROL JUSTIFICATION

When justifying the selection of the hierarchy of controls (HOC) for the elimination of hazards or minimisation of SHE risks the following criteria must be taken into consideration.

- The ability or inability to totally eliminate the hazard at source.
- The ability or inability to totally eliminate contact with the hazard.
- The ability or inability to totally eliminate the hazard within delegated physical and or financial means.
- The consideration of all credible control options available to eliminate hazard or minimise risk within personal sphere of control.
- The selected level 2 control measure(s) will have valid potential to effectively minimise the SHE risk.
- The full HOC has been considered (*including any level 2 combinations*).

Note: The justification should be recorded (where practicable within the assessment itself), however, other records should be maintained to support justification if needed for both existing and proposed control hierarchies. Consideration should be given to reasons for selection and rejection.

Example: The following is an example of where human factors or mechanical failure form part of the risk and related causal / control factors. *(E.g. it is not possible to totally eliminate human error or mechanical failure as a root cause in the context of the hazard as it is defined in this assessment etc.)*

RISK MATRIX

			CONSEQUENCE					
			1	2	3	4	5	
			Safety & Health	**Safety & Health**	**Safety & Health**	**Safety & Health**	**Safety & Health**	
			Illness or injury not requiring medical treatment.	Minor illness/ injury requiring medical treatment (e.g. First Aid and MTI).	Short term (reversible) impact on health/body function. Multiple medical treatment injuries (MTI's). Immediate admission to hospital for treatment.	Life Threatening injury or multiple moderate injuries causing hospitalisation Permanent total disability Severe and irreversible loss to quality of life.	Death	
			Environment	**Environment**	**Environment**	**Environment**	**Environment**	
			No adverse effect on an environmental value (e.g. water, soil, air, wildlife). That is, the impact is wholly contained in a controlled area. No damage or remediation required Regulator notification not required. No penalties. Does not contribute to corporate environmental notification KPI.	An adverse effect on an environmental value, which may be visual, olfactory, audible and may cause an unhealthy, offensive or unsightly condition because of contamination. Cost of any potential damage or remediation <$5K (Qld, SA, Vic) <$10K (NSW), <$20K (WA). Regulator notification unlikely to be required. Penalty unlikely, but regulator could serve a show cause notice. Does not contribute to corporate environmental notification KPI.	Environmental harm that is not trivial or negligible. Cost of damage and/or remediation >$5K but <$50K (Qld, SA, Vic), >$10K (NSW), >$20K but <$100K (WA). Regulator notification mandatory. Penalty or prosecution possible. Contributes to corporate environmental notification KPI.	Environmental harm that is of a high impact or widespread. Cost of damage and/or remediation >$50K (Qld, NSW, SA & Vic), >$20K but < $1M. Regulator notification mandatory. Penalty or prosecution likely. Contributes to corporate environmental notification KPI. Major damage to environmental reputation at regional level.	Environmental harm that is irreversible, high impact or widespread. Caused to an area of high conservation value (e.g. a National Park) or area of special significance (e.g. Great Barrier Reef Marine Park). Cost of damage and/or remediation >$1M. Regulator notification mandatory. Penalty or prosecution almost certain. Contributes to corporate environmental notification KPI. Major damage to environmental reputation at national level.	
LIKELIHOOD	**5**	Is expected to occur, almost inevitable > 10 times per year	**5**	**10**	**15**	**20**	**25**	**Board Approval Required (via Managing Director and CEO) or Group Executive Delegate**
	4	Is expected to occur in most circumstances, Not surprised if it happens At least annually and up to 10 times per year	**4**	**8**	**12**	**16**	**20**	
	3	Might occur in some circumstances, Once in the next 2 to 10 years	**3**	**6**	**9**	**12**	**15**	**Head/GM Approval Required**
	2	Could occur in some circumstances, Surprised if it happens Once in the next 11 to 50 years	**2**	**4**	**6**	**8**	**10**	
	1	May occur but only in exceptional circumstances. It would be highly unexpected Not in the next 50 years	**1**	**2**	**3**	**4**	**5**	
			Supervisor or Manager Approval Required				**Manager Approval Required**	

FOR SECURITY RISK CONSEQUENCE FACTORS SEE – 04-FRM-003-COM

6.3 RISK APPROVAL, ESCALATION & MONITORING

Risk Level	Escalation and Approval Requirements	Monitoring and Review
***Extreme* – 20 - 25**	**Board Approval Required (via Managing Director CEO or Group Executive Delegate)** The process, task or activity in question must not occur or must cease until actions are taken to eliminate the hazard or minimise the risk. Reasonable due diligence must be applied to ensure control plans are implemented within the approved timeframes and control effectiveness is achieved and maintained.	**Specific review of effectiveness of new or additional controls before process, task or activity can occur or recommence**
***High* – 10 - 16**	**Head/ GM Approval Required** Actions are to be taken to eliminate the hazard or minimise the risk. Reasonable due diligence must be applied to ensure control plans are implemented. within the approved timeframes and control effectiveness is achieved and maintained.	**Regular consideration of control effectiveness and new or additional control options**
***Moderate* – 5 - 9**	**Manager Approval Required** Actions are to be taken to eliminate the hazard or minimise the risk. Reasonable due diligence must be applied to ensure control plans are implemented within the approved timeframes and control effectiveness is achieved and maintained.	**Routine consideration of control effectiveness and new or additional control options**
***Low* – 1 - 4**	**Supervisor Approval Required** The process or activity in question continues with existing controls. Reasonable due diligence must be applied to ensure ongoing effectiveness of existing controls.	**Ongoing monitoring of existing control effectiveness** *(within agreed BAU arrangements)*

Background Notes

The following background notes are intended to provide context and should be discussed before the risk assessment.

1. Likelihood of AT explosion
   The likelihood of an AT experiencing a catastrophic explosion and fire it is extremely low. Since electrification of the CQCN there have been an estimated 6300 years of accumulated AT operation (see estimate below in note 2). Advice from Aurizon staff who commenced their service in the 1980s is that we have never had such an explosive incident with an AT. The most serious incidents were typically HV bushing failures.

