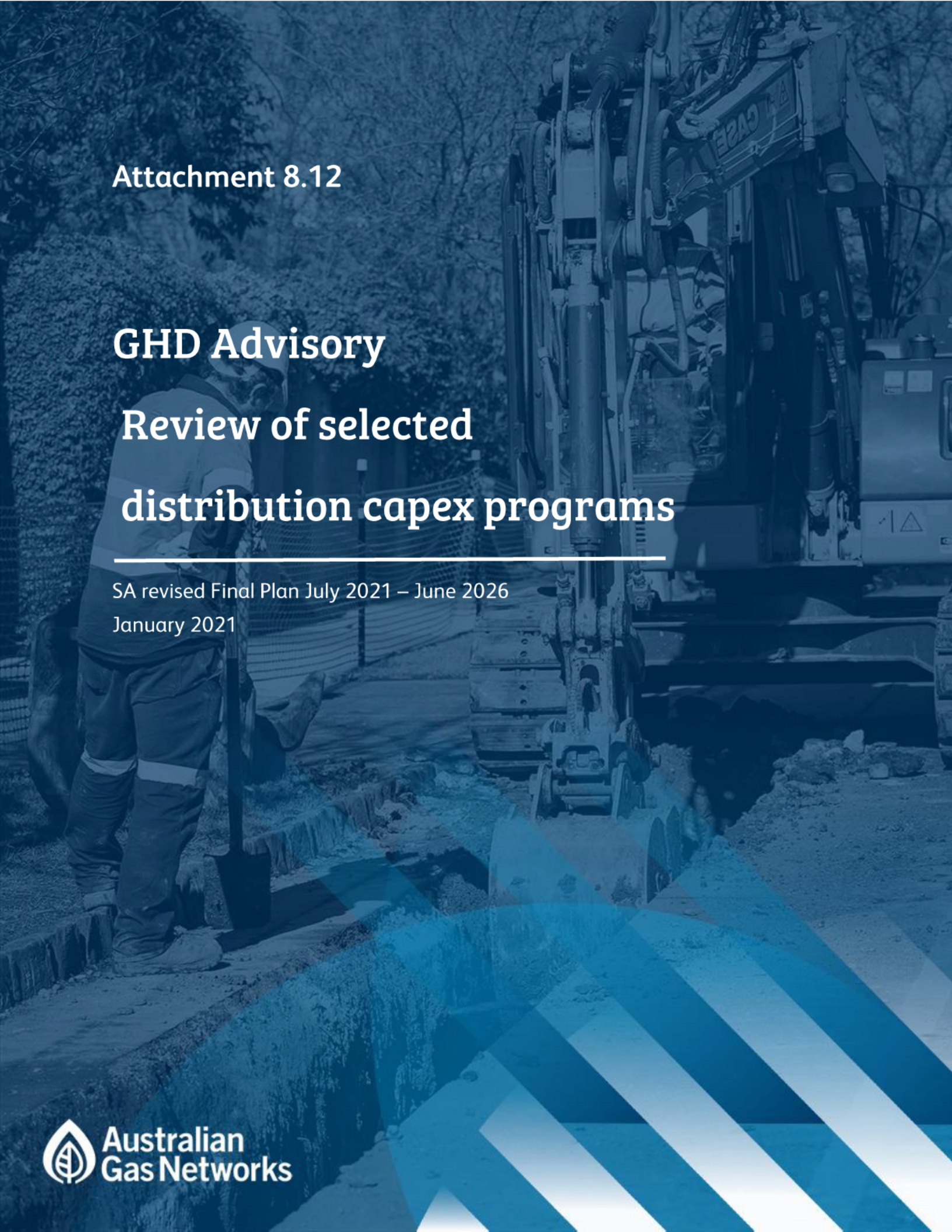


Attachment 8.12

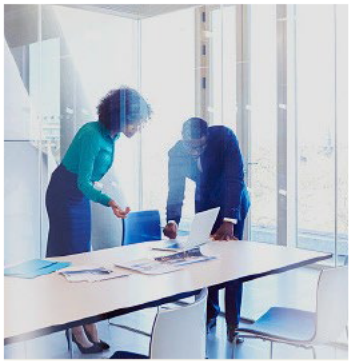
GHD Advisory Review of selected distribution capex programs

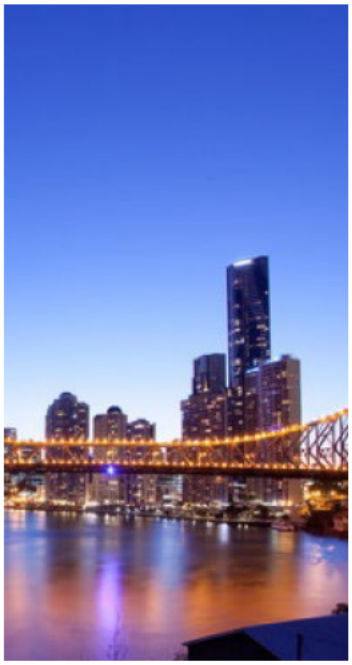
SA revised Final Plan July 2021 – June 2026

January 2021

Australian Gas Networks

GHD Advisory





Review of selected distribution capex programs

Australian Gas Networks (SA)

12 January 2021

Project Number: 12542885

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Executive summary

The Australian Energy Regulator (AER) is reviewing the access arrangement (AA) that will apply to Australian Gas Networks (SA) (AGN) for the 2021 to 2026 period.

As part of their submission to the AER, AGN proposed new capital expenditure for their:

- Mains replacement program
- Other distribution capital expenditure

AGN's mains replacement program involves the replacement of pipes (and associated services) that have significantly deteriorated, such that there is an increasing risk of, and there are increasing numbers of gas leaks. The program is ongoing and undertaken to ensure public safety. For the next AA period (2021-26), AGN propose the proactive replacement of 860 km of mains across the following programs:

- 520 km of CI/UPS block replacement
- 38 km of CI/UPS block replacement for North Adelaide
- 14 km of HDPE 250 replacement
- 198 km of HDPE 575 DN40 HP replacement
- 90 km of HDPE 575 DN40 MP replacement

In its draft determination the AER accepted the mains replacement program is justified on the grounds that it is necessary to maintain and improve the safety and integrity of service consistent with National Gas Rules (NGR) 79(1)(b) and 79(2)(c)(i)(ii).[1] However, based predominately on advice provided by their technical consultant, Zincara, the AER determined that "AGN did not provide adequate justification for the speed and scope of its mains replacement program to enable us to form the view it is conforming capital expenditure"[2]. As a result, the AER approved only 607 km of the mains replacement program.

Other distribution capital expenditure proposed by AGN included:

- The replacement of 32 network valves that are currently inoperable or have had leaks repaired but are in a deteriorated state. (SA103 Valve Replacement)
- Pipeline modification for inline inspection (SA105 Inline Inspection (Pigging)), which includes conducting physical FEED studies on three of the highest priority transmission pipelines in its network and undertaking one high priority inline modification project. The purpose of the FEED studies and the inline modification project is to inform an inline inspection (pigging) program that will allow AGN to monitor corrosion on 200 km of transmission pipelines in the network using intelligent pigs.

In its draft determination, the AER stated it required further justification on some of AGN's valve replacement and pipeline modification programs to enable them to form a view whether this is conforming capital expenditure.[3] The AER agreed from a safety perspective that valves should be replaced when they are inoperable (or frozen). However, it determined that 16 of the 32 valves proposed to be replaced should not be proactively replaced and should continue to be monitored during the access period.[4] The AER also decided to support the modification and inline inspection of one of the priority pipelines. However, it did not

[1] AER, *Attachment 5: Capital Expenditure, Draft Decision – Australian Gas Networks (SA) Access Arrangement 20121-26*, p. 14

[2] AER, *Attachment 5: Capital Expenditure, Draft Decision – Australian Gas Networks (SA) Access Arrangement 20121-26*, p. 6

[3] AER, *Attachment 5: Capital Expenditure, Draft Decision – Australian Gas Networks (SA) Access Arrangement 20121-26*, p. 8

[4] AER, *Attachment 5: Capital Expenditure, Draft Decision – Australian Gas Networks (SA) Access Arrangement 20121-26*, p. 38

support the need to undertake FEED studies for those pipelines that are not being modified in the next AA period (2021-26).

GHD's engagement and qualifications

AGN engaged GHD to provide a technical specialist view on whether the proposed mains replacement and other distribution system capital expenditure put forward by AGN complies with the relevant parts of the NGR, particularly Rule 79 of the NGR[5].

This report has been prepared under the guidance of knowledgeable people with considerable experience in the gas industry. This experience includes design, construction, and operation of gas gathering systems, gas transmission pipelines, and gas distribution networks across Australia and New Zealand.

GHD's assessment

An assessment against Rule 79 of the NGR requires consideration of whether new capital expenditure is conforming in that the capital expenditure must be such as would be incurred by a prudent service provider acting efficiently, in accordance with accepted good industry practice, to achieve the lowest sustainable cost of providing services; and the capital expenditure must be justifiable on a ground stated in subrule 79(2) of the NGR.

CI/UPS - block

GHD disagrees with the AER's decision to defer 115 km of replacement. From FY18 to FY20 the CI/UPS leaks per km has increased from approximately one leak per km, which itself is high for a distribution network and an order of magnitude higher than older-style HDPE systems, to three leaks per km. This is a significant increase in a short period of time and shows that the condition of these mains is deteriorating. Delay of the replacement to the subsequent AA period is not prudent. Further, AGN has demonstrated their capability to deliver the requested volume of CI/UPS mains replacement, having delivered a higher total volume of mains replacement in the current and prior AA periods than requested in the next regulatory period.

HDPE 575 DN40 HP - Insertion

GHD disagrees with the AER's decision to reject the replacement of DN40 HP mains installed in 1991 and 1992.

