GPA Engineering Pty Ltd
Phone 08 8299 8300
enquiries@gpaeng.com.au
gpaeng.com.au

HAZOP Report

Project Marlin: EGP Reversal

Jemena Ltd

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CONTENTS

1 INTRODUCTION

Jemena is undertaking front end engineering and design, to facilitate a total installed cost (TIC) estimate and schedule to reverse flow the Eastern Gas Pipeline (EGP) south of the Kembla Grange Meter Station (KGMS), to allow the supply of gas into the Victorian and New South Wales gas markets from a new LNG import terminal to be based at Port Kembla.

There is expected to be a total of up to 500 MMSCFD of gas being injected into the EGP from the Floating Storage and Regasification Unit (FSRU) in Port Kembla to be transported to the Victorian and New South Wales gas pipeline networks. Jemena has completed a pipeline modelling report "Project Marlin Pre-FEED Report" which outlines the required flow rates and capacities of the various EGP Facilities to achieve the requirements of Project Marlin.

The EGP, shown in Figure 1, was commissioned in 2000 to supply natural gas from Victoria to the Sydney region. The EGP is a DN450 pipeline with an MAOP of 14,895 kPag.

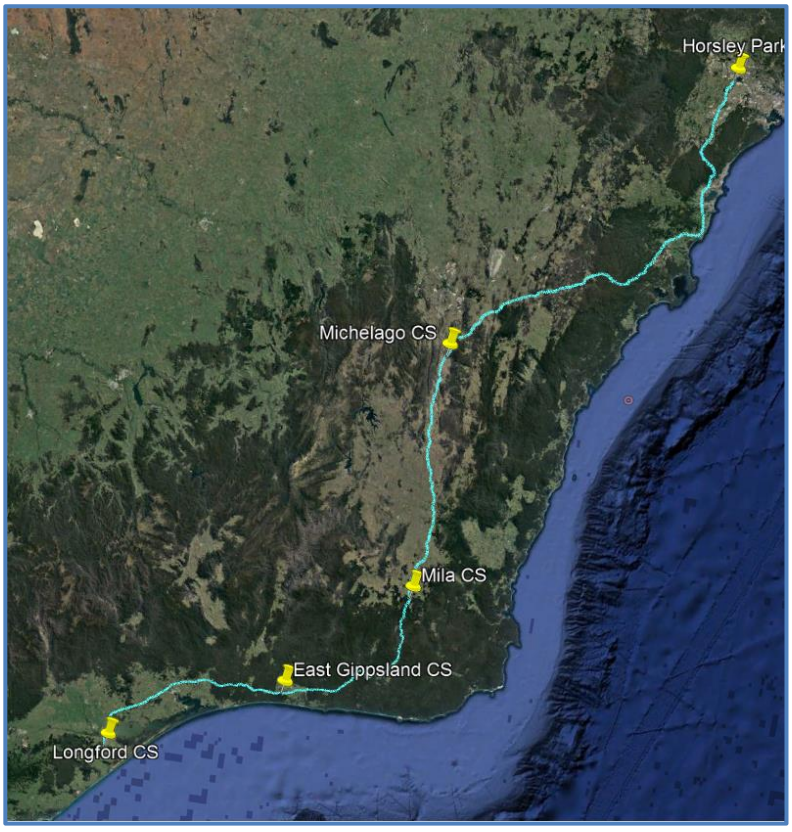


Figure 1: Eastern Gas Pipeline

This project requires new plant, equipment and modifications to existing Jemena facilities along the EGP. The new plant and facility alterations will allow the injection of gas from the Port Kembla LNG import terminal into the EGP upstream of the Kembla Grange Main Line Valve (MLV). The modifications under this project will also allow for the reverse flow of gas south into the Victorian and New South Wales gas pipeline networks and increase northern flow via increased capacity at the Wilton Meter Station (WMS).

The facilities required to be modified include:

- Kembla Grange Main Line Valve (MLV) Station,
- Mila Compressor Station (MCS),
- Michelago Compressor Station (MOCS),
- Vic Hub Interconnect (located within the Longford Compressor Station, LCS); and,
- Wilton Meter Station (WMS).

A new facility, the Kembla Grange Meter Station (KGMS), will be constructed to supply the gas imported from Port Kembla into the EGP.

This HAZOP Report forms part of GPA Engineering's Safety in Design process.

The following report summarises the findings of a Hazard and Operability Study, HAZOP, held on Microsoft Teams on the following dates: 5th, 16th – 18th November 2020. The HAZOP dealt specifically with design facilitating the EGP flow reversal.

2 SCOPE OF STUDY

Specifically, the scope of the HAZOP includes the following:

2.1 KEMBLA GRANGE METER STATION (KGMS)

A new meter station will be installed adjacent to the Kembla Grange MLV to meter gas entering the EGP from the Port Kembla LNG import terminal via the Port Kembla Lateral Looping Pipeline. The meter station project scope includes:

- Pig Receiver on the Port Kembla Lateral Looping Pipeline,
- Metering skid and associated control systems,
- Gas Quality Measurement Equipment,
- Hot tap tie in into the EGP north of Kembla Grange MLV.

2.2 KEMBLA GRANGE MAIN LINE VALVE STATION (MLV)

A piping connection off the south side of the Kembla Grange MLV will be installed including a pressure control valve that is used to bypass the MLV when operating at reduced pressures in the EGP north of the MLV.

The control valve will be used to ensure that pressure in the Port Kembla Lateral Looping Pipeline remains below approximately 9 MPa, which is required to maximise delivery volumes from the LNG terminal. The Longford gas bypassing the MLV will be blended with the imported gas downstream of the new KGMS.

The piping connection for the PCV will be from the existing pipeline cold vent. Valving will be provided to allow this to be used to blowdown the Port Kembla Lateral Looping Pipeline, EGP main line north or EGP mainline south sections.

2.3 MICHELAGO COMPRESSOR STATION (MOCS)

The Michelago Compressor Station will be modified to enable compression of reverse flow in the EGP.

Flow switching pipework and actuated valves of the same size and specification as the existing compressor station will connect into the suction and discharge headers of the compressor to enable reverse flow with compression.

The non-return valve (400-CV-64018) in the above ground pipework will be removed to enable the compressor to be bypassed in reverse flow operation of the EGP. The Station Control System will be modified to include a start/load permissive for the compressor package to prevent starting/loading until the valves are in the correct positions.

2.4 MILA COMPRESSOR STATION (MCS)

Mila Compressor Station will be modified to enable compression of reverse flow in the EGP.

Flow switching pipework and actuated valves of the same size and specification as the existing

compressor station will connect into the suction and discharge headers of the compressor to enable reverse flow with compression.

The non-return valve (400-CV-64018) between the compressor offtakes will be replaced by a new actuated switching valve to enable the compressor to be bypassed in reverse flow operation of the EGP. The Station Control System will be modified to include a start/load permissive for the compressor package to prevent starting/loading until the valves are in the correct positions.

2.5 LONGFORD COMPRESSOR STATION (LCS)

The Longford Compressor Station will be modified to increase the capacity ofof gas able to be directed from the EGP into the VicHub Interconnect pipeline. This new interconnect facility at the Victorian Hub (within the LCS) will be known as Vic Hub 2 (VH2) and include:

- Single Dry Gas Filter with quick opening closure and manual bypass,
- Gas Chromatograph,
- Flow Metering Skid,
- A parallel connection to the existing Vic Hub Water Bath Heater,
- A new Water Bath Heater with bypass Temperature Control Valve (TCV); and,
- Dual Run Flow Control Skid with overpressure slam shut valves.

The offtakes to both Victorian Hubs will be actuated to enable remote operation and management of the interconnect facilities. The facility will be designed to allow gas to be compressed (via LCS) and delivered into the TGP at the same time as flow gas from the EGP to Vic Hub Interconnect.

2.6 WILTON METER STATION (WMS)

The Wilton Meter Station will be expanded to increase the gas supply to the Moomba Sydney Pipeline (MSP) from 150 TJ/d to 325 TJ/d by installation of a new parallel run with a capacity of 175 TJ/d including:

- A new water bath heater with bypass temperature control valve (TCV),
- Relocation of the existing JGN dual run ultrasonic metering skid with series prove pipework; and,
- Relocation of the existing dual run flow control skid with overpressure slam shut valves.

The capacity to the Jemena Gas Network (JGN) will be increased from 150TJ/d to 200 TJ/d by installation of the following equipment:

- A new dual run Ultrasonic metering skid with series prove pipework sized for 200 TJ/d: and,
- A new dual run flow control skid with overpressure slam shut valves sized for 200 TJ/d. The flow control valve runs will include be a single fail closed PCV c/w low noise trim.

Additional modifications required include:

- Installation of an additional parallel inlet dry gas filter,
- Parallel DN250 connection to the MSP; and,
- Parallel DN250 connection to the JGN including hot tap tie-in connection.

The study specifically excluded the following:

- The water bath heater vendor packages
- Any normal flow paths through existing equipment
- A detailed layout review

2.7 PREVIOUS HAZOP STUDIES

This represents the first formal HAZOP study for the EGP Reversal Project.

A design review was conducted on the 1st October 2020 refer to document GAS-599-MM-PM-001.

Operating experience from the EGP and existing stations was drawn upon in reviewing hazards associated with the EGP Reversal Project.

2.8 ASSUMPTIONS

The following was assumed or used as the basis in the HAZOP:

- That the P&IDs of the existing facilities are true and correct
- Operators are trained and competent.

2.9 INFORMATION REVIEWED

The key representation of the design that was reviewed was detailed in the documents listed in the Appendix 2.

2.10 REFERENCE DOCUMENTS

The following supplementary documents were issued for HAZOP and were available for reference during the study:

Table 1: Documents available as reference for HAZOP Study

Document	Revision	Document Description
GAS-599-DG-DN-001	B	PROJECT MARLIN: EGP REVERSAL DESIGN BASIS MANUAL - FACILITIES
GAS-559-RP-HZ-002	1	HAZOP Brief

3 METHODOLOGY

The study was carried out as a workshop and was attended by key operations, maintenance and engineering personnel.

The HAZOP was a detailed design level study dealing with the specific process, control and interface issues related to the EGP Reversal Project. The design was sufficiently mature to enable the HAZOP to take place.

The workshop focused on each aspect of the process individually and used a set of guidewords to prompt and promote discussion. The Guidewords and overall methodology was in accordance with the guidelines of Australian Standard AS IEC 61882 – HAZOP Studies. Guidewords used are attached in Appendix 3.

The key issues uncovered were recorded in the formal HAZOP minutes appearing in Appendix 1 of this report.

The workshop progressed in the following order:

- A general overview of the scope of the EGP Reversal Project was given. Boundaries for the study were established and interface points between existing and new systems clearly defined.
- The study then progressed to the detailed review of each process subsystem (node) as defined in Table 2 below. An overview of the function of each node was considered followed by a line-by-line review that utilised the standard guidewords.

The nodes analysed during the study are summarised below:

Table 2: Node Summary

Part 1

Node	Description
1	Description: Port Kembla metering and discharge to EGP Drawings: GAS-557-DW-PD-001, GAS-557-DW-PD-002, GAS-557-DW-PD-003 Plant and Equipment: Pig Receiver, meter station Line: G-11-C9D-400, G-10-C9D-400, G-01-CE15X-450, G-02-CE15X-400, G-005-C9D-400, G-006-C9D-300, G-09-C9D-400, G-08-C9D-300
2	Description: Piping connection to the Kembla Grange MLV from Longford side Drawings: 550-PI-001, GAS-557-DW-PD-003 Plant and Equipment: pressure control valve Line: NG-02-C9D-200, G-06-C9D-150
3	Description: Blowdown for the Port Kembla Lateral Looping Pipeline via the existing cold vent at the Kembla Grange MLV site. Drawings: 550-PI-001, GAS-557-DW-PD-003 Plant and Equipment: Line: G-06-C9D-150
4	Description: Instrument gas supply Drawings: 550-PI-001

Node	Description
	Plant and Equipment: Line:
5	Description: Overview

Part 2

Node	Description
6	Description: Michelago reverse flow: EGP to compressor suction Drawings: GAS-530-DW-PD-020, GAS-530-DW-PD-018, 530-DW-PD-001 Plant and Equipment: Line: G-020-CE15X-400, G-905-C9D-400, G-64907-C9D-400
7	Description: Michelago reverse flow: compressor discharge to EGP Drawings: 530-DW-PD-001, GAS-530-DW-PD-018, GAS-530-DW-PD-020 Plant and Equipment: Line: G-64906-C9D-400, G-906-C9D-400, G-903-C9D-400, G-901-C9D-400, G-001-CE15X-400, NG-01-XX-450
8	Description: Michelago reverse Flow with no compression Drawings: GAS-530-DW-PD-018 Plant and Equipment: Line: G-029-CE15X-400
9	Description: Michelago forward flow: EGP to compressor suction Drawings: 530-DW-PD-001, GAS-530-DW-PD-018, GAS-530-DW-PD-020 Plant and Equipment: Line: NG-01-XX-450, G-001-CE15X-400, G-64906-C9D-400, G-906-C9D-400, G-64907-C9D-400
10	Description: Michelago forward flow: compressor discharge to EGP Drawings: 530-DW-PD-001, GAS-530-DW-PD-018, GAS-530-DW-PD-020 Plant and Equipment: Line: G-901-C9D-400, G-64904-C9D-400, G-020-CE15X-400, NG-01-XX-450
10A	Description: Michelago MLV actuated pressurisation bypass Drawings: GAS-530-DW-PD-020 Plant and Equipment: Line: G—XXX-C9D-150
11	Description: Mila reverse flow: EGP to compressor suction Drawings: 525-PI-001, GAD-525-DW-PD-039, GTS-525-DW-PD-022 Plant and Equipment: Line: G-909-C9D-400, GAS-525-DW-PD-039, G-905-C9D-400, G-XXX-C9D-400, G-001-XX-400, G-002-PL9Z-400, G-003-C9D-400
12	Description: Mila reverse flow: comrpessor discharge to EGP Drawings: 525-PI-001, GAD-525-DW-PD-039, GTS-525-DW-PD-022 Plant and Equipment: Line: G-021-C9D-400, G-902-C9D-400, G-903-C9D-400, G-906-C9D-400, G-908-C9D-400

Node	Description
13	Description: Mila reverse flow with no compression Drawings: 525-PI-001 Plant and Equipment: Line:NG-01-XX-450,
14	Description: Mila forward flow: EGP to compressor suction Drawings: 525-PI-001, GAD-525-DW-PD-039, GTS-525-DW-PD-022 Plant and Equipment: Line: G-908-C9D-400, G-001-XX-400, G-906-C9D-400, G-907-C9D-400
15	Description: Mila forward flow: compressor discharge to EGP Drawings: 525-PI-001, GAD-525-DW-PD-039, GTS-525-DW-PD-022 Plant and Equipment: Line: G-021-C9D-400, G-902-C9D-400, G-904-C9D-400, G-908-C9D-400,
15A	Description: Mila MLV actuated pressurisation bypass Drawings: GAS-530-DW-PD-039 Plant and Equipment: Line: G—XXX-C9D-150
15B	Description: Michelago and Mila: Overview
16	Description: Longford: EGP to VicHub2 Water Bath Heater Drawings: 510-PI-092, PO-510-PI-110, GAS-511-DW-PD-001, GAS-511-DW-PD-002, GAS-511-DW-PD-003, Plant and Equipment: 510-F-103, 510-HT-102 Line: G-076-C9D-400, G-076-C9D-400, G-701-C9D-400, G-701-C9D-400, G-704-C9D-400, G-702-C9D-400,
17	Description: Longford: VicHub2 to Vic Hub WBH cross over Drawings: GAS-511-DW-PD-003,510-DW-PD-006 Plant and Equipment: 510-HT-101 Line: 510-DW-PD-006, G-716-C9D-200, G-112-C9-200
18	Description: Longford: VicHub2 Water Bath Heater to Flow Regulators Drawings: GAS-511-DW-PD-002, GAS-511-DW-PD-004 Plant and Equipment: 510-HT-102 Line: G-708-C9D-300, G-711-C9D-400, G-712-C9D-400, G-713-C9D-400, G-717-C9D-400,
19	Description: Longford: VicHub2 flow regulators to Gas Net Drawings: GAS-511-DW-PD-004, PO-511-DW-PD-001 Plant and Equipment: Line: G-714-C9D-400, G-718-C9D-400, G-715-C9D-400, G-717-C9D-400,
20	Description: Longford: Fuel Gas to VicHub2 WBH Drawings: GAS-511-DW-PD-004, GAS-511-DW-PD-002 Plant and Equipment: Line: FG-716-C6D-50, FG-709-C3D-50
21	Description: Longford: VicHub2 Filter Separator Liquids to Closed Drain Drawings: GAS-511-DW-PD-001, 510-DW-PD-101 Plant and Equipment: Line: CD-708-C6D-50,
22	Description: Longford: VicHub2 Filter Separator Bund Liquids to open drain

Node	Description
	Drawings: GAS-511-DW-PD-001, 510-PI-140 Plant and Equipment: Line: UPVC
23	Description: Longford: Vic Hub Actuated inlet isolation valves Drawings: GAS-511-DW-PD-002 Plant and Equipment: Line: G-077-C9D-200
23A	Description: Longford: Overview
24	Description: Wilton: EGP to APA Water Bath Heater Drawings: 563-DW-PD-001, 563-DW-PD-002, 563-DW-PD-016 Plant and Equipment: 563-F-01, 563-F-02, Line: 563-G-847-X70-250, 563-G-802-C9D-300, 563-G-802-C9D-300, 563-G-64882-C9D-250. G-64888-C9D-250
25	Description: Wilton: APA Water Bath Heater to APA Metering (563-MR-03, 563-MR-04) Drawings: 563-DW-PD-016, 563-DW-PD-017 Plant and Equipment: 563-HT-001 Line: G-64889-C9D-250, G-64890-C9D-250, G-64880-C9D-250
26	Description: Wilton: APA Flow Metering to Moomba Wilton Mainline Header Drawings: 563-DW-PD-017, 563-DW-PD-018, 563-DW-PD-012 Plant and Equipment: 563-MR-03, 563-MR-04, 563-RR-03, 563-RR-04 (existing equipment, moved location) Line: G-64890-C9D-250, 563-817-PL9Z-250
27	Description: Wilton: Dry Gas Filters to JGN metering via HEX (existing equipment, increased flow and changed composition) Drawings: 563-DW-PD-002, 563-DW-PD-003, Plant and Equipment: 563-HE-01, 563-HE-02 Line: 563-G-808-C9D-250,
28	Description: Wilton: JGN Metering skid Drawings: 563-DW-PD-008 Plant and Equipment: 563-MR-05, 563-MR-06 Line:
29	Description: Wilton: JGN Flow Control Skid Drawings: 563-DW-PD-008, 563-DW-PD-010 Plant and Equipment: 563-RR-05, 563-RR-06 Line: 563-G-815-C9D-250, G-64884-C9D-400, G-64885-C9D-400,
30	Description: Wilton: Instrument Air/Gas Drawings: 563-DW-PD-010, 563-DW-PD-003, 563-DW-PD-011 Plant and Equipment: Line:
31	Description: Wilton Fuel Gas Supply to APA Water Bath Heater Drawings: 563-DW-PD-014, 563-DW-PD-016 Plant and Equipment: Line:
32	Description: Wilton: Overview

Following the Node by Node review general discussions were had on the piping layout and any other operational issues. This included hazard identification using a set of standard risk assessment prompts.

The minutes were reviewed by the HAZOP study team, allocation of the action item responsibilities was completed and priority categories assigned as detailed in

Table 3.

Table 3: HAZOP Priority Categories

Priority	Description
1	To be completed in FEED
2	To be completed in Detailed Design (Prior to construction)
3	To be completed prior to Commissioning
4	To be completed prior to hand-over to Operations

4 STUDY TEAM

The study team comprised the following personnel with their responsibilities in relation to this project outlined below:

Table 4: HAZOP Study Team Members

5th November – Kembla Grange

HAZOP Team Member	Position/Role	Company
Lisa Hein	Chairperson / Facilitator	GPA Engineering
India Carsburg (IC)	Graduate Mechanical Engineer / Scribe	GPA Engineering
Matthew Skaras (MS)	Project Manager	Jemena
Max Imsungnoen	Project Engineer	Jemena
Michael Peoples	Gas Managing Engineer (in part)	Jemena
David Young (DY)	Principal Engineer	Enscope
Nathan Biggins (NB)	Project Manager	Jemena
Stephen Chow (SC)	Project Engineer	Jemena
Akshay Qazi	Systems Controller	Jemena
Steven Bonnici (SB)	Project Manager	Zinfra
Martin Richards (MR)	Pipeline Operator and Technician	Zinfra
Mick Arneil (MA)	Manager, Field Transmission (South)	Zinfra
Sarah Greening (SG)	Project Manager	GPA Engineering
Simon Hanlin	Senior Process Engineer	GPA Engineering
Dylan Falls (DF)	Graduate Process Engineer	GPA Engineering
Peter Blyton (PB)	Senior Mechanical Engineer	GPA Engineering
Adrian Zatta (AZ)	Senior EI&C Engineer	GPA Engineering

16th November - Longford Vic Hub

HAZOP Team Member	Position/Role	Company
Lisa Hein	Chairperson / Facilitator	GPA Engineering
Max Imsungnoen	Project Engineer	Jemena
David Young (DY)	Principal Engineer	Enscope
Stephen Chow (SC)	Project Engineer	Jemena
Luke Gigliotti	Team Leader - Control Room	Jemena
Richard Lamin (RL)	Pipeline Operator Technician	Jemena
Mick Arneil (MA)	Manager, Field Transmission (South)	Zinfra
Sarah Greening (SG)	Project Manager	GPA Engineering
Simon Hanlin	Senior Process Engineer	GPA Engineering
Peter Blyton (PB)	Senior Mechanical Engineer	GPA Engineering
Adrian Zatta (AZ)	Senior EI&C Engineer	GPA Engineering

17th November - Wilton Meter Station (WMS).

HAZOP Team Member	Position/Role	Company
Lisa Hein	Chairperson / Facilitator	GPA Engineering
David Young (DY)	Principal Engineer	Enscope
Stephen Chow (SC)	Project Engineer	Jemena
Luke Gigliotti	Team Leader - Control Room	Jemena
Steven Bonnici (SB)	Team Leader - EGP	Jemena
Adam Christian (AC)	Operations - Wilton Meter Station	Jemena
Mitchell Graham (MG)	Operations - Wilton Meter Station	Jemena
Simon Hanlin	Senior Process Engineer	GPA Engineering
Peter Blyton (PB)	Senior Mechanical Engineer	GPA Engineering
Adrian Zatta (AZ)	Senior EI&C Engineer	GPA Engineering

18th November - Michelago and Mila Compressor Stations

HAZOP Team Member	Position/Role	Company
Lisa Hein	Chairperson / Facilitator	GPA Engineering
David Young (DY)	Principal Engineer	Enscope
Stephen Chow (SC)	Project Engineer	Jemena
Luke Gigliotti	Team Leader - Control Room	Jemena
Mick Arneil (MA)	Manager, Field Transmission (South)	Zinfra
Richard Lamin (RL)	Pipeline Operator Technician	Jemena
Matthew Evans (ME)	Operations	Jemena
Jon Valsamis (JV)	Systems Controller	Jemena
Simon Hanlin	Senior Process Engineer	GPA Engineering
Peter Blyton (PB)	Senior Mechanical Engineer	GPA Engineering
Adrian Zatta (AZ)	Senior EI&C Engineer	GPA Engineering

5 DISCUSSION OF FINDINGS

The overall process was successful in achieving the objectives of the study. The study team possessed the necessary experience and knowledge to be able to address the majority of the issues at the time within the confines of the meeting.

Where information was not adequate, actions have been assigned to GPA Engineering or Jemena personnel to follow up and obtain further clarification.

The study is considered to be at a 30% design completion stage. A HAZOP will be conducted for the water bath heather vendor package as well as a subsequent HAZOP during detailed design and a layout review.

Details of all discussions and findings appear in the formal HAZOP study minutes appearing in Appendix 1.

Key issues potentially impacting in a significant manner on the final system implementation and operation are summarised below.

Kembla Grange

- Details of the FSRU flow control and pressure protection requires a review to determine if it is fit for purpose and to determine any requirements for integration with Jemena equipment.
- In accordance with Jemena's Isolation philosophy GTS-960-DG-PI-001 Section 10.1.2, Jemena have advised GPA to remove the second isolation valve from the pig receiver inlet as a single valve isolation is considered suitable based on a pigging frequency of 5-10 yearly.

Longford Vic Hub

- Pigging of the EGP is currently set up for the forward flow direction. To enable pigging in the reverse direction a review of the configuration of the pipework is required to ensure that a pig can be received at the Longford Compressor Station Pig Barrel.
- When changing modes or directions of flow, a specific sequence of opening and closing valving is required. This is currently planned to be done using procedures. To avoid potential for human error, a review of the requirements to fully automate mode switching is proposed for consideration.

Wilton

- A new filter is being introduced to increase capacity. Operations have requested, where possible for quick opening closures and filter elements to have commonality with existing filters at Longford Compressor Station and the existing filter at WMS.
- Operations reported that the filter isolations valves and plug valves in general frequently pass. When this happens isolations must be sought further upstream resulting in loss of production. Double block and bleed isolation is to be added to existing filter 563-F-01 to be consistent with new installation and Jemena's isolation philosophy. Similarly, the isolation philosophy for the flow control skid and flow control runs requires a review due to the frequent occurrence of passing valves. A review is required to determine if single valve isolation or double block and bleed is required.

- The proposed design of instrument air (IA) with instrument gas (IG) back up is based on a similar Jemena design in service. However, failure of the IA will introduce a flammable mix of air and gas to the system. The IA system has duty standby compressors already and it is suggested that the need for the IG supply as a backup for IA system is reviewed to minimise the risk.
- Site utilities; power, air and water require a capacity check to determine if they can meet the additional demands from the Water Bath Heater (WBH)
- The new project introduces multiple new flow paths. The project is requested to provide an Operating & Maintenance Philosophy documenting the various modes, capacity limits and redundancies associated with each run.

Mila and Michelago Compressor Stations

- When changing the direction of the flow in the EGP large differential pressures (DP) may be present across switching valves. DP interlocks will be required across all flow switching valves and flow valve sequencing for MLV-1 and flow switching valves must be programmed so that the compressor suction pressure is not higher than discharge pressure.
- The existing facility vented ESD may leave some sections at pressure due to the introduction of new valving. A review of the existing Station ESD is required. Determine the requirements for the new switching valve and whether it is required to vent/blowdown on Station ESD. The project is required to document the new Isolation and Blowdown Philosophy.