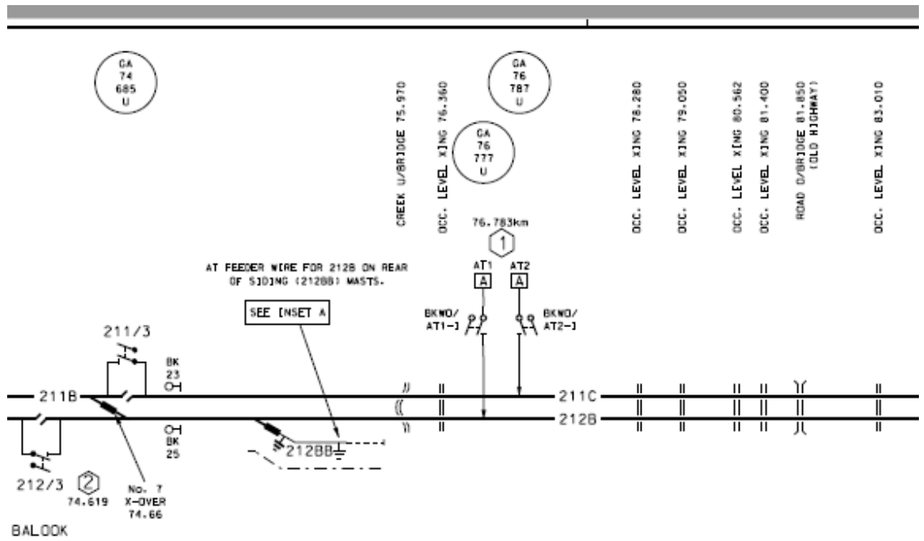
2. Estimated cumulative operating years for ATs in the CQCN
   Approximately 64 of these ATs were installed as part of the BW and GA power upgrades from around 2007 (i.e. these 64 ATs have been operating in their respective locations for around 10 years)
   - Wycarbah 4+4+4=12
   - Duaringa 4+4+4=12
   - Bluff 4+4+4=12
   - Raglan 4+4+4 = 12
   - Wotonga 4+4+4=12
   - DBCT 2+2=4
   - Bolingbroke 4+4+4=12

   There is a total of 254 ATs in the CQCN (source NAMS 21/05/2019). Assume that 190 (i.e. 254-64) of these have been operating in their respective locations since the inception of the CQCN electrification; i.e. around 30 years.
   Estimated 'operating years' for ATs in the CQCN = (64 * 10) + (190 * 30) = 6340 operating years.

3. Estimated personnel presence at trackside AT sites
   Trackside AT sites are only routinely attended for oil sampling (1 X 30 minutes per annum), visual check (1 X 30 minutes per annum) and vegetation control (4 X 30 minutes per annum)
   Total = 3 hours per annum. Normally workers visit site in pairs.
   As a percentage of the year this is 3/(24*365) = 0.03% of the year

4. Likelihood of personnel being injured by an explosion event at a trackside AT site
   From 1, 2 and 3 above it can be concluded that the probability of personnel being injured by the explosion of an AT at a trackside AT site is miniscule.

5. Layout of a typical trackside double AT site and the role of the PSC
   The aerial photograph below shows that there is no other infrastructure in close proximity to the Balook AT site. This site follows the typical layout of a double AT site which has a PSC between two ATs. The PSC's function is to provide a means connecting outputs from the AT into the SCADA system and Fault Locator System. The AT will continue to function properly in the absence of the PSC. If one AT were to catastrophically explode and catch fire it is plausible that, given the absence of fire walls, the adjacent PSC may be destroyed.



6. <u>Impact on continuity of operations from the loss of one AT and a PSC at a double AT site</u>
   Simulations were undertaken to assess the operational impact of having one AT out of service at each of the following trackside AT sites: Balook, Epala and Dingo. The summary of results is as follows as per email from [redacted] to [redacted] on 23/05/2019:

[redacted]

Hi [redacted],

I have completed the two simulations.

Simulation 1: One AT at Balook AT site is disconnected. There is no issue with the voltage drop.

Simulation 2: One AT at Epala AT site and one AT at Dingo AT site are disconnected. There is no issue with the voltage drop.

I am satisfied that if we were to lose one AT at either one of the aforementioned sites, there would be no impact to the performance of the network.

Regards,

AURIZON

[redacted]

Electrical Engineer
Network Asset Management

Appendix 2 Risk Assessment: Dingo Autotransformer Site Renewal - Explosion & Fire Risk

Assessment Title: Dingo Autotransformer Site Renewal - Explosion & Fire Risk

Note 1: *The original of this document, duly signed by the treatment owner and authorising officer, is held by the Document Controller within related business area.*

1. REFERENCE DOCUMENTS

The following sources of reference material have been used to develop this document:

Reference No.	Document Title
04-PRI-014	SHE Risk Management

Aurizon's Five Safety Principles

1. Safety is the core Aurizon value
2. All injuries can be prevented
3. Management is accountable for creating and maintaining a safe workplace
4. We are ALL responsible for preventing injuries
5. Working safely is a condition of employment

2. RISK ASSESSMENT CONTEXT

Risk Assessment Forum – Location	
Risk Context Summary	In AECOM's Assessment Report of Aurizon Network's FY18 Capital Expenditure Claim (Capex Claim), published on the Queensland Competition Authority's (QCA) website 27th May 2019, it was recommended to the QCA that Aurizon's Capital Expense for project IV.00154 Autotransformer Renewals be *"…rejected from the FY17/18 claim in its entirety, due to the lack of justification as for not addressing fire and explosion risk at the autotransformer sites."* Therefore, AECOM deemed the project as not prudent in scope because it did not adequately address the requirements of AS2067:2016 in respect of fire and explosion protection. An earlier analysis undertaken by Aurizon Network in 2013 titled; '*Risk Analysis of Fire, Explosion & Oil Spillage for Existing Feeder Stations, V.03.4900.373'*, considered fire and explosion risks at Feeder Stations rather than trackside autotransformer (AT) sites. At the time of the risk assessment AS2067:2008 was the current standard. AECOM also recommended in its assessment report; *"that a risk assessment is undertaken by Aurizon Network for each autotransformer site to determine the requirements for fire and explosion risk protection and then a decision be made on the prudency of standard."* With the subsequent release of AS2067:2016 Aurizon Network has decided to revisit the fire and explosion risks with a focus on the three trackside AT sites (Balook, Dingo and Ambrose-Epala).