GHD reviewed the same squeeze off failure data as the AER and Zincara. GHD supports AGN's conclusion that a clear flattening of the failure trend after 1993 can be seen in the HDPE DN40 and DN50 data set (which would have been subject to the same procedure). It is also difficult to define a single year from data which is statistically low frequency and has a high-risk consequence if a failure occurs, therefore it is prudent to be conservative.

In addition to the information available to the AER and Zincara, GHD was provided with a memo from the network operator from August 1991 that states consideration should be given to installing limit stops which would prevent squeeze off damage. AGN stated this procedure took approximately one year to implement due to the requirement to manufacture and replace a large number of squeeze off jacks, additional time to develop new procedures and train operators would also be required.

HDPE 575 DN40 MP (direct)

GHD agrees AGN that the DN40 MP mains need to be replaced due to the failure history of HDPE 575 mains. Direct burial is the only remedy available to reduce risks further than the current risk rating.

[5] Rule 79 of the NGR sets out the "New capital expenditure criteria" including the criteria that needs to be meet for expenditure to be considered conforming, the justification of the conforming capital expenditure, and the treatment of capital expenditure for revenue.

The current (untreated) risk rating is intermediate for the DN40 MP, rather than high as is the case for the DN40 HP. Both programs replace mains made of the same material (HPDE 575) and were subject to the same squeeze off procedures prior to 1993. The same slow-crack growth and subsequent failures may be occurring across the mains where that material was used, and the squeeze off procedure applied. We suggest the differing failure rates in the DN50 data compared with the DN40 is likely explained by the lower operating stresses in the DN40 resulting in a longer time to failure.

In terms of the risk of failure of the HDPE 575, a prudent operator would consider the uncertainty inherent in relying on the small amount of data available and adopt a conservative position based on an ALARP approach. This would be to replace the mains, because the (known) consequence is at least a major or catastrophic impact, rather than to rely on increased surveillance through leak surveys and the analysis of leak reports. The latter are administrative controls, susceptible to human error, and system failures, which may lead to failures not being detected and responded to in a timely manner. According to the ALARP Principle, an effective control (mains replacement) can only be discounted when its cost is grossly disproportionate to the risk benefit it provides.

It is unclear from the evidence if the cost is commensurate with the risk reduction from replacing the mains. Further, the cost of replacement is much higher for the DN40 MP compared to the DN40 HP due to direct replacement being the only option.

Based on the current evidence and in the absence of this assessment, AGN should continue to monitor these mains for signs of an increase in failure rate as has been seen in other HDPE 575 mains and re-evaluate the current risk level and mains replacement program if this is to occur.

While we agree with the AER's decision to defer this program to the 2026-31 access period, continued monitoring is required. A prudent operator will act proactively rather than reactively, so AGN should establish practice that will enable a timely response if this is needed within the current access period.

SA103 – Valve Replacement

GHD agrees with the AER that proactive replacement of all leaking valves is not prudent due to the minimal failure rate attributable to the previous repair of valves. However, GHD supports a revised approach to prioritise and proactively replace an additional three transmission valves and six distribution values from those approved in the draft determination.

Our assessment considers the incremental number of customers, and high demand or high-risk sites affected during an isolation event with these valves becoming inoperable. Consistent with AGN's Risk Management Framework, the incremental effect of the inoperable value is a loss of supply to more than 10,000 customers, or to high demand or multiple high-risk sites meaning these valves are classified as high risk. Reducing this risk would be prudent and consistent with Rule 79 of the NGR. Based on this assessment, it would be prudent to proactively replace of two additional transmission valves (valve numbers 285 and 298) and three distribution valves (valve numbers 965, 728, and 612).

Three further distribution valves are identified as moderate risk as the incremental numbers of customers affected exceeds or is likely to exceed 1,000 during the AA period (but is less than 10,000). These valves are rated moderate in accordance with AGN's Risk Management Framework. Replacement of these additional distribution valves is considered prudent given risk reduction versus the costs [redacted] and the fact that these valves are in demand growth areas of the network.

Finally, one additional transmission valve needs replacing; the risk rating on this valve is moderate. This valve has a defect in the body of the valve that provided a gas leak path. However, the nature of the repair on the valve body, and the type of defect in the valve body, means it is prudent to replace this valve rather than continue managing risks of a valve with an in-situ repair for long-term service.

SA105 – ILI

GHD agrees with AGN that ILI is a good tool for determining pipeline integrity and consider the practice consistent with Rule 79(1) of the NGR. However, our assessment aligns with that of the AER. GHD considers completing the FEED studies for the M42 and M101 in the next AA period is not efficient in accordance with Rule 79(2) of the NGR for the following reasons:

- An optimised FEED study including necessary modifications in the subsequent AA period for M42 and M101 should not materially change the timing of the ILI run and therefore the timing of any risk assessment based on the ILI data. GHD notes this timing should enable AGN to leverage learnings from the M12/M84 work being completed in the next AA period.
- Further, GHD can not envisage that significant cost savings would not be attained by conducting multiple FEED projects simultaneously. Conversely, there is a likelihood that cost efficiencies from learnings from one program to the next may be missed with simultaneous execution.

1. Background

The Australian Energy Regulator (AER) is reviewing the AA that will apply to Australian Gas Networks (SA) (AGN) for the 2021 to 2026 period.

Mains replacement program

AGN's mains replacement program involves the replacement of pipes (and associated services) that have significantly deteriorated, such that there is an increasing risk of, and there are increasing numbers of gas leaks. The program is ongoing and undertaken to ensure public safety. For the next AA period (2021-26), AGN propose the proactive replacement of 860 km of mains across the following programs:

- 520 km of CI/UPS block replacement
- 38 km of CI/UPS block replacement for North Adelaide
- 14 km of HDPE 250 replacement
- 198 km of HDPE 575 DN40 HP replacement
- 90 km of HDPE 575 DN40 MP replacement

In the draft determination the AER accepted the mains replacement program is justified on the grounds that it is necessary to maintain and improve the safety and integrity of service consistent with National Gas Rules (NGR) 79(1)(b) and 79(2)(i)(ii).[6] However, based predominately on advice provided by their technical consultant, Zincara, the AER determined that "AGN did not provide adequate justification for the speed and scope of its mains replacement program to enable us to form the view it is conforming capex"[7]. On this basis, the AER, formed its own estimate of conforming capex and decided to allow $189.1 million of mains replacement capex, which is $80.4 million (29.8 per cent) less than AGN's forecast capex of $269.5 million[8].

The AER's decision reduces the quantities of mains replaced during the period to:

- 405 km of CI/UPS block replacement
- 38 km of CI/UPS North Adelaide replacement
- 14 km of HDPE 250 replacement
- 150 km of HDPE 575 DN40 HP replacement

The AER did not accept the HDPE 575 DN40 MP replacement program.

Other distribution capital expenditure

AGN's proposal to the AER also included other distribution system capital expenditure on:

- the replacement of 32 valves that are currently inoperable or have had leaks repaired but are in a deteriorated state. (SA103 Valve Replacement)
- Pipeline modification for inline inspection (SA105 Inline Inspection (Pigging)), which includes conducting physical FEED studies on three of the highest priority transmission pipelines in its network and undertaking one high priority inline modification project. The purpose of the FEED studies and the inline modification project is to inform an inline inspection (pigging) program that will

[6] AER, *Attachment 5: Capital Expenditure, Draft Decision – Australian Gas Networks (SA) Access Arrangement 20121-26*, p. 14

[7] AER, *Attachment 5: Capital Expenditure, Draft Decision – Australian Gas Networks (SA) Access Arrangement 20121-26*, p. 6

[8] AER, *Attachment 5: Capital Expenditure, Draft Decision – Australian Gas Networks (SA) Access Arrangement 20121-26*, p. 8

allow AGN to monitor corrosion on 200 km of transmission pipelines in the network using intelligent pigs.

In the draft determination, the AER stated it required further justification on some of AGN's valve replacement and pipeline modification programs to enable them to form a view on whether this is conforming capex.[9]

The AER agreed from a safety perspective that valves should be replaced when they are inoperable (or frozen). However, it determined that 16 of the 32 valves proposed to be replaced should not be replaced and should continue to be monitored during the access period.[10] As such the AER's draft decision was to allow $2.8 million, compared to AGN's proposed forecast cost of $5.2 million.

The AER decided to support the modification of one of the priority pipelines to allow for inline inspection. It did not support the need to undertake FEED studies for those pipelines that are not being modified in the next AA period (2021-26). The AER, therefore, proposed a revised estimate of $23.88 million, compared to AGN's proposed forecast cost of $32 million.

1.1 GHD's engagement

To support AGNs response to the AER's draft determination, AGN has engaged GHD Pty Ltd (GHD) to provide a technical specialist view on whether the proposed mains replacement, SA103 Valve replacement and SA105 Inline Inspection (pigging) expenditure as put forward by AGN complies with the relevant parts of the NGR, particularly Rule 79 of the NGR[11].

1.1.1 GHD experience and expertise

This report has been prepared under the guidance of knowledgeable people with considerable experience in the gas industry. This experience includes design, construction, and operation of gas gathering systems, gas transmission pipelines, and gas distribution networks across Australia and New Zealand. This includes the following:

- Supporting gas asset owners with regulatory submissions
- Operational management of 4,500 km of gas distribution networks, and operational management of 5,000 km of gas transmission pipelines
- Working within operating companies to support design and construction of HDPE pipeline networks for gas
- Extensive experience in pipeline risk assessments for distribution networks and transmission pipelines, as well as pipeline integrity assessments and remaining life assessments
- Delivery of integrity programs for gas networks and transmission pipelines, including development of asset management plans and regulatory submissions
- Technical due diligence for acquisition of gas transmission pipelines and gas distribution networks

1.1.2 GHD's approach

GHD's approach consisted of the following steps:

[9] AER, *Attachment 5: Capital Expenditure, Draft Decision – Australian Gas Networks (SA) Access Arrangement 20121-26*, p. 8

[10] AER, *Attachment 5: Capital Expenditure, Draft Decision – Australian Gas Networks (SA) Access Arrangement 20121-26*, p. 38

[11] Rule 79 of the NGR sets out the "New capital expenditure criteria" including the criteria that needs to be meet for expenditure to be considered conforming, the justification of the conforming capital expenditure, and the treatment of capital expenditure for revenue.