Global Issues

- Lower pressures in the EGP than design when switching directions may induce high velocities and flow induced or acoustic induced vibration (FIV/AIV). Low pressure/high velocity alarms and trips to be installed and instrumentation (such as thermowells) to be altered to accommodate for potential high velocities. Add DP interlocks across flow switching valves as appropriate.
- Minimum turndown of equipment to be established and advised.

6 CONCLUSIONS

The study was able to adequately review the design of the EGP Reversal Project which is estimated to be at a 30% complete stage.

The review concluded that in most respects the proposed designs were in accordance with requirements of the applicable industry standards and that the design had been documented and completed to the point where the Study Team was confident in the successful implementation of the project.

However a number of key issues requiring final resolution were identified.

A detailed close-out review is essential in guaranteeing that all design and safety objectives are met following final detailed design and construction.

All HAZOP study actions must be closed out prior to system commissioning and the requirement for further formal reviews assessed during the project implementation as the detailed design develops.

APPENDIX 1 FORMAL STUDY MINUTES

GPA	HAZOP MINUTES	20617-REP-015
	Project Marlin - EGP Reversal	SHEET 1 of 10

Client	**Jemena Ltd**
Client Project No	**GAS-599**
GPA Project No	**20617**
Project Title	**Project Marlin - EGP Reversal**
Facilitator	**Lisa Hein**
Scribe	**India Carsburg**
Workshop Date	**04/11/2020**
Workshop Location	**Microsoft Teams**
HAZOP Sponsor	**Nathan Biggins**
HAZOP Stage	**30%, FEED, Stage 1 Kembla Grange MLV and Kembla Grange Meter Station**

HAZOP Participants:

GPA Engineering

Sarah Greening (SG)	Project Manager
India Carsburg (IC)	Graduate Mechanical Engineer / Scribe
Lisa Hein (LH)	Senior Consultant - Risk and Advisory / Facilitator
Simon Hanlin (SH)	Senior Process Engineer
Dylan Falls (DF)	Graduate Process Engineer
Peter Blyton (PB)	Senior Mechanical Engineer
Adrian Zatta (AZ)	Senior EI&C Engineer

Jemena

Nathan Biggins (NB)	Project Manager
Max Imsungnoen (MI)	Project Engineer
Stephen Chow (SC)	Project Engineer
Matthew Skaras (MS)	Project Manager
Luke Gigliotti (LG)	EI&C Engineer (Akshay - Systems Controller attended in place)
Michael Peoples (MP)	Gas Managing Engineer (in part)

Enscope

David Young (DY)	Principal Engineer

Zinfra

Steven Bonnici (SB)	Project Manager
Martin Richards (MR)	Pipeline Operator and Technician
Mick Arneil (MA)	Manager, Field Transmission (South)

Background:

Jemena is undertaking Front End Engineering and Design (FEED) to facilitate a total installed cost (TIC) estimate and schedule to reverse flow the Eastern Gas Pipeline (EGP) south of the Kembla Grange Meter Station (KGMS), to allow the supply of gas into the Victorian and New South Wales gas networks.

The following, key pieces of documentation, formed the basis of the HAZOP (additional information was available – see HAZOP report):

- Pig Receiver P&ID: GAS-557-DW-PD-001(B)
- Metering P&ID: GAS-557-DW-PD-002(B)
- EGP Hot Tap Tie-in P&ID: GAS-557-DW-PD-003(B)
- MLV and Sales Tap P&ID: 550-PI-001

The HAZOP specifically dealt with:

- Pig Receiver on the Port Kembla Pipeline,
- Metering skid and associated control systems,
- Gas Quality Measurement Equipment,
- Hot tap tie in into the EGP north of the existing Kembla Grange MLV, the MLV bypass line/pipeline and station blowdown line

The HAZOP specifically excluded a full formal review of:

- Port Kembla Pipeline,
- Mila Compressor Station (MCS),
- Michelago Compressor Station (MOCS),
- Vic Hub Interconnect (located within the Longford Compressor Station, LCS); and,
- Wilton Meter Station (WMS).

The HAZOP was conducted using a series of guide words which were applied to each of the key phases of operation.

NODE 1: PORT KEMBLA METERING AND DISCHARGE TO EGP

DRAWINGS: GAS-557-DW-PD-001, GAS-557-DW-PD-002, GAS-557-DW-PD-003 **PLANT & EQUIPMENT:** PIG RECEIVER, METER STATION **INSTRUMENTATION: -** **LINE NUMBERS:** G-11-C9D-400, G-10-C9D-400, G-01-CE15X-450, G-02-CE15X-400, G-005-C9D-400, G-006-C9D-300, G-09-C9D-400, G-08-C9D-300

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
1.1	HIGH FLOW	Low pressure in EGP caused by supply interruption.	Potential FIV (flow induced vibration) on thermowells and metering equipment due may result in unmetered gas.	Flow control on FSRU	Confirm the lowest pressure possible in the EGP and ensure it is included in design conditions for all equipment and in the heat mass balance table.	**1**	**DY**		
1.2	HIGH FLOW	Line break on EGP	Loss of containment fed by EGP	Control room monitoring, remote actuated MLV's.	Install pressure rate of change alarms on inlet of Port Kembla pipeline. Confirm remote actuated MLV is included in design and pipeline isolation plan.	**2** **2**	**SH** **SH**		
1.3	HIGH FLOW	High flow in pig receiver – during pigging operations (pigging is for integrity inspections only, will occur at a low frequency).	High flow in the kicker line, potential damage of pipe due to flow induced vibration.	Pigging procedures will specify a flow rate to ensure max velocity (nominally 50 m/s) in kicker line is not exceeded.	Pig kicker line to be included in line sizing calculation with a velocitysizing limit of 50 m/s..	**1**	**SH**		
1.4	HIGH LEVEL	N/A							
1.5	LOW FLOW	Closed manual outlet valves at the Kembla station for maintenance or human error.	Loss of supply	Operations monitoring	None required.				
1.6	LOW FLOW	High pressure in northern end of EGP	High pressure, potential deadhead of FSRU pump (12MPa). Note: Jemena equipment is rated for 14.9MPa.	Flow/pressure control on FSRU pumps	Confirm FSRU flow control and pressure protection is fit for purpose. Confirm if pressure signals from Jemena equipment installed at KGMS are required to be relayed to the FSRU pumps.	**1** **1**	**MS** **MS**		
1.7	LOW FLOW	SLV semi-closure	Lack of supply		Install Position/fail to operate alarm on the SLV.	**1**	**AZ**		
1.8	LOW LEVEL	N/A							
1.9	ZERO FLOW / EMPTY	No issues							
1.10	REVERSE FLOW	Line break upstream of pig trap Port Kembla	EGP backflow through line break	One NRV included Control room monitoring. MLV can be closed remotely to stop backflow.	Add Reverse flow alarm to KGMS meter run, ensure it doesn't trigger falsely at zero flow. Confirm if secondary NRV is required by evaluating risk reduction and confirming if design has reduced risk ALARP (Additional NRV may be included during detailed design).	**2** **2**	**GPA** **MS**		
1.11	HIGH PRESSURE	Blocked discharge, refer low flow 3.5.	Over pressure should not occur as pump deadhead pressure is less than Jemena equipment design pressure.	Pump deadhead pressure low than MAOP of line.	As per 3.4				**A HAZOP for the FSRU connection will be conducted later in the design process. These issues will be further verified in this HAZOP.**

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
1.12	LOW PRESSURE	No issues							
1.13	HIGH TEMPERATURE	No issues							
1.14	LOW TEMPERATURE	Re-pressuring vented section due to joule-thompson effect.	Potential low temperature embrittlement conditions in equipment.	Jemena stated that venting and repressurising procedures will be developed to include flowrate limits to avoid exceeding minimum design temperatures. Actual temperatures will be monitored with temperature gun during the process. - There is a pressurisation bypass line included around the shutdown valve.	None required				
1.15	IMPURITIES	Commissioning debris. Pipeline is lined so corrosion products are not expected.		Cleaning procedures will be used during commissioning	None required				
1.16	CHANGE IN COMPOSITION / CONCENTRATION	High Wobbe index may be received from FSRU due to settle out in ships during transport.	Off spec gas	Metered nitrogen injection based on GC test results is included in the design. The FSRU has a GC which will confirm gas properties prior to loadout.	Configure and include a high Wobbe Index alarm for the 557-AIT-64008 sampling system.	**1**	**SH**		
1.17	CHANGE IN COMPOSITION / CONCENTRATION	Excessive odorant injection	Off spec gas	Operation monitoring.	None required				
1.18	TWO PHASE FLOW	No issues							
1.19	REACTIONS	No issues							
1.20	TESTING EQUIPMENT / PRODUCT	Gas sampling and analysis is included in system for verification of gas being delivered into the EGP. Only one in line GC is proposed for the KGMS. If unavailable delivery into the EGP may be prevented and loadout from the FSRU may be delayed.	Delay in production or offspec gas.	Additional GC on FSRU. Dilution of any offspec gas due to high volume of gas in EGP. Variability may occur between cargos but not within the same cargo. A manual test with portable equipment could be carried out prior to unloading.	Confirm if single GC is enough in regard to quality monitoring according to commercial arrangements. .	**1**	**MS**		
1.21	PLANT ITEM OPERABILITY	Commissioning and start up. Intended filling of Pt Kembla Pipeline is by gas from the EGP, however an NRV is installed in the KGMS pipework preventing backflow from the EGP.	Unable to commissioning/fill Pt Kembla Pipeline.		Install bypass around NRV	**1**	**SH**		
1.22	PLANT ITEM OPERABILITY	Venting – Some manual vents shown as single ball valve, inconsistent with typical vent arrangements	Single vent ball valve will become damaged when used for venting and throttling.		Update manual vents at KGMS to include isolation ball valve and throttling valve.	**1**	**PB**		

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
1.23	PLANT ITEM MAINTAINABILITY	Pig receiver isolation for maintenance. Meter run isolation for maintenance. Pig receiver proposed design had a double block and bleed. Presented design was based on Atlas pig receiver design (GAS-447-DW-PD-001) with double block and bleed installed upstream of the pig trap.	Proving isolation prior to proceeding with maintenance with a single valve. Ensuring single valve isolation remains effective when equipment is open to atmosphere. Inadequate isolation will result in process having to be further isolated upstream and production impacts. Potential safety issue if single valve passes during the maintenance.	Pig receiver proposed design retained double block and bleed. According to Jemena isolation policy GTS-960-DG-PI-001 section 10.1.2 states DBB is only required in system above ANSI 600 where the item being isolated is subjected to maintenance which involves breaking gas containment, on a frequency of once per year or more. Pigging frequency is expected to be 5-10 yearly for integrity inspections. Isolation will be proven using a single vented ball valve. If isolation cannot be proven, the process will be isolated further upstream until it can be proven. For routine maintenance meters will be calibrated in line, removal not required. Blind flanges will be installed downstream of single isolations before proceeding with maintenance activities.	Jemena have advised GPA to remove the second isolation valve from the design based on a pigging frequency of 5-10 yearly and requirements in GTS-960-DG-PI-001 Section 10.1.2 GPA to update P&IDs and remove the DBB isolation configuration and ensure this philosophy is reflected in other elements of the design.	**1**	**SH**		Refer to Jemena's Piping Design Guide and Material Specification for Gas Pipeline Facilities. The relevant section to refer to for isolations is GTS-960-DG-PI-001 section 10.1.2 as follows: Positive isolation (spade/blind/dropout spool) is mandatory where maintenance involving breaking gas containment is done in confined spaces. Valve isolation is acceptable for non-confined-spaces. DBB is required in class #600 and above where the item being isolated is subjected to maintenance which involves breaking gas containment, on a frequency of one year or less.
1.24	ELECTRICAL AREA CLASSIFICATION	No issues - All equipment will be hazardous area rated according to the area							
1.25	EARTHING	No issues - station is earthed (fenced)							Earthing and HA classifications to be completed in detailed design.
1.26	ISOLATION	Ref 3.21 maintainability							
1.27	INSTRUMENTS TOO MANY	UG TIT at Kembla inlet		Jemena stated that there was sufficient temperature indication elsewhere	Remove UG TIT (064001)	**1**	**SH**		
1.28	INSTRUMENTS TOO FEW	Sufficient pressure transmitters							
1.29	CORRECT LOCATION OF INSTRUMENTS	No issues							

NODE 2: PIPING CONNECTION TO THE PORT KEMBLA PIPELINE HOT-TAP FROM SOUTHERN SIDE OF KEMBLA GRANGE MLV

DRAWINGS: 550-PI-001, GAS-557-DW-PD-003 **PLANT & EQUIPMENT:** PRESSURE CONTROL VALVE **INSTRUMENTATION: -** **LINE NUMBERS:** PRESSURE CONTROL VALVE

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
2.1	HIGH FLOW	Control valve PV-064009 fails open Or inadvertent opening ofbypass valve	Induced vibration	Control Valve is Fail Closed Manual bypass managed using procedures and is designed for reverse flow only (Blowdown), refer item 3.1.	Complete AIV or FIV (acoustic or flow induced vibration) assessment during detailed design.	**2**	**PB**		
2.2	HIGH LEVEL	No issues							
2.3	LOW FLOW	Low dP across MLV	Lack of supply to the north		Add a low dP alarm across MLV 1/PV-64009 to alert operators of low dP across MLV so that they can open it.	**1**	**AZ**		
2.4	LOW LEVEL	No issues							
2.5	ZERO FLOW / EMPTY	Valve fails closed	Interruption to supply		Implement out of position alarm on the pressure control valve (PV-064009). Add high dP alarm across MLV 1/PV-64009	**2** **1**	**AZ** **AZ**		
2.6	REVERSE FLOW	Pressure north is higher than pressure south.	Misdirected flow, no safety consequence	Operator will open MLV	As per 2.3				
2.7	HIGH PRESSURE	High pressure from upstream (southern) compression	Potential for pressure to exceed design operating pressure of 12MPag used for equipment and line sizing		Confirm highest possible operating pressure scenario from the south Update equipment and line sizing calculations for PV-064009 and bypass line if required.	**2** **2**	**DY** **SH**		
2.8	LOW PRESSURE	No new issues.							
2.9	HIGH TEMPERATURE	No issues							
2.10	LOW TEMPERATURE	Pressure drop across PV64009	Minimum gas delivery temperature lower than minimum EGP delivery temperature requirement of 2°C	Minimum temp above minimum pipe rating of -10C. Distance from bypass tie to hot tap is ~20m per 200617-50-550 Rev B.	Install additional temperature transmitter before the hot tap tie in, a suitable distance downstream of bypass inlet to allow blending of Pt Kembla and Longford gas.	**1**	**SH**		
2.11	IMPURITIES	No new issues.							
2.12	CHANGE IN COMPOSITION / CONCENTRATION	No new issues.							
2.13	TWO PHASE FLOW	No new issues.							
2.14	REACTIONS	No new issues.							

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
2.15	TESTING EQUIPMENT / PRODUCT	No new issues.							
2.16	PLANT ITEM OPERABILITY	No new issues.							
2.17	PLANT ITEM MAINTAINABILITY	No new issues.							
2.18	ELECTRICAL AREA CLASSIFICATION	No new issues.							
2.19	EARTHING	No new issues.							
2.20	ISOLATION	No new issues.							
2.21	INSTRUMENTS TOO MANY	No new issues.							
2.22	INSTRUMENTS TOO FEW	Refer 4.10							
2.23	CORRECT LOCATION OF INSTRUMENTS	Loss of communication between MLV and Meter Station.	Potential unintended control of FCV.		Confirm if signal from PIT2 to PIC64009 needs to be hardwired or if coms is sufficient.	**1**	**MS**		

NODE 3: BLOWDOWN FOR THE PORT KEMBLA PIPELINE VIA THE EXISTING COLD VENT AT THE KEMBLA GRANGE MLV SITE.

DRAWINGS: 550-PI-001, GAS-557-DW-PD-003

PLANT & EQUIPMENT: COLD VENT / PORTABLE BLOWDOWN SILENCER

INSTRUMENTATION: -

LINE NUMBERS: G-06-C9D-150

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
3.1	HIGH FLOW	Fully open plug valve	Noise, FIV, instrument damage		Confirm the sizing of plug valve (150-PV-064010) for blow down, required to limit flow to acceptable levels through the meter station.	**2**	**SH**		
3.2	HIGH LEVEL	No new issues							
3.3	LOW FLOW	No new issues							
3.4	LOW LEVEL	No new issues							
3.5	ZERO FLOW / EMPTY	No new issues							
3.6	REVERSE FLOW	Southern side of EGP will still be live during blow down, passing valves, continuously venting.	Loss of product via vent.	This issue is known to Jemena and addressed procedurally when venting is required.	No actions				
3.7		Control valve is closed (not bi-directional). Reverse flow around control valve using the bypass plug valve.	Potential damage to control valve		Confirm reverse flow using the bypass (150-PV-064010) for blow down scenario will not damage thecontrol valve (PV-064009) with the vendor.	**2**	**PB**		

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
3.8	HIGH PRESSURE	No new issues							
3.9	LOW PRESSURE	No new issues							
3.10	HIGH TEMPERATURE	No new issues							
3.11	LOW TEMPERATURE	During de-pressuring JT effect will cause cooling	Potential for low temperature embrittlement for existing pipe piping material.		Determine minimum gas temperature during blow down. Ensure pipe is rated for minimum temp	**2**	**SH**		
3.12	IMPURITIES	No new issues							
3.13	CHANGE IN COMPOSITION / CONCENTRATION	No new issues							
3.14	TWO PHASE FLOW	No new issues							
3.15	REACTIONS	No new issues							
3.16	TESTING EQUIPMENT / PRODUCT	No new issues							
3.17	PLANT ITEM OPERABILITY	Passing of a single isolation valves V-01, V-02, V-10 a known issue. This existing vent (blowdown bleed, V-05) is presently used for bleeding the EGP or local equipment. Upstream plug valves V-01, V-02, V-10 are known to pass. Vent connection currently has a flange – no valve. Installing a local vent is currently undertaken with upstream isolation valves passing.	Inadequate isolation.	New valve 150-BV-64021 at TIP 550-01 on the vent will be vented cavity ball valve. Jemena accept the risk of installing the vent silencer with existing isolations and passing upstream valves. A construction risk assessment will take place prior to installing the new equipment.	None required				
3.18		Height of equipment and potential vibration in the vent stack.	Damage of equipment due to vibrations		Review structural support for the portable blowdown silencer considering higher connection flange location with 150-BV-64021 installed.	**2**	**PB**		
3.19	PLANT ITEM MAINTAINABILITY	No new issues							
3.20	ELECTRICAL AREA CLASSIFICATION	No new issues							
3.21	EARTHING	No new issues							
3.22	ISOLATION	No new issues							
3.23	INSTRUMENTS TOO MANY	No new issues							
3.24	INSTRUMENTS TOO FEW	No new issues							
3.25	CORRECT LOCATION OF INSTRUMENTS	No new issues							

NODE 4: INSTRUMENT GAS SUPPLY

DRAWINGS: 550-PI-001 **PLANT & EQUIPMENT:** INSTRUMENT GAS **INSTRUMENTATION: -** **LINE NUMBERS: -**

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
4.1	HIGH FLOW	Failure of PV 062005 or PV062007	Over pressure. Noise. Operators attend site once a month for site inspections, failure would go undetected. PSV vents to atmosphere.	PSV 062008	Change PI to PIT with high and low pressure alarm (PI62008)	**1**	**SH**		
4.2	HIGH LEVEL	No new issues							
4.3	LOW FLOW	Failure of supply to control valve	PV064009 will close – supply disruption		As per 2.6				
4.4	LOW LEVEL	No new issues							
4.5	ZERO FLOW / EMPTY	No new issues							
4.6	REVERSE FLOW	No new issues							
4.7	HIGH PRESSURE	No new issues, ref 4.1	Blowing out actuator on valve, loss of containment.	PSV 062008	None required				
4.8	LOW PRESSURE	No new issues							
4.9	HIGH TEMPERATURE	No new issues							
4.10	LOW TEMPERATURE	Cooling associated with pressure drop	Low temperatures in downstream equipment.	Instrument tubing will be stainless steel rated below the expected minimum process temperature downstream of the pressure cut Liquids drop out not expected – dry gas	Include passive heat recovery loop into the instrument gas panel tubing.	**1**	**AZ**		
4.11	IMPURITIES	No new issues							
4.12	CHANGE IN COMPOSITION / CONCENTRATION	No new issues							
4.13	TWO PHASE FLOW	No new issues							
4.14	REACTIONS	CS to SS transition	Galvanic corrosion	FIK shown on P&ID (I.G.)	None required				
4.15	TESTING EQUIPMENT / PRODUCT	Lack of Maintenance	Failure of equipment	Maintenance plans in place	None required				
4.16	PLANT ITEM OPERABILITY	No new issues							
4.17	PLANT ITEM MAINTAINABILITY	Maintenance on instrument gas panel will require PCV to be out of service	Supply interruption	Portable supply could be used.	None required				
4.18	ELECTRICAL AREA CLASSIFICATION	No new issues							

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
4.19	EARTHING	No new issues							
4.20	ISOLATION	No new issues							
4.21	INSTRUMENTS TOO MANY	No new issues							
4.22	INSTRUMENTS TOO FEW	No new issues							
4.23	CORRECT LOCATION OF INSTRUMENTS	No new issues							

NODE 5: GENERAL HAZARD IDENTIFICATION AND FACILITY OVERVIEW

DRAWINGS: GAS-557-DW-PD-001, GAS-557-DW-PD-002, GAS-557-DW-PD-003, 550-PI-001

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
5.1	TOXICITY	No new issues							
5.2	SERVICES REQUIRED	No new issues							
5.3	MATERIALS OF CONSTRUCTION	No new issues							
5.4	COMMISSIONING	No new issues							
5.5	BREAKDOWN	No new issues							
5.6	STARTUP / SHUTDOWN	No new issues							
5.7	EFFLUENT	No new issues							
5.8	NOISE / VIBRATION	Noise from control valve PV-64009	Noise may be above allowable threshold		Specify noise attenuating trim for PV-64009 and acoustic insulation to be installed on valve and downstream piping	**1**	**SH**		
5.9	FIRE / EXPLOSION	No new issues							
5.10	SAFETY EQUIPMENT	No new issues							
5.11	QUALITY AND CONSISTENCY	No new issues							
5.12	OUTPUT – RELIABILITY AND BOTTLENECKS	No new issues							
5.13	EFFICIENCY	No new issues							
5.14	SIMPLICITY	No new issues							
5.15	MOBILE EQUIPMENT / PLANT MOVEMENT	No new issues							

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
5.16	PROCESS PLANT NORMAL / ABNORMAL MAINTENANCE	No new issues							
5.17	PROCESS PLANT PROCESS FUNCTIONALITY	No new issues							
5.18	ERGONOMICS	No new issues							
5.19	GUARDING	No new issues							
5.20	WARNINGS	No new issues							
5.21	VULNERABILITY	No new issues							
5.22	3RD PARTY INTERFERENCE	No new issues							
5.23	NATURAL EVENTS	No new issues							

	HAZOP MINUTES	20617-REP-018
GPA	Project Marlin: EGP Reversal	SHEET 1 of 18

Client	**Jemena Ltd**
Client Project No	**GAS-599**
GPA Project No	**20617**
Project Title	**Project Marlin: EGP Reversal**
Facilitator	**Lisa Hein**
Scribe	**Peter Blyton** **Sarah Greening**
Workshop Date	**12/11/2020**
Workshop Location	**Microsoft Teams**
HAZOP Sponsor	**Nathan Biggins** **Matthew Skaras**
HAZOP Stage	**30% FEED Stage 2:** • **VicHub2 located at Longford Compressor Station (LCS)**

HAZOP Participants:

GPA Engineering

Sarah Greening (SG)	Project Manager / Minute Taker
Lisa Hein (LH)	Senior Consultant - Risk and Advisory / Facilitator
Simon Hanlin (SH)	Senior Process Engineer
Peter Blyton (PB)	Senior Mechanical Engineer / Minute Taker
Adrian Zatta (AZ)	Senior EI&C Engineer

Jemena

David Young (DY)	Engineering Manager
Max Imsungnoen (MI)	Project Engineer
Stephen Chow (SC)	Project Engineer
Luke Gigliotti (LG)	Team Leader - Control Room
Richard Lamin (RL)	Pipeline Operator Technician
Mick Arneill (MA)	Manager - Gas Transmission South

Background:
Jemena is undertaking Front End Engineering and Design (FEED) to facilitate a total installed cost (TIC) estimate and schedule to reverse flow the Eastern Gas Pipeline (EGP) south of the Kembla Grange Meter Station (KGMS), to allow the supply of gas into the Victorian and New South Wales gas networks.

The following, key pieces of documentation, formed the basis of the HAZOP (refer HAZOP report for additional information):

- Longford Compressor Station
  - Launcher Station P&ID: 510-PI-092
  - Gas Manifold P&ID: PO-510-PI-110
  - Vic Hub 2 – Metering Run P&ID: GAS-511-DW-PD-003
  - Vic Hub 2 – Pressure Regulation P&ID: GAS-511-DW-PD-004
  - Vic Hub 2 – Inlet Filter Separator P&ID: GAS-511-DW-PD-001
  - Vic Hub 2 – Water Bath Heater P&ID: GAS-511-DW-PD-002
  - Vic Hub – Water Bath Heater 510-HT-101 P&ID: 510-DW-PD-006
  - Inlet Filter Separator P&ID: 510-DW-PD-101
  - Open Drain Interceptor P&ID: 510-PI-140
  - Vic Hub – Bi-Directional Pipeline P&ID: PO-511-DW-PD-001

The HAZOP specifically dealt with:

- Vic Hub Interconnect (located within the Longford Compressor Station, LCS)

The HAZOP specifically excluded a full formal review of:

- Water Bath Heater 510-HT-102, Vendor Package HAZOP will be completed as part of Detailed Design

The HAZOP was conducted using a series of guide words which were applied to each of the key phases of operation.