Facilitator: [redacted]	[redacted]
Attendees at risk assessment meeting:	**Consultation:**
[redacted]	[redacted]

3. SHE RISK ASSESSMENT (CONDUCTED IN ACCORDANCE WITH 04-PRI-014 – SHE RISK MANAGEMENT)

- When conducting the SHE Risk Assessment, consideration should be given to the related business area Hazard and Risk Inventory to identify any Hazards/Safety Risks that have been previously approved by the relevant Level of Authority required by 04-PRI-014.
- Refer to 04-PRI-014 SHE Risk Management for determining the level of risk and authorisation. **See section 6.3 and 6.4 below**.
- The effectiveness of the implementation of all Control Measures shall be categorised in accordance with the criteria in **section 6.1 below.**
- Control selection and justification shall be evaluated using the guidelines in **section 6.2 below.**

SAFETY RISK ASSESSMENT		
CEO Enterprise/ Group Executive:	[redacted]	**Risk Assessment Context: (Detailed)** In AECOM's Assessment Report of Aurizon Network's FY18 Capital Expenditure Claim (Capex Claim), published on the Queensland Competition Authority's (QCA) website 27th May 2019, it was recommended to the QCA that Aurizon's Capital Expense for project IV.00154 Autotransformer Renewals be "…rejected from the FY17/18 claim in its entirety, due to the lack of justification as for not addressing fire and explosion risk at the autotransformer sites." Therefore, AECOM deemed the project as not prudent in scope because it did not adequately address the requirements of AS2067:2016 in respect of fire and explosion protection. An earlier analysis undertaken by Aurizon Network in 2013 titled; 'Risk Analysis of Fire, Explosion & Oil Spillage for Existing Feeder Stations, V.03.4900.373', considered fire and explosion risks at Feeder Stations rather than trackside autotransformer (AT) sites. At the time of the risk assessment AS2067:2008 was the current standard. AECOM also recommended in its assessment report; "that a risk assessment is undertaken by Aurizon Network for each autotransformer site to determine the requirements for fire and explosion risk protection and then a decision be made on the prudency of standard." With the subsequent release of AS2067:2016 Aurizon Network has decided to revisit the fire and explosion risks with a focus on the three trackside AT sites.
Head/GM Portfolio:	[redacted]	
Assessment Owner:	[redacted]	
Developed By:	[redacted]	
Authorisation and Date:	_____ __/__/20__	

1. IDENTIFY AND DESCRIBE			2. ASSESS AND EVALUATE					3. CONTROL AND MONITOR		
Risk No.	List Activity or Aspect and **Hazard** - e.g. What is it that has potential to cause harm?	**Risk** What is the risk associated with the hazard? **(The Risk Of)+(Due To)+ (Resulting In)**	**Existing Controls** What existing precautionary controls do I currently have in place and how effective are they? Confirm the Hierarchy of Control (HOC) and justify **Consider the following in order:** 1. Regulations 2. Codes of Practice 3. International / Australian or Industry Standard	**Justifications** Explain why this arrangement of controls was chosen. (also see **Section 6.2** below)	**Risk Evaluation** C	L	Level of Risk Extreme High Moderate Low	**Proposed Controls** Are there additional precautionary controls options I can apply to minimise the risk? (Apply the proposed Hierarchy of Control and justify)	**Justifications** Explain why this arrangement of controls was chosen. (also see **Section 6.2** below)	**Accountable Officer** Who will implement the proposed controls?	**Due Date** When are the proposed controls due?	**Date for next review** To monitor control effectiveness.

1	***Catastrophic AT fault resulting in explosion and intense fire***	*Risk of an AT tank rupturing* *Due to a mechanical failure of the AT* *Resulting in an explosion and the distribution of burning oil which has the potential to cause serious injury or fatality*	**Elimination* **Substitution* **Isolation* **Engineering* - *Robust design (e.g. type test requirements in Spec includes 10 X short circuit tests)* - *Oil bunding* - *Primary track feeder protection & secondary protection functions (e.g. Fault Locator)* **Administration* - *ECO Control room instructions* - *SWMS* - *ECOs and NPs are trained to ensure site staff move to a position of safety prior to energising a transformer* **PPE*	*A robust design is specified because the service conditions for an AT include frequent short circuit faults. The ATs are designed for these conditions.* *Calculated personnel exposure is approx. 3hrs per year X 2 persons (see background notes below)*	[redacted]	• *Use of less flammable insulating fluids* *<u>Risk Score assuming proposed controls are implemented</u>* *Consequence =* *Likelihood =* *Risk Score =*				
2	***Catastrophic AT fault causing infrastructure damage <u>within</u> the AT site which negatively impacts on operations***	*Risk of a negative impact on train operations* *Due to a catastrophic explosion of an AT* *Resulting in one of the two ATs at an AT site and the associated PSC being destroyed*	**Elimination* **Substitution* **Isolation* **Engineering* - *Oil bunding* - *Redundancy of ATs* - *Primary track feeder protection & secondary protection functions (e.g. Fault Locator)* **Administration* - *Emergency response procedures* **PPE*			• *Installation of Fire Resistant Barriers* • *Use of less flammable insulating fluids* *<u>Risk Score assuming proposed controls are implemented</u>* *Consequence =* *Likelihood =* *Risk Score =*				
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4	***Voltage surge (e.g. lightning) causes catastrophic AT failure***	*Risk of an AT tank rupturing* *Due to a severe voltage surge (e.g. lightning strike to OHL)* *Resulting in an AT explosion and the distribution of burning oil*	**Elimination* **Substitution* **Isolation* **Engineering* - *Lightning rods and surge arrestors on adjacent masts (refer SAF/SPC/5175/ELE/NET Section 9.5.14)* - *Primary track feeder protection & secondary protection functions (e.g. Fault Locator)* **Administration* **PPE*							

4. RISK ASSESSMENT AUTHORISATION

Prepared by: [redacted]

I hereby accept and endorse the results of the assessments in so far as they relate to my respective area of accountability and responsibility. I have duly escalated the approval of any treatments not within my authority or delegations.

I hereby agree to undertake those activities and responsibilities that have been designated to me in the above risk assessment.

Note: The SHE risk assessments above meet the defined requirements in 04-PRI-014 and subsequently contributes to satisfying the related risk management and legal obligations.