1 Reviewed the relevant documents provided by AGN in its submission, the AER draft determination and the report prepared by the AER's technical consultant, Zincara

2 Conducted question and answer sessions with AGN representatives to develop an understanding of the internal information they possess to support their submission which was either not included or has been obtained since the submission.

3 Reviewed additional information provided by AGN including asset and risk management documents and operational procedures

4 Formed our assessment on whether the expenditure, including the timing of expenditure where applicable, conforms with Rule 79 of the NGR.

1.1.3 Limitations

This report has been prepared by GHD for Australian Gas Networks (SA) and may only be used and relied on by Australian Gas Networks (SA) for the purpose agreed between GHD and the Australian Gas Networks (SA) as set out in section 1 of this report.

GHD otherwise disclaims responsibility to any person other than Australian Gas Networks (SA) arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Australian Gas Networks (SA) and others who provided information to GHD (including the Australian Energy Regulator, Zincara, and others as indicated in this report), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

GHD assessment is limited to a technical assessment based on the information provided. GHD has not conducted financial analysis.

2. Rule 79 of the NGR

Rule 79 of the NGR sets out the "New capital expenditure criteria" including the criteria that needs to be met for expenditure to be considered conforming, the justification of the conforming capital expenditure, and the treatment of capital expenditure for revenue.

In making its decision on the allowable capital expenditure for an AA the AER must determine if the proposed expenditure is conforming consistent with the criteria in Rule 79 of the NGR.

Rule 79 of the NGR states:

(1) Conforming capital expenditure is capital expenditure that conforms with the following criteria:

(a) the capital expenditure must be such as would be incurred by a prudent service provider acting efficiently, in accordance with accepted good industry practice, to achieve the lowest sustainable cost of providing services;

(b) the capital expenditure must be justifiable on a ground stated in subrule (2).

(2) Capital expenditure is justifiable if:

(a) the overall economic value of the expenditure is positive; or

(b) the present value of the expected incremental revenue to be generated as a result of the expenditure exceeds the present value of the capital expenditure; or

(c) the capital expenditure is necessary:

(i) to maintain and improve the safety of services; or

(ii) to maintain the integrity of services; or

(iii) to comply with a regulatory obligation or requirement; or

(iv) to maintain the service provider's capacity to meet levels of demand for services existing at the time the capital expenditure is incurred (as distinct from projected demand that is dependent on an expansion of pipeline capacity); or

(d) the capital expenditure is an aggregate amount divisible into 2 parts, one referable to incremental services and the other referable to a purpose referred to in paragraph (e), and the former is justifiable under paragraph (b) and the latter under paragraph (c).

(3) In deciding whether the overall economic value of capital expenditure is positive, consideration is to be given only to economic value directly accruing to the service provider, gas producers, users and end users.

(4) In determining the present value of expected incremental revenue:

(a) a tariff will be assumed for incremental services based on (or extrapolated from) prevailing reference tariffs or an estimate of the reference tariffs that would have been set for comparable services if those services had been reference services; and

(b) incremental revenue will be taken to be the gross revenue to be derived from the incremental services less incremental operating expenditure for the incremental services; and

(c) a discount rate is to be used equal to the rate of return implicit in the reference tariff.

(5) If capital expenditure made during an access arrangement period conforms, in part, with the criteria laid down in this rule, the capital expenditure is, to that extent, to be regarded as conforming capital expenditure.

(6) The AER's discretion under this rule is limited.

2.1.1 Definitions for prudence and efficiency

As identified by the AER's technical consultants, Zincara, NGR 79 does not define "prudence", "efficiency" and "good industry practice". For consistency, GHD has adopted the same definitions used by Zincara in its assessment. As per Zincara's report[12]:

> *"Prudence", means "caution in managing one's activities to avoid undesirable consequences" Zincara has interpreted this to mean that for the project to be prudent, the decision is made on the basis that it is timely for the project to proceed to rectify ongoing safety and reliability issues.*
>
> *"Efficiency" means functioning or producing effectively and with the least waste of effort. This means that the choice of which option to adopt for the project must be made on the basis that the most effective solution has been adopted. The "least amount of effort" refers to the cost of the project and in that context the project must be carried out at market rates.*
>
> *"Good industry Practice" means that the actions that a prudent operator would adopt in in similar Australian conditions.*

2.1.2 Other terminology used in this report

In this report, access arrangement (AA) periods are referred to as follows:

- The 'current AA period' refers to the AA period covering the years 2016 to 2021
- The 'next AA period' refers to the AA period covering the years 2021 to 2026
- The 'subsequent AA period' refers to the AA period covering the years 2026 to 2031

A list of abbreviations and acronyms used in this report is provided in Appendix A.

[12] Zincara, *AER Access Arrangement 2019 AGN Capital Expenditure,* report prepared for the AER, 2020, p. 14

3. Mains replacement assessment

This section covers GHD's assessment of the following proposed capital experience against Rule 79 of the NGR:

- 520 km of CI/UPS block replacement
- 198 km of HDPE 575 DN40 HP replacement
- 90 km of HDPE 575 DN40 MP replacement

AGN's mains replacement program is the single most important activity they undertake to ensure public safety.[13] In the draft determination, the AER accepted that the mains replacement is justified on the grounds that it is necessary to maintain and improve the safety of services and to maintain the integrity of services[14]. GHD considers expenditure justified on these grounds is necessarily underpinned by a dynamic risk-based prioritisation framework. Such a framework enables a prudent service provider to appropriately manage risks, including the changing the order and timing for risk treatments as new risks arise and risk profiles change. On this basis, GHD has provided an assessment of AGN's risk framework as applied to the mains replacement program.

The operation of this dynamic risk-based prioritisation framework is demonstrated through the reprioritisation and implementation of work over time and is relevant to the assessment of the mains programs against Rule 79 of the NGR. In discussions with AGN, they explained how their risk prioritisation framework was updated annually to reflect changing risks and learnings from the previous year. These reviews allows AGN to reprioritise the location of mains replacement for the coming year, allowing them to delay areas of lower risk and bring forward areas that need to be replaced more urgently[15].

3.1 Assessment of AGN risk framework for mains replacement

As a prudent operator, GHD would expect AGN to comply with AS/NZS 4645.1-2018 and the South Australian Work Health and Safety Act 2012. Both the Standard and the legislation are performance-based and require the operator seeking to comply using a risk-based approach. Therefore, GHD would expect AGN to have Risk Management Standards and processes that demonstrate how they will comply.

The key features of a robust risk management approach include:

- A risk management framework with suitable risk assessment criteria for the consequences of concern
- Risk registers for identifying and assessing the risks
- Application of risk controls
- Application of the As Low As Reasonably Practicable (ALARP) concept to residual risk (after controls have been applied)
- Be updated and kept "live" to monitor changes in the risk profile

In the context of AGN's management of its gas assets, the consequences of concern include the health and safety of its workforce and the public, and the security of gas supply to its customers.

[13] AGN, *AGN Final Plan - Access Arrangement 2021-26*, July 2020, p. 94

[14] AER, *Attachment 5: Capital Expenditure, Draft Decision – Australian Gas Networks (SA) Access Arrangement 2021-26*, p. 14

[15] GHD discussion with AGN representative 16/12/20

GHD reviewed the following information from AGN regarding its risk-based approach to asset management:

- AGN SA_Attachment 8.10_Risk Management Framework
- 420-RP-AM-0014_0.0 SA Formal Safety Assessment (FSA) Report, issued 01/04/2019
- AGN SA_Attachment 8.3 Distribution Mains Services Integrity Plan (DMSIP)_CONFIDENTIAL
- AGN SA DMSIP_September 2016
- AGN SA DMSIP_September 2017
- AGN SA DMSIP_September 2018
- AGN SA DMSIP_September 2019
- AGN SA DMSIP_September 2020
- AGN SA_2016-21 Access Arrangement_Attachment 8.14_AGN Risk Prioritisation Model_CONFIDENTIAL

Collectively the documents demonstrate that AGN is managing its asset risks appropriately and in line with good industry practice and standards.

3.1.1 Mains risk assessment and prioritisation

In 2015, AGN developed a quantified risk prioritisation model based on the UK HSE[16] Ofgem 10-year review of the Iron Mains Replacement Programme. The modelling was applied to the HDPE and CI/UPS mains and prioritised the fatality risk per km of pipe based on crack frequency for locations in the Adelaide CBD and suburbs. The ALARP Principle was used to determine intolerable, broadly acceptable, and tolerable risks and identify the highest risk locations, and therefore, priority in mains replacement.