NODE 16: LONGFORD: EGP TO VICHUB2 WATER BATH HEATER

DRAWINGS: 510-PI-092, PO-510-PI-110, GAS-511-DW-PD-001, GAS-511-DW-PD-002, GAS-511-DW-PD-003

PLANT & EQUIPMENT: 510-F-103

INSTRUMENTATION: -

LINE NUMBERS: G-076-C9D-400, NG-01-C9D-400, G-701-C9D-400, G-702-C9D-400, G-703-C9D-400, G-704-C9D-400, G-705-C9D-400, G-706-C9D-400, G-707-C9D-400

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
16.1	HIGH FLOW	High flow nomination Low downstream pressure	High DP across Filter 510-F-103 Loss of effective metering	High DP alarm PDI-64101B for Filter 510-F-103 HH DP shutdown of UV-64101 High flow alarm on FI-64112	No actions				
16.2	HIGH LEVEL	Liquid slug Entrained oil from upstream gas compressors at Orbost and/or ESSO Entrained hydrocarbon liquids Inadequate operation of manual liquid draining of Filter 510-F-103	Liquid carry-over, resulting in off-spec gas	High level alarm LSH-011107/8 on Filter 510-F-103 HH level shutdown on LSHH-011107/8 on Filter 510-F-103 Inlet gas supplied per AS4564 gas specification.	P&ID and datasheet to show that Filter 510-F-103 liquids collection boot is separated into two compartments. P&IDs currently shows this as one compartment which would allow gas to bypass the filter element. Add transmitter to LG-011107/8	**1** **1**	**PB** **AZ**		
16.3	LOW FLOW	Blocked Filter 510-F-103	High DP across filter, leading to filter element damage Flow nomination shortfall	High DP alarm PDI-64101B for Filter 510-F-103 HH DP shutdown of UV-64101	No action				
16.4	LOW LEVEL	No issues identified.							
16.5	ZERO FLOW / EMPTY	Inadvertent closure of downstream valves	Failure to deliver flow nomination	Flow trend monitoring by Operations Personnel	Add position feedback and out of position alarm on downstream flow control valves FV-64118& FV-64124.	**1**	**AZ**		
16.6	REVERSE FLOW	Higher pressure in downstream GasNet than EGP	Reverse flow, leading to filter element damage Loss of effective metering	Check valves in flow control runs					
16.7	HIGH PRESSURE	Inadvertent opening of UV-6470	High pressure from compressor discharge header Very high flow through Filter 510-F-103, leading to filter element damage	Refer High Flow The pressure rating of the piping system and equipment exceeds the upstream pressure source.	Correct the PSV set-point shown on the P&ID for Filter 510-F-103.	**1**	**SH**		

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
16.8	LOW PRESSURE	Lower pressure than expected in the EGP due to continuous withdrawal of gas from the EGP	High gas velocities through the piping and Filter 510-F-103. Longford Compressor discharge harder pressure too low to start compressors.	Refer High Flow Operator intervention	Consider implementation of low pressure alarm on the EGP Consider implementing a back pressure control loop on PV-6440 to maintain adequate pressure in the Longford compressor discharge header to start compressors.	**1** **1**	**DY** **DY**		
16.9	HIGH TEMPERATURE	Hot day (45 deg C) with flow from LCS into the EGP (i.e. north flow), exit temp from LCS would be high, if flow direction swapped to reverse the inlet temp from EGP into VicHub2 would be hotter		Operating temperature up to 46 degC in Vic Hub 2 is being considered Filter design temp is 50 degC	Review how quickly the flow direction can be swapped from north to south flow, i.e. is it plausible 4 hour blocks of direction change. If required would an increase the design temp be required?	**1**	**DY**		
16.10	LOW TEMPERATURE	Repressuriation of Filter 510-F-103 after maintenance	Piping seeing lower temp than designed for	Filter design temp is 15MPa Min piping design temp is -10degC	Check expected repressuring minimum temperatures are above pipe minimum design temperatures.	**2**	**SH**		
16.11	IMPURITIES	H2S is present in gas from Orbost or from Esso, therefore could be in the pipeline. Mercury from Esso (it is in their field and have they have mercury removal) Lube oil Seal oil	Off spec gas Not expecting enough H2S to have corrosion issues OH&S for maintenance – ops not expecting to be exposed. NORM (normally occurring radioactive material)	Spot checks are done on pigging, not yet in the plant. Filter for liquids removal	Operating procedures to include a note regarding materials that could be present in gas	**3**	**DY**		
16.12	CHANGE IN COMPOSITION / CONCENTRATION	Gas is odourised as it is discharged from Longford Compressor Station. If flow is reversed the gas could be odourised again. Mixed gas within plant with different odourised rates	High odorant results in more customers claiming gas leads AEMO will pick this up also		Control functional description to consider odourising controls to ensure it is not doubled up.	**3**	**DY**		
16.13	TWO PHASE FLOW	Nil			No action				
16.14	REACTIONS	Not expecting any issues		Orbost treats for H2S	No action				

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
16.15	TESTING EQUIPMENT / PRODUCT	Metering skid has a single meter only.		All maintenance can be done online (eg meter verification)	Develop procedure for verifying the accuracy of the single meter run and the GC. Probe for the GC will see higher flows during testing. Wake frequency calculation to consider all possible high flow scenarios. Note:External (not Gerni), Welker probe is desired.	**3** **2**	**DY** **AZ**		
16.16	PLANT ITEM OPERABILITY	Closure on filter, type shown on P&ID is the preferred option Pigs – direction of pigging is unknown	Need to be able to receive a pig if flowing from north to south		Pigs – confirm the planned direction of pigging and review the configuration of the pipework to ensure that a pig can be received at the Longford Compressor Station Pig Barrel (location of kicker and equalisation line)	**2**	**DY**		
16.17	PLANT ITEM MAINTAINABILITY	Isolation of filter or strainer for maintenance Meter – single series with no double head for proving	No way to re-pressurise after isolation for maintenance. Large ball valve required to open to re-pressurise isolated strainer/filter, leading to damage to large ball valve. After 10 years difficult to prove the calibration (Esso sometimes query this) No immediate concerns		Strainer - install a pressuriation line around valve 400-BV-064844. Filter - install a pressurisation line around filter isolation valve 400-BV-064844 including an RO to limit the pressurisation rate of the filter and avoid damage to the filter elements.	**1**	**PB**		
16.18		If pigging in reverse (North to South) corrosion by-products in PV-6440 and meter FE-6433	Blockage or damage to PV or FE		If pigging required to be performed north to south the pigging procedure should include closure of PV-6433 during pigging and consider impact of corrosion by-products.	**3**	**DY**		
16.19	ELECTRICAL AREA CLASSIFICATION	HA classification will need to be done		This will be part of the project	No action				
16.20	EARTHING	NIl							
16.21	ISOLATION	Drawing consistency			Implement a consistent approach with regards to valve cavity bleeds	**1**	**PB**		
16.22	INSTRUMENTS TOO MANY	Nil							
16.23	INSTRUMENTS TOO FEW	Nil							
16.24	CORRECT LOCATION OF INSTRUMENTS	Nil							

NODE 17: LONGFORD: VICHUB2 TO VIC HUB WBH CROSS OVER

DRAWINGS: GAS-511-DW-PD-003, 510-DW-PD-006 **PLANT & EQUIPMENT:** - **INSTRUMENTATION:** - **LINE NUMBERS: G-716-C9D-200, G-100-C9-200, G-111-C9-200, G-112-C9-200**

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
17.1	HIGH FLOW	Refer previous node (node 16)	Required heating duty exceeds heater duty could lead to lower than required temp at the regulators (heater can't keep up), hence delivery temperature.	Downstream flow control valve, there will be a max nomination which can be entered per run which should prevent this.	Ensure that a nomination leading to higher than design flows cannot be entered into SCADA Philosophy similar to Hoarlsey to be implemented	**2**	**DY**		
17.2		High volumetric flow through the heater tubes	Exceeding the existing heater tube design velocity		Check the sizing of the VH1 heater for project operating conditions. .	**2**	**DY**		
17.3	HIGH LEVEL	N/A							
17.4	LOW FLOW	Refer previous node (node 16)		Heater controls are assumed to be working	No action				
17.5	LOW LEVEL	N/A							
17.6	ZERO FLOW / EMPTY	Refer node 16							
17.7	REVERSE FLOW	See operability (this node)		All rated for 900#	No action				
17.8	HIGH PRESSURE	Refer node 16							
17.9	LOW PRESSURE	Refer node 16							
17.10	HIGH TEMPERATURE	Loss of 510-HT-101 heater control	Excessive gas temperature downstream of 510-HT-101	Existing heater controls	Review the 510-HT-101 heater control logic and ensure the design is appropriate for reverse flow operation.	**2**	**AZ**		
17.11	LOW TEMPERATURE	Gas temp will be lower than current operating conditions (temp coming in around 19 deg rather than 40deg from the compressor).	Could decrease/change the heater capacity. There are currently scenarios where up to 120 TJ/d resulted in shutdown due to the parameters being considered, this has occurred during winter.	High inlet pressure expected in reverse flow mode compared to current mode A control system was implemented to increase the heater capacity from 135 to 150 however conditions over winter this resulted in numerous trips possibly on high inlet Pressure.	Refer HIGH TEMPERATURE action				
17.12	IMPURITIES	Refer node 16							
17.13	CHANGE IN COMPOSITION / CONCENTRATION	Refer node 16							
17.14	TWO PHASE FLOW	Refer node 16							
17.15	REACTIONS	Refer node 16							

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
17.16	TESTING EQUIPMENT / PRODUCT	Existing – nothing added in the node							
17.17	PLANT ITEM OPERABILITY	Switching from EGP North to South then reverse, leading to back flow through the equipment	Line back to filter gets reverse flow for repressurisation Noting this is not significant, may be a meter pulse	NRV at the filter, which is what needs to be protected	Consider relocating 64101 to the other side of filter and meter run Consider new actuated/switching valve at the tie-in point or 64866 to be actuated Consider remote versus manual requirements	**1** **1**	**DY** **DY**		
17.18		If VH1 heater is off-line for maintenance fuel gas is not being heated.	Limited compressor capacity or off spec fuel gas.	Back-up electric heater.	Consider additional FG heating control loop through the new VH2 water bath heater	**1**	**DY**		
17.19	PLANT ITEM MAINTAINABILITY	Refer above							
17.20	ELECTRICAL AREA CLASSIFICATION	HA classification on previous project is not available for this section of the plant		Equipment is expected to be okay	HA classification to be completed for areas where new equipment is being installed.	**2**	**SH**		
17.21	EARTHING	Nil							
17.22	ISOLATION	Nil							
17.23	INSTRUMENTS TOO MANY	Nil							
17.24	INSTRUMENTS TOO FEW	Nil							
17.25	CORRECT LOCATION OF INSTRUMENTS	Nil							

NODE 18: LONGFORD: VICHUB2 WATER BATH HEATER TO FLOW REGULATORS

HEATER BATH TEMP 50 TO 60 DEG C. OLPERATES DIFFERENTLY TO THE OTHER HEATER. TEMP WILL BE ACHIEVEED BY MIXING HOT HEATED GAS WITH BYPASSED GAS.

DRAWINGS: GAS-511-DW-PD-002, GAS-511-DW-PD-004 **PLANT & EQUIPMENT:** 510-HT-102 **INSTRUMENTATION:** - **LINE NUMBERS:** G-708-C9D-300, G-711-C9D-400, G-712-C9D-400, G-713-C9D-400, G-717-C9D-400

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
18.1	HIGH FLOW	TY-064114 fails shut directing more flow through the heater than design	Heater damage / vibration	Position transmitter feedback with out of position alarm	Determine the operational limits of the heater and consider implementing trips or high flow alarms	**2**	**AZ**		
18.2	HIGH LEVEL	N/A							

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
18.3	LOW FLOW	Refer NODE 16 Insulation shown on P&ID is for temperature conservation (start up after shut in overnight)							
18.4	LOW LEVEL	N/A							
18.5	ZERO FLOW / EMPTY	No flow through the heater – there will be a bath temp range, it will continue to fire until it reaches the high limit then go into standby mode		There will be a detailed design vendor HAZOP for the heater	No action				
18.6	REVERSE FLOW	Refer node 16							
18.7	HIGH PRESSURE	Heater design pressure and temp shown incorrectly on P&ID			Design pressure on the heater to be changed to 14,895 kPag, temp should be VTC	**1**	**SH**		
18.8	LOW PRESSURE	Refer node 16							
18.9	HIGH TEMPERATURE	TCV control will be via Jemena DCS. If this valve closed inadvertently more gas than is required would be directed to the heater leading to high temperatures.	Wasting fuel gas	Heater package won't overheat gas. Discrepancy alarm on TCV	No action required				
18.10	LOW TEMPERATURE	TCV open too far	Low temp trip downstream AEMO may call with a warning	Discrepancy alarm on TCV Low temp on alarm at regulator outlet (64115)	Add low temperature trip to TIT-64128.	**1**	**AZ**		
18.11		Manual butterfly (64001) at outlet of heater to allow for manual trimming	Not expected to be used or required		Delete this valve	**1**	**PB**		
18.12	IMPURITIES	Water dosing (biocide)		Vendor HAZOP					
18.13	CHANGE IN COMPOSITION / CONCENTRATION	Nil							
18.14	TWO PHASE FLOW	Nil							
18.15	REACTIONS	Nil							
18.16	TESTING EQUIPMENT / PRODUCT								

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
18.17	PLANT ITEM OPERABILITY	Insufficient isolation to maintain TCV-64114 with heater 510-HT-102 online.	Maintenance cannot be completed without depressuring the heater 510-HT-102 and using isolations further upstream/downstream.	Heater can be used with some limitations if TCV-64114 is out of service VicHub 1 heater 510-HT-101 available Valve body/internals not expected to require repair Valve actuator and instrumentation can be maintained with the valve remaining in service. Note – TCV is butterfly type and may be wafer style Can be repaired / replaced during a shutdown	No action required				
18.18	PLANT ITEM OPERABILITY	No bypass arrangement for bundle inspection. Intention is to isolate the run. If VH2 WBH is out and VH1 WBH fails we will lose flow or capacity		Philisophy for maintenance is to isolate whole run to work on the heater. There is 2 tube bundles runs (burners) with redundancy during normal operating conditions.	Removable spool required to get the bundle out (add note to P&ID)	**1**	**SH**		
18.19	PLANT ITEM MAINTAINABILITY	Note only - Heater will be registered type B appliance In Victoria							
18.20		No repressurisation line around isolation ball valve BV-64867 upstream of heater 510-HT-102 No automatic ball valve and plug for repressurisation around the slam shut valves SDV-64116 and SDV-64122.	Repressurisation across BV64867 not possible following double block and bleed isolation on inlet of 510-HT-102. Damage to slam shut valves on re-opening with high DP	Volume between slam shut and regulatoris small Frequency of operation of slam shut valves is rare	Relocate pressurisation line from valve 64886 to 64867 Show inhibit/interlock on not opening the SDV's unless the downstream valves are confirmed closed	**1** **2**	**PB** **SH**		
18.21									
18.22	ELECTRICAL AREA CLASSIFICATION	Heater location is adjacent to a road and a 22kW cable underground In the vicinity	HA zones in this area will be extended		HA classification ot be completed in detailed design.	**2**	**SH**		
18.23	EARTHING	Nil							
18.24	ISOLATION	Bleed is not available between the ball and the plug on the bypass line around BV-64875/64888	Not able to achieve DB&B		Add bleed point between ball and plug valve on pressurisation line around inlet isolation valves BV-64875/64888. Change pressurisation line configuration to 2 ball valves and an orifice (with a bleed)	**1** **1**	**PB** **PB**		
18.25	INSTRUMENTS TOO MANY	Nil							

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
18.26	INSTRUMENTS TOO FEW	Nil							
18.27	CORRECT LOCATION OF INSTRUMENTS	Nil							

NODE 19: LONGFORD: VICHUB2 FLOW REGULATORS TO GAS NET

DRAWINGS: PO-511-DW-PD-001, GAS-511-DW-PD-004 **PLANT & EQUIPMENT:** - **INSTRUMENTATION:** - **LINE NUMBERS:** G-717-C9D-400, G-714-C9D-400, G-718-C9D-400, G-715-C9D-400

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
19.1	HIGH FLOW	Refer Node 16 Loss of control of flow control valves Both flow control runs open simultaneously	Flow induced vibration in thermowells	Thermowell wake frequency calculations to be completed as part of detailed design High flow alarm on FI-64112	Consider high velocity alarm on FI-64112, based on upstream flowrate and downstream set pressure.	**1**	**DY**		
19.2	HIGH LEVEL	No issues identified							
19.3	LOW FLOW	Refer Node 16							
19.4	LOW LEVEL	No issues identified							
19.5	ZERO FLOW / EMPTY	Refer Node 16							
19.6	REVERSE FLOW	Refer Node 16							
19.7	HIGH PRESSURE	Blocked discharge, pressure bleeds past flow control valves	High pressure downstream of flow control valves	Control valves close on high pressure. Slam shut closes PSVs downstream of flow control valves (leakage PSV only) Piping spec break downstream of flow control skid outlet isolation valves. SIL assessment planned to be completed for this system.	Set slam shut trip to the pressure rating of the downstream system.	**1**	**AZ**		
19.8	LOW PRESSURE	No issues identified							
19.9	HIGH TEMPERATURE	Refer Node X							
19.10	LOW TEMPERATURE	Refer Node 16 JT cooling over control valves Insufficient headting from WBH	Temp below gas spec Temp below material design rating	Downstream temp trip Heat recovery in downstream piping	Add new TIT to DCS downstream of both flow control valves Convert TIT-64128 into SIS low temperature trip	**1** **1**	**SH** **AZ**		
19.11	IMPURITIES	No new issues.							
19.12	CHANGE IN COMPOSITION / CONCENTRATION	No new issues.							

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
19.13	TWO PHASE FLOW	No new issues.							
19.14	REACTIONS	No new issues.							
19.15	TESTING EQUIPMENT / PRODUCT			Statutory PM checks on PSVs, CFTs	Confirm requirement for DN20 vents downstream of flow control valves	**1**	**DY**		
19.16	PLANT ITEM OPERABILITY	Isolation of flow control skid from downstream pipeline, single valve isolation provided			Confirm isolation philosophy for flow control skid and flow control runs, determine if single valve isolation or DB&B required. Add isolation valve at TIP-510-04, with bleed upstream to provide DB&B (if required, ref action above).	**1** **1**	**DY** **PB**		
19.17	PLANT ITEM MAINTAINABILITY	Removal of PSV-66121/66127 for maintenance / testing	No bleed between PSV-66121/66127 and isolation valve below		Add bleed ring / test & tap valve below PSV-66121/66127	**1**	**SH**		
19.18	ELECTRICAL AREA CLASSIFICATION								
19.19	EARTHING	Close proximity to 22kV			Review proximity to existing 22kV electrical cable route	**1**	**DY**		
19.20	ISOLATION	Refer Plant Item Operability							
19.21	INSTRUMENTS TOO MANY	No causes							
19.22	INSTRUMENTS TOO FEW	No causes							
19.23	CORRECT LOCATION OF INSTRUMENTS	No causes							

NODE 20: LONGFORD: FUEL GAS TO VICHUB2 WBH

DRAWINGS: GAS-511-DW-PD-004, GAS-511-DW-PD-002 **PLANT & EQUIPMENT:** - **INSTRUMENTATION:** - **LINE NUMBERS:** FG-716-C6D-50, FG-709-C3D-50

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
20.1	HIGH FLOW			HAZOP for WBH package will be completed during detailed design	No action				
20.2	HIGH LEVEL	No causes							
20.3	LOW FLOW	No causes							
20.4	LOW LEVEL	No causes							
20.5	ZERO FLOW / EMPTY	No causes							

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
20.6	REVERSE FLOW	No causes							
20.7	HIGH PRESSURE	No causes							
20.8	LOW PRESSURE	No causes							
20.9	HIGH TEMPERATURE	No causes							
20.10	LOW TEMPERATURE	No causes							
20.11	IMPURITIES	No causes							
20.12	CHANGE IN COMPOSITION / CONCENTRATION	No causes							
20.13	TWO PHASE FLOW	No causes							
20.14	REACTIONS	No causes							
20.15	TESTING EQUIPMENT / PRODUCT	No causes							
20.16					Query with Jemena Commercial regarding the best location for fuel gas offtake for the new WBH for gas accounting	**2**	**DY**		
20.17	PLANT ITEM MAINTAINABILITY	No causes							
20.18	ELECTRICAL AREA CLASSIFICATION	No causes							
20.19	EARTHING	No causes							
20.20	ISOLATION				Include DB&B isolation for fuel gas offtake from flow control skid.	**1**	**PB**		
20.21	INSTRUMENTS TOO MANY	No causes							
20.22	INSTRUMENTS TOO FEW				Include fuel gas flowmeter as part of WBH package.	**2**	**SH**		
20.23	CORRECT LOCATION OF INSTRUMENTS	No causes							

NODE 21: LONGFORD: VICHUB2 FILTER SEPARATOR LIQUIDS TO CLOSED DRAIN

DRAWINGS: GAS-511-DW-001, 510-DW-PD-101 **PLANT & EQUIPMENT:** - **INSTRUMENTATION:** - **LINE NUMBERS:** CD-708-C6D-50

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
21.1	HIGH FLOW	Gas breakthrough High liquid loading on drain system	Overpressure of closed drain system (CL600) from upstream CL900 system. Frequency pump out of closed drain drum	ROs in drain connections sized for gas breakthrough scenario Open path downstream to closed drain drum	No action				
21.2	HIGH LEVEL	Refer Node 16 regarding Filter 510-F-103							
21.3	LOW FLOW	No issues identified							
21.4	LOW LEVEL	No issues identified							
21.5	ZERO FLOW / EMPTY	No issues identified							
21.6	REVERSE FLOW	No issues identified							
21.7	HIGH PRESSURE	Refer High Flow							
21.8	LOW PRESSURE	No issues identified							
21.9	HIGH TEMPERATURE	No issues identified							
21.10	LOW TEMPERATURE	JT cooling during gas breakthrough	Low temperature	Operator intervention, closes manual valve is gas breakthrough scenario	Ensure minimum design temp of piping suitable for gas breakthrough scenario	**2**	**SH**		
21.11	IMPURITIES	Refer Node 16 Solids from upstream		Notification from upstream Operator regarding prescence of Mercury Filter captures solids	No action				
21.12	CHANGE IN COMPOSITION / CONCENTRATION	No issues identified							
21.13	TWO PHASE FLOW	High velocity liquid slug during gas breakthrough scenario		Piping designed for slugging	No action				
21.14	REACTIONS	No issues identified							
21.15	TESTING EQUIPMENT / PRODUCT	No issues identified							
21.16	PLANT ITEM OPERABILITY	Simultaneous draining of 510-F-103 using manual drain valves, and automatic draining from other filter vessels		Drain drum is open to atmosphere and unlikely to experience backflow from 510-F-103 to other filters if draining simultaneously	No action				
21.17	PLANT ITEM MAINTAINABILITY	RO blockage due to solids			Add rodding point to CD header in DN50 section	**1**	**PB**		
21.18	ELECTRICAL AREA CLASSIFICATION	No issues identified							
21.19	EARTHING	No issues identified							
21.20	ISOLATION	Filter isolation	Inadequate isolation		Confirm isolation philosophy for isolation of CD header from filter.	**1**	**DY**		

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
21.21	INSTRUMENTS TOO MANY	No causes							
21.22	INSTRUMENTS TOO FEW	No causes							
21.23	CORRECT LOCATION OF INSTRUMENTS	No causes							

NODE 22: LONGFORD: VICHUB2 FILTER SEPARATOR BUND LIQUIDS TO OPEN DRAIN

DRAWINGS: GAS-511-DW-PD-001, 501-PD-140 **PLANT & EQUIPMENT:** - **INSTRUMENTATION:** - **LINE NUMBERS:** UPVC

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
22.1	HIGH FLOW	Draining high level in sump, DN100 drain valve.	Spillage through other vents/connections in the OD system	Operator controls flow using manual valve, drain valve not fully opened for draining.	No action				
22.2	HIGH LEVEL								
22.3	LOW FLOW	No issues identified.							
22.4	LOW LEVEL	No issues identified.							
22.5	ZERO FLOW / EMPTY	No issues identified.							
22.6	REVERSE FLOW	No issues identified.							
22.7	HIGH PRESSURE	No issues identified.							
22.8	LOW PRESSURE	No issues identified.							
22.9	HIGH TEMPERATURE	No issues identified.							
22.10	LOW TEMPERATURE	No issues identified.							
22.11	IMPURITIES			Operators will manage impurities	No action				
22.12	CHANGE IN COMPOSITION / CONCENTRATION	No issues identified.							
22.13	TWO PHASE FLOW	No issues identified.							
22.14	REACTIONS	No issues identified.							
22.15	TESTING EQUIPMENT / PRODUCT	No issues identified.							
22.16	PLANT ITEM OPERABILITY	No issues identified.							
22.17	PLANT ITEM MAINTAINABILITY	No issues identified.							

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
22.18	ELECTRICAL AREA CLASSIFICATION			Hazardous area classification will be assessed as part of detailed design.	No action				
22.19	EARTHING	No issues identified.							
22.20	ISOLATION	No issues identified.							
22.21	INSTRUMENTS TOO MANY	No issues identified.							
22.22	INSTRUMENTS TOO FEW	No issues identified.							
22.23	CORRECT LOCATION OF INSTRUMENTS	No issues identified.							

NODE 23: LONGFORD: VIC HUB ACTUATED INLET ISOLATION VALVES

DRAWINGS: 510-DW-PD-006 **PLANT & EQUIPMENT:** - **INSTRUMENTATION:** - **LINE NUMBERS:** G-077-C9D-200

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
23.1	MISDIRECTED FLOW	Incorrect valve line-up	Imbalance penalties Not meeting flow nomination.	Proposed control will include a matrix of flow operation modes with permissives for selecting and changing mode.	Review option to fully automate flow mode switching	**2**	**DY**		
23.2	HIGH FLOW	High DP across actuated valves UV-533 High flow velocity in DN20 repressurisation line.	Damage to UV-533 valve seat	Low DP open permissive across flow switching valves	Review mounting and installation of actuators on existing manual valves to be actuated. Ensure actuated valves have low DP permissive for opening. Review sizing of DN20 repressurisation line.	**2** **1** **2**	**DY** **AZ** **SH**		
23.3	HIGH LEVEL	No issues identified.							
23.4	LOW FLOW	No issues identified.							
23.5	LOW LEVEL	No issues identified.							
23.6	ZERO FLOW / EMPTY	No issues identified.							
23.7	REVERSE FLOW	No issues identified.							
23.8	HIGH PRESSURE	No issues identified.							
23.9	LOW PRESSURE	No issues identified.							
23.10	HIGH TEMPERATURE	No issues identified.							