Treatment Owner Endorsement

Endorsed by: _____

Position: _____

Date: _____

Endorsed by: _____

Position: _____

Date: _____

Endorsed by: _____

Position: _____

Date: _____

Endorsed by: _____

Position: _____

Date: _____

I am satisfied this risk assessment has been conducted in accordance with 04-PRI-014, and that the deliberations and findings reflect the scope and intent of the risk assessment.

Note: *This assessment finds that the relevant legal obligations to manage SHE risk will be met via application of the stated hierarchy of controls and any additional actions, including monitoring as defined in this risk assessment.*

Authorised by: _____

Position: _____

Date: _____

5. REVISION STATUS

VERSION	*DATE*	*DESCRIPTION*	*Author*

6. RELATED INFORMATION

6.1 CONTROL EFFECTIVENESS

CONTROL EFFECTIVENESS		
FE	**Fully Effective**	Nothing more to be done except review and monitor the existing controls. Controls are well designed for the risk, address the root cause and Management believes that they are effective and reliable.
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LI	**Largely Ineffective**	Significant controls gaps. Either controls do not treat root causes, or they do not operate at all effectively.
TI	**None or Totally ineffective**	Virtually no credible control. Management has no confidence that any degree of control is being achieved due to poor control design and/or very limited operational effectiveness.

6.2 CONTROL JUSTIFICATION

When justifying the selection of the hierarchy of controls (HOC) for the elimination of hazards or minimisation of SHE risks the following criteria must be taken into consideration.

- The ability or inability to totally eliminate the hazard at source.
- The ability or inability to totally eliminate contact with the hazard.
- The ability or inability to totally eliminate the hazard within delegated physical and or financial means.
- The consideration of all credible control options available to eliminate hazard or minimise risk within personal sphere of control.
- The selected level 2 control measure(s) will have valid potential to effectively minimise the SHE risk.
- The full HOC has been considered (*including any level 2 combinations*).

Note: The justification should be recorded (where practicable within the assessment itself), however, other records should be maintained to support justification if needed for both existing and proposed control hierarchies. Consideration should be given to reasons for selection and rejection.

Example: The following is an example of where human factors or mechanical failure form part of the risk and related causal / control factors. *(E.g. it is not possible to totally eliminate human error or mechanical failure as a root cause in the context of the hazard as it is defined in this assessment etc.)*

RISK MATRIX

			CONSEQUENCE					
			1	2	3	4	5	
			Safety & Health	**Safety & Health**	**Safety & Health**	**Safety & Health**	**Safety & Health**	
			Illness or injury not requiring medical treatment.	Minor illness/ injury requiring medical treatment (e.g. First Aid and MTI).	Short term (reversible) impact on health/body function. Multiple medical treatment injuries (MTI's). Immediate admission to hospital for treatment.	Life Threatening injury or multiple moderate injuries causing hospitalisation Permanent total disability Severe and irreversible loss to quality of life.	Death	
			Environment	**Environment**	**Environment**	**Environment**	**Environment**	
			No adverse effect on an environmental value (e.g. water, soil, air, wildlife). That is, the impact is wholly contained in a controlled area. No damage or remediation required Regulator notification not required. No penalties. Does not contribute to corporate environmental notification KPI.	An adverse effect on an environmental value, which may be visual, olfactory, audible and may cause an unhealthy, offensive or unsightly condition because of contamination. Cost of any potential damage or remediation <$5K (Qld, SA, Vic) <$10K (NSW), <$20K (WA). Regulator notification unlikely to be required. Penalty unlikely, but regulator could serve a show cause notice. Does not contribute to corporate environmental notification KPI.	Environmental harm that is not trivial or negligible. Cost of damage and/or remediation >$5K but <$50K (Qld, SA, Vic), >$10K (NSW), >$20K but <$100K (WA). Regulator notification mandatory. Penalty or prosecution possible. Contributes to corporate environmental notification KPI.	Environmental harm that is of a high impact or widespread. Cost of damage and/or remediation >$50K (Qld, NSW, SA & Vic), >$20K but < $1M. Regulator notification mandatory. Penalty or prosecution likely. Contributes to corporate environmental notification KPI. Major damage to environmental reputation at regional level.	Environmental harm that is irreversible, high impact or widespread. Caused to an area of high conservation value (e.g. a National Park) or area of special significance (e.g. Great Barrier Reef Marine Park). Cost of damage and/or remediation >$1M. Regulator notification mandatory. Penalty or prosecution almost certain. Contributes to corporate environmental notification KPI. Major damage to environmental reputation at national level.	
LIKELIHOOD	**5**	Is expected to occur, almost inevitable > 10 times per year	**5**	**10**	**15**	**20**	**25**	**Board Approval Required (via Managing Director and CEO) or Group Executive Delegate**
	4	Is expected to occur in most circumstances, Not surprised if it happens At least annually and up to 10 times per year	**4**	**8**	**12**	**16**	**20**	
	3	Might occur in some circumstances, Once in the next 2 to 10 years	**3**	**6**	**9**	**12**	**15**	**Head/GM Approval Required**
	2	Could occur in some circumstances, Surprised if it happens Once in the next 11 to 50 years	**2**	**4**	**6**	**8**	**10**	
	1	May occur but only in exceptional circumstances. It would be highly unexpected Not in the next 50 years	**1**	**2**	**3**	**4**	**5**	
			Supervisor or Manager Approval Required				**Manager Approval Required**	

FOR SECURITY RISK CONSEQUENCE FACTORS SEE – 04-FRM-003-COM

6.3 RISK APPROVAL, ESCALATION & MONITORING

Risk Level	Escalation and Approval Requirements	Monitoring and Review
***Extreme* – 20 - 25**	**Board Approval Required (via Managing Director CEO or Group Executive Delegate)** The process, task or activity in question must not occur or must cease until actions are taken to eliminate the hazard or minimise the risk. Reasonable due diligence must be applied to ensure control plans are implemented within the approved timeframes and control effectiveness is achieved and maintained.	**Specific review of effectiveness of new or additional controls before process, task or activity can occur or recommence**
***High* – 10 - 16**	**Head/ GM Approval Required** Actions are to be taken to eliminate the hazard or minimise the risk. Reasonable due diligence must be applied to ensure control plans are implemented. within the approved timeframes and control effectiveness is achieved and maintained.	**Regular consideration of control effectiveness and new or additional control options**
***Moderate* – 5 - 9**	**Manager Approval Required** Actions are to be taken to eliminate the hazard or minimise the risk. Reasonable due diligence must be applied to ensure control plans are implemented within the approved timeframes and control effectiveness is achieved and maintained.	**Routine consideration of control effectiveness and new or additional control options**
***Low* – 1 - 4**	**Supervisor Approval Required** The process or activity in question continues with existing controls. Reasonable due diligence must be applied to ensure ongoing effectiveness of existing controls.	**Ongoing monitoring of existing control effectiveness** *(within agreed BAU arrangements)*

Background Notes

The following background notes are intended to provide context and should be discussed before the risk assessment.