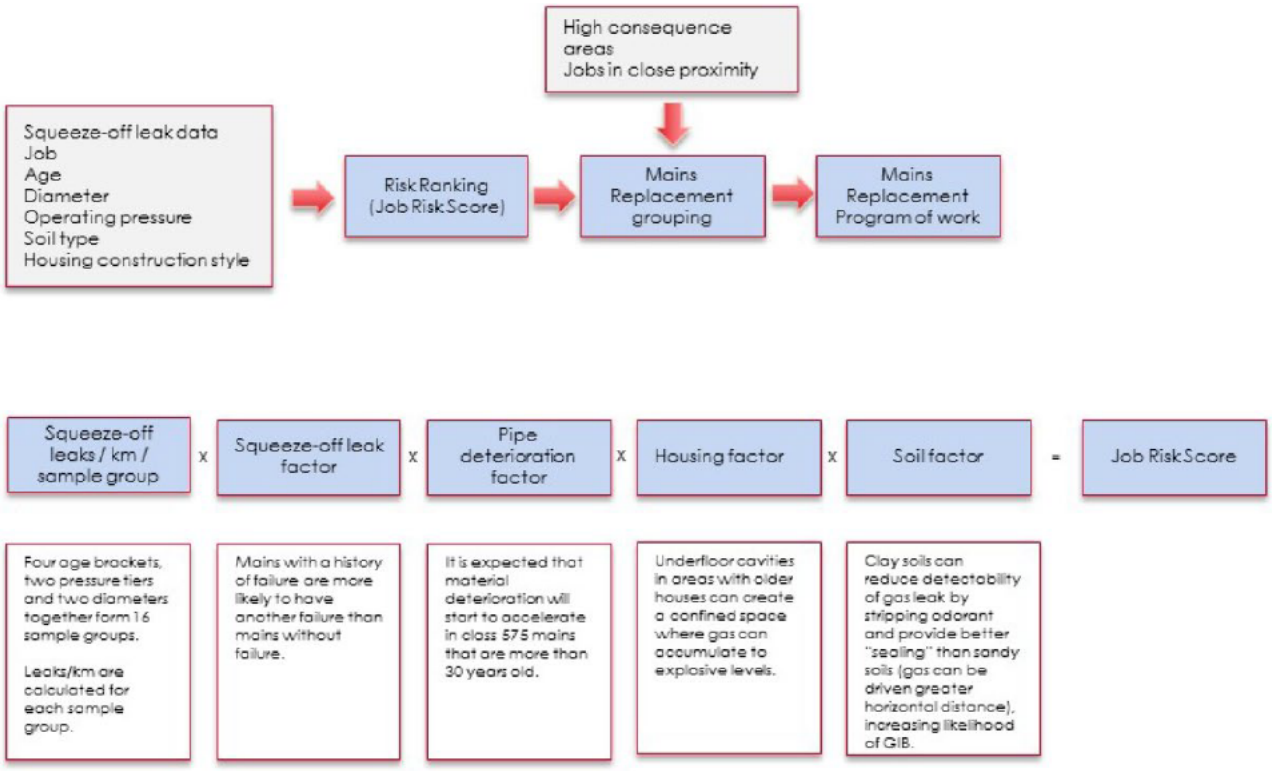
AGN provided information to GHD[17] about its focussed operational approach to managing the integrity of its gas mains, which included the last five annual DMSIPs. Each DMSIP provides an assessment of the asset class and locational asset risk, and their risk-based prioritisation for treatment using a risk prioritisation model based on a modified, more granular version of the 2015 model noted above. The forecast replacement schedule covers a 10-year period and identified the mains replacement kilometres for each category.

An example of the risk prioritisation process and model (for HDPE 575) is provided in Figure 1.

[16] UK HSE/Ofgem, *10 year review of the Iron Mains Replacement Programme*, RR888 - HSE/Ofgem: 10 year review of the Iron Mains Replacement Programme

[17] AGN, *SA DMSIP 2016, 2017, 2018, 2019 and 2020*

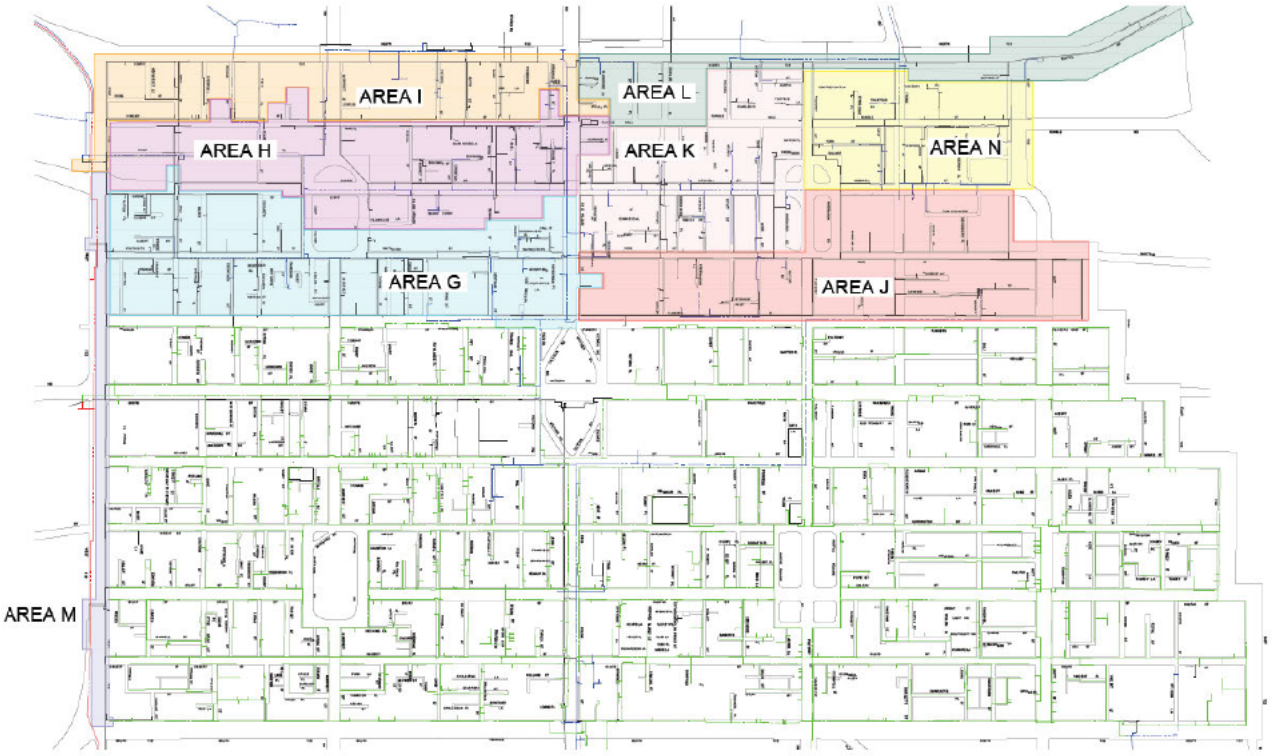
Figure 1: HDPE 575 Risk Prioritisation Process and Model



Source: AGN, SA DMSIP, September 2020, Confidential, Figure 4, p. 27

An example of the focus areas for CI/UPS mains replacement in CY20 and CY21 as determined from the updated risk prioritisation model is provided below Figure 2. This shows the geographic level of granularity in used by AGN in their risk assessments.

Figure 2: Risk reduction areas in Adelaide CBD for CY20 and CY21



Source: AGN, SA DMSIP, September 2020, Confidential, Figure 5, p. 30

The documents reviewed by GHD provide evidence that AGN has been undertaking a dynamic risk-based prioritisation process for its asset classes and locations from 2015 onwards. This process makes use of continuously updated field data. [18] The result is that AGN should have a risk estimate based on an up-to-date, current understanding of the impact different factors have on the conditions of their mains.

In GHD's opinion, AGN's approach and processes are consistent with the actions of a prudent operator prioritising and reprioritising their mains replacements program, considering the outcomes of a quantified risk assessment.

GHD notes that the DMSIP submitted to the AER as standalone document[19] (AGN's AAP 21-26 Proposal - Attachment 8.3) does not include information about AGN's replacement schedules and the location-based risk assessment that AGN are performing and updating annually. This information would have provided further justification that AGN's proposed rate of mains replacement was based on risk reduction and as such determined in a prudent manner.

3.1.2 GHD's assessment

GHD observes that AGN have developed a risk-based method which, if adhered to, should produce a dynamic risk-based mains replacement schedule. The mains replacement schedule covers a 10-year period and identified the replacement quantity for each category, providing a consistent prioritisation of the mains replacement schedule. Any deferral (or acceleration) away from this process would, over time, result in a less prudent outcome. This would result in moving away from industry good practice for the ALARP

[18] GHD discussion with AGN representative 09/12/20

[19] AGN, *Attachment 8.3 Distribution Mains Services Integrity Plan (DMSIP), SA Final Plan July 2021 – June 2026*, July 2020

demonstration required by AS/NZS 4645 and the legislation and therefore does not represent what is expected from a prudent operator.

3.2 Assessment of mains replacement programs

3.2.1 Cast iron / unprotected steel block replacement

AGN proposed to replace 558 km of low-pressure CI/UPS mains in the next AA period (2021-26). AGN's CI/UPS block replacement program focuses on the completion of cast iron and unprotected steel mains replacement within the next AA period. This would be a significant safety milestone for the network.

CI/UPS mains have a significantly higher failure rate than MDPE and HDPE. The replacement of these mains by AGN is in line with other networks around Australia.

GHD reviewed leakage rate data for the period FY06 to FY20 provided by AGN. GHD notes the data provided to the AER before the draft determination covered the period up to and including CY19 and AGN was able to supply GHD with updated data covering the years FY20 and CY20. Based on our analysis of the data up to CY19, GHD supports the replacement of the remaining CI/UPS during the next AA period (2021-26). The leak profile based on the smaller data set indicates the leak rate was approaching one leak per km, which is high for a distribution network and an order of magnitude higher than older-style HDPE systems. The additional data for FY20 and CY20 reinforces the prudency of promptly replacing the CI/UPS with the leak rate increasing to over one leak per km and close to three leaks per km in the final year of data.