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
23.11	LOW TEMPERATURE	JT cooling across repressurisation line	Low temp below equipment design		Confirm lowest possible process temperatures are within piping and equipment limits	**2**	**PB**		
23.12	IMPURITIES	No issues identified.							
23.13	CHANGE IN COMPOSITION / CONCENTRATION	No issues identified.							
23.14	TWO PHASE FLOW	No issues identified.							
23.15	REACTIONS	No issues identified.							
23.16	TESTING EQUIPMENT / PRODUCT	No issues identified.							
23.17	PLANT ITEM OPERABILITY				Review blowdown philosophy and if UV-533/UV-532 are to be FC or FO, and required position during LCS blowdown	**1**	**DY**		
23.18	PLANT ITEM MAINTAINABILITY	No issues identified.							
23.19	ELECTRICAL AREA CLASSIFICATION	No issues identified.							
23.20	EARTHING	No issues identified.							
23.21	ISOLATION	No issues identified.							
23.22	INSTRUMENTS TOO MANY	No issues identified.							
23.23	INSTRUMENTS TOO FEW	No issues identified.							
23.24	CORRECT LOCATION OF INSTRUMENTS	No issues identified.							

NODE 23A: LONGFORD: OVERVIEW

DRAWINGS: 510-PI-092, 501-PD-140, PO-510-PI-110, PO-511-DW-PD-001, GAS-511-DW-PD-001, GAS-511-DW-PD-002, GAS-511-DW-PD-003, GAS-511-DW-PD-004, 510-DW-PD-006, 510-DW-PD-101

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
23.1 A	TOXICITY	No new causes.							
23.2 A	SERVICES REQUIRED	No increase in overall plant utility load due to reduction in compressor operation.							
23.3 A	MATERIALS OF CONSTRUCTION				No action				
23.4 A	COMMISSIONING	No issues identified.							

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
23.5 A	BREAKDOWN								
23.6 A	STARTUP / SHUTDOWN	Capacity for TGP ~30TJ/day, well below LCS capacity	LCS running at reduced efficiency	Compressor bypass available for operating at reduced capacity.	Confirm LCS operating philosophy for reduced capacity supply to TGP only.	**2**	**DY**		
23.7 A	EFFLUENT	Refer Node 22							
23.8 A	NOISE / VIBRATION			Proposed design includes acoustic enclosure / wall around flow control skid. Details to be confirmed during detailed design. Regulators will be provided with low noise trim. Additional acoustic insulation on piping & valves may be used if required.	No action				
23.9 A	FIRE / EXPLOSION				Update existing vent radiation zone assessment based on new plant capacity	**2**	**SH**		
23.10 A	SAFETY EQUIPMENT	Additional load on station vent	Increase in station blowdown time		Review station blowdown time with new equipment added.	**2**	**DY**		
23.11 A	QUALITY AND CONSISTENCY								
23.12 A	OUTPUT – RELIABILITY AND BOTTLENECKS								
23.13 A	EFFICIENCY	Refer STARTUP / SHUTDOWN							
23.14 A	SIMPLICITY	Many possible configurations and modes at LCS with VicHub2	STTM/nomination logic complexity increase.		STTM/nomination logic and modes/configurations to be reviewed and defined with Jemena EIC team	**2**	**DY**		
23.15 A	MOBILE EQUIPMENT / PLANT MOVEMENT			Site layout provides space for WBH process bundle and burner tube removal.					
23.16 A	PROCESS PLANT NORMAL / ABNORMAL MAINTENANCE			Constructability and accessibility reviews to be completed as part of designed design.					
23.17 A	PROCESS PLANT PROCESS FUNCTIONALITY	New WBH not always required, and may be unused for long periods (~months)	Corrosion risks if WBH is shut down for long periods and allowed to reach ambient temperature		Review standby philosophy for new WBH	**2**	**DY**		
23.18 A	ERGONOMICS			Filter element access will be reviewed as part of layout/model reviews. Control valve access for maintenance to be reviewed as part of layout/model reviews.	New WBH to have stairs instead of ladders to access the top of the WBH.	**2**	**PB**		
23.19 A	GUARDING								
23.20 A	WARNINGS	Flow control skid introduces hazardous area outside of the LCS site access road		Plant hazardous area drawings will be revised as part of detailed design.	No action				
23.21 A	VULNERABILITY								

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
23.22 A	3RD PARTY INTERFERENCE			VicHub2 equipment installed within existing LCS plant boundary.	No action				
23.23 A	NATURAL EVENTS								

Client	**Jemena Ltd**
Client Project No	**GAS-599**
GPA Project No	**20617**
Project Title	**Project Marlin: EGP Reversal**
Facilitator	**Lisa Hein**
Scribe	**Peter Blyton**
Workshop Date	**12/11/2020**
Workshop Location	**Microsoft Teams**
HAZOP Sponsor	**Nathan Biggins** **Matthew Skaras**
HAZOP Stage	**30% FEED Stage 2:** • **Wilton Meter Station (WMS)**

HAZOP Participants:

GPA Engineering

Lisa Hein (LH)	Senior Consultant - Risk and Advisory / Facilitator
Simon Hanlin (SH)	Senior Process Engineer
Peter Blyton (PB)	Senior Mechanical Engineer / Minute Taker
Adrian Zatta (AZ)	Senior EI&C Engineer

Jemena

David Young (DY)	Engineering Manager
Stephen Chow (SC)	Project Engineer
Luke Gigliotti (LG)	Team Leader - Control Room
Steven Bonnici (SB)	Team Leader - EGP
Adam Christian (AC)	Operations - Wilton Meter Station
Mitchell Graham (MG)	Operations - Wilton Meter Station

Background:
Jemena is undertaking Front End Engineering and Design (FEED) to facilitate a total installed cost (TIC) estimate and schedule to reverse flow the Eastern Gas Pipeline (EGP) south of the Kembla Grange Meter Station (KGMS), to allow the supply of gas into the Victorian and New South Wales gas networks.

The following, key pieces of documentation, formed the basis of the HAZOP (additional information was available – see HAZOP report):

- Wilton Meter Station
  - Receiver Station P&ID: 563-DW-PD-001
  - Dry Gas Filters P&ID: 563-DW-PD-002
  - APA Water Bath Heater P&ID: 563-DW-PD-016
  - APA Flow Metering P&ID: 563-DW-PD-017
  - APA Pressure Reduction Skid P&ID: 563-DW-PD-018
  - Heat Exchangers P&ID: 563-DW-PD-003
  - JGN Flow Metering P&ID: 563-DW-PD-008
  - JGN Pressure Reduction Skid P&ID: 563-DW-PD-010
  - Connection to APA P&ID: 563-DW-PD-012
  - APA Pressure Reduction Skid P&ID: 563-DW-PD-015
  - Instrument Air Package P&ID: 563-DW-PD-011
  - Hot Water Heater Fuel Gas Train P&ID: 563-DW-PD-014

The HAZOP specifically dealt with:

- Wilton Meter Station (WMS).

The HAZOP specifically excluded a full formal review of:

- Water Bath Heater 563-HT-001, Vendor Package HAZOP will be completed as part of Detailed Design

The HAZOP was conducted using a series of guide words which were applied to each of the key phases of operation.

NODE 24: WILTON: EGP TO APA WATER BATH HEATER

DRAWINGS: 563-DW-PD-001, 563-DW-PD-002, 563-DW-PD-016 **PLANT & EQUIPMENT:** 563-F-01, 563-F-02 **INSTRUMENTATION:** - **LINE NUMBERS:** 563-G-847-X70-250, 563-G-849-H150-300,563-G-802-C9D-300, 563-G-800-C9D-250, 563-G-846-C9D-250, 563-G-64881-C9D-250, G-64888-C9D-250

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
24.1	HIGH FLOW	Low pressure in WLP leading to high volumetric flow. One filter offline with full flow through a single filter unit	FIV Erosional velocity limits exceeded High DP across filters 563-F-01/02	Filter bypass line available when filter unit is offline Filter High DP alarms (2 stages of alarm) and HH DP trip provided (PDI-64103/64807), HH trip shuts SLV-64800.	Operating procedures to include requirements for filter element change-out and agreeing reductions in flow nomination or use of filter bypass line while a filter unit is offline. Agree minimum pressures into WMS with Jemena Commercial.	**3** **1**	**DY** **DY**		
24.2	HIGH LEVEL	Liquid slug Solids, dust in gas from pipeline Inadequate operation of manual liquid draining of Filter 563-F-01/02	Liquids carry over, leading to off-spec gas High DP across Filters 563-F-01/02	Dry sales gas, with no nearby upstream gas compressors, no history of oil in inlet gas	No action				
24.3	LOW FLOW	Blocked Filter 563-F-01/02	High DP across filter, leading to filter element damage Flow nomination shortfall	Filter High DP alarms and HH DP trip provided (PDI-64103/64807), HH trip shuts SLV-64800.	No action				
24.4	LOW LEVEL	No issues identified.							
24.5	ZERO FLOW / EMPTY	Inadvertent closure of downstream valves	Failure to deliver flow nomination	Flow trend monitoring by Operations Personnel Position feedback and out of position alarm provided on downstream flow control valves on new skids.	No action				
24.6	REVERSE FLOW	Higher pressure in downstream JGN or APA pipelines than WLP	Reverse flow, leading to filter element damage Loss of effective metering	Check valve in each flow control run Flow control valves will close when downstream pressure is higher than upstream pressure	No action				
24.7	HIGH PRESSURE	Inadvertent closure of downstream valves		The pressure rating of the piping system (C9D, 15.32 MPag) and equipment exceeds the upstream pressure source (14.895 MPag).	No action				

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
24.8	LOW PRESSURE	Lower pressure in WLP than design	High gas velocities through the piping and Filter 563-F-01/02 AIV/FIV Wake frequency limits on thermowells and sampling probes	Refer High Flow Operator intervention Low pressure alarm PAL-64802 on WLP	Agree set point and re-set low pressure alarm PAL-64802 Consider low pressure trip on WLP using PIT-64802, and/or alternatives such as velocity calculation using sum of flow through flow meters and inlet pressure	**1** **1**	**SH** **SH**		
24.9	HIGH TEMPERATURE	No issues identified		Mechanical design temperature meets environmental / solar insolation temperature	No action				
24.10	LOW TEMPERATURE	Repressuriation of Filter 563-F-01/02 after maintenance	Piping seeing lower temp than designed for	Filter design temp is 15MPa Min piping design temp is -10degC	Check expected repressuring minimum temperatures Update P&ID to include minimum design temperature for inlet filters 563-F-01/02	**2** **1**	**SH** **SH**		
24.11	IMPURITIES	Sulphur Solids & dust from pipeline Pyrophorics NORMs (normally occurring radioactive material)	Off spec gas Filter blockage, refer LOW FLOW	Filters 563-F-01/02	No action				
24.12	CHANGE IN COMPOSITION / CONCENTRATION	Step change in gas composition during change in gas supply from Longford or Port Kembla LNG import, some mixing will occur between the two gas supplies	Regulators will adjust based on energy flow	Gas Chromatograph to identify change in gas composition, as input to energy flow nominations	No action				
24.13	TWO PHASE FLOW	No issues identified							
24.14	REACTIONS	No issues identified							
24.15	TESTING EQUIPMENT / PRODUCT	No issues identified		Existing CFT on SLV-64800 GC sample point has been relocated to station inlet such that it is common to all runs	No action				
24.16	PLANT ITEM OPERABILITY	Repressurisation line around DB&B on inlet of 563-F-02 relies on a plug valve for second isolation, which is not recommended.	Insufficient isolation integrity for maintenance of 563-F-02.		Modify repressurisation bypass line around DB&B arrangements on inlet of 563-F-02 such that repressurisation connects in between the two DN250 ball valves, and remove vent on repressurisation line making 250-BV-64102 the second block valve for the repressurisation line.	**1**	**PB**		

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
24.17	PLANT ITEM MAINTAINABILITY	Access into filter required for element changeout Consistency of parts and filter elements with similar filter units at other Jemena sites Maintenance overrides required on SLV-64800 and Filter DP transmitters		Quick opening closure provided	QOC and filter elements to have commonality with other filters at Longford and existing filter at WMS Modify functionality of SLV-64800 to provide MOS required for maintenance Modify functionality to DP transmitters (both filters) to provide MOS required for maintenance	**2** **2** **2**	**PB** **PB** **AZ**		
24.18	ELECTRICAL AREA CLASSIFICATION	No issues identified							
24.19	EARTHING	No issues identified							
24.20	ISOLATION	Existing Filter 563-F-01 has single valve isolation only WBH 563-HT-001 has single valve isolation only.			Add DB&B isolation for existing filter 563-F-01 Relocate repressurisation line around 250-BV-641557 to be located around 250-BV-64154.	**1** **1**	**PB** **PB**		
24.21	INSTRUMENTS TOO MANY	Inconsistent instrument makes and models	Additional sparing for instruments		Ensure new instrumentation is consistent with existing instrumentation used on site	**2**	**DY**		
24.22	INSTRUMENTS TOO FEW	NO CAUSES							
24.23	CORRECT LOCATION OF INSTRUMENTS	NO CAUSES							

NODE 25: WILTON: APA WATER BATH HEATER TO APA METERING

DRAWINGS: 563-DW-PD-016, 563-DW-PD-017 **PLANT & EQUIPMENT:** 563-HT-001 **INSTRUMENTATION:** - **LINE NUMBERS:** G-64889-C9D-250, G-64890-C9D-250

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
25.1	HIGH FLOW	TCV-64148 fails closed, resulting in more flow through the WBH, velocities could exceed design under low pressure scenarios	Heater damage / vibration of process bundle	Position transmitter feedback with out of position alarm on TCV-64148 Physical clamp allows manual setting of minimum closure of TCV-64148	Define maximum flow velocity of WBH. Potentially implement trips or high velocity alarms	**2**	**SH**		
25.2	HIGH LEVEL	No issues identified							

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
25.3	LOW FLOW	Refer NODE 24	Unstable operation of heater control.	Insulation and heat tracing shown on P&ID is for heat conservation/temperature (start up after shut in overnight)	All new pipework between 563-HT-001 and flow control skid to be heat traced and insulated, piping on skid does not require heat tracing and insulation Determine minimum turndown for each flow control run at the site	**2** **2**	**AZ** **SH**		
25.4	LOW LEVEL	No issues identified		563-HT-001 has low water level alarm, will be reviewed as part of Vendor Package HAZOP	No action				
25.5	ZERO FLOW / EMPTY	No flow through the heater – there will be a bath temp range, it will continue to fire until it reaches the high limit then go into standby mode		There will be a detailed design vendor HAZOP for the heater	No action				
25.6	REVERSE FLOW	Refer NODE 24							
25.7	HIGH PRESSURE	No sources of additional pressure			Add WBH process bundle design pressure & temperature to the P&ID	**2**	**SH**		
25.8	LOW PRESSURE	Refer HIGH FLOW							
25.9	HIGH TEMPERATURE	Loss of heater control TCV-64148 control will be via SCS. If this closed inadvertently all gas would be directed through heater.	Over-temperature of piping/equipment Wasting fuel gas due to overheating over process gas	High temperature control setpoint on WBH, and a HH temperature trip Position discrepancy alarm on TCV	No action				
25.10	LOW TEMPERATURE	Insufficient heating from 563-HT-001 TCV-64148 open more than required position	Bypassing of cold gas around 563-HT-001, leading to low gas temperature downstream of flow control valves	Low temp trip TALL- downstream on flow control skids (refer NODE 26) Position discrepancy alarm on TCV-64148 Low temp on alarm at regulator outlet (refer NODE 26)	No action				
25.11	IMPURITIES	Refer NODE 24							
25.12	CHANGE IN COMPOSITION / CONCENTRATION	Water dosing (biocide) Refer NODE 24		Vendor HAZOP					
25.13	TWO PHASE FLOW	No issues identified							
25.14	REACTIONS	No issues identified							
25.15	TESTING EQUIPMENT / PRODUCT	No issues identified							

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
25.16	PLANT ITEM OPERABILITY	Manual butterfly 150-CV[BUV]-64105 at outlet of heater to allow for manual trimming	Not expected to be used or required		Delete manual butterfly valve 150-CV[BUV]-64105 on outlet of 563-HT-001 Document in Operating Philosophy that 250-BV-641557 may be used to stop flow through WBH and bypass flow using TCV to maintain plant operation., This scenario only possible with low inlet pressures in order to meet outlet temperature requirement.	**1** **3**	**SH** **DY**		
25.17	PLANT ITEM MAINTAINABILITY	TCV-64148 maintenance cannot be done without depressurng the heater	New APA run offline / no flow during TCV maintenance	Removable spools provided at connection to WBH process bundle	Replace 25-BV-641559 with DN50 ball and plug valve vent arrangement	**1**	**PB**		
25.18	ELECTRICAL AREA CLASSIFICATION								
25.19	EARTHING								
25.20	ISOLATION	Removal and maintenance of TCV-64148	Single valve isolation provided only, no DB&B available without using isolations further upstream resulting in full station outage	TCV-64148 actuator and instrumentation can be maintained without process isolation	No action				
25.21	INSTRUMENTS TOO MANY								
25.22	INSTRUMENTS TOO FEW	Temperature upstream of 563-HT-001 is not monitored			WBH 563-HT-001 to include temperature instrumentation on both process gas and water Add TIT upstream of 563-HT-001 & 250-BV-64154 (equivalent to TIT-64808 upstream of existing heaters 563-HE-01/02)	**2** **1**	**AZ** **AZ**		
25.23	CORRECT LOCATION OF INSTRUMENTS								

NODE 26: WILTON: APA FLOW METERING TO MOOMBA WILTON MAINLINE HEADER

DRAWINGS: 563-DW-PD-017, 563-DW-PD-018, 563-DW-PD-012, 563-DW-PD-015

PLANT & EQUIPMENT: 563-MR-03, 563-MR-04, 563-RR-03, 563-RR-04

INSTRUMENTATION: -

LINE NUMBERS: 563-G-B11-C9D-250, 563-G-810-C9D-250, 563-G-B14-C9D-250, G-84890-C9D-250, 563-G-815-C9D-250, 563-G-817-PL92-250, 563-G-XXX-PL62-250, 563-G-816-C9D-250, 563-G-818-PL9Z-250, 563-G-819-PL9Z-250, 563-G-839-C9D-250, 563-G-B19-PL92-250, G-64887-PL62-250, 563-G-869-PL6Z-300, 563-G-068-PL6Z-300, 563-G-870-PL6Z-300, 563-G-069-PL6Z-300,

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
26.1	HIGH FLOW	Refer NODE 24 Flow control valves more open than expected	Refer NODE 24 Additional noise, FIV, high filter DP, equipment vibration and damage	Active, monitor and slam shut on flow control skid High velocity alarm FAH-64858 and HH velocity trip FAHH-64858 which closes SLV-64800 on meter runs 563-MR-03/04 SCADA to have adjustable priority system for controlling flow through each run	Determine velocity limits for all piping and equipemnt within the station and reassess HH velocity trip FAHH-64858 functionality and flow control system configuration as part of detailed design	**2**	**SH**		
26.2	HIGH LEVEL	No issues identified							
26.3	LOW FLOW	Refer NODE 25 regarding turndown		Low flow alarm FAL-64858	Refer action – limits of station				
26.4	LOW LEVEL	No issues identified							
26.5	ZERO FLOW / EMPTY	Refer NODE 24/25							
26.6	REVERSE FLOW	Refer ISOLATION							
26.7	HIGH PRESSURE	Refer NODE 24/25 Fail open of flow control valves Blocked discharge, pressure bleeds past flow control valves	Overpressure of downstream piping system, lower pressure rating (CL600) than upstream system (CL900)	Control valves (active and monitor) close on high pressure Slam shut valve SSV-64864/64865 closes on high pressure Piping spec break downstream of flow control skid outlet isolation valves SIL assessment completed for this system, existing skid relocated from JGN	SIL assessment to be recompleted, as frequency of blocked discharge increased due to issues with flow nominations	**2**	**DY**		
26.8	LOW PRESSURE	Refer NODE 24 HIGH FLOW			Refer common action for min inlet press.				
26.9	HIGH TEMPERATURE	Refer NODE 25		TAH and TAHH	No action				

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
26.10	LOW TEMPERATURE	Refer NODE 25 APA flow control runs 563-RR-03/04 have a common outlet temperature monitoring instrument	Unable to monitor separate temperature on outlet of 563-RR-03/04	TAL and TALL Low temperature is input to low flow selector	Confirm the temperature control loop required when operating the various flow control runs in parallel	**2**	**DY**		
26.11	IMPURITIES	No issues identified							
26.12	CHANGE IN COMPOSITION / CONCENTRATION	No issues identified							
26.13	TWO PHASE FLOW	No issues identified							
26.14	REACTIONS	No issues identified							
26.15	TESTING EQUIPMENT / PRODUCT	563-MR-03/04 flow meter capacity exceeded when in series configuration	Loss of effective metering	563-MR-03/04 can be configured in parallel Series configuration required for meter validation	Include maintenance overrides (MOS) for all equipment and instrumentation	**2**	**AZ**		
26.16	PLANT ITEM OPERABILITY	No new issues							
26.17	PLANT ITEM MAINTAINABILITY								
26.18	ELECTRICAL AREA CLASSIFICATION								
26.19	EARTHING								
26.20	ISOLATION			Z-crossover line between meter runs includes check valve 250-CV-64989 to prevent flow bypassing the meters during series configuration Locked valves used to ensure metering skid remains in desired configuration	Add 2x ball valves shown on outlet of new APA flow control skid (on PFD) to P&ID Isolation valves to be located at each end of the new loop line to APA TIP Add additional valve to the existing connection to APA MLV Add additional ball valve to the crossover connection between RR-01/02 and RR-03/04	**1** **1** **1** **1**	**PB** **SH** **PB** **PB**		
26.21	INSTRUMENTS TOO MANY	No causes							
26.22	INSTRUMENTS TOO FEW	No causes							
26.23	CORRECT LOCATION OF INSTRUMENTS	No causes							

NODE 27: WILTON: DRY GAS FILTERS TO JGN METERING VIA HEX (EXISTING EQUIPMENT, INCREASED FLOW AND CHANGED COMPOSITION)

DRAWINGS: 563-DW-PD-002, 563-DW-PD-003 **PLANT & EQUIPMENT:** 563-HE-01, 563-HE-02 **INSTRUMENTATION:** - **LINE NUMBERS:** 563-G-803-C9D-250, 563-G-804-C9D-250, 563-G-805-C9D-250, 563-G-806-C9D-250, 563-G-807-C9D-250, 563-G-808-C9D-250

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
27.1	HIGH FLOW	Refer NODE 24/25 – lower inlet pressure	Vibration of heat exchanger tubes, leading to equipment damage		No new actions Refer Item 26.1 action regarding velocity limits in station				
27.2	HIGH LEVEL	No issues identified							
27.3	LOW FLOW	Refer NODE – turndown							
27.4	LOW LEVEL	No issues identified							
27.5	ZERO FLOW / EMPTY	No issues identified							
27.6	REVERSE FLOW	Refer NODE – CVs in control runs							
27.7	HIGH PRESSURE	No change to existing							
27.8	LOW PRESSURE	No change to existing							
27.9	HIGH TEMPERATURE	No change to existing							
27.10	LOW TEMPERATURE	Refer NODE 26 – downstream temp control/monitoring No change to existing							
27.11	IMPURITIES	No change to existing							
27.12	CHANGE IN COMPOSITION / CONCENTRATION	No change to existing							
27.13	TWO PHASE FLOW	No change to existing							
27.14	REACTIONS	No change to existing							
27.15	TESTING EQUIPMENT / PRODUCT	GC sample point has been relocated from downstream of HXs to station inlet such that it is common to all runs	Lower sampled gas temperatures may exceed capacity of sampling system heater.		Review and ensure suitable heating of gas sampled for GC	**2**	**SH**		
27.16	PLANT ITEM OPERABILITY	Capacity of both heaters 563-HE-01/02 required to meet highest duty	No redundancy of heating units when running at highest duty / transient cases Flow will be limited if one heating unit is offline	Both heaters 563-HE-01/02 currently run in parallel	Document in the Operating Philosophy for reduction in inlet pressure or capacity curtailment / reduction in flow nomination if one heater unit 563-HE-01/02 is offline	**3**	**DY**		
27.17	PLANT ITEM MAINTAINABILITY	No change to existing							

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
27.18	ELECTRICAL AREA CLASSIFICATION	No change to existing							
27.19	EARTHING	No change to existing							
27.20	ISOLATION	No causes							
27.21	INSTRUMENTS TOO MANY	No causes							
27.22	INSTRUMENTS TOO FEW	Refer HIGH PRESSURE	No ability to measure pressure upstream of 563-HE-01/02		Change PI-64980/64981 to a PIT Change PI-64814 to a PIT Add a virtual DP across heaters 563-HE-01/02	**1** **1** **1**	**AZ** **AZ** **AZ**		
27.23	CORRECT LOCATION OF INSTRUMENTS	No causes							

NODE 28: WILTON: JGN METERING SKID

DRAWINGS: 563-DW-PD-008 **PLANT & EQUIPMENT:** - **INSTRUMENTATION:** - **LINE NUMBERS:** G-64882-C9D-250, G-64883-C9D-250

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
28.1	HIGH FLOW	Refer Node 24 Loss of control of flow control valves Both flow control runs open simultaneously	Flow induced vibration in piping and thermowells, leading to equipment damage	2x100% metering and flow control skids Thermowell wake frequency calculations as part of detailed design High velocity alarm on FI-64105/64107	Consider duplicating HH velocity trip logic used on existing metering runs at WMS	**1**	**DY**		
28.2	HIGH LEVEL	No issues identified							
28.3	LOW FLOW	Refer Node 24 Larger flow meters than existing JGN meters	Inadequate flow turndown, loss of effective metering		No action Ref Item 25.3 action regarding turndown				
28.4	LOW LEVEL	No issues identified							
28.5	ZERO FLOW / EMPTY	Refer Node 24							
28.6	REVERSE FLOW	Refer Node 24							