1. Likelihood of AT explosion
   The likelihood of an AT experiencing a catastrophic explosion and fire it is extremely low. Since electrification of the CQCN there have been an estimated 6300 years of accumulated AT operation (see estimate below in note 2). Advice from Aurizon staff who commenced their service in the 1980s is that we have never had such an explosive incident with an AT. The most serious incidents were typically HV bushing failures.

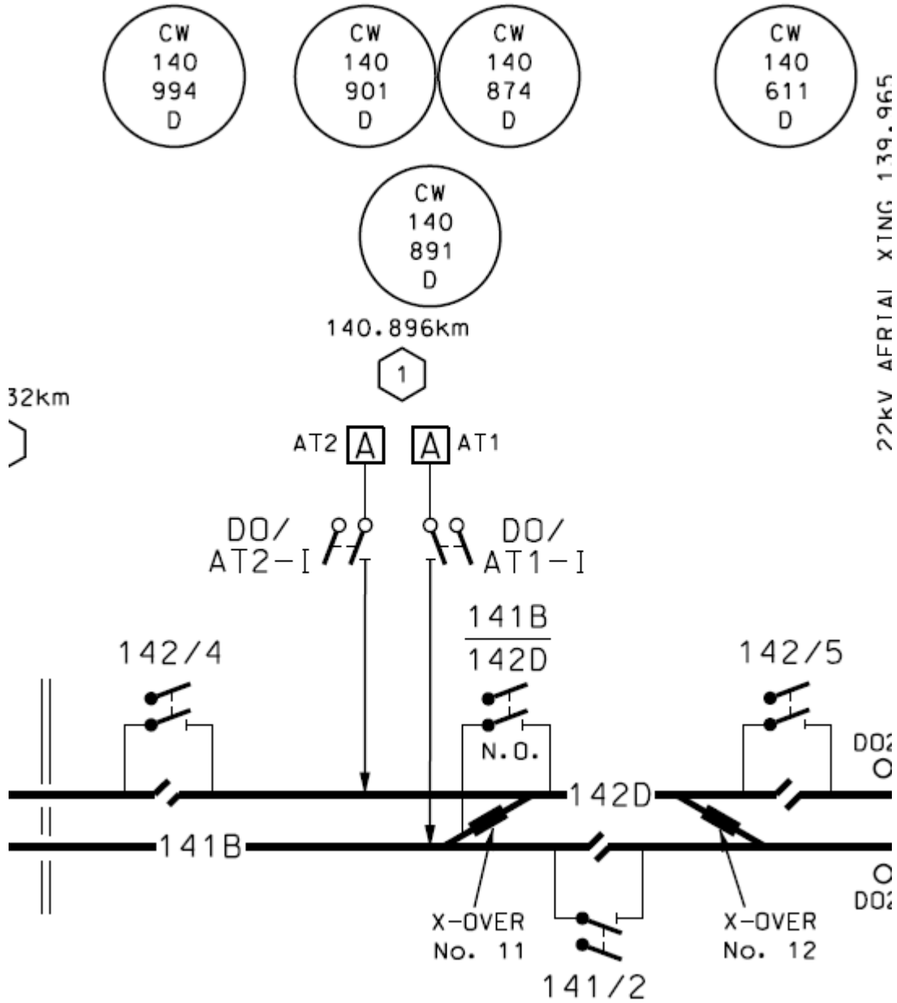
2. Estimated cumulative operating years for ATs in the CQCN
   Approximately 64 of these ATs were installed as part of the BW and GA power upgrades from around 2007 (i.e. these 64 ATs have been operating in their respective locations for around 10 years)
   - Wycarbah 4+4+4=12
   - Duaringa 4+4+4=12
   - Bluff 4+4+4=12
   - Raglan 4+4+4 = 12
   - Wotonga 4+4+4=12
   - DBCT 2+2=4
   - Bolingbroke 4+4+4=12

   There is a total of 254 ATs in the CQCN (source NAMS 21/05/2019). Assume that 190 (i.e. 254-64) of these have been operating in their respective locations since the inception of the CQCN electrification; i.e. around 30 years.
   Estimated 'operating years' for ATs in the CQCN = (64 * 10) + (190 * 30) = 6340 operating years.

3. Estimated personnel presence at trackside AT sites
   Trackside AT sites are only routinely attended for oil sampling (1 X 30 minutes per annum), visual check (1 X 30 minutes per annum) and vegetation control (4 X 30 minutes per annum)
   Total = 3 hours per annum. Normally workers visit site in pairs.
   As a percentage of the year this is 3/(24*365) = 0.03% of the year

4. Likelihood of personnel being injured by an explosion event at a trackside AT site
   From 1, 2 and 3 above it can be concluded that the probability of personnel being injured by the explosion of an AT at a trackside AT site is miniscule.

5. Layout of a typical trackside double AT site and the role of the PSC
   The aerial photograph below shows that there is no other infrastructure in close proximity to the Dingo AT site. This site follows the typical layout of a double AT site which has a PSC between two ATs. The PSC's function is to provide a means connecting outputs from the AT into the SCADA system and Fault Locator System. The AT will continue to function properly in the absence of the PSC. If one AT were to catastrophically explode and catch fire it is plausible that, given the absence of fire walls, the adjacent PSC may be destroyed.



6. Impact on continuity of operations from the loss of one AT and a PSC at a double AT site
Simulations were undertaken to assess the operational impact of having one AT out of service at each of the following trackside AT sites: Balook, Epala and Dingo. The summary of results is as follows as per email from [redacted] to [redacted] on 23/05/2019:

[redacted]

Hi [redacted],

I have completed the two simulations.

Simulation 1: One AT at Balook AT site is disconnected. There is no issue with the voltage drop.

Simulation 2: One AT at Epala AT site and one AT at Dingo AT site are disconnected. There is no issue with the voltage drop.