Figure 3 shows data from FY13 to FY20, which indicates a significant increase in CI/UPS leaks per km over time and a step increase in FY19 and FY20. The data also indicates a slowdown in the replacement of CI/UPS mains replacement. This slowdown was caused by reprioritisation of HDPE mains replacement in the current AA period (2016-21). The decision to reprioritise mains replacement work was because of several significant HDPE failures which resulted in 'Gas In Building' incidents causing explosions[20]. This demonstrates that the reduction in CI/UPS replacement was not due to AGN's inability to complete the required volume, and as such GHD disagrees with Zincara's assessment that the next AA period replacement volume for CI/UPS should be based on the volume achieved during the current AA period (2016-21).

The timing of the slowdown in CI/UPS replacement appears in GHD notes the data provided to the AER before the draft determination covered the period up to and including CY19 and AGN was able to supply GHD with updated data covering the years FY20 and CY20. Based on our analysis of the data up to CY19, GHD supports the replacement of the remaining CI/UPS during the next AA period (2021-26). The leak profile based on the smaller data set indicates the leak rate was approaching one leak per km, which is high for a distribution network and an order of magnitude higher than older-style HDPE systems. The additional data for FY20 and CY20 reinforces the prudency of promptly replacing the CI/UPS with the leak rate increasing to over one leak per km and close to three leaks per km in the final year of data.

Figure 3 to be strongly correlated with the increase in leaks per km, presumably as the condition of the remaining CI/UPS mains rapidly deteriorate.

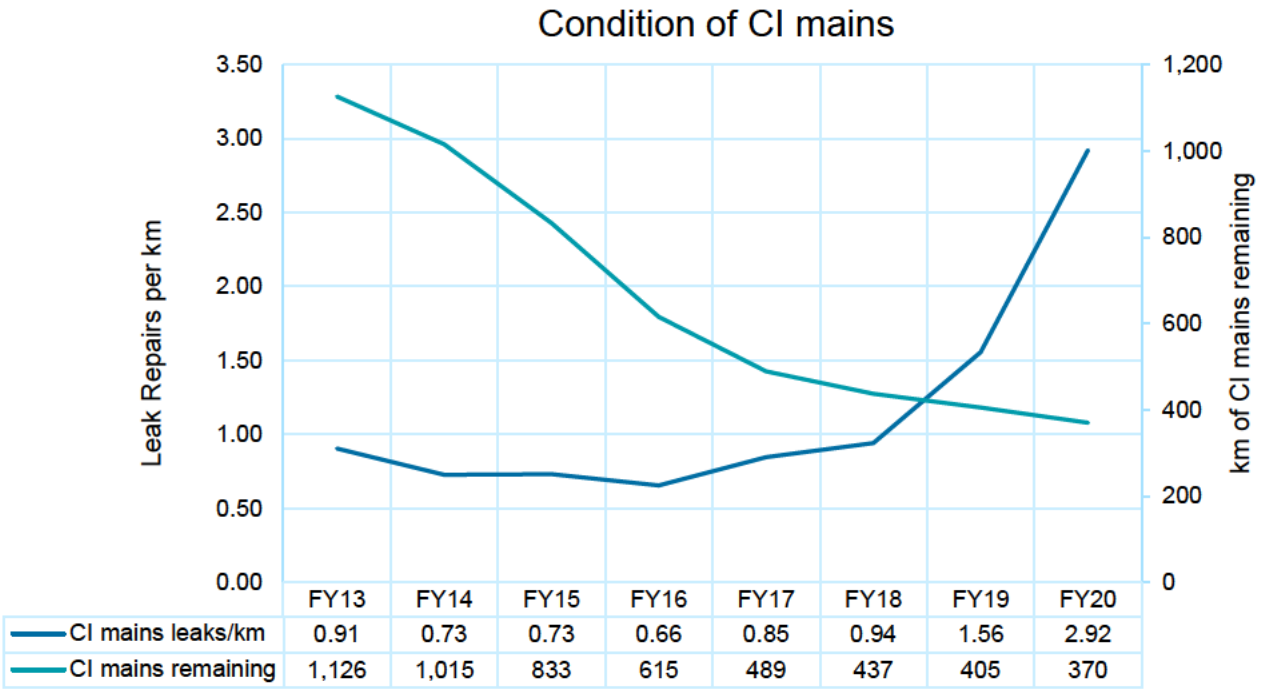
The data suggest an increasing risk profile for the remaining CI/UPS. As such, the complete replacement of the remaining CI/UPS within the next AA period (2021-26) would be prudent.

GHD notes the data provided to the AER before the draft determination covered the period up to and including CY19 and AGN was able to supply GHD with updated data covering the years FY20 and CY20. Based on our analysis of the data up to CY19, GHD supports the replacement of the remaining CI/UPS during the next AA period (2021-26). The leak profile based on the smaller data set indicates the leak rate was approaching one leak per km, which is high for a distribution network and an order of magnitude higher

[20] GHD discussion with AGN representative 09/12/20

than older-style HDPE systems. The additional data for FY20 and CY20 reinforces the prudency of promptly replacing the CI/UPS with the leak rate increasing to over one leak per km and close to three leaks per km in the final year of data.

Figure 3: Condition of CI mains



	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20
CI mains leaks/km	0.91	0.73	0.73	0.66	0.85	0.94	1.56	2.92
CI mains remaining	1,126	1,015	833	615	489	437	405	370

Source: GHD analysis of AGN data

GHD notes AGN has previously delivered 1,074 km of CI/UPS in the 2011-16 AA period, which is significantly more than the requested volume of 520 km of CI/UPS for the next AA period (2021-26).[21] Additionally, the overall proactive mains replacement quantity of 860 km AGN proposed for the next AA period (2021-26) is ~20 per cent lower than the quantity of proactive mains replacement they have successfully delivered in the past two AA periods[22]. Both factors demonstrate that AGN has the capacity to effectively deliver the requested volume of CI/UPS within the next AA period.

If the risk-assessment and dynamic reprioritisation process (as assessed by GHD in section 3.1) is applied by AGN, the reduction in mains replacement put forward by the AER in it's draft determination could prevent ALARP from being achieved. It is practicable to implement the CI/UPS block replacement at the rate AGN proposed, as demonstrated by the volume of mains replacement delivered in the two previous AA periods.

Based on the evidence provided by AGN and for the reasons outlined above, GHD considers the capital expenditure justified as it is necessary to maintain and improve the safety of services (NGR 79(2)(c)(i)) and to maintain the integrity of services (79(2)(c)(ii). Further, we find the expenditure is conforming as it is capital expenditure that would be incurred by a prudent service provider acting efficiently, in accordance with good industry practice, to achieve the lowest sustainable cost of providing services (NGR 79(1)(b)).

3.2.2 HDPE 575 DN40 HP replacement

AGN proposed to replace 198 km of high-pressure HDPE 575 DN40 mains by insertion in the next AA period that were installed before 1993. Based on squeeze off failure rate data for these mains, Zincara and the AER

[21] GHD discussion with AGN representative 09/12/20

[22] AGN delivered 1,088 km of proactive mains replacement in the AA period 2011-16 and 1,053 km in the current AA period (2016-21). Source: GHD discussion with AGN representative 06/01/21.

determined to accept the program for mains installed before 1991 but not for the mains installed between 1991 and 1993. This results in a total DN40 HP mains replacement program of 150 kms for the 2021-2026 AA period.

GHD analysed the same squeeze off failure rate data as Zincara and the AER. GHD's opinion is that the data supports AGNs proposed DN40 HP replacement program.

In addition to the failure rate data, GHD was provided with evidence in the form of a memo of a change in the squeeze-off procedure used by the previous asset owner. This memo, dated August 1991, states that the squeeze-off procedure should be modified to include limit stops to prevent squeeze-off damage. It also notes that using limit stops to prevent squeeze-off damage allowed an unacceptable high volume of gas to pass through the squeeze-off isolation point.

GHD notes that around the time the memo was issued, the use of limit-stops was becoming more common. The memo suggests the practice of using two-stops with a vent in-between to overcome the issues of excess gas passing but does not mandate or recommend this procedure be adopted.

Based on the memo and discussions with AGN, GHD understands that before this procedure change, the operators were not using limits stops. Failure to use limit stops during squeeze-off procedures causes mains to be over squeezed. Over squeezing is now known to promote slow-crack growth and has caused many failures in AGN's HDPE 575 mains.

GHD's experience with gas operators is that changes in procedures are varyingly adopted. In some cases, where the change is mandated the effectiveness of the change is more immediate, whereas other changes may take longer to come into practice. AGN has indicated that the memo's suggestion of using two squeeze offs with limit stops and a vent in-between took around a year to implement. This implementation duration was influenced by the time taken to manufacture and replace a large number of squeeze off tools. It is expected that additional time would have been also required to develop and train operators on the new procedures[23].

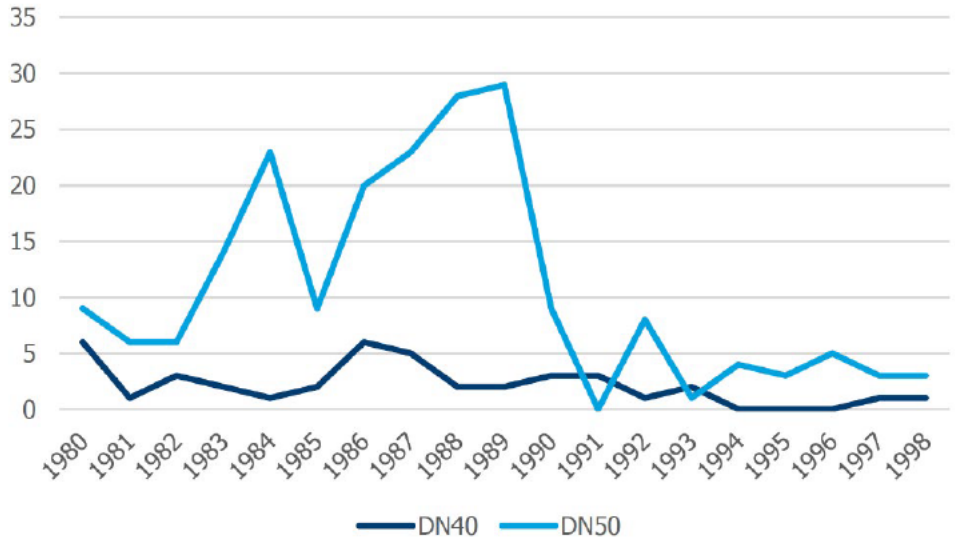
The small sample size of failure rate data applicable to the DN40 mains makes it difficult to determine with statistical confidence a particular year where the procedure causing the issue was changed.