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
28.7	HIGH PRESSURE	Blocked discharge, pressure bleeds past flow control valves Slam shut valves require control segregation from SCS	High pressure downstream of flow control valves	Control valves close on high pressure. Slam shut closes PSVs downstream of flow control valves Piping spec break downstream of flow control skid outlet isolation valves. SIL assessment planned to be completed for this system.	Set slam shut trip to the pressure rating of the downstream system. Change slam shut valve to be pneumatically operated using slam shut panel to match other slam shut valves at WMS	**1** **1**	**SH** **SH**		
28.8	LOW PRESSURE	No issues identified							
28.9	HIGH TEMPERATURE	Refer Node 24							
28.10	LOW TEMPERATURE	Refer Node 24 JT cooling over control valves Insufficient heating from heaters 563-HE-01/02 Cold locked in gas on startup	Temp below gas spec Temp below material design rating	Downstream temp trip Heat recovery in downstream piping Heat tracing and lagging	Add new TIT to SCS downstream of both flow control valves Convert TIT-64147 into low temperature trip Consider heat tracing and insulation limits to be from outlet of heaters 563-HE-01/02 and upstream of flow control runs on straight run piping and excluding meter and flow control skids, or consider startup override for heaters 563-HE-01/02	**1** **1** **2**	**SH** **SH** **DY**		
28.11	IMPURITIES	No new issues							
28.12	CHANGE IN COMPOSITION / CONCENTRATION	No new issues							
28.13	TWO PHASE FLOW	No new issues							
28.14	REACTIONS	No new issues							
28.15	TESTING EQUIPMENT / PRODUCT			Statutory PM checks on PSVs, CFTs	Confirm requirement for DN20 vents downstream of flow control valves	**1**	**DY**		
28.16	PLANT ITEM OPERABILITY	Isolation of flow control skid from downstream pipeline, single valve isolation provided			Confirm isolation philosophy for flow control skid and flow control runs, determine if single valve isolation or DB&B required. Add isolation valve at TIP-510-04, with bleed upstream to provide DB&B (if required, ref action above).	**1** **1**	**DY** **PB**		
28.17	PLANT ITEM MAINTAINABILITY	Removal of PSV-64135/64148 for maintenance / testing	No bleed between PSV-64135/64148 and isolation valve below		Add bleed ring / test & tap valve below PSV-64135/64148 Add vent adjacent to TW-64147	**1** **1**	**PB** **PB**		

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
28.18	ELECTRICAL AREA CLASSIFICATION	No new causes							
28.19	EARTHING	No new causes							
28.20	ISOLATION	Pressurisation line double block and bleed design inadequate as it relies on a plug valve.	Insufficient isolation of regulator run.		Add re-pressurisation line around 400-BV-64127/64138 to connect in upstream of the slam shut valve. Repressurisation line to be two DN50 ball valves, with RO if required All small bore vents (DN20/DN25) to be provided with a needle valve for throttling and bleed plug	**1** **1**	**PB** **PB**		
28.21	INSTRUMENTS TOO MANY	No new causes							
28.22	INSTRUMENTS TOO FEW	No new causes							
28.23	CORRECT LOCATION OF INSTRUMENTS	No new causes							

NODE 29: WILTON: JGN FLOW CONTROL SKID

DRAWINGS: 563-DW-PD-008, 563-DW-PD-010 **PLANT & EQUIPMENT:** 563-RR-06 **INSTRUMENTATION:** - **LINE NUMBERS:** 563-G-815-C9D-250, G-64884-C9D-400, G-64885-C9D-400, 563-G-820-PL6Z-250, G-64886-PL6Z-400

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
29.1	HIGH FLOW	Refer NODE 28							
29.2	HIGH LEVEL								
29.3	LOW FLOW								
29.4	LOW LEVEL								
29.5	ZERO FLOW / EMPTY								
29.6	REVERSE FLOW								
29.7	HIGH PRESSURE								
29.8	LOW PRESSURE								
29.9	HIGH TEMPERATURE								
29.10	LOW TEMPERATURE								
29.11	IMPURITIES								

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
29.12	CHANGE IN COMPOSITION / CONCENTRATION								
29.13	TWO PHASE FLOW								
29.14	REACTIONS								
29.15	TESTING EQUIPMENT / PRODUCT								
29.16	PLANT ITEM OPERABILITY								
29.17	PLANT ITEM MAINTAINABILITY								
29.18	ELECTRICAL AREA CLASSIFICATION								
29.19	EARTHING								
29.20	ISOLATION								
29.21	INSTRUMENTS TOO MANY								
29.22	INSTRUMENTS TOO FEW								
29.23	CORRECT LOCATION OF INSTRUMENTS								

NODE 30: WILTON: INSTRUMENT AIR/GAS

DRAWINGS: 563-DW-PD-003, 563-DW-PD-010, 563-DW-PD-011 **PLANT & EQUIPMENT:** - **INSTRUMENTATION:** - **LINE NUMBERS:** -

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
30.1	HIGH FLOW	Excessive demand / load for IA from instruments	Low pressure in distribution header	Existing IA receiver 563-V-01	No actions				
30.2	HIGH LEVEL	No issued identified							
30.3	LOW FLOW	No issued identified							
30.4	LOW LEVEL	No issued identified							
30.5	ZERO FLOW / EMPTY	Failure of the IA system	Station shutdown	Two redundant air compressor skids Backup IG supply	No actions				

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
30.6	REVERSE FLOW	Reverse flow of IG into IA system	Flammable mix of air and gas, potential fire / explosion	Check valves and 3-way solenoids on Air/Gas Panel to prevent backflow of air/gas into each supply	Per 30.12				
30.7	HIGH PRESSURE	Failure of IG regulator PCV-64889A	Overpressure of downstream equipment	PSV-64888A					
30.8	LOW PRESSURE								
30.9	HIGH TEMPERATURE								
30.10	LOW TEMPERATURE	Large pressure cut across IG regulator PCV-64889A	Low temperature downstream of PCV, below design temperature of actuators	Low flow demand, length of tubing will allow ambient heat recovery IG offtake is downstream of heaters	No actions				
30.11	IMPURITIES			Routine maintenance of IA system	No actions				
30.12	CHANGE IN COMPOSITION / CONCENTRATION	IA with backup IG, failure of IA will introduce a flammable mix of air and gas	Potential fire / explosion	HA rated equipment, no ignition sources present Check valves on Air/Gas Panel to prevent backflow of air/gas into each supply	Review appropriateness of using IG supply as a backup for IA system	**2**	**DY**		
30.13	TWO PHASE FLOW	Refer IMPURITIES							
30.14	REACTIONS	Refer 30.12							
30.15	TESTING EQUIPMENT / PRODUCT	No issues identified							
30.16	PLANT ITEM OPERABILITY	No issues identified							
30.17	PLANT ITEM MAINTAINABILITY	No issues identified		Each SDV/PCV can be individually isolated from the Air/Gas Panel	No actions				
30.18	ELECTRICAL AREA CLASSIFICATION	No issues identified							
30.19	EARTHING	No issues identified							
30.20	ISOLATION	No issues identified							
30.21	INSTRUMENTS TOO MANY	No issues identified							
30.22	INSTRUMENTS TOO FEW	No issues identified							
30.23	CORRECT LOCATION OF INSTRUMENTS	No issues identified							

NODE 31: WILTON FUEL GAS SUPPLY TO APA WATER BATH HEATER

DRAWINGS: 563-DW-PD-014, 563-DW-PD-016 **PLANT & EQUIPMENT:** - **INSTRUMENTATION:** - **LINE NUMBERS:** FG-XXX-C1D-50

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
31.1	HIGH FLOW			HAZOP for WBH package will be completed during detailed design	No actions				
31.2	HIGH LEVEL								
31.3	LOW FLOW								
31.4	LOW LEVEL								
31.5	ZERO FLOW / EMPTY								
31.6	REVERSE FLOW								
31.7	HIGH PRESSURE								
31.8	LOW PRESSURE								
31.9	HIGH TEMPERATURE								
31.10	LOW TEMPERATURE								
31.11	IMPURITIES								
31.12	CHANGE IN COMPOSITION / CONCENTRATION								
31.13	TWO PHASE FLOW								
31.14	REACTIONS								
31.15	TESTING EQUIPMENT / PRODUCT								
31.16	PLANT ITEM OPERABILITY	Fuel gas supply take-off downstream of custody transfer flowmeters	WBH fuel gas will require custody transfer metering		Fuel gas supply take-off to be relocated upstream of custody transfer meters	**1**	**SH**		
31.17	PLANT ITEM MAINTAINABILITY								
31.18	ELECTRICAL AREA CLASSIFICATION								
31.19	EARTHING								
31.20	ISOLATION				Include DB&B isolation for fuel gas offtake	**1**	**PB**		
31.21	INSTRUMENTS TOO MANY								
31.22	INSTRUMENTS TOO FEW				Include fuel gas flowmeter and fuel gas regulation as part of WBH package	**2**	**SH**		

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
31.23	CORRECT LOCATION OF INSTRUMENTS	No new causes							

NODE 32: WILTON: OVERVIEW

DRAWINGS: 563-DW-PD-002, 563-DW-PD-003, 563-DW-PD-008, 563-DW-PD-010, 563-DW-PD-011, 563-DW-PD-014, 563-DW-PD-015, 563-DW-PD-016, 563-DW-PD-017, 563-DW-PD-018

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
32.1	TOXICITY	No new causes							
32.2	SERVICES REQUIRED	Additional power demand for WBH forced draft fans Additional water required for WBH U/G services in location proposed for the new WBH & skids Existing open drain to the south of the existing site access road Additional plant equipment outside existing lighting zones	Inadequate capacity of existing site power supply Inadequate plant lighting		Review size of 3PH power supply and DC power supplies for additional demand Review capacity of existing IA system for additional demand Review location of existing open drain and U/G services (stormwater, comms & power) relative to proposed location for new WBH & skids Review additional plant lighting requirements Review additional and/or change to existing station security system	**1** **1** **1** **2** **1**	**AZ** **SH** **PB** **AZ** **PB**		
32.3	MATERIALS OF CONSTRUCTION	No issues identified							
32.4	COMMISSIONING	First fill of WBH requires testing of town water supply to ensure suitable			No action				
32.5	BREAKDOWN	No issues identified							
32.6	STARTUP / SHUTDOWN	No issues identified							
32.7	EFFLUENT	Emergency or accidental release of water from WBH	Loss of containment of contaminated water	Truck load-out point provided on WBH for emptying	Review biocide/dosing chemicals used in WBH to ensure WBH does not require bunding	**2**	**DY**		

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
32.8	NOISE / VIBRATION	Increased station capacity	Possible additional noise impacting on nearby sensitive receptors	New flow control valves specified with low noise trims New JGN metering and flow control skids are larger size with lower velocities and likely lower noise level	No actions				
32.9	FIRE / EXPLOSION	Proximity of new plant equipment (WBH & Metering Skid) to private land to the south of the station Proximity to existing APA ethane flare	Encroachment of private/public on exclusion zones or hazardous area zones	Station clearances will be designed per AS2885 requirements Station hazardous area zones will be within fence boundary	No actions				
32.10	SAFETY EQUIPMENT	No issues identified		Fire protection system and LV rescue equipment provided as part of any new LV switchroom Fire extinguishers and other safety equipment will be reviewed as part of layout and 3D model reviews	No actions				
32.11	QUALITY AND CONSISTENCY	No issues identified							
32.12	OUTPUT – RELIABILITY AND BOTTLENECKS	No new issues							
32.13	EFFICIENCY	No new issues							
32.14	SIMPLICITY	Additional multiple runs and hence operating configurations available			Document in the Operating & Maintenance Philosophy the various capacity limits and redundancy associated with each run under the various operating and maintenance conditions	**3**	**DY**		
32.15	MOBILE EQUIPMENT / PLANT MOVEMENT	New WBH & skids change the existing site access routes	New site access routes required	Site access routes will be reviewed as part of layout review workshops	No actions				
32.16	PROCESS PLANT NORMAL / ABNORMAL MAINTENANCE			WBH clearance zones included on layout	No actions				
32.17	PROCESS PLANT PROCESS FUNCTIONALITY								
32.18	ERGONOMICS			Will be reviewed as part of layout review workshops	No actions				
32.19	GUARDING			Requirement for bollards will be reviewed as part of layout review workshops Vehicle access routes will be outside of HA zones	No actions				
32.20	WARNINGS								

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
32.21	VULNERABILITY	Change in noise characteristics due to change in capacity and operation of the station	Impact on other nearby sensitive receptors	Jemena Lands Department responsible for liaison with nearby residents and sensitive receptors / stakeholder engagement	No actions				
32.22	3RD PARTY INTERFERENCE	Refer FIRE / EXPLOSION Plant noise and lighting	Impact on other nearby sensitive receptors						
32.23	NATURAL EVENTS	Grass fire		Flooding not an issue for this area Station hardstand within fence boundary is hardstand, no grassed surfaces	No actions				

GPA	**HAZOP MINUTES**	**20617-REP-018**
	Project Marlin: EGP Reversal	**SHEET 1 of 19**

Client	**Jemena Ltd**
Client Project No	**GAS-599**
GPA Project No	**20617**
Project Title	**Project Marlin: EGP Reversal**
Facilitator	**Lisa Hein**
Scribe	**Peter Blyton**
Workshop Date	**12/11/2020**
Workshop Location	**Microsoft Teams**
HAZOP Sponsor	**Nathan Biggins** **Matthew Skaras**
HAZOP Stage	**30% FEED Stage 2:** • **Michelago Compressor Station (MOCS)** • **Mila Compressor Station (MCS)**

HAZOP Participants:

GPA Engineering

Lisa Hein (LH)	Senior Consultant - Risk and Advisory / Facilitator
Simon Hanlin (SH)	Senior Process Engineer
Peter Blyton (PB)	Senior Mechanical Engineer / Minute Taker
Adrian Zatta (AZ)	Senior EI&C Engineer

Jemena

David Young (DY)	Engineering Manager
Stephen Chow (SC)	Project Engineer
Luke Gigliotti (LG)	Team Leader - Control Room
Richard Lamin (RL)	Pipeline Operator Technician
Mick Arneill (MA)	Manager - Gas Transmission South
Matthew Evans (ME)	Operations
Jon Valsamis (JV)	Systems Controller

Background:
Jemena is undertaking Front End Engineering and Design (FEED) to facilitate a total installed cost (TIC) estimate and schedule to reverse flow the Eastern Gas Pipeline (EGP) south of the Kembla Grange Meter Station (KGMS), to allow the supply of gas into the Victorian and New South Wales gas networks.

The following, key pieces of documentation, formed the basis of the HAZOP (additional information was available – see HAZOP report):

- Michelago Compressor Station
  - Station Isolation Valves P&ID: 530-DW-PD-001
  - Mainline Valve P&ID: 530-DW-PD-018
  - Flow Switching Valves P&ID: GAS-530-DW-PD-020
- Mila Scraper Station & MLV
  - Intermediate Scraper Station P&ID: 525-PI-001
- Mila Compressor Station
  - Flow Switching Valves P&ID: GAS-525-DW-PD-039
  - Station Isolation Valves P&ID: GTS-525-DW-PD-022

The HAZOP specifically dealt with:

- Michelago Compressor Station (MOCS)
- Mila Compressor Station (MCS), Scraper Station and MLV

The HAZOP specifically excluded a full formal review of:

- Compressor units at each compressor station
- EGP mainline pipeline

The HAZOP was conducted using a series of guide words which were applied to each of the key phases of operation.

NODE 6: MICHELAGO REVERSE FLOW: EGP TO COMPRESSOR SUCTION

DRAWINGS: 530-DW-PD-001, 530-DW-PD-018, GAS-530-DW-PD-020

PLANT & EQUIPMENT: -

INSTRUMENTATION: -

LINE NUMBERS: G-64907-C9D-400, G-64904-C9D-400, G-020-CE15X-400, G-904-C9D-400, G-905-C9D-400, G-XXX-C9D-400

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
6.1	HIGH FLOW	Large differential pressure across switching valves, opening of SDV-64104 Higher pressure on suction than discharge	Damage to SDVs High flow leading to FIV (flow induced vibration), equipment damage Forward flow of gas through the compressor when the discharge valve opens, resulting in compressor driving the turbine.	Equalisation line and UV-64109 to be used reduce differential pressure across SDVs / station prior to mode change. Operating procedures.	Add DP interlocks across all flow switching valves, DP permissive to be set at 500 kPa. DP interlock to be between PIT-64107 & PIT-64103, with DP in either direction. Ensure valve sequencing (MLV-1 and flow switching valves) is such that compressor suction pressure does not end up higher than compressor discharge.	**1** **2**	**AZ** **AZ**		
6.2	HIGH LEVEL	No issues identified							
6.3	LOW FLOW	Low demand	Waste of fuel gas	Compressor recycle	No Actions				
6.4	LOW LEVEL	No issues identified							
6.5	ZERO FLOW / EMPTY	Compressor not running, MLV-1 closed. Switching valves out of position	Build-up of high DP across the station, unable to equalise pressure across the station. Inability to start compressor	Equalisation line and UV-64109 to be used to reduce differential pressure across SDVs / station. Operating procedures. Switching valve position interlocks.	Develop the sizing cases for equalisation line with Jemena Commercial.	**1**	**DY**		
6.6	REVERSE FLOW	DP across unit suction valve SDV-64001, higher pressure downstream	Immediate opening of SDV-64001 as PDIT-64004 would not detect a forward DP	Anti-surge & recycle line check valves, compressor can't be spun in reverse direction	Re-range PDIT-64004 such that it can detect both forward and reverse DP across SDV-64001 Review reverse equalisation across loading line and SDV-64002, JT cooling in opposite direction than loading line was designed with downstream stainless steel section	**2** **2**	**AZ** **SH**		
6.7	HIGH PRESSURE	No issues identified		MAOP of system 14.895 MPag, all piping rated for this MAOP	No Actions				
6.8	LOW PRESSURE	Low pressure in EGP during import of LNG at lower pressure (~11 MPag)	Compressor suction pressure below minimum for compressor unit	Compressor suction pressure alarm and trip	Review compressor suction low pressure trips to ensure they are suitable	**2**	**DY**		
6.9	HIGH TEMPERATURE	No issues identified							
6.10	LOW TEMPERATURE	No issues identified							
6.11	IMPURITIES	No issues identified							

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
6.12	CHANGE IN COMPOSITION / CONCENTRATION	Change in composition with new gas supplies (LNG import)	Fixed composition parameters used in compressor surge control and FG system incorrect when gas composition changes		Review range of compositions and select worst case composition to calculate fixed parameters in compressor surge controller and FG system	**2**	**SH**		
6.13	TWO PHASE FLOW	No issues identified		Compressor suction scrubber, no history of liquids under current operation	No Actions				
6.14	REACTIONS	No issues identified							
6.15	TESTING EQUIPMENT / PRODUCT	No issues identified							
6.16	PLANT ITEM OPERABILITY	New equipment causing obstruction to vehicle and crane access	Inadequate crane and vehicle access for maintenance		Consider alternative piping & equipment layouts routed further due west with access from the due east direction.	**2**	**PB**		
6.17	PLANT ITEM MAINTAINABILITY	Refer OPERABILITY							
6.18	ELECTRICAL AREA CLASSIFICATION								
6.19	EARTHING				Review requirement for relocation of light pole, earthing and electrical supply.	**2**	**AZ**		
6.20	ISOLATION	Isolation and venting of new switching valve piping Station / compressor unit ESD blows down existing piping to vent	Requirement for venting Switching valve piping is upstream of compressor unit SDVs so remains pressurised on Station ESD		Provide manual vents on switching valve piping. Review isolation, depressurisation and pressurisation of the new switching valve piping to determine requirement for repressurisation lines around switching valves, vents etc. Review existing Station ESD and if new switching valve piping is required to vent/blowdown on Station ESD, and document as part of Isolation and Blowdown Philosphy Configure flow switching valves to close on EGP mainline ESD	**1** **1** **1** **2**	**PB** **SH** **DY** **SH**		
6.21	INSTRUMENTS TOO MANY	No causes							
6.22	INSTRUMENTS TOO FEW				Jemena Ops to provide feedback on where Pressure Gauges to be added	**2**	**Jemena**		
6.23	CORRECT LOCATION OF INSTRUMENTS	No causes							

NODE 7: MICHELAGO REVERSE FLOW: COMPRESSOR DISCHARGE TO EGP

DRAWINGS: 530-DW-PD-001, 530-DW-PD-018, GAS-530-DW-PD-020

PLANT & EQUIPMENT: -

INSTRUMENTATION: -

LINE NUMBERS: G-901-C9D-400, NG-01-XX-450, G-001-CE15X-400, G-64906-C9D-400, G-906-C9D-400, G-903-C9D-400, G-901-C9D-400

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
7.1	HIGH FLOW	Refer NODE 6 Low pressure in system during import of LNG at lower pressure (~11 MPag)	Higher volumetric flow and velocities, leading to flow induced vibration and equipment damage		Review velocity limits within existing system to ensure these are not exceeded	**2**	**DY**		
7.2	HIGH LEVEL	No issues identified							
7.3	LOW FLOW	Refer NODE 6							
7.4	LOW LEVEL	No issues identified							
7.5	ZERO FLOW / EMPTY	Refer NODE 6 Compressor not running, MLV-1 closed	Trapped gas and differential pressure across switching valves		Configure flow switching valves to prevent trapped pressure when compressor not running Consider configuring pipeline north and south free flow modes in lieu of a single bi-directional free-flow mode Configure MLV-1 to operate as a “virtual check-valve” to replace the functionality of the check valve which was removed. MLV-1 to open automatically once DP across the station is low enough for change to free-flow mode to avoid trapping pressure in the Station	**2** **2** **2**	**SH** **SH** **PB**		
7.6	REVERSE FLOW	Refer NODE 6 Reverse flow when transitioning between modes and compressor package starting up. Compressor trip		Check valves within compressor station	No actions				
7.7	HIGH PRESSURE	Gas flow down from 850m elevation to sea level, increases in pressure as it goes forward/southern flow	Exceedance of MAOP at lower sea levels	MAOP of system 14.895 MPag, all piping rated for this MAOP	Add high pressure trip to southern side of MLV set to ensure pressure at sea level does not exceed pipeline MAOP due to gravity head when flowing south. Trip to ESD compressor station.	**1**	**SH**		
7.8	LOW PRESSURE	Refer HIGH FLOW							

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
7.9	HIGH TEMPERATURE	Heat of compression	High compressor discharge temperature	Compressor coolers	Review design temperatures of suction and discharge lines, and connection to the EGP for new Southern flow operating scenario. Query Jemena Commercial if TIT-4 requires duplication on the other side of MLV-1A, for purposes of pipeline linepack calculations	**2** **2**	**SH** **DY**		
7.10	LOW TEMPERATURE	Low atmospheric temperature		Piping and equipment designed for -10 deg C	No action				
7.11	IMPURITIES	No issues identified							
7.12	CHANGE IN COMPOSITION / CONCENTRATION	Refer NODE 6							
7.13	TWO PHASE FLOW	No issues identified							
7.14	REACTIONS	No issues identified							
7.15	TESTING EQUIPMENT / PRODUCT	No issues identified							
7.16	PLANT ITEM OPERABILITY	Refer NODE 6							
7.17	PLANT ITEM MAINTAINABILITY	Refer NODE 6			Consider alternative switching valve piping layout with new equipment located due west of the slope up to the A/G MLV-1	**2**	**PB**		
7.18	ELECTRICAL AREA CLASSIFICATION	No issues identified							
7.19	EARTHING	No issues identified							
7.20	ISOLATION	Refer NODE 6							
7.21	INSTRUMENTS TOO MANY	No issues identified							
7.22	INSTRUMENTS TOO FEW	Refer HIGH TEMPERATURE							
7.23	CORRECT LOCATION OF INSTRUMENTS	Refer HIGH TEMPERATURE							

NODE 8: MICHELAGO REVERSE FLOW WITH NO COMPRESSION

DRAWINGS: 530-DW-PD-018 **PLANT & EQUIPMENT:** - **INSTRUMENTATION:** - **LINE NUMBERS:** G-029-CE15X-400

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
8.1	HIGH FLOW	Opening of MLV-1 with high DP	Flow induced vibration, leading to equipment damage		Refer previous action – DP interlocks				
8.2	HIGH LEVEL	No issues identified							
8.3	LOW FLOW	No issues identified							
8.4	LOW LEVEL	No issues identified							
8.5	ZERO FLOW / EMPTY	Compressor not running, MLV-1 closed	No flow in line, build-up of DP		Refer previous action – MLV-1 configuration as a "virtual check valve" Add differential pressure transmitter such that MLV-1 does not open until DP in either direction is very low	**1**	**AZ**		
8.6	REVERSE FLOW	Refer ZERO FLOW MLV-1 left open on compressor start MLV-1 passes and cannot hold discharge pressure across station	Station bypass		MLV-1 to be configured to close as part of compressor start sequence	**2**	**AZ**		
8.7	HIGH PRESSURE			MAOP of system 14.895 MPag, all piping rated for this MAOP	No action				
8.8	LOW PRESSURE	No issues identified							
8.9	HIGH TEMPERATURE	No issues identified							
8.10	LOW TEMPERATURE	No issues identified							
8.11	IMPURITIES	No issues identified							
8.12	CHANGE IN COMPOSITION / CONCENTRATION	No issues identified							
8.13	TWO PHASE FLOW	No issues identified							
8.14	REACTIONS	No issues identified							
8.15	TESTING EQUIPMENT / PRODUCT	No issues identified							
8.16	PLANT ITEM OPERABILITY	Refer NODE 6 & 7							
8.17	PLANT ITEM MAINTAINABILITY	Refer NODE 6 & 7							
8.18	ELECTRICAL AREA CLASSIFICATION	No issues identified							
8.19	EARTHING	No issues identified							
8.20	ISOLATION	Refer NODE 6 & 7							
8.21	INSTRUMENTS TOO MANY	No issues identified							
8.22	INSTRUMENTS TOO FEW				Confirm that MLV-1 is controlled by SCP	**2**	**DY**		

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
8.23	CORRECT LOCATION OF INSTRUMENTS	No issues identified							

NODE 9: MICHELAGO FORWARD FLOW: EGP TO COMPRESSOR SUCTION

DRAWINGS: 530-DW-PD-001, 530-DW-PD-018, GAS-530-DW-PD-020 **PLANT & EQUIPMENT:** - **INSTRUMENTATION:** - **LINE NUMBERS:** G-64907-C9D-400, NG-01-XX-450, G-001-CE15X-400, G-64906-C9D-400, G-906-C9D-400, G-907-C9D-400, G-XXX-C9D-400