I am satisfied that if we were to lose one AT at either one of the aforementioned sites, there would be no impact to the performance of the network.

Regards,

AURIZON

[redacted]

Electrical Engineer
Network Asset Management

Appendix 3 Risk Assessment: Ambrose-Epala Autotransformer Site Renewal - Explosion & Fire Risk

Assessment Title: Ambrose-Epala Autotransformer Site Renewal - Explosion & Fire Risk

Note 1: *The original of this document, duly signed by the treatment owner and authorising officer, is held by the Document Controller within related business area.*

1. REFERENCE DOCUMENTS

The following sources of reference material have been used to develop this document:

Reference No.	Document Title
04-PRI-014	SHE Risk Management

Aurizon's Five Safety Principles

1. Safety is the core Aurizon value
2. All injuries can be prevented
3. Management is accountable for creating and maintaining a safe workplace
4. We are ALL responsible for preventing injuries
5. Working safely is a condition of employment

2. RISK ASSESSMENT CONTEXT

Risk Assessment Forum – Location	
Risk Context Summary	In AECOM's Assessment Report of Aurizon Network's FY18 Capital Expenditure Claim (Capex Claim), published on the Queensland Competition Authority's (QCA) website 27th May 2019, it was recommended to the QCA that Aurizon's Capital Expense for project IV.00154 Autotransformer Renewals be *"…rejected from the FY17/18 claim in its entirety, due to the lack of justification as for not addressing fire and explosion risk at the autotransformer sites."* Therefore, AECOM deemed the project as not prudent in scope because it did not adequately address the requirements of AS2067:2016 in respect of fire and explosion protection. An earlier analysis undertaken by Aurizon Network in 2013 titled; '*Risk Analysis of Fire, Explosion & Oil Spillage for Existing Feeder Stations, V.03.4900.373',* considered fire and explosion risks at Feeder Stations rather than trackside autotransformer (AT) sites. At the time of the risk assessment AS2067:2008 was the current standard. AECOM also recommended in its assessment report; *"that a risk assessment is undertaken by Aurizon Network for each autotransformer site to determine the requirements for fire and explosion risk protection and then a decision be made on the prudency of standard."* With the subsequent release of AS2067:2016 Aurizon Network has decided to revisit the fire and explosion risks with a focus on the three trackside AT sites (Balook, Dingo and Ambrose-Epala).

Facilitator: [redacted]	[redacted]
Attendees at risk assessment meeting: [redacted]	**Consultation:** [redacted]

3. SHE RISK ASSESSMENT (CONDUCTED IN ACCORDANCE WITH 04-PRI-014 – SHE RISK MANAGEMENT)

- When conducting the SHE Risk Assessment, consideration should be given to the related business area Hazard and Risk Inventory to identify any Hazards/Safety Risks that have been previously approved by the relevant Level of Authority required by 04-PRI-014.
- Refer to 04-PRI-014 SHE Risk Management for determining the level of risk and authorisation. **See section 6.3 and 6.4 below**.
- The effectiveness of the implementation of all Control Measures shall be categorised in accordance with the criteria in **section 6.1 below.**
- Control selection and justification shall be evaluated using the guidelines in **section 6.2 below.**

SAFETY RISK ASSESSMENT		
CEO Enterprise/ Group Executive:	[redacted]	**Risk Assessment Context: (Detailed)** In AECOM's Assessment Report of Aurizon Network's FY18 Capital Expenditure Claim (Capex Claim), published on the Queensland Competition Authority's (QCA) website 27th May 2019, it was recommended to the QCA that Aurizon's Capital Expense for project IV.00154 Autotransformer Renewals be "…rejected from the FY17/18 claim in its entirety, due to the lack of justification as for not addressing fire and explosion risk at the autotransformer sites." Therefore, AECOM deemed the project as not prudent in scope because it did not adequately address the requirements of AS2067:2016 in respect of fire and explosion protection. An earlier analysis undertaken by Aurizon Network in 2013 titled; 'Risk Analysis of Fire, Explosion & Oil Spillage for Existing Feeder Stations, V.03.4900.373', considered fire and explosion risks at Feeder Stations rather than trackside autotransformer (AT) sites. At the time of the risk assessment AS2067:2008 was the current standard. AECOM also recommended in its assessment report; "that a risk assessment is undertaken by Aurizon Network for each autotransformer site to determine the requirements for fire and explosion risk protection and then a decision be made on the prudency of standard." With the subsequent release of AS2067:2016 Aurizon Network has decided to revisit the fire and explosion risks with a focus on the three trackside AT sites.
Head/GM Portfolio:	[redacted]	
Assessment Owner:	[redacted]	
Developed By:	[redacted]	
Authorisation and Date:	_____ __/__/20__	

1. IDENTIFY AND DESCRIBE			2. ASSESS AND EVALUATE					3. CONTROL AND MONITOR		
Risk No.	List Activity or Aspect and **Hazard** - e.g. What is it that has potential to cause harm?	**Risk** What is the risk associated with the hazard? **(The Risk Of)+(Due To)+ (Resulting In)**	**Existing Controls** What existing precautionary controls do I currently have in place and how effective are they? Confirm the Hierarchy of Control (HOC) and justify **Consider the following in order:** 1. Regulations 2. Codes of Practice 3. International / Australian or Industry Standard	**Justifications** Explain why this arrangement of controls was chosen. (also see **Section 6.2** below)	**Risk Evaluation** C	L	Level of Risk Extreme High Moderate Low	**Proposed Controls** Are there additional precautionary controls options I can apply to minimise the risk? (Apply the proposed Hierarchy of Control and justify)	**Justifications** Explain why this arrangement of controls was chosen. (also see **Section 6.2** below)	**Accountable Officer** Who will implement the proposed controls?	**Due Date** When are the proposed controls due?	**Date for next review** To monitor control effectiveness.