The memo applies to both the DN50 and DN40 mains, therefore the failure rates for each main type can be used to infer when the change of practice became effective across all installations. GHD has considered the failure rate data for both mains. Considered together, the data for DN50 and DN40 show a clear flattening of the trend after 1993.

GHD considers the higher failure rates observed in the DN50 data are likely correlated with the higher operating stresses of these mains. We expect the same types of failures to be observed across the HDPE 575 fleet, albeit at different rates for this reason.

[23] GHD discussion with AGN representative 09/12/20

Figure 4: DN40 and DN50 squeeze off failure rates



Source: Attachment 8.3 Distribution Mains Services Integrity Plan (DMSIP), SA Final Plan July 2021 – June 2026, July 2020

Based on the above evidence, GHD considers likely the practice causing the increased failure rates in the HDPE 575 may have taken some time to change and it is possible that mains installed up to 1993 were affected by the practice.

In our assessment we have also considered the risks associated with not replacing the mains installed between 1991 and 1993. The small sample size of failure rates and the nature of the mains suggest a statistically low frequency event but one with a potentially high-risk consequence. Consistent with AGN's risk assessment process we recommend replacement of the mains up to 1993, consistent with AGN's original proposal.

In terms of the risk of failure of the HDPE 575, a prudent operator would consider the uncertainty inherent in relying on the small amount of data available and adopt a conservative position based on an ALARP approach. This would be to replace the mains, because the known consequence is at least a major or catastrophic impact, rather than to rely on increased surveillance through leak surveys and the analysis of leak reports. The latter are administrative controls, susceptible to human error, and system failures, which may lead to mains failures not being detected and responded to in a timely manner. According to the ALARP Principle, an effective control (mains replacement) can only be discounted when its cost is grossly disproportionate to the risk benefit it provides. This does not appear to be the case for the HDPE 575 HP mains replacement.

Based on the evidence provided by AGN and for the reasons outlined above, GHD considers the capital expenditure justified as it is necessary to maintain and improve the safety of services (NGR 79(2)(c)(i)) and to maintain the integrity of services (79(2)(c)(ii). Further, we find the expenditure is conforming as it is capital expenditure that would be incurred by a prudent service provider acting efficiently, in accordance with good industry practice (NGR 79(1)(b)).

3.2.3 HDPE 575 DN40 MP replacement

AGN proposed to replace 90 kms of medium pressure HDPE 575 DN40 mains by direct burial in the next AA period, and the remaining 159 km in the following period that were installed after 1993. Based on squeeze off failure data that shows there were three failures reported for the MP DN40 between 2005 and 2011, and that no further failures have since been reported, and the fact that direct burial is the most expensive method of mains replacement, the AER determined the proposal to mitigate risk in this category is disproportionate

to the risk being managed. As such they proposed the whole program be deferred until the 2026-31 AA period and no capex be allocated to this program in the 2021-26 period.

GHD reviewed the same failure rate data as Zincara. Based on the failure data for the DN40 mains alone, and in the absence of any further information such as the failure rates associated with other HDPE 575 mains, GHD would come to the same conclusion as Zincara and the AER. However, there are risks associated with not replacing these mains which Zincara has not considered in its assessment.

The current (untreated) risk rating is lower for the DN40 MP, than for the DN40 HP, which is rated high. Both programs replace mains made of the same material (HDPE 575) and were subject to the same squeeze of procedures prior to 1993. It is possible that the same slow-crack growth is occurring at locations across the mains where HDPE 575 was used and the squeeze off procedure applied without stops. We suggest the differing failure rates in the DN50 data compared with the DN40 (Figure 4) is likely explained by the lower operating stresses in the DN40 resulting in a longer time to failure.

On this basis, GHD agrees with AGN that the mains need to be replaced due to the failure history of HDPE 575 mains.

The risk treatment options available for this type of main are less than with other mains included in the mains replacement programs. Specifically, there is no option to run a camera through the main to establish or clarify the risks of failure. Cameras can show locations where there is squeeze off damage and therefore enable spot reinforcement which prolongs the operational life of the main. AGN is using this approach for the DN50 mains where a camera can fit.

Operationally AGN has increased the frequency of leak inspection and reduced the pressure in these mains. Increased leak inspection is a measure typically used to reduce risks where camera inspections are not possible. However, leak inspection is not a particularly effective measure for managing squeeze off leaks on HDPE mains. The failure nature of HDPE leaks would mean the leak inspection programs may not detect a leak before it is detected by the public and it is not likely to be cost effective to increase the inspection rates to levels where there is confidence leaks can be detected in a timely manner. GHD notes that neither of these actions alters the risk-assessment outcome because the actions do not materially change the risk consequences or likelihood. Replacement is the only practical measure to reduce the risk that applies to these mains.

As observed by the AER, replacement by direct burial is the most expensive method of main replacement. However, unlike with DN40 HP and other types of mains, insertion methods cannot be used with DN40 MP mains. As highlighted by Zincara[24], if insertion was used, the capacity reduction from the smaller pipe diameter at medium pressure would prevent continuation of the current level of supply to customers, as there would be insufficient capacity to maintain minimum network supply pressures. That is, there would be insufficient gas at customer location.

In the absence of replacement during the next AA period, the risk for these mains would remain as intermediate.

In terms of the risk of failure of the HDPE 575, a prudent operator would consider the uncertainty inherent in relying on the small amount of data available and adopt a conservative position based on an ALARP approach. This would be to replace the mains, because the (known) consequence is at least a major or catastrophic impact, rather than to rely on increased surveillance through leak surveys and the analysis of leak reports. The latter are administrative controls, susceptible to human error, and system failures, which may lead to failures not being detected and responded to in a timely manner. According to the ALARP Principle, an effective control (mains replacement) can only be discounted when its cost is grossly disproportionate to the risk benefit it provides.

[24] Zincara, *AER Access Arrangement 2019 AGN Capital Expenditure*, report prepared for the AER, November 2020, p. 34

Based on the current evidence, it is unclear if the risk posed by the DN40 MP mains is not commensurate with the cost required to further reduce the risk by replacing them. Further, the cost of replacement is much higher for the DN40 MP compared to the DN40 HP due to direct replacement being the only option.

GHD recommends AGN undertake an assessment addressing the questions of whether the costs associated with replacement are disproportionate to the risk benefit from this risk treatment.

In the absence of this assessment, GHD agrees with the AER's decision that the replacement program should be deferred to the subsequent AA period. In the meantime, we recommend AGN continue to monitor these mains for signs of an increase in failure rate as has been seen in other HDPE 575 mains and re-evaluate the current risk level and mains replacement program if this is to occur, consistent with their risk-management practices.

As noted elsewhere in this report, a prudent operator will act proactively. AGN should use the monitoring and establish a practice that will enable a timely response to an increase in failure rates if this is needed within the 2021-2026 access period.

4. Other distribution system assets assessment

This section covers GHD's assessment of the following proposed capital expenditure under the Other distribution system assets category against Rule 79:

- SA103 valve replacement assessment
- SA105 inline inspection (pigging) assessment

These proposed expenditures both have detailed business cases which provide key information on these projects, additional information to support this submission was obtained from AGN through interviews with staff and document requests.

4.1 Assessment of SA103 replacement of valves

AGN operates 1,207 steel valves across the South Australian transmission and distribution networks, which are used to isolate the network in an emergency and for maintenance purposes. Majority of these valves were installed in the 1970's and 1980's[25].

In their submission, AGN proposed the replacement of 32 valves across the networks, which consist of:

- 16 inoperable valves (6 transmission and 10 distribution)
- 16 leaking valves (4 transmission and 12 distribution)[26]

In their draft determination, the AER agreed with the replacement of the 16 inoperable valves from a safety perspective and approved the expenditure as conforming capital expenditure. However, it did not agree with the proactive replacement of the remaining 16 previously leaking valves, indicating the maintenance program should be able to manage the operation of them.

When assessing the validity of the capital expenditure against Rule 79 of the NGR, GHD has reviewed the information provided in AGN's replacement business case.

AGN approach

AGN's business case for the replacement of 16 leaking valves, which includes a combination of cast iron and steel valves, is predicated on the following points:

- Leaking valves are a leading indicator for inoperable valves
    - Inoperable valves have a High risk ranking in accordance with AGN's risk-assessment framework (assessed by GHD in section 3.1)
- Proactive replacement is cheaper than reactive replacement
- There are an increasing number of valve leaks due to age of valves in network, which are nearing the end of their design life
- Continuous replacement program appropriately manages the system age and therefore the age correlated risks in the system

[25] AGN, *Attachment 8.8 – Capex business cases – South Australia, SA Final Plan July 2021 – June 2026*, July 2020, p. 18

[26] AGN, *Attachment 8.8 – Capex business cases – South Australia, SA Final Plan July 2021 – June 2026*, July 2020, p. 18

The business case stated that leaking valves tend to become inoperable and therefore are recommended to be replaced.