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
9.1	HIGH FLOW	Refer NODE 6							
9.2	HIGH LEVEL	No issues identified							
9.3	LOW FLOW	No issues identified							
9.4	LOW LEVEL	No issues identified							
9.5	ZERO FLOW / EMPTY	Refer NODE 6 & 7							
9.6	REVERSE FLOW	Refer NODE 8							**Virtual DP logic on MLV-1 to operate in both directions (north or south flow of EGP)**
9.7	HIGH PRESSURE	Refer NODE 6							
9.8	LOW PRESSURE	No issues identified							
9.9	HIGH TEMPERATURE	No issues identified							
9.10	LOW TEMPERATURE	Refer NODE 6							
9.11	IMPURITIES	No issues identified							
9.12	CHANGE IN COMPOSITION / CONCENTRATION	No issues identified							
9.13	TWO PHASE FLOW	No issues identified							
9.14	REACTIONS	No issues identified							
9.15	TESTING EQUIPMENT / PRODUCT	No issues identified							
9.16	PLANT ITEM OPERABILITY	No issues identified							
9.17	PLANT ITEM MAINTAINABILITY	No issues identified							
9.18	ELECTRICAL AREA CLASSIFICATION	No issues identified							

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
9.19	EARTHING	No issues identified							
9.20	ISOLATION	Refer NODE 6-8							
9.21	INSTRUMENTS TOO MANY	No issues identified							
9.22	INSTRUMENTS TOO FEW	No issues identified							
9.23	CORRECT LOCATION OF INSTRUMENTS	No issues identified							

NODE 10: MICHELAGO FORWARD FLOW: COMPRESSOR DISCHARGE TO EGP

DRAWINGS: 530-DW-PD-001, 530-DW-PD-018, GAS-530-DW-PD-020

PLANT & EQUIPMENT: -

INSTRUMENTATION: -

LINE NUMBERS: G-901-C9D-400, G-64904-C9D-400, G-020-CE15X-400, G-904-C9D-400, G-901-C9D-400

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
10.1	HIGH FLOW	All issues captured in NODE 7							
10.2	HIGH LEVEL								
10.3	LOW FLOW								
10.4	LOW LEVEL								
10.5	ZERO FLOW / EMPTY								
10.6	REVERSE FLOW								
10.7	HIGH PRESSURE								
10.8	LOW PRESSURE								
10.9	HIGH TEMPERATURE								
10.10	LOW TEMPERATURE								
10.11	IMPURITIES								
10.12	CHANGE IN COMPOSITION / CONCENTRATION								
10.13	TWO PHASE FLOW								
10.14	REACTIONS								
10.15	TESTING EQUIPMENT / PRODUCT								
10.16	PLANT ITEM OPERABILITY								

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
10.17	PLANT ITEM MAINTAINABILITY								
10.18	ELECTRICAL AREA CLASSIFICATION								
10.19	EARTHING								
10.20	ISOLATION								
10.21	INSTRUMENTS TOO MANY								
10.22	INSTRUMENTS TOO FEW								
10.23	CORRECT LOCATION OF INSTRUMENTS								

NODE 10A: MICHELAGO MLV ACTUATED PRESSURISATION BYPASS

DRAWINGS: GAS-530-DW-PD-020 **PLANT & EQUIPMENT:** - **INSTRUMENTATION:** - **LINE NUMBERS:** G-XXX-C9D-150

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
10.1	HIGH FLOW	Opening of UV-64109 under high DP	High velocities, flow induced vibration, leading to equipment damage		Refer Item 6.5 and 10.10. Pressurisation valve to be sized to limit velocities to within acceptable limits.	**2**	**SH**		
10.2	HIGH LEVEL	No issues identified							
10.3	LOW FLOW	No issues identified							
10.4	LOW LEVEL	No issues identified							
10.5	ZERO FLOW / EMPTY	No issues identified							
10.6	REVERSE FLOW	Refer LOW TEMPERATURE							
10.7	HIGH PRESSURE	No issues identified							
10.8	LOW PRESSURE	No issues identified							
10.9	HIGH TEMPERATURE	No issues identified							
10.10	LOW TEMPERATURE	Opening of UV-64109 with higher pressure on RO side	UV and RO cannot be operated in both directions as RO will be upstream of UV in one flow direction, leading to UV exposed to excessively low temperatures, valve freezing		Select appropriate valve for repressurisation in both directions and remove RO	**2**	**SH**		
10.11	IMPURITIES	No issues identified							

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
10.12	CHANGE IN COMPOSITION / CONCENTRATION	No issues identified							
10.13	TWO PHASE FLOW	No issues identified							
10.14	REACTIONS	No issues identified							
10.15	TESTING EQUIPMENT / PRODUCT	No issues identified							
10.16	PLANT ITEM OPERABILITY	Removal of UV-64109	Single valve isolation provided only		Review isolation requirements for removal of UV-64109 while station remains online	**2**	**DY**		
10.17	PLANT ITEM MAINTAINABILITY	Refer OPERABILITY							
10.18	ELECTRICAL AREA CLASSIFICATION	No issues identified							
10.19	EARTHING	No issues identified							
10.20	ISOLATION				UV-64109 to be configured to close on pipeline mainline ESD	**2**	**SH**		
10.21	INSTRUMENTS TOO MANY	No issues identified							
10.22	INSTRUMENTS TOO FEW	Low temperatures not monitored by instrumentation on repressurisation			Review requirements for low temperature piping to handle minimum temperatures on repressurisation	**2**	**PB**		
10.23	CORRECT LOCATION OF INSTRUMENTS	No issues identified							

NODE 11: MILA REVERSE FLOW: EGP TO COMPRESSOR SUCTION

DRAWINGS: 525-PI-001, GAS-525-DW-PD-039, GTS-525-DW-PD-022 **PLANT & EQUIPMENT:** - **INSTRUMENTATION:** - **LINE NUMBERS:** G-909-C9D-400, NG-01-XX-458, G-905-C9D-400, G-XXX-C9D-400, G-002-PL9Z-400, G-003-C9D-400

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
11.1	HIGH FLOW	Refer NODE 6							
11.2	HIGH LEVEL	No issues identified							
11.3	LOW FLOW	Refer NODE 6							
11.4	LOW LEVEL	No issues identified							
11.5	ZERO FLOW / EMPTY	Two MLVs in series (compared with two MLVs in parallel at Michelago)	Potential greater probability of either MLV inadvertently operating / not being able to open	New MLV can be bypassed using DN150 kicker-line on Launcher Trap E-02 using V-15	No new actions. Refer OPERABILITY – action to consider parallel MLV configuration				
11.6	REVERSE FLOW	Refer NODE 6							

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
11.7	HIGH PRESSURE	Refer NODE 6 – pressure change due to elevation differences along the pipeline							
11.8	LOW PRESSURE	Refer NODE 6							
11.9	HIGH TEMPERATURE	Refer NODE 6							
11.10	LOW TEMPERATURE	Refer NODE 6							
11.11	IMPURITIES	Refer NODE 6							
11.12	CHANGE IN COMPOSITION / CONCENTRATION	Refer NODE 6 – fixed composition in compressor surge control system and FG system							
11.13	TWO PHASE FLOW	Refer NODE 6							
11.14	REACTIONS	Refer NODE 6							
11.15	TESTING EQUIPMENT / PRODUCT	Refer NODE 6							
11.16	PLANT ITEM OPERABILITY	Refer NODE 6			UV-64110 to be FL, double acting gas-over-oil MLV similar to MLV-7, IG to be taken from pipeline side of MLV. Re-tag UV-64110 to MLV-7 Re-tag MLV-7 to MLV-7A Consider putting this new MLV in parallel to the existing MLV, for a similar configuration to Michelago / EGCS Consider alternative site layout with switching valves located west of MLV-7 Pipeline operability checks to be reviewed in regards to change in delivery pressures at different receipt points along the EGP when flowing south	**1** **1** **1** **1** **2** **2**	**SH** **SH** **SH** **SH** **DY** **Jemena**		
11.17	PLANT ITEM MAINTAINABILITY	Refer OPERABILITY Possible need for pigging of the EGP in reverse flow direction	Pigging facilities not necessarily configured for pigging in reverse flow direction		Confirm if pigging operation required in reverse flow direction.	**2**	**Jemena**		
11.18	ELECTRICAL AREA CLASSIFICATION	Refer NODE 6							
11.19	EARTHING	Refer NODE 6							

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
11.20	ISOLATION	Refer NODE 6 Construction tie-in at TIP-525-04 will be behind single valve isolation off the pipeline, using V-16 Construction tie-in at Cann River side of MLV-7 will be behind single valve isolation off the pipeline, using V-07 & V-23 Construction tie-in requires installation of pipeline bypass line between pig trap kicker line connection points	Not able to complete tie-in if valve does not seal	Sealant injection on V-16 & V-07 Testing of V-16, V-07 & V-23 prior to commencing construction tie-in Existing pipeline bypass line on site to be installed (will require dimensional check as pig traps may be displaced/moved)	No actions				
11.21	INSTRUMENTS TOO MANY	Refer NODE 6							
11.22	INSTRUMENTS TOO FEW	Refer NODE 6							
11.23	CORRECT LOCATION OF INSTRUMENTS	GC take-off is located in the dead leg adjacent to UV-64110	Loss of effective GC monitoring of gas composition		Move GC tapping point 25-BV-64006 to main flow path piping adjacent to TIP-525-04	**1**	**SH**		

NODE 12: MILA REVERSE FLOW: COMPRESSOR DISCHARGE TO EGP

DRAWINGS: 525-PI-001, GAS-525-DW-PD-039, GTS-525-DW-PD-022 **PLANT & EQUIPMENT:** - **INSTRUMENTATION:** - **LINE NUMBERS:** G-908-C9D-400, G-906-C9D-400, G-903-C9D-400, G-902-C9D-400, G-021-C9D-400

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
12.1	HIGH FLOW	Refer NODE 7							
12.2	HIGH LEVEL	Refer NODE 7							
12.3	LOW FLOW	Refer NODE 7							
12.4	LOW LEVEL	Refer NODE 7							
12.5	ZERO FLOW / EMPTY	Refer NODE 7							
12.6	REVERSE FLOW	Refer NODE 7							
12.7	HIGH PRESSURE	Refer NODE 7							
12.8	LOW PRESSURE	Refer NODE 7							
12.9	HIGH TEMPERATURE	Refer NODE 7							
12.10	LOW TEMPERATURE	Refer NODE 7							

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
12.11	IMPURITIES	Refer NODE 7							
12.12	CHANGE IN COMPOSITION / CONCENTRATION	Refer NODE 7							
12.13	TWO PHASE FLOW	Refer NODE 7							
12.14	REACTIONS	Refer NODE 7							
12.15	TESTING EQUIPMENT / PRODUCT	Refer NODE 7							
12.16	PLANT ITEM OPERABILITY	Refer NODE 7							
12.17	PLANT ITEM MAINTAINABILITY	Refer NODE 7							
12.18	ELECTRICAL AREA CLASSIFICATION	Refer NODE 7							
12.19	EARTHING	Refer NODE 7							
12.20	ISOLATION	Refer NODE 7							
12.21	INSTRUMENTS TOO MANY	Refer NODE 7							
12.22	INSTRUMENTS TOO FEW	Refer NODE 7							
12.23	CORRECT LOCATION OF INSTRUMENTS	Refer NODE 7							

NODE 13: MILA REVERSE FLOW WITH NO COMPRESSION

DRAWINGS: 525-PI-001 **PLANT & EQUIPMENT:** - **INSTRUMENTATION:** - **LINE NUMBERS:** NG-01-C9D-400, NG-01-XX-450

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
13.1	HIGH FLOW	Refer NODE 8							
13.2	HIGH LEVEL	Refer NODE 8							
13.3	LOW FLOW	Refer NODE 8							
13.4	LOW LEVEL	Refer NODE 8							
13.5	ZERO FLOW / EMPTY	Refer NODE 8 Refer NODE 11 – ZERO FLOW							
13.6	REVERSE FLOW	Refer NODE 8							
13.7	HIGH PRESSURE	Refer NODE 8							

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
13.8	LOW PRESSURE	Refer NODE 8							
13.9	HIGH TEMPERATURE	Refer NODE 8							
13.10	LOW TEMPERATURE	Refer NODE 8							
13.11	IMPURITIES	Refer NODE 8							
13.12	CHANGE IN COMPOSITION / CONCENTRATION	Refer NODE 8							
13.13	TWO PHASE FLOW	Refer NODE 8							
13.14	REACTIONS	Refer NODE 8							
13.15	TESTING EQUIPMENT / PRODUCT	Refer NODE 8							
13.16	PLANT ITEM OPERABILITY	Refer NODE 8							
13.17	PLANT ITEM MAINTAINABILITY	Refer NODE 8							
13.18	ELECTRICAL AREA CLASSIFICATION	Refer NODE 8							
13.19	EARTHING	Refer NODE 8							
13.20	ISOLATION	Refer NODE 8							
13.21	INSTRUMENTS TOO MANY	Refer NODE 8							
13.22	INSTRUMENTS TOO FEW	Refer NODE 8							
13.23	CORRECT LOCATION OF INSTRUMENTS	Refer NODE 8							

NODE 14: MILA FORWARD FLOW: EGP TO COMPRESSOR SUCTION

DRAWINGS: 525-PI-001, GAS-525-DW-PD-039, GTS-525-DW-PD-022

PLANT & EQUIPMENT: -

INSTRUMENTATION: -

LINE NUMBERS: G-908-C9D-400, G-906-C9D-400, G-907-C9D-400, G-002-PL9Z-400, G-003-C9D-400

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
14.1	HIGH FLOW	Refer NODE 9							
14.2	HIGH LEVEL	Refer NODE 9							
14.3	LOW FLOW	Refer NODE 9							
14.4	LOW LEVEL	Refer NODE 9							

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
14.5	ZERO FLOW / EMPTY	Refer NODE 9							
14.6	REVERSE FLOW	Refer NODE 9							
14.7	HIGH PRESSURE	Refer NODE 9							
14.8	LOW PRESSURE	Refer NODE 9							
14.9	HIGH TEMPERATURE	Refer NODE 9							
14.10	LOW TEMPERATURE	Refer NODE 9							
14.11	IMPURITIES	Refer NODE 9							
14.12	CHANGE IN COMPOSITION / CONCENTRATION	Refer NODE 9							
14.13	TWO PHASE FLOW	Refer NODE 9							
14.14	REACTIONS	Refer NODE 9							
14.15	TESTING EQUIPMENT / PRODUCT	Refer NODE 9							
14.16	PLANT ITEM OPERABILITY	Refer NODE 9							
14.17	PLANT ITEM MAINTAINABILITY	Refer NODE 9							
14.18	ELECTRICAL AREA CLASSIFICATION	Refer NODE 9							
14.19	EARTHING	Refer NODE 9							
14.20	ISOLATION	Refer NODE 9							
14.21	INSTRUMENTS TOO MANY	Refer NODE 9							
14.22	INSTRUMENTS TOO FEW	Refer NODE 9							
14.23	CORRECT LOCATION OF INSTRUMENTS	Refer NODE 9							

NODE 15: MILA FORWARD FLOW: COMPRESSOR DISCHARGE TO EGP

DRAWINGS: 525-PI-001, GAS-525-DW-PD-039, GTS-525-DW-PD-022

PLANT & EQUIPMENT: -

INSTRUMENTATION: -

LINE NUMBERS: G-909-C9D-400, NG-01-XX-450, G-904-C9D-400, G-902-C9D-400, G-021-C9D-400

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
15.1	HIGH FLOW	Refer NODE 10							

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
15.2	HIGH LEVEL	Refer NODE 10							
15.3	LOW FLOW	Refer NODE 10							
15.4	LOW LEVEL	Refer NODE 10							
15.5	ZERO FLOW / EMPTY	Refer NODE 10							
15.6	REVERSE FLOW	Refer NODE 10							
15.7	HIGH PRESSURE	Refer NODE 10							
15.8	LOW PRESSURE	Refer NODE 10							
15.9	HIGH TEMPERATURE	Refer NODE 10							
15.10	LOW TEMPERATURE	Refer NODE 10							
15.11	IMPURITIES	Refer NODE 10							
15.12	CHANGE IN COMPOSITION / CONCENTRATION	Refer NODE 10							
15.13	TWO PHASE FLOW	Refer NODE 10							
15.14	REACTIONS	Refer NODE 10							
15.15	TESTING EQUIPMENT / PRODUCT	Refer NODE 10							
15.16	PLANT ITEM OPERABILITY	Refer NODE 10							
15.17	PLANT ITEM MAINTAINABILITY	Refer NODE 10							
15.18	ELECTRICAL AREA CLASSIFICATION	Refer NODE 10							
15.19	EARTHING	Refer NODE 10							
15.20	ISOLATION	Refer NODE 10							
15.21	INSTRUMENTS TOO MANY	Refer NODE 10							
15.22	INSTRUMENTS TOO FEW	Refer NODE 10							
15.23	CORRECT LOCATION OF INSTRUMENTS	Refer NODE 10							

NODE 15A: MILA MLV ACTUATED PRESSURISATION BYPASS

DRAWINGS: GAS-525-DW-PD-039 **PLANT & EQUIPMENT:** - **INSTRUMENTATION:** - **LINE NUMBERS:** G-XXX-C9D-150

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
15.1	HIGH FLOW	Refer NODE 10A							
15.2	HIGH LEVEL	Refer NODE 10A							
15.3	LOW FLOW	Refer NODE 10A							
15.4	LOW LEVEL	Refer NODE 10A							
15.5	ZERO FLOW / EMPTY	Refer NODE 10A							
15.6	REVERSE FLOW	Refer NODE 10A							
15.7	HIGH PRESSURE	Refer NODE 10A							
15.8	LOW PRESSURE	Refer NODE 10A							
15.9	HIGH TEMPERATURE	Refer NODE 10A							
15.10	LOW TEMPERATURE	Refer NODE 10A							
15.11	IMPURITIES	Refer NODE 10A							
15.12	CHANGE IN COMPOSITION / CONCENTRATION	Refer NODE 10A							
15.13	TWO PHASE FLOW	Refer NODE 10A							
15.14	REACTIONS	Refer NODE 10A							
15.15	TESTING EQUIPMENT / PRODUCT	Refer NODE 10A							
15.16	PLANT ITEM OPERABILITY	Refer NODE 10A							
15.17	PLANT ITEM MAINTAINABILITY	Refer NODE 10A							
15.18	ELECTRICAL AREA CLASSIFICATION	Refer NODE 10A							
15.19	EARTHING	Refer NODE 10A							
15.20	ISOLATION	Refer NODE 10A							
15.21	INSTRUMENTS TOO MANY	Refer NODE 10A							
15.22	INSTRUMENTS TOO FEW	Refer NODE 10A							
15.23	CORRECT LOCATION OF INSTRUMENTS	Refer NODE 10A							

NODE 15B: MICHELAGO AND MILA: OVERVIEW

DRAWINGS: 530-DW-PD-001, 530-DW-PD-018, GAS-530-DW-PD-020, 525-PI-001, GAS-525-DW-PD-039, GTS-525-DW-PD-022

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
15.1 A	TOXICITY	No issues identified							
15.2 A	SERVICES REQUIRED	Additional demand on instrument air system Instrument gas for new MLV (Mila only) New equipment and valves outside of existing plant lighting zones Poor communications service at Mila & Michelago	Insufficient IA supply Insufficient lighting		Review IA system capacity for new IA demands Confirm requirements for additional plant lighting required at Michelago & Mila Review if communications service can be improved at Mila & Michelago	**2** **3** **3**	**DY** **DY** **DY**		
15.3 A	MATERIALS OF CONSTRUCTION	Refer NODE X – low temperature materials may be required for repressurisation line							
15.4 A	COMMISSIONING			Repressurisation valve V-23 (DN50) available around V-07 for repressuristation from pipeline	No actions				
15.5 A	BREAKDOWN	No issues identified							
15.6 A	STARTUP / SHUTDOWN	Refer NODES							
15.7 A	EFFLUENT	No issues identified							
15.8 A	NOISE / VIBRATION	Refer NODES No new issues identified							
15.9 A	FIRE / EXPLOSION	No new issues identified							
15.10 A	SAFETY EQUIPMENT	Piping and equipment in new areas of the plant	New piping and equipment outside of existing plant fire detection camera zones	Safety equipment location will be assessed as part of layout and 3D model reviews	No actions				
15.11 A	QUALITY AND CONSISTENCY	Refer NODE X – series/parallel MLVs			Review Mila electrical contactor isolation and consider if these can be upgraded to be consistent with Michelago	**2**	**DY**		
15.12 A	OUTPUT – RELIABILITY AND BOTTLENECKS	Compressor stations (Mila & Michelago) operating in opposite directions	Station suction/discharge will quickly increase/drop		Confirm philosophy for ensuring that EGP and all compressor stations are all configured in either northern or southern flow, and if this will be automated	**2**	**DY**		
15.13 A	EFFICIENCY	No issues identified							
15.14 A	SIMPLICITY	Refer OUTPUT - RELIABILITY							
15.15 A	MOBILE EQUIPMENT / PLANT MOVEMENT	No new issues identified							
15.16 A	PROCESS PLANT NORMAL / ABNORMAL MAINTENANCE	No new issues identified							
15.17 A	PROCESS PLANT PROCESS FUNCTIONALITY	No new issues identified							

Item No	Guideword	Problem Description		Existing Safeguard	Action Required	Cat	Action By	Complete Yes/No	Closeout Comments and Reference(s)
		Cause	Consequence						
15.18 A	ERGONOMICS	No new issues identified		Will be assessed as part of layout and 3D model reviews					
15.19 A	GUARDING	No issues identified		Will be assessed as part of layout and 3D model reviews					
15.20 A	WARNINGS	No issues identified		Will be assessed as part of layout and 3D model reviews					
15.21 A	VULNERABILITY	No issues identified		All new piping and equipment within existing station fenceline					
15.22 A	3RD PARTY INTERFERENCE	No issues identified		All new piping and equipment within existing station fenceline					
15.23 A	NATURAL EVENTS	No issues identified		Bushfire assessments completed					

APPENDIX 2 STUDY DOCUMENTATION

This appendix contains all drawings and documents relating to the design specifically reviewed during the study process.

Document/Drawing Number	Revision	Description
550-PI-001	0B	Kembla Grange MLV & Sales Tap Remote Actuated MLV & DN200 Sales Tap
GAS-557-DW-PD-001	B	Kembla Grange Meter Station Pig Receiver
GAS-557-DW-PD-002	B	Kembla Grange Meter Station Metering
GAS-557-DW-PD-003	B	Kembla Grange Meter Station EGP Hot Tap Tie In
530-DW-PD-001	3B	Michelago Compressor Station Isolation Valves
530-DW-PD-018	4B	Michelago Compressor Station Mainline Valve
GAS-530-DW-PD-020	B	Michelago Compressor Station Flow Switching Valves
525-PI-001	3A	Mila Scraper Station & MLV Intermediate Scraper Station
530-525-DW-PD-039	3B	Mila Compressor Station Flow Switching Valves
GTS-525-DW-PD-022	2B	Mila Compressor Station Isolation Valves
GAS-510-DW-PF-001	2A	Longford Compressor Station Vic Hub – Facilities Located within the LCS PFD
GAS-510-DW-PF-101	3A	Longford Compressor Station Main Gas Station
550-PI-092	2B	Longford Compressor Station Launcher Station
PO-510-PI-110	4B	Longford Compressor Station Gas Manifold
GAS-511-DW-PD-003	B	Longford Compressor Station Vic Hub 2 – Metering Run
GAS-511-DW-PD-002	B	Longford Compressor Station Vic Hub 2 – Water Bath Heater
GAS-511-DW-PD-004	B	Longford Compressor Station Vic Hub 2 – Pressure Regulation
PO-511-PD-001	1B	Longford Compressor Station Vic Hub 2 – Bi-directional Pipeline
GAS-511-DW-PD-001	B	Longford Compressor Station Vic Hub 2 – Inlet Filter Separator
510-PI-140	5A	Longford Compressor Station Open Drain Interceptor
510-DW-PD-101	0A	Longford Compressor Station Inlet Filter Separator

Document/Drawing Number	Revision	Description
510-DW-PD-006	5B	Longford Compressor Station Vic Hub
563-DW-PF-001	1B	Wilton Meter Station PFD
563-DW-PD-002	2B	Wilton Meter Station Dry Gas Filters
563-DW-PD-001	2B	Wilton Meter Station Receiver Station
GAS-563-DW-PD-016	B	Wilton Meter Station APA Water Bath Heater
GAS-563-DW-PD-017	B	Wilton Meter Station APA Flow Metering
GAS-563-DW-PD-015	B	Wilton Meter Station APA Pressure Reduction Skid (Run No 4)
563-DW-PD-012	2B	Wilton Meter Station Connection to APA
563-DW-PD-003	2A	Wilton Meter Station Heat Exchangers
563-DW-PD-008	2A	Wilton Meter Station JGN Flow Metering
563-DW-PD-010	7B	Wilton Meter Station JGN Pressure Reduction Skid (Run No. 3)
563-DW-PD-011	2A	Wilton Meter Station Instrument Air Package
563-DW-PD-014	4B	Wilton Meter Station Hot Water Heater Fuel Gas Train
563-DW-PD-009	3A	Wilton Meter Station JGN Pressure Reduction Skid (Run No. 4)

APPENDIX 3 GUIDEWORDS

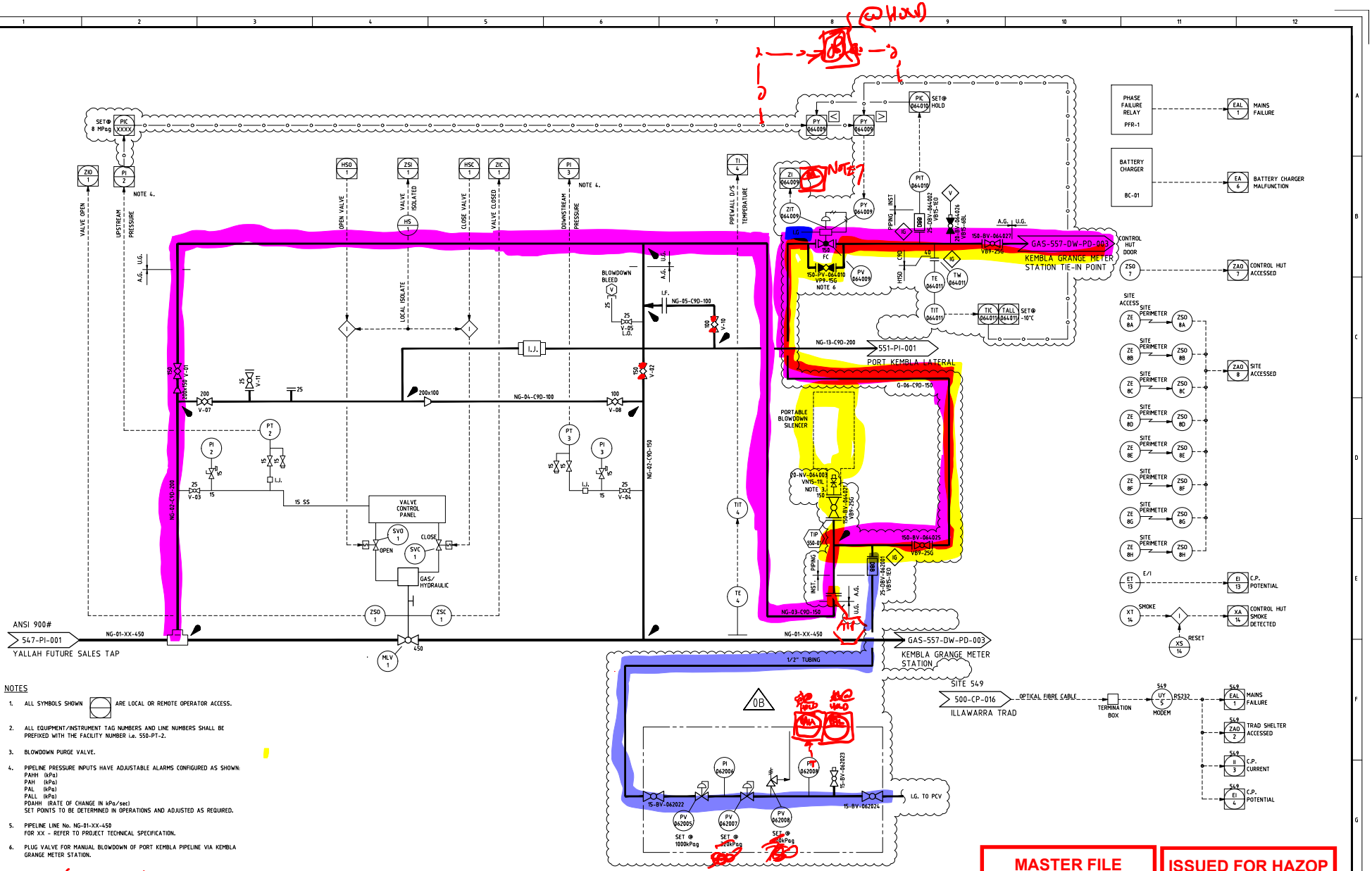
Appendix 3A Nodal Guidewords

- High Flow/High Level
- Low Flow/Low Level
- Zero Flow/ Empty
- Reverse Flow
- High Pressure
- Low Pressure
- High Temperature
- Low Temperature
- Impurities
- Change In Composition/ Change In Concentration
- Two Phase Flow
- Reactions
- Testing Equipment
- Testing Product
- Operability
- Maintainability
- Electrical Area Classification
- Instruments Too Many
- Instruments Too Few
- Instruments Correct Locations
- Earthing
- Isolation

Appendix 3B Overview Guidewords

- Toxicity
- Services
- Materials Of Construction
- Commissioning
- Startup/Shutdown
- Effluent
- Noise/Vibration
- Fire
- Explosion
- Safety Equipment

APPENDIX 4 HAZOP P&ID MARK-UPS



NOTES

1. ALL SYMBOLS SHOWN ◯ ARE LOCAL OR REMOTE OPERATOR ACCESS.
2. ALL EQUIPMENT/INSTRUMENT TAG NUMBERS AND LINE NUMBERS SHALL BE PREFIXED WITH THE FACILITY NUMBER i.e. 550-PT-2.
3. BLOWDOWN PURGE VALVE.
4. PIPELINE PRESSURE INPUTS HAVE ADJUSTABLE ALARMS CONFIGURED AS SHOWN:
   PAHH (kPa)
   PAH (kPa)
   PAL (kPa)
   PALL (kPa)
   PDAHH (RATE OF CHANGE IN kPa/sec)
   SET POINTS TO BE DETERMINED IN OPERATIONS AND ADJUSTED AS REQUIRED.
5. PIPELINE LINE No. NG-01-XX-450
   FOR XX - REFER TO PROJECT TECHNICAL SPECIFICATION.
6. PLUG VALVE FOR MANUAL BLOWDOWN OF PORT KEMBLA PIPELINE VIA KEMBLA GRANGE METER STATION.