1	***Catastrophic AT fault resulting in explosion and intense fire***	*Risk of an AT tank rupturing* *Due to a mechanical failure of the AT* *Resulting in an explosion and the distribution of burning oil which has the potential to cause serious injury or fatality*	**Elimination* **Substitution* **Isolation* **Engineering* - *Robust design (e.g. type test requirements in Spec includes 10 X short circuit tests)* - *Oil bunding* - *Primary track feeder protection & secondary protection functions (e.g. Fault Locator)* **Administration* - *ECO Control room instructions* - *SWMS* - *ECOs and NPs are trained to ensure site staff move to a position of safety prior to energising a transformer* **PPE*	*A robust design is specified because the service conditions for an AT include frequent short circuit faults. The ATs are designed for these conditions.* *Calculated personnel exposure is approx. 3hrs per year X 2 persons (see background notes below)*	[redacted]	• *Use of less flammable insulating fluids* *<u>Risk Score assuming proposed controls are implemented</u>* *Consequence =* *Likelihood =* *Risk Score =*				
2	***Catastrophic AT fault causing infrastructure damage <u>within</u> the AT site which negatively impacts on operations***	*Risk of a negative impact on train operations* *Due to a catastrophic explosion of an AT* *Resulting in one of the two ATs at an AT site and the associated PSC being destroyed*	**Elimination* **Substitution* **Isolation* **Engineering* - *Oil bunding* - *Redundancy of ATs* - *Primary track feeder protection & secondary protection functions (e.g. Fault Locator)* **Administration* - *Emergency response procedures* **PPE*			• *Installation of Fire Resistant Barriers* • *Use of less flammable insulating fluids* *<u>Risk Score assuming proposed controls are implemented</u>* *Consequence =* *Likelihood =* *Risk Score =*				
3	***Catastrophic AT fault causing infrastructure damage <u>external to</u> the AT site which negatively impacts on operations***	*Risk of a negative impact on train operations* *Due to a catastrophic explosion of an AT* *Resulting in damage to the track or other adjacent infrastructure*	**Elimination* **Substitution* **Isolation* *- Remote location of site* **Engineering* - *Oil bunding* - *Primary track feeder protection & secondary protection functions (e.g. Fault Locator)* **Administration* **PPE*	*The Ambrose-Epala AT site is 'remote' from adjacent infrastructure. See background notes below.*		• *Installation of Fire Resistant Barriers* • *Use of less flammable insulating fluids* *<u>Risk Score assuming proposed controls are implemented</u>* *Consequence =* *Likelihood =* *Risk Score =*				
4	***Voltage surge (e.g. lightning) causes catastrophic AT failure***	*Risk of an AT tank rupturing* *Due to a severe voltage surge (e.g. lightning strike to OHL)* *Resulting in an AT explosion and the distribution of burning oil*	**Elimination* **Substitution* **Isolation* **Engineering* - *Lightning rods and surge arrestors on adjacent masts (refer SAF/SPC/5175/ELE/NET Section 9.5.14)* - *Primary track feeder protection & secondary protection functions (e.g. Fault Locator)* **Administration* **PPE*							

4. RISK ASSESSMENT AUTHORISATION

Prepared by: [redacted]

I hereby accept and endorse the results of the assessments in so far as they relate to my respective area of accountability and responsibility. I have duly escalated the approval of any treatments not within my authority or delegations.

I hereby agree to undertake those activities and responsibilities that have been designated to me in the above risk assessment.

Note: The SHE risk assessments above meet the defined requirements in 04-PRI-014 and subsequently contributes to satisfying the related risk management and legal obligations.

Treatment Owner Endorsement

Endorsed by: _____

Position: _____

Date: _____

Endorsed by: _____

Position: _____

Date: _____

Endorsed by: _____

Position: _____

Date: _____

Endorsed by: _____

Position: _____

Date: _____

I am satisfied this risk assessment has been conducted in accordance with 04-PRI-014, and that the deliberations and findings reflect the scope and intent of the risk assessment.

Note: *This assessment finds that the relevant legal obligations to manage SHE risk will be met via application of the stated hierarchy of controls and any additional actions, including monitoring as defined in this risk assessment.*

Authorised by: _____

Position: _____

Date: _____

5. REVISION STATUS

VERSION	*DATE*	*DESCRIPTION*	*Author*

6. RELATED INFORMATION

6.1 CONTROL EFFECTIVENESS

CONTROL EFFECTIVENESS		
FE	**Fully Effective**	Nothing more to be done except review and monitor the existing controls. Controls are well designed for the risk, address the root cause and Management believes that they are effective and reliable.
SE	**Substantially Effective**	Most controls are designed correctly and are in place and effective. Some more work to be done to improve effectiveness or, the accountable person/s have some reservations about operational effectiveness and reliability.
PE	**Partially Effective**	While design of controls may be largely correct in that they treat most of the root causes of the risk they are not currently very effective or, some of the controls do not seem correctly designed in that they do not treat the root causes, those that are correctly designed are operating effectively.
LI	**Largely Ineffective**	Significant controls gaps. Either controls do not treat root causes, or they do not operate at all effectively.
TI	**None or Totally ineffective**	Virtually no credible control. Management has no confidence that any degree of control is being achieved due to poor control design and/or very limited operational effectiveness.

6.2 CONTROL JUSTIFICATION

When justifying the selection of the hierarchy of controls (HOC) for the elimination of hazards or minimisation of SHE risks the following criteria must be taken into consideration.

- The ability or inability to totally eliminate the hazard at source.
- The ability or inability to totally eliminate contact with the hazard.
- The ability or inability to totally eliminate the hazard within delegated physical and or financial means.
- The consideration of all credible control options available to eliminate hazard or minimise risk within personal sphere of control.
- The selected level 2 control measure(s) will have valid potential to effectively minimise the SHE risk.
- The full HOC has been considered (*including any level 2 combinations*).

Note: The justification should be recorded (where practicable within the assessment itself), however, other records should be maintained to support justification if needed for both existing and proposed control hierarchies. Consideration should be given to reasons for selection and rejection.