In discussions with GHD, AGN advised[27] there are two common re-occurring leak types experienced throughout the network. They include leakage through the stem sealant grease check valve and cracks in the cast iron valve stems. Both leak failure modes could be attributed to age, amongst other contributing factors which are not age related.

GHD reviewed valve repair data covering a four-year period from 2016 to 2019 provided by AGN (Figure 5). This revealed only one of 21 valves required further repair after the initial leak repair, and none of the valves that had leak repairs became inoperable. Based on this information, GHD considers the repair of valves should be managed by a maintenance program and not valve replacement.

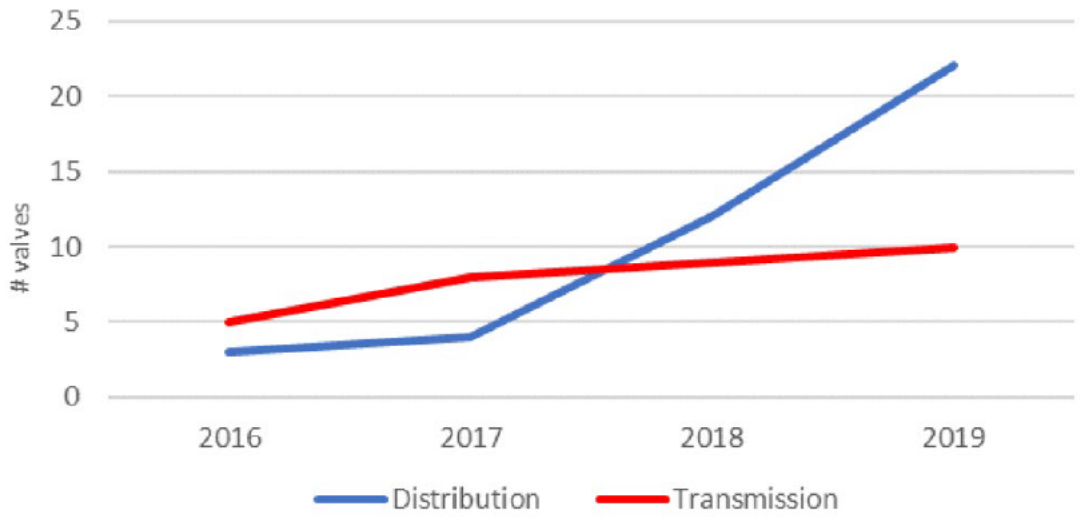
AGN's representatives indicated the valve maintenance program had improved over the last three years, with the use of enhanced maintenance techniques and the addition of experienced subcontractors with specialised tooling. The benefits of the updated program have been noted in instances where valves considered inoperable were repaired and subsequently did not require replacement.

GHD considered the current approach taken for valve maintenance appears to be in line with good industry practice. However, GHD notes past maintenance practice can play a role in the ongoing operability of equipment such as valves or regulators. GHD has not investigated the past practises and frequency of maintenance on valves and therefore is not able to provide an assessment as to whether past practices, which may have changed, have played a role in the life expectancy of each valve.

AGN indicated they have experienced an increasing trend of inoperable and leaking valves, which is represented below in Figure 5, and predicts the number to increase in the coming years due to the age of the assets. From 2017 through to 2019, the number of valve incidents increased by more than five times.

Although not confirmed, GHD's considers the increasing trend could be linked to the improved maintenance program that has identified previously undetected leaks. If this is the case, it should be recognised that the program is working and will minimise gas leaks and improve safety to its operators and the public.

Figure 5: Number of leaking and inoperable valves



Source: AGN [28]

[27] GHD discussion with AGN representative 11/12/20

[28] AGN, *Attachment 8.8: Capex Business Cases – South Australia, SA Final Plan July 2021 – Jun 2026*, July 2020, p. 22, Figure 1.2

As outlined in AGN's business case, proactive replacement of valves is AGN's preferred method for the following reasons:

- Reactive replacement is 30 per cent more expensive as determined during the Newton Road valve incident.
- Valve failure tends to occur during periods of high network utilisation such as winter, which can make reactive replacement more challenging to isolate the network whilst minimising the number of affected customers.
- Valves are generally not kept in storage, due to cost and variety of valve sizes and types throughout the network.

GHD considers proactive maintenance programs are prudent where the service provider can show that the maintenance activity will prevent escalation of consequences, whether it be safety or reliability.

Gas leakage in valves for the failure modes as previously described, would be considerably smaller than a pinhole leak and significantly smaller than a leak experienced in the network pipe system and therefore carry significantly lower risk to operators and the safety to the public.

The prudent operator would be guided by the principles of ALARP. In this case, for a period of time, the risk could be maintained at ALARP through increased maintenance, inspection and repair because the leaking values are point source of location, the locations are known, and generally would have restricted access to the public, until the valve could be repaired under maintenance.

Following discussions with AGN representatives[29], AGN undertook further analysis of the valve repair data. This consisted of a more detail risk-based assessment of the criticality of the individual valve concerned and the effect a failure would have on customer support.

AGN's further analysis of the 16 previously leaking valves indicates some represent a more significant risk to supply than others. For instance, AGN data shows one of the previously leaking valves rejected by the AER in its decision would affect supply to upwards of 67,000 customers[30] if the valve became inoperable.

GHD has evaluated the risks associated with the rejected valves. While the valves have been evaluated against AGN's full risk assessment framework[31], the primary risk from inoperable valves is focused on the risk to supply. The risk to supply arises if there is a need to isolate the network and there is an inoperable valve in the section to be isolated, meaning the smallest section of the network cannot be isolated and instead a larger section must be isolated.

GHD evaluated the risks to supply based on the incremental number of customers affected if an isolation valve was inoperable, and AGN had to use the adjacent upstream isolation valve. The calculation established the incremental number of customers affected by the valve operable compared to if it was inoperable. Depending on whether the valve is transmission or distribution and the location of the valve in the network, the number of customers affected can vary significantly.

Under AGN's Risk Management Framework, the number of customers affected is considered under AGN's Operations category, two of these rankings are provided in Table 1 below.

[29] GHD discussion with AGN representative 11/12/20

[30] AGN, BC_SA103_Valve Data.xls provided to GHD

[31] AGN, *Attachment 8.10 Risk Management Framework – AGN SA Final Plan*, July 2020, p. 9

Table 1: AGN's Operational Capacity Consequence Ratings

Consequence Category	Significant	Major
Operational Capacity	Unplanned loss of service to greater than • >1,000 customers • multiple demand customers (>10TJ pa) • to a single high risk site, without alternate supply options, (hospital, nursing home, home on life support)	Unplanned loss of service to: • a regional area or greater than >10,000 customers • a demand customer (>10TJ pa) with customer loss of revenue or infrastructure damage • to multiple high risk sites without alternate supply options (hospitals, nursing homes, homes on life support) • extensive property damage
Risk Rating when combined with an Unlikely Likelihood	Moderate	High

Source: AGN, *Attachment 8.10 Risk Management Framework – AGN SA Final Plan*, July 2020

Using this risk assessment, valves that are leaking and incrementally affect more than >10,000 customers, or a demand customer (>10 TJ pa) with customer loss of revenue, or multiple high-risk sites without alternative supply options are considered high risk and should be replaced.

Based on updated information provided to GHD[32], GHD recommends the additional replacement of two transmission valves (valve numbers 285 and 298) and three distribution valves (valve numbers 965, 728 and 612) is prudent during this access period to reduce the risk of a high risk loss of supply event occurring.

Three further distribution valves are identified as moderate risk as the incremental numbers of customers effected exceeds or is likely to exceed 1,000 during the AA period (but is less than 10,000). These valves are rated moderate in accordance with AGN's Risk Management Framework. Maintaining the safety and integrity of the service is a key part of good industry practice and the NGR 79(2)(i)(ii) states that capital expenditure is justifiable to maintain and improve safety of services or maintain integrity of services. Proactively replacing valves that are a higher supply risk demonstrates prudence in reducing the maximum potential customer impact for a given cost. Replacement of these additional distribution valves that were installed in 1979, 1992 and 1996 is considered prudent given the risk reduction versus the costs [redacted] and the fact that these valves are located in demand growth areas.

Finally, one additional transmission valve needs replacing, the risk rating on this valve is moderate. This valve has defect in the body of the valve that provided a gas leak path. However, the nature of the repair on the valve body, and the type of defect in the valve body, means it is prudent to replace this valve rather than continue managing risks of a valve with an in-situ repair for long-term service.

In conclusion, GHD recommends the proactive replacement of three additional transmission valves and six distribution values. GHD also recommends an ALARP assessment be carried out for the remaining transmission and distribution valves that are rated as a moderate risk to determine whether replacement is practicable, considering the cost of valve replacement and the risk reduction.

4.2 Assessment of SA105 pipeline modification for inline inspection

AGN currently monitors corrosion on the 200 km of transmission pipelines in the network through Direct Current Voltage Gradient (DCVG) surveys and proposes adding inline inspections using intelligent pigs for

[32] AGN, BC_SA103_Valve Data.xls, provided to GHD

its ongoing corrosion inspection to increase the information available to manage the structural integrity of the pipeline. Inline inspections pipelines need to be modified so the intelligent pigs can pass through the mains, especially in older pipelines with inconsistent diameters or tight bends.

AGN's proposed pipeline modification for inline inspection program (SA105 Inline Inspection (Pigging)) involves conducting physical FEED studies on three of the highest priority transmission pipelines in its network and undertaking one high priority inline modification project. This program will give AGN the ability to conduct inline inspections (ILI), also commonly referred to as intelligent pigging, on the transmission pipelines within the gas distribution network. Inspection tools travel inside the pipeline, propelled by the gas flow, and capturing data at that point in time, and records irregularities associated with the pipe wall, which may impact pipeline structural integrity.