MASTER FILE

ISSUED FOR HAZOP

DRAWING No.	REFERENCE DRAWINGS
500-CP-016	C.P. TRAD UNIT SLD & CONNECTION DETAILS - ILLAWARRA RAIL
551-PI-001	BHP (PORT KEMBLA) LAUNCHER AND RECEIVER STATIONS - P & ID
500-PI-001	LEGEND

ASSET MANAGER

Jemena

Produced by
Jemena Asset Management (6) Pty Ltd
ABN 52 104 352 650

ASSET OWNER

Jemena

Jemena EGP(1) P/L
ABN 15 068 570 847
Jemena EGP(2) P/L
ABN 77 006 919 115

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENG CHK	APPRV
0B	28.10.20	ISSUED FOR HAZOP (20617)	GPA	SJH	PJB	NKH
0A	09.09.20	ISSUED FOR REVIEW (20617)	GPA		SLH	
A		AS BUILT	DH		SLH	PV

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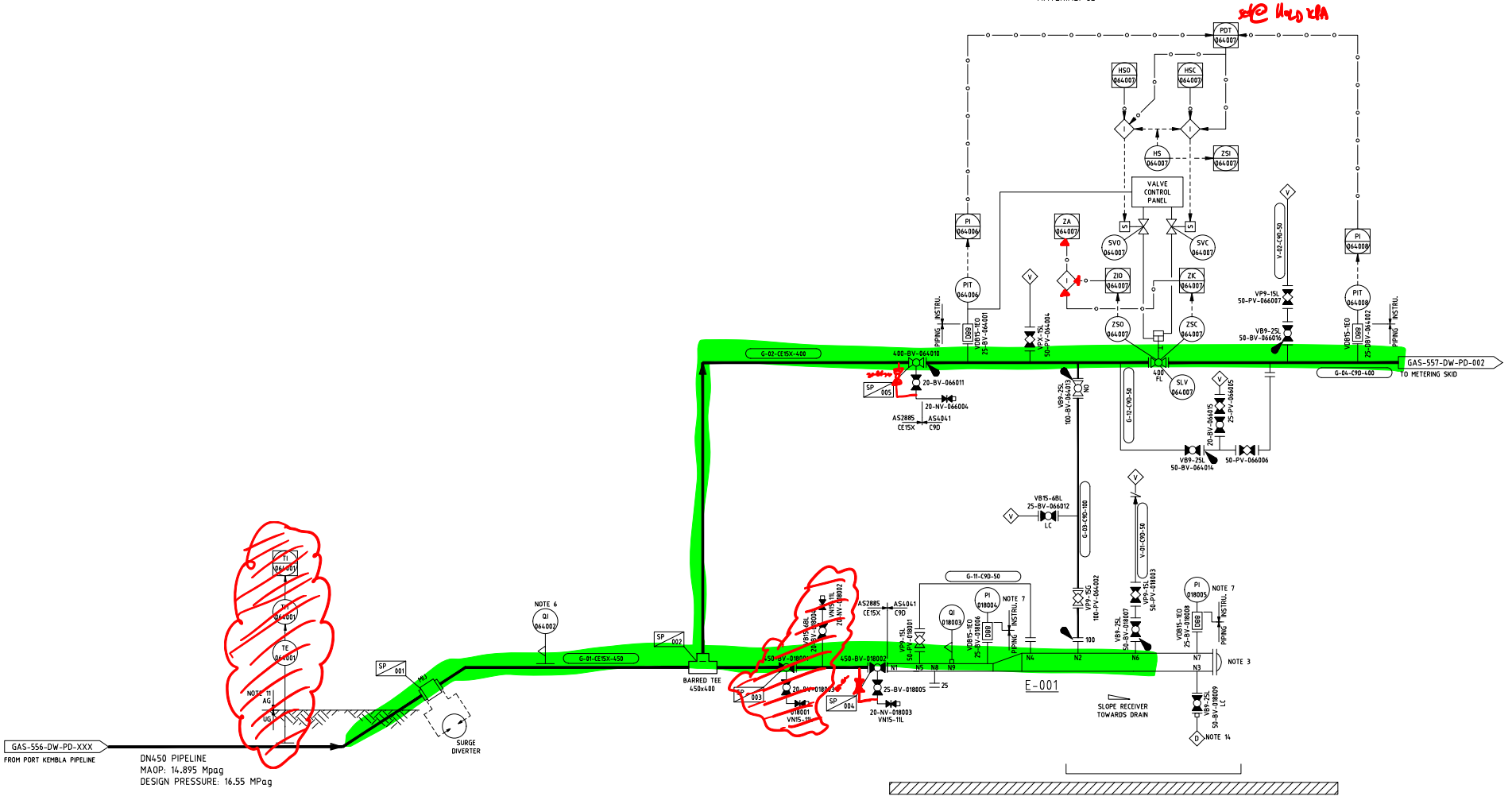
KEMBLA GRANGE MLV & SALES TAP
REMOTE ACTUATED MLV & DN200 SALES TAP
PIPING AND INSTRUMENT - DIAGRAM

	FACILITY	SUBJECT
DRAWN		
DESIGN	SCALE	-
CHECKED	SUPERSEDES	A1
APPROVED	DRAWING NUMBER	REV 0B
DATE	550-PI-001	

557-E-HOLD
PIG RECEIVER

SIZE MAJOR/MINOR: DN650xDN450
DESIGN PRESSURE: 16.55 MPag
DESIGN TEMPERATURE: -10°C/65°C
MATERIAL: CS



NOTES:

1.
2.
3. RECEIVER SCRAPER TRAP FITTED WITH QUICK-OPENING SCREW TYPE CLOSURE INCLUDING PRESSURE ALERT.
4.
5.
6. NON-INTRUSIVE PIG SIGNALLER PLACED SUCH THAT DISTANCE BETWEEN SCRAPER TRAP ISOLATION VALVE AND DOWNSTREAM PIG PASSAGE INDICATOR IS MORE THAN THE LENGTH OF AN INTELLIGENT PIG.
7. PI TO BE VISIBLE FROM THE PIG LAUNCHER QOC.
8.
9.
10.
11. BURIED TEMPERATURE ELEMENT STRAPPED TO PIPE AND COATED IN PLACE (OVER TOP OF EXISTING JEMENA SPEC COATING).

MASTER FILE

ISSUED FOR HAZOP

DRG No.	DRG DESC												
DRAWING No.	REFERENCE DRAWINGS												

ASSET MANAGER
Jemena
Produced by
Jemena Asset Management (6) Pty Ltd
ABN 52 104 352 650

ASSET OWNER
Jemena
Jemena EGP(1) P/L
ABN 15 068 570 847
Jemena EGP(2) P/L
ABN 77 006 919 115

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENG CHK	APPRV
B	27/10/20	ISSUED FOR HAZOP (20617)	GPA	MS	SJH	PJB	NKH
A	17/09/20	ISSUED FOR INFORMATION ONLY	GPA				

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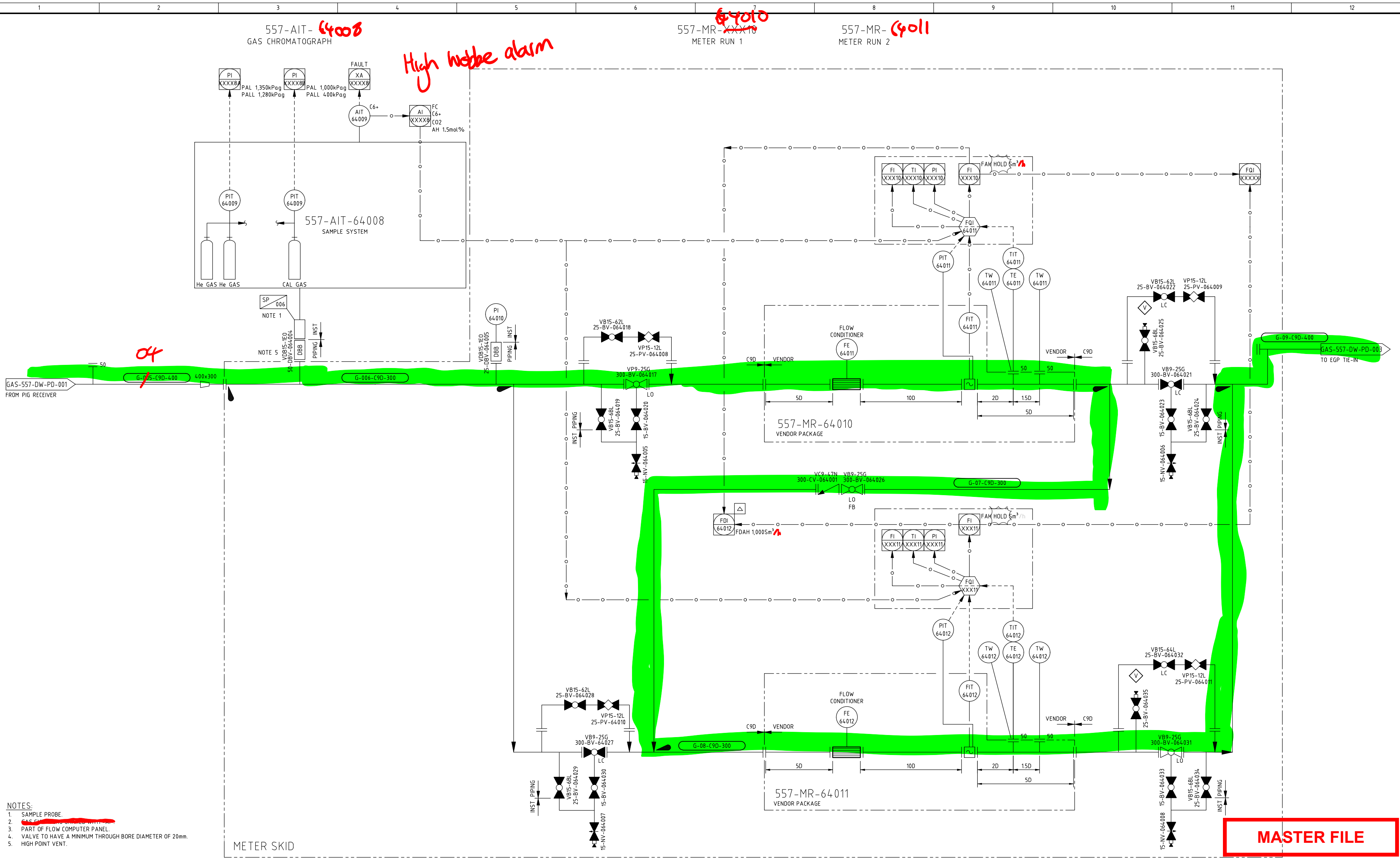
KEMBLA GRANGE METER STATION
PIG RECEIVER
PIPING & INSTRUMENTATION DIAGRAM

DRAWN	GPA		
DESIGN	PJB	SCALE N.T.S.	
CHECKED	SJH	SUPERSEDES	A1
APPROVED	NKH	DRAWING NUMBER	REV
DATE	27/10/20	GAS-557-DW-PD-001	B



NOTES:
1. SAMPLE PROBE.
2. [illegible]
3. PART OF FLOW COMPUTER PANEL.
4. VALVE TO HAVE A MINIMUM THROUGH BORE DIAMETER OF 20mm.
5. HIGH POINT VENT.

MASTER FILE

ISSUED FOR HAZOP

DRG No.	DRG DESC
DRAWING No.	REFERENCE DRAWINGS

ASSET MANAGER
Jemena
Produced by Jemena Asset Management (6) Pty Ltd
ABN 52 104 352 650

ASSET OWNER
Jemena
Jemena EGP(1) P/L
ABN 15 068 570 847
Jemena EGP(2) P/L
ABN 77 006 919 115

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENG CHK	APPRV
B	26/10/20	ISSUED FOR HAZOP (20617)	GPA	SJH	PJB	NKH
A	17/09/20	ISSUED FOR INFORMATION ONLY	GPA			

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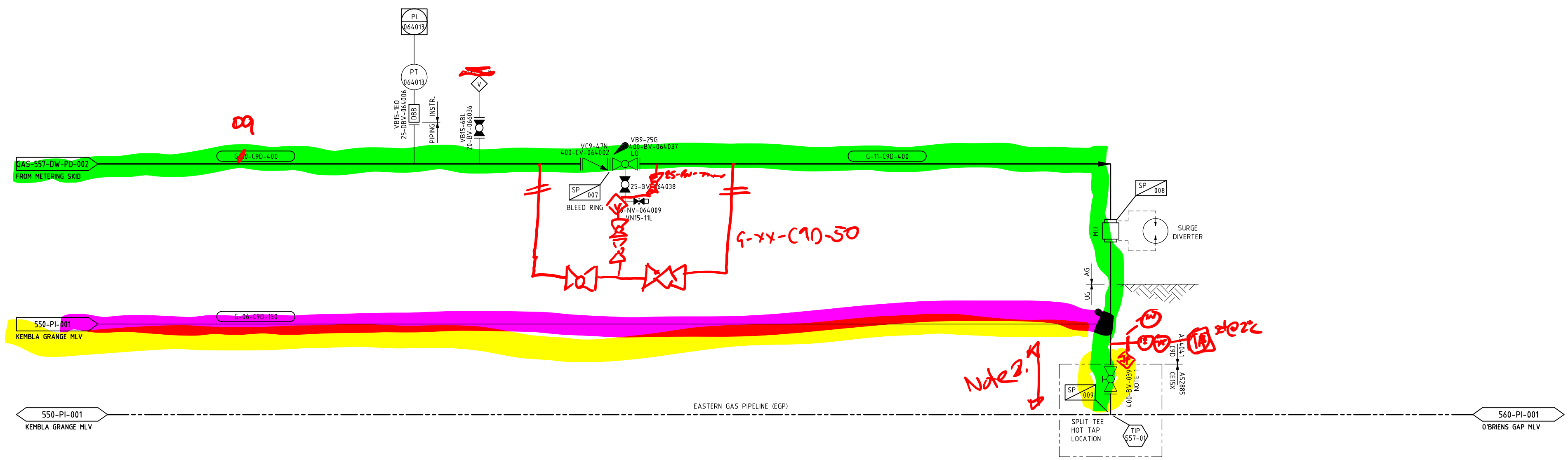
KEMBLA GRANGE METER STATION
METERING
PIPING & INSTRUMENTATION DIAGRAM

DRAWN	GPA		
DESIGN	PJB	SCALE	N.T.S.
CHECKED	SJH	SUPERSEDES	A1
APPROVED	NKH	DRAWING NUMBER	REV
DATE	26/10/20	GAS-557-DW-PD-002	B



NOTES:

1. VALVE COMPLETE WITH VALVE PIT AND EXTENDED HANDLE FOR OPERATION FROM GRADE.

MASTER FILE

ISSUED FOR HAZOP

DRAWING No.	REFERENCE DRAWINGS
DRG No.	DRG DESC

ASSET MANAGER

Jemena

Produced by Jemena Asset Management (6) Pty Ltd ABN 52 104 352 650

ASSET OWNER

Jemena

Jemena EGP(1) P/L ABN 15 068 570 847
Jemena EGP(2) P/L ABN 77 006 919 115

REV	DATE	DESCRIPTION	DRAWN		CHECKED		ENG CHK		APPRV	
B	26/10/20	ISSUED FOR HAZOP (20617)	GPA	AMS	SJH		PJB		NKH	
A	17/09/20	ISSUED FOR INFORMATION ONLY	GPA							

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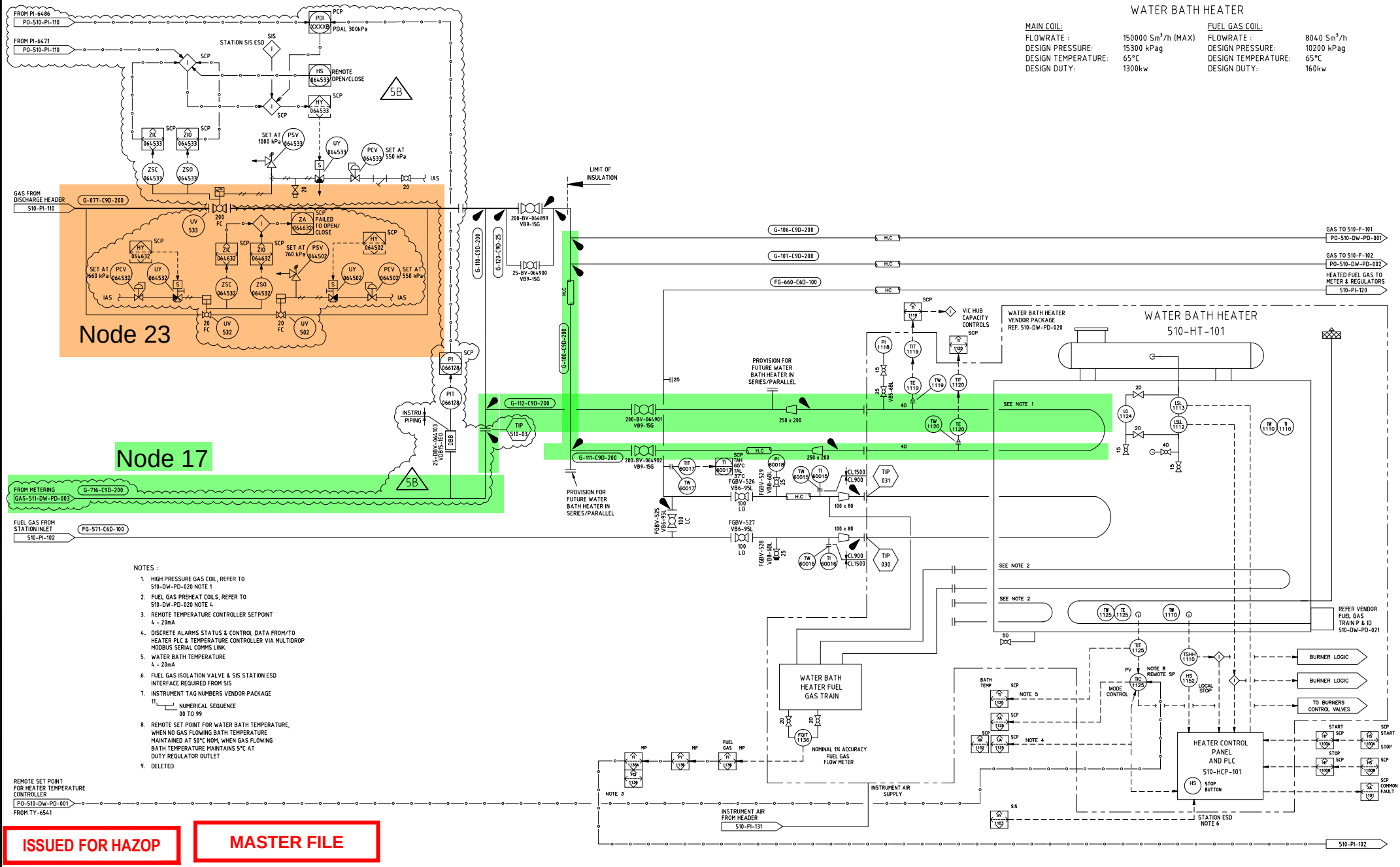
KEMBLA GRANGE METER STATION
EGP HOT TAP TIE-IN
PIPING & INSTRUMENTATION DIAGRAM

DRAWN	GPA		
DESIGN	PJB	SCALE N.T.S.	
CHECKED	SJH	SUPERSEDES	A1
APPROVED	NKH	DRAWING NUMBER GAS-557-DW-PD-003	REV B
DATE	26/10/20		

510-HT-101
WATER BATH HEATER

MAIN COIL:		FUEL GAS COIL:	
FLOWRATE :	150000 Sm³/h (MAX)	FLOWRATE :	8040 Sm³/h
DESIGN PRESSURE:	15300 kPag	DESIGN PRESSURE:	10200 kPag
DESIGN TEMPERATURE:	65°C	DESIGN TEMPERATURE:	65°C
DESIGN DUTY:	1300kw	DESIGN DUTY:	160kw



NOTES :

1. HIGH PRESSURE GAS COIL, REFER TO 510-DW-PD-020 NOTE 1
2. FUEL GAS PREHEAT COILS, REFER TO 510-DW-PD-020 NOTE 4
3. REMOTE TEMPERATURE CONTROLLER SETPOINT 4 - 20mA
4. DISCRETE ALARMS STATUS & CONTROL DATA FROM/TO HEATER PLC & TEMPERATURE CONTROLLER VIA MULTIDROP MODBUS SERIAL COMMS LINK.
5. WATER BATH TEMPERATURE 4 - 20mA
6. FUEL GAS ISOLATION VALVE & SIS STATION ESD INTERFACE REQUIRED FROM SIS
7. INSTRUMENT TAG NUMBERS VENDOR PACKAGE
   11 — NUMERICAL SEQUENCE 00 TO 99
8. REMOTE SET POINT FOR WATER BATH TEMPERATURE, WHEN NO GAS FLOWING BATH TEMPERATURE MAINTAINED AT 50°C NOM, WHEN GAS FLOWING BATH TEMPERATURE MAINTAINS 5°C AT DUTY REGULATOR OUTLET
9. DELETED.