Example: The following is an example of where human factors or mechanical failure form part of the risk and related causal / control factors. *(E.g. it is not possible to totally eliminate human error or mechanical failure as a root cause in the context of the hazard as it is defined in this assessment etc.)*

RISK MATRIX

			CONSEQUENCE					
			1	2	3	4	5	
			Safety & Health	**Safety & Health**	**Safety & Health**	**Safety & Health**	**Safety & Health**	
			Illness or injury not requiring medical treatment.	Minor illness/ injury requiring medical treatment (e.g. First Aid and MTI).	Short term (reversible) impact on health/body function. Multiple medical treatment injuries (MTI's). Immediate admission to hospital for treatment.	Life Threatening injury or multiple moderate injuries causing hospitalisation Permanent total disability Severe and irreversible loss to quality of life.	Death	
			Environment	**Environment**	**Environment**	**Environment**	**Environment**	
			No adverse effect on an environmental value (e.g. water, soil, air, wildlife). That is, the impact is wholly contained in a controlled area. No damage or remediation required Regulator notification not required. No penalties. Does not contribute to corporate environmental notification KPI.	An adverse effect on an environmental value, which may be visual, olfactory, audible and may cause an unhealthy, offensive or unsightly condition because of contamination. Cost of any potential damage or remediation <$5K (Qld, SA, Vic) <$10K (NSW), <$20K (WA). Regulator notification unlikely to be required. Penalty unlikely, but regulator could serve a show cause notice. Does not contribute to corporate environmental notification KPI.	Environmental harm that is not trivial or negligible. Cost of damage and/or remediation >$5K but <$50K (Qld, SA, Vic), >$10K (NSW), >$20K but <$100K (WA). Regulator notification mandatory. Penalty or prosecution possible. Contributes to corporate environmental notification KPI.	Environmental harm that is of a high impact or widespread. Cost of damage and/or remediation >$50K (Qld, NSW, SA & Vic), >$20K but < $1M. Regulator notification mandatory. Penalty or prosecution likely. Contributes to corporate environmental notification KPI. Major damage to environmental reputation at regional level.	Environmental harm that is irreversible, high impact or widespread. Caused to an area of high conservation value (e.g. a National Park) or area of special significance (e.g. Great Barrier Reef Marine Park). Cost of damage and/or remediation >$1M. Regulator notification mandatory. Penalty or prosecution almost certain. Contributes to corporate environmental notification KPI. Major damage to environmental reputation at national level.	
LIKELIHOOD	**5**	Is expected to occur, almost inevitable > 10 times per year	**5**	**10**	**15**	**20**	**25**	**Board Approval Required (via Managing Director and CEO) or Group Executive Delegate**
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	2	Could occur in some circumstances, Surprised if it happens Once in the next 11 to 50 years	**2**	**4**	**6**	**8**	**10**	
	1	May occur but only in exceptional circumstances. It would be highly unexpected Not in the next 50 years	**1**	**2**	**3**	**4**	**5**	
			Supervisor or Manager Approval Required				**Manager Approval Required**	

FOR SECURITY RISK CONSEQUENCE FACTORS SEE – 04-FRM-003-COM

6.3 RISK APPROVAL, ESCALATION & MONITORING

Risk Level	Escalation and Approval Requirements	Monitoring and Review
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***High* – 10 - 16**	**Head/ GM Approval Required** Actions are to be taken to eliminate the hazard or minimise the risk. Reasonable due diligence must be applied to ensure control plans are implemented. within the approved timeframes and control effectiveness is achieved and maintained.	**Regular consideration of control effectiveness and new or additional control options**
***Moderate* – 5 - 9**	**Manager Approval Required** Actions are to be taken to eliminate the hazard or minimise the risk. Reasonable due diligence must be applied to ensure control plans are implemented within the approved timeframes and control effectiveness is achieved and maintained.	**Routine consideration of control effectiveness and new or additional control options**
***Low* – 1 - 4**	**Supervisor Approval Required** The process or activity in question continues with existing controls. Reasonable due diligence must be applied to ensure ongoing effectiveness of existing controls.	**Ongoing monitoring of existing control effectiveness** *(within agreed BAU arrangements)*

Background Notes

The following background notes are intended to provide context and should be discussed before the risk assessment.

1. Likelihood of AT explosion
   The likelihood of an AT experiencing a catastrophic explosion and fire it is extremely low. Since electrification of the CQCN there have been an estimated 6300 years of accumulated AT operation (see estimate below in note 2). Advice from Aurizon staff who commenced their service in the 1980s is that we have never had such an explosive incident with an AT. The most serious incidents were typically HV bushing failures.

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   Approximately 64 of these ATs were installed as part of the BW and GA power upgrades from around 2007 (i.e. these 64 ATs have been operating in their respective locations for around 10 years)
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   Estimated 'operating years' for ATs in the CQCN = (64 * 10) + (190 * 30) = 6340 operating years.

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   Total = 3 hours per annum. Normally workers visit site in pairs.
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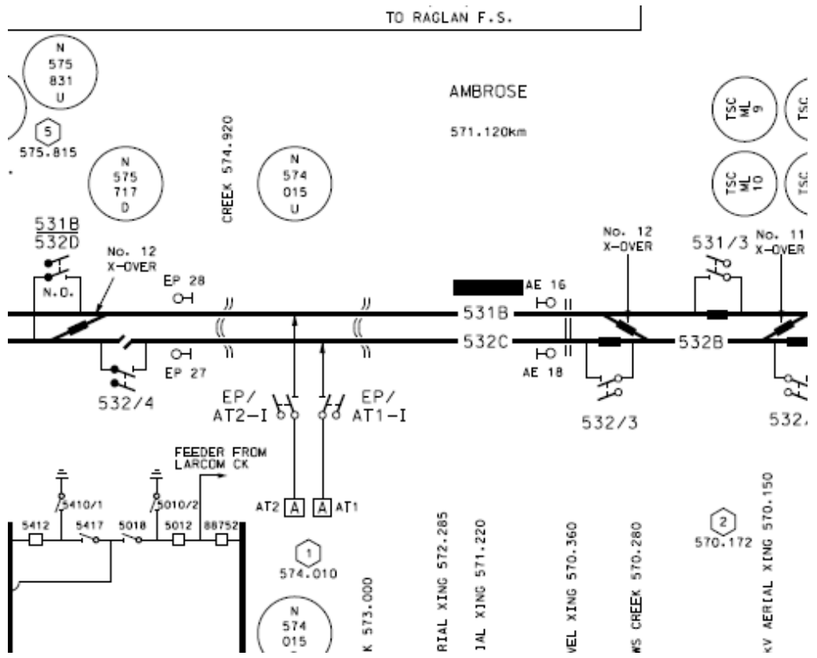

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[redacted]

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Simulation 2: One AT at Epala AT site and one AT at Dingo AT site are disconnected. There is no issue with the voltage drop.

I am satisfied that if we were to lose one AT at either one of the aforementioned sites, there would be no impact to the performance of the network.

Regards,

AURIZON.

[redacted]

Electrical Engineer
Network Asset Management