Intelligent pigging is one of many inspection techniques that allows an assessment of the condition of the pipeline. A combination of these inspection techniques should be performed to evaluate the pipelines integrity and its remaining life. The Australian Standard AS 2885.3 – Pipelines – Gas and Liquid Petroleum - Operation and Maintenance requires remaining life assessments to be conducted at intervals not exceeding 10 years.

Ongoing maintenance activities by AGN have identified potential integrity issues through coating defect, which is primarily associated with the age of the pipelines and materials used for external coating protection. AGN have proposed to undertake ILI surveys to obtain additional pipeline integrity data. However, these pipelines were not designed to accept inline inspection tools and need to be modified to accept them.

AGN proposed the following program for three pipelines they had identified as the highest priority[33] in the next AA period:

- FEED study for M12/M84, M42 and M101;
- Modification to M12/M84; and
- Inline inspection of M12/M84.

In its draft determination, the AER have rejected the FEED study for M42 and M101. The AER based their recommendation on advice from their technical advisor, Zincara. Zincara advised the FEED studies should not be allowed on the basis that no modification to either pipeline occurs during the AA period and it is unlikely that significant cost savings would be achieved by simultaneously performing multiple FEED studies.[34].

The program schedule for M42 and M101 pipelines, as summarised by the AGN's business case, proposed the FEED study for both pipelines to occur in the first three years of the next AA period (21/22, 21/23 and 23/24), with pipeline modifications and inspection undertaken in the subsequent AA period (2026-31).

AGN advised[35] this schedule was proposed to allow more accurate costing for pipeline modification and inspection (findings of the FEED Study) to be incorporated into the next AA period's cost estimate, and to gain efficiencies whilst conducting multiple FEED studies at once, although AGN's representatives could not quantify the savings. In addition, consideration was given to spreading capital expenditure across multiple AA periods to regulate tariff increases.

Based on the information provided to GHD there is insufficient evidence to suggest the FEED studies rejected by the AER should be conducted in the next AA period. GHD makes this finding for the following reasons:

- An optimised FEED study including necessary modifications in the subsequent AA period for M42 and M101 should not materially change the timing of the ILI run and therefore the timing of any risk

[33]AGN, *Attachment 8.8 Capex Business Cases – AGN SA Final Plan*, July 2020, SA105, p. 71

[34] Zincara, *AER Access Arrangement 2019 AGN Capital Expenditure, report prepared for the AER*, November 2020, p. 71

[35] GHD discussion with AGN representative 11/12/20

assessment based on the ILI data. GHD notes this timing should enable AGN to leverage learnings from the M12/M84 work being completed in the next AA period.

- GHD can not envisage that significant cost savings would not be attained by conducting multiple FEED projects simultaneously. Conversely, there is a likelihood that cost efficiencies from learnings from one program to the next may be missed with simultaneous execution.

5. Summary of GHD's assessment

An assessment against Rule 79 of the NGR requires consideration of whether new capital expenditure is conforming in that the capital expenditure must be such as would be incurred by a prudent service provider acting efficiently, in accordance with accepted good industry practice, to achieve the lowest sustainable cost of providing services; and the capital expenditure must be justifiable on a ground stated in subrule 79(2) of the NGR.

5.1 Mains replacement programs

CI/UPS - block

GHD disagrees with the AER's decision to defer 115 km of replacement. From FY18 to FY20 the CI/UPS leaks per km has increased from approximately one leak per km, which itself is high for a distribution network and an order of magnitude higher than older-style HDPE systems, to three leaks per km. This significant increase in a short period of time, shows that the condition of these mains is deteriorating, and it is not prudent to delay their replacement to the next AA period.

AGN has demonstrated their capability to deliver the requested volume of CI/UPS mains replacement, having delivered a higher total volume of mains replacement in the current and prior AA period than requested next year.

DN40 HP - Insertion

GHD does not agree with the AER's decision to reject the replacement of DN40 HP mains between 1991 and 1993.

GHD reviewed the same data as the AER and Zincara and supports AGN's conclusion a clear flattening of the trend after 1993 can be seen in the DN40 and DN50 (which would have been subject to the same procedure). It is also difficult to define a single year from data which is statistically low frequency and has a high-risk consequence if a failure occurs, therefore it is prudent to be conservative.

In addition to the information available to the AER and Zincara, GHD was provided with a memo from the network operator from August 1991 that states consideration should be given to installing limit stops which would prevent squeeze off damage. AGN stated this procedure took approximately one year to implement due to the requirement to manufacture and replace a large number of squeeze off tools, additional time to develop new procedures and train operators would also be required.

DN40 MP (direct)

GHD agrees with AGN that the mains need to be replaced due to the failure history of HDPE 575 mains. Direct burial is the only remedy to reduce risks further than the current rating.

The current (untreated) risk rating is intermediate for the DN40 MP, rather than high as is the case for the DN40 HP. Both programs replace mains made of the same material HPDE 575) and were subject to the same squeeze off procedures prior to 1993. It is possible that the same slow-crack growth and subsequent failures are occurring across the mains where that material was used and the squeeze off procedure applied. We suggest the higher failure rates in the DN50 data might be plausibly explained by the different pressures.

In terms of the risk of failure of the HDPE 575, a prudent operator would consider the uncertainty inherent in relying on the small amount of data available and adopt a conservative position based on an ALARP approach. This would be to replace the mains, because the (known) consequence is at least a major or catastrophic impact, rather than to rely on increased surveillance through leak surveys and the analysis of leak reports. The latter are administrative controls, susceptible to human error, and system failures, which may lead to failures not being detected and responded to in a timely manner. According to the ALARP

Principle, an effective control (mains replacement) can only be discounted when its cost is grossly disproportionate to the risk benefit it provides.

It is unclear from the evidence if the risk posed by mains is not commensurate with the cost required to further reduce the risk by replacing them. Further, the cost of replacement is much higher for the DN40 MP compared to the DN40 HP due to direct replacement being the only option.

Based on the current evidence and in the absence of this assessment, AGN should continue to monitor these mains for signs of an increase in failure rate as has been seen in other HDPE 575 mains and re-evaluate the current risk level and mains replacement program if this is to occur.

While we agree with the AER's decision to defer this program to the 2026-31 access period, continued monitoring is required. A prudent operator will act proactively rather than reactively, so AGN should establish practice that will enable a timely response if this is needed within the next access period.

5.2 Other distribution system assets

SA103 – Valve Replacement

GHD agrees with the AER that proactive replacement of all leaking valves is not prudent due to the minimal failure rate attributable to the previous repair of valves. However, GHD supports a revised approach to prioritise and proactively replace an additional three additional transmission valves and six distribution values from those approved in the draft determination.

Our assessment considers the incremental number of customers, high demand or high-risk sites affected during an isolation event with these valves becoming inoperable. Consistent with AGN's Risk Management Framework, the incremental effect of the inoperable value is a loss of supply to more than 10,000 customers, or to high demand or multiple high-risk sites meaning these valves are classified as high risk. Reducing this risk would be prudent and consistent with Rule 79 of the NGR. Based on this assessment, it would be prudent to proactively replace of two transmission valves (valve numbers 285 and 298) and three distribution valves (valve numbers 965, 728, and 612).

Three further distribution valves are identified as moderate risk as the incremental numbers of customers effected exceeds or is likely to exceed 1,000 during the AA period (but is less than 10,000). These valves are rated moderate in accordance with AGN's Risk Management Framework. Replacement of these additional distribution valves is considered prudent given risk reduction versus the costs [redacted] and the fact that these valves are in demand growth areas of the network.

Finally, one additional transmission valve needs replacing; the risk rating on this valve is moderate. This valve has defect in the body of the valve that provided a gas leak path. However, the nature of the repair on the valve body, and the type of defect in the valve body, means it is prudent to replace this valve rather than continue managing risks of a valve with an in-situ repair for long-term service.

SA105 – ILI

GHD agrees with AGN that ILI is a good tool for determining pipeline integrity and consider the practice consistent with Rule 79(1) of the NGR. However, our assessment aligns with that of the AER. GHD considers completing the FEED studies for the M42 and M101 in this AA period is not efficient in accordance with Rule 79(2) of the NGR for the following reasons:

- An optimised FEED study including necessary modifications in the subsequent AA period for M42 and M101 should not materially change the timing of the ILI run and therefore the timing of any risk assessment based on the ILI data. GHD notes this timing should enable AGN to leverage learnings from the M12/M84 work being completed in the next AA period.

- Further, GHD can not envisage that significant cost savings would not be attained by conducting multiple FEED projects simultaneously. Conversely, there is a likelihood that cost efficiencies from learnings from one program to the next may be missed with simultaneous execution.

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Appendices

Appendix A List of acronyms

The following acronyms, terms and abbreviations have been used in this report.

Acronym / term / abbreviation	Meaning
AA	Access Arrangement
AER	Australian Energy Regulator
AGN	Australian Gas Networks (SA)
ALARP	As Low As Reasonably Practicable
AS	Australian Standard
CBD	Central Business District
CI	Cast Iron
CSG	Coal Seam Gas
CY	Calendar year
DCVG	Direct Current Voltage Gradient
DMSIP	Distribution Mains and Services Integrity Plan
DN	Nominal Diameter
FEED	Front End Engineering Design
FSA	Formal Safety Assessment
FY	Financial Year
HDPE	High Density Polyethylene
HP	High Pressure (distribution pressure class)
HSE	Health Safety and Environment
HSS	Heat Shrink Sleeve
ILI	Inline Inspection (intelligent pig)
MP	Medium Pressure (distribution pressure class)
NGR	National Gas Rules
NZS	New Zealand Standard
UAFG	Unaccounted For Gas
UPS	Unprotected Steel

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