ISSUED FOR HAZOP

MASTER FILE

REV	DATE	DESCRIPTION	PROJECT	DRAWN	DESIGNED	CHECKED	ENGINEER	APPROVED	CLIENT
5B	2/11/20	ISSUED FOR HAZOP (20617)		GPA		SJH	PJB	NKH	
5A	16/09/20	ISSUED FOR REVIEW (20617)		GPA		PJB			
5	05/02/15	AS BUILT FUEL GAS TRAIN AMENDED DWG No UPDATED TO CURRENT FORMAT		JB		MR		AJ	
4	08/11	LCS4 PROJECT AS BUILT		JEM	JEM	PFR	PFR	PFR	
3	6/4/06	AS BUILT (PROJECT SKY)	09082001	KF	PFR	RG	PFR	PFR	NS
2	17/3/06	ISSUED FOR CONSTRUCTION	4619	KF	PFR	RG	PFR	PFR	NS
1	5/3/03	AS BUILT		J.S.					
0	26/8/02	ISSUED FOR CONSTRUCTION		J.W.		D.J.	P.B.	DLM	

DRAWING No.	REFERENCE DRAWINGS
510-DW-PD-021	WATER BATH HEATER 510-HT-101 - FUEL GAS TRAIN - P&ID
510-DW-PD-020	WATER BATH HEATER 510-HT-101 - HEAT TRANSFER COILS & BATH - P&ID

ASSET MANAGER

Jemena

Produced by
Jemena Asset Management (6) Pty Ltd
ABN 52 104 352 650

ASSET OWNER

Jemena

Jemena EGP(1) P/L
ABN 15 068 570 847
Jemena EGP(2) P/L
ABN 77 006 919 115

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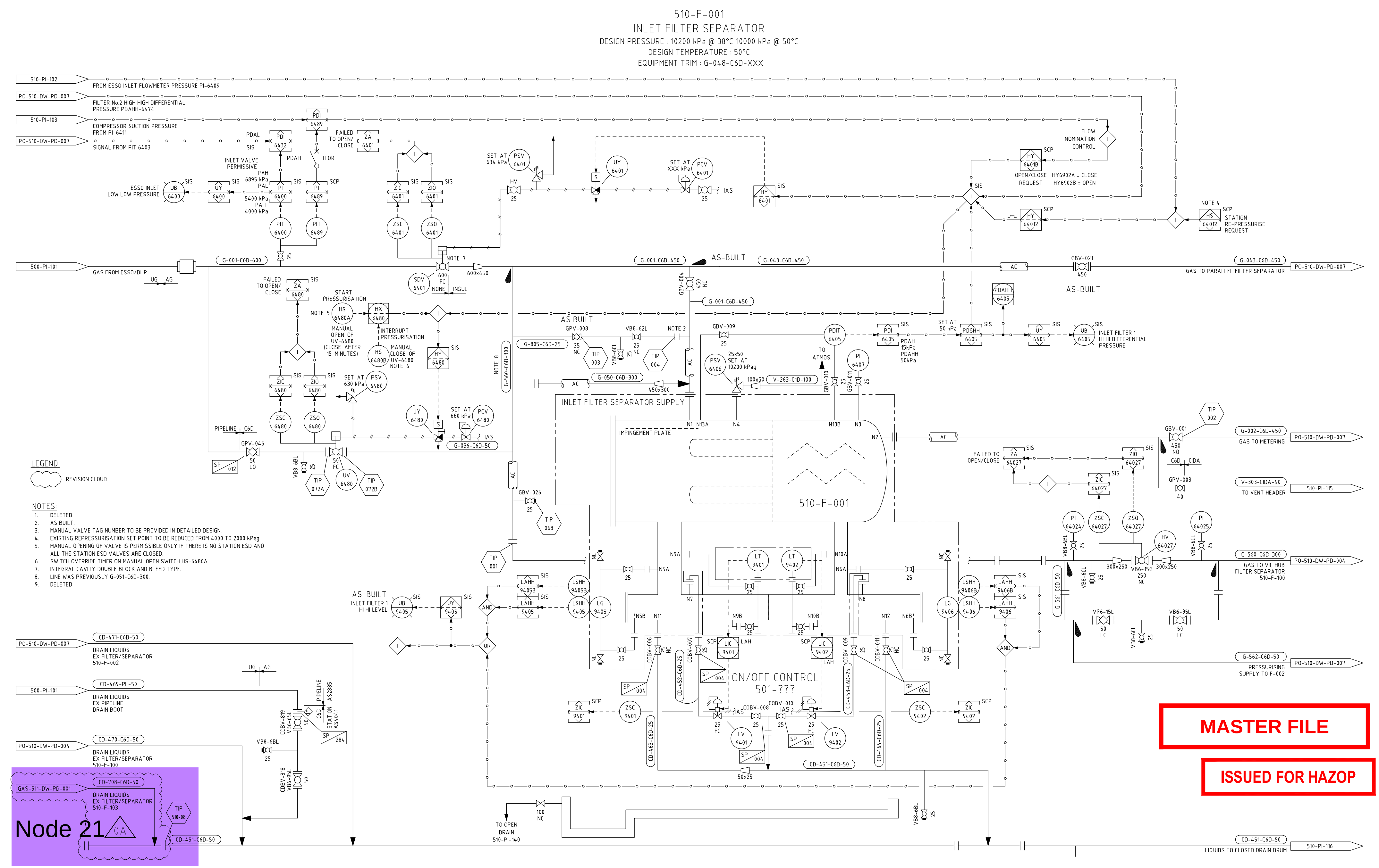
LONGFORD COMPRESSOR STATION
VIC HUB - WATER BATH HEATER 510-HT-101
PIPING & INSTRUMENTATION DIAGRAM

DRAWN	M.L.	FACILITY	SUBJECT
DESIGN	P.BANNISTER	SCALE	N.T.S.
CHECKED	D.JENKIN	SUPERSEDES	PO-510-DW-PD-006_5
APPROVED	D.MITVALSKY	DRAWING NUMBER	510-DW-PD-006
DATE	27/02/02	REV	5B

A1



REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENG CHK	APPRV
0A	2/11/20	ISSUED FOR HAZOP (20617)	GPA	SJH	PJB	NKH
0	24/07/17	REDRAWN. INCLUDES ALL PREVIOUS REVISIONS. AS BUILT 05/05/12	JB			

DRAWING No. | REFERENCE DRAWINGS

ASSET MANAGER
Jemena
Produced by Jemena Asset Management (6) Pty Ltd ABN 52 104 352 650

ASSET OWNER
Jemena
Jemena EGP(1) P/L ABN 15 068 570 847
Jemena EGP(2) P/L ABN 77 006 919 115

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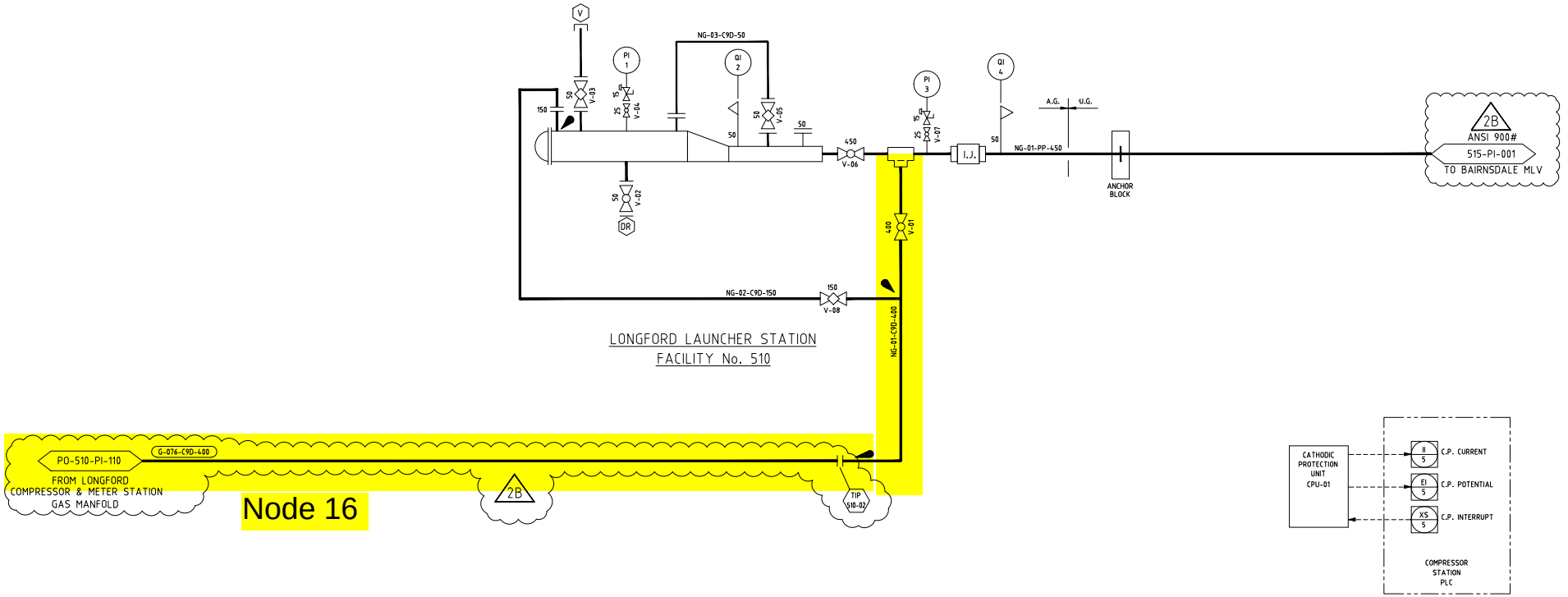
LONGFORD COMPRESSOR STATION
INLET FILTER SEPARATOR
PIPING & INSTRUMENTATION DIAGRAM

DRAWN	EC	FACILITY	SUBJECT
DESIGN	GRT	SCALE	N.T.S.
CHECKED	PR	SUPERSEDES	510-PI-101
APPROVED	PAC	DRAWING NUMBER	
DATE	08/10/99	510-DW-PD-101	REV 0A

A1

V-09

LAUNCHER TRAP



NOTES

1. ALL SYMBOLS SHOWN ARE LOCAL OR REMOTE OPERATOR ACCESS.
2. ALL EQUIPMENT/INSTRUMENT TAG NUMBERS AND LINE NUMBERS SHALL BE PREFIXED WITH THE FACILITY NUMBER i.e. 510-TIT-1
3. PIPELINE LINE No. NG-01-PP-450 FOR PP - REFER TO PROJECT TECHNICAL SPECIFICATION.

MASTER FILE

ISSUED FOR HAZOP

500-PI-109	COMPRESSOR DISCHARGE HEADER
500-PI-001	LEGEND
DRAWING No.	REFERENCE DRAWINGS

ASSET MANAGER

Jemena

Produced by
Jemena Asset Management (6) Pty Ltd
ABN 52 104 352 650

ASSET OWNER

Jemena

Jemena EGP(1) P/L
ABN 15 068 570 847
Jemena EGP(2) P/L
ABN 77 006 919 115

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENG CHK	APPRV
2B	2/11/20	ISSUED FOR HAZOP (20617)	GPA	SJH	PJB	NKH
2A	09/09/20	ISSUED FOR REVIEW (20617)	GPA		SLH	
2	01/04	AS BUILT	BG		PFR	PAC
1	03/03	AS BUILT TO PROTECT	DMI		GRT	GRM
0		AS BUILT	DH		PWD	PV

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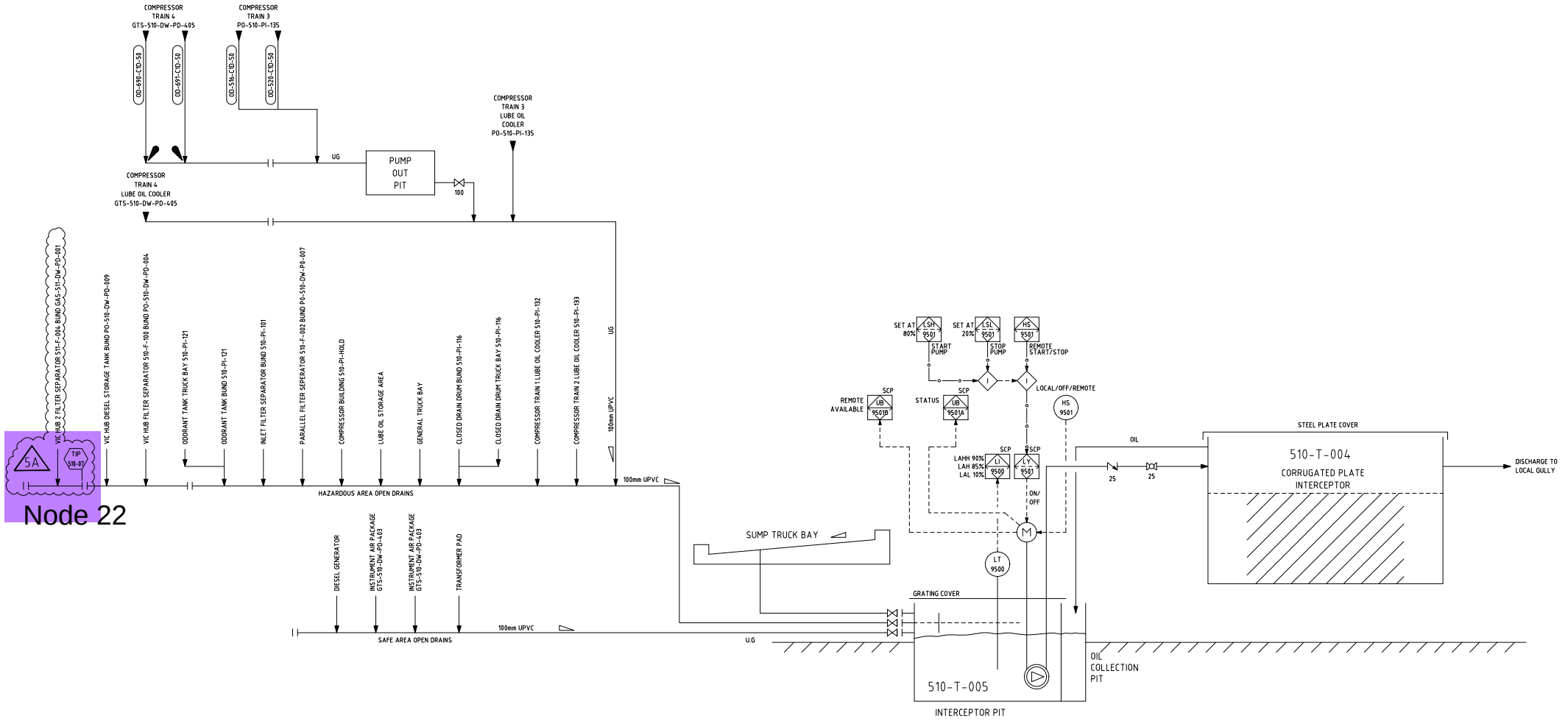
LONGFORD COMPRESSOR STATION
LAUNCHER STATION
PIPING & INSTRUMENTATION DIAGRAM

DRAWN	FACILTY	SUBJECT	
DESIGN	SCALE N.T.S.		
CHECKED	SUPERSEDES		A1
APPROVED	DRAWING NUMBER		REV.
DATE		510-PI-092	2B

INTERCEPTOR PIT	510-T-005 OIL COLLECTION PIT	510-P-001 CPI FEED PUMP	510-PM-001 CPI FEED PUMP MOTOR	510-T-004 CORRUGATED PLATE INTERCEPTOR
DIMENSIONS : 1600 mmH x 950 mmW x 2575 mmL CAPACITY: 2m^2 NOM	DIMENSIONS : 1600 mmH x 950 mmW x 1200 mmL CAPACITY: 1m^2 NOM	DIMENSIONS : 24m^{2}hr @ 3.9 m	SIZE : 0.55 kW	DIMENSIONS : 2425 mmL x 2159 mmW x 1278 mmH



MASTER FILE

ISSUED FOR HAZOP

ASSET MANAGER

Jemena

Produced by
Jemena Asset Management (6) Pty Ltd
ABN 52 104 352 650

ASSET OWNER

Jemena

Jemena EGP(1) P/L
ABN 15 068 570 847
Jemena EGP(2) P/L
ABN 77 006 919 115

REV	DATE	DESCRIPTION	PROJECT	DRAWN	DESIGNED	CHECKED	ENGINEER	APPROVED	CLIENT
5A	2/11/20	ISSUED FOR HAZOP (20617)		GPA			SJH	PJB	NKH
5	08/11	LCS4 PROJECT AS BUILT		JEM	JEM	PFR		PFR	PFR
4	1/04	AS BUILT		BG				PFR	PAC
3	3/03	AS BUILT TO TNGP & VICHUB PROJECTS	6008&02300	AN				GRT	GRM
2	12/00	ISSUED AS BUILT	08407905	EC				PFR	PV
1	6/99	EQUIPMENT TAG NUMBERS REVISED	08407905	MR				PFR	RR
0	8/10/99	ISSUED FOR CONSTRUCTION	08407905	EC				PFR	RR

DRAWING No. | REFERENCE DRAWINGS

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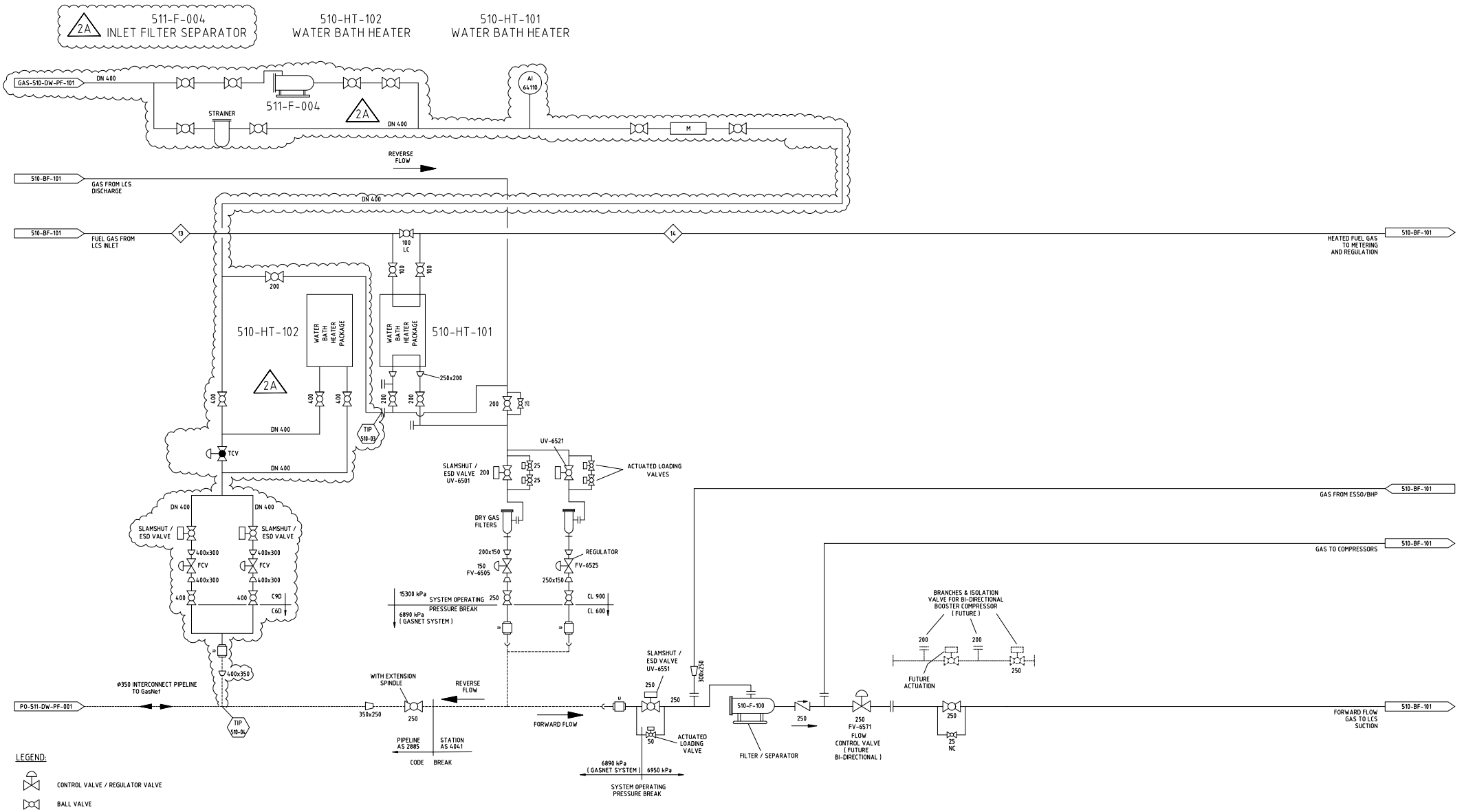
LONGFORD COMPRESSOR STATION
OPEN DRAIN INTERCEPTOR
PIPING & INSTRUMENTATION DIAGRAM

DRAWN	EC	FACILTY	SUBJECT
DESIGN	GRT	SCALE	N.T.S.
CHECKED	PR	SUPERSEDES	A1
APPROVED	PAC	DRAWING NUMBER	REV.
DATE	08/10/00	510-PI-140	5A



MASTER FILE

ISSUED FOR HAZOP

ASSET MANAGER

Jemena

Produced by
Jemena Asset Management (6) Pty Ltd
ABN 52 104 352 650

ASSET OWNER

Jemena

Jemena EGP(1) P/L
ABN 15 068 570 847
Jemena EGP(2) P/L
ABN 77 006 919 115

REV	DATE	DESCRIPTION	PROJECT	DRAWN	DESIGNED	CHECKED	ENGINEER	APPROVED	CLIENT
2A	2/11/20	ISSUED FOR HAZOP (20617)		GPA			SJH	PJB	NKH
2	19/05/09	ISSUED FOR CONSTRUCTION	25697	KW	DXB	KLM	DXB	DAE	
B	27/02/09	ISSUED FOR REVIEW (POST HAZOP)	25697	AP	DXB	KLM	DXB	DXB	
A-A	11/08	ISSUED FOR DETAILED DESIGN HAZOP	25697	KW	JYA	KLM	DXB	DXB	
A	06/08	ISSUED FOR HAZOP	00341	BH		TLV	AH	GPG	
1	21/03/03	AS BUILT	510	JS				DLM	
0	26/08/02	ISSUED FOR CONSTRUCTION	510	ML			DJ	PB	DLM

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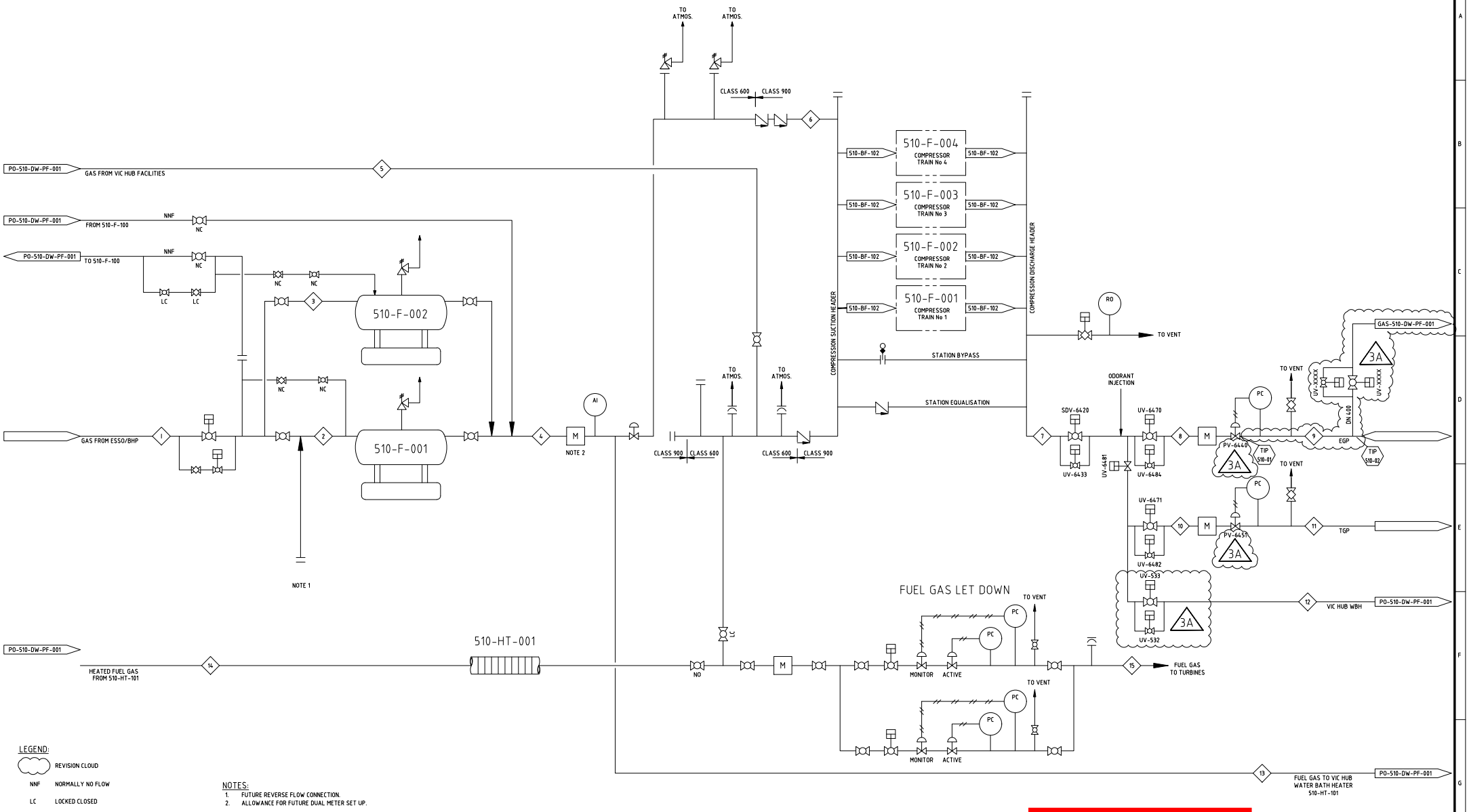
LONGFORD COMPRESSOR STATION
VIC HUB - FACILITIES LOCATED WITHIN THE LCS
PROCESS FLOW DIAGRAM

DRAWN	JW	FACILTY	SUBJECT
DESIGN	PB	SCALE	N.T.S.
CHECKED	DJ	SUPERSEDES	PO-510-DW-PF-001
APPROVED	DM	DRAWING NUMBER	GAS-510-DW-PF-001
DATE	28/02/02		REV 2A

A1

DRAWING No. | REFERENCE DRAWINGS



REV	DATE	DESCRIPTION	PROJECT	DRAWN	DESIGNED	CHECKED	ENGINEER	APPROVED	CLIENT
3A	2/11/20	ISSUED FOR HAZOP (20617)		GPA		SJH	PJB	NKH	
3	15/05/12	AS-BUILT BY LONGFORD EXPANSION PROJECT		GWN		PFR 13.7.10			
2	19/05/09	ISSUED FOR CONSTRUCTION	25697	KW	DXB	KLM	DXB	DAE	
B	27/02/09	ISSUED FOR REVIEW (POST HAZOP)	25697	KW	DXB	KLM	DXB	DAE	
A-A	11/08	ISSUED FOR DETAILED DESIGN HAZOP	25697	AP	JTA	KLM	DXB	DXB	
A	06/08	ISSUED FOR HAZOP	00341	N/C		TLV	AN	GPG	
1	03/03	AS-BUILT TOTNSP & VICHUB PROJECTS	600032310	AN			PR	GTF	
0	08/10/01	ISSUED FOR CONSTRUCTION	08407905	EC			PFR	RR	

ASSET MANAGER
Jemena
Produced by
Jemena Asset Management (6) Pty Ltd
ABN 52 104 352 650

ASSET OWNER
Jemena
Jemena EGP(1) P/L
ABN 15 068 570 847
Jemena EGP(2) P/L
ABN 77 006 919 115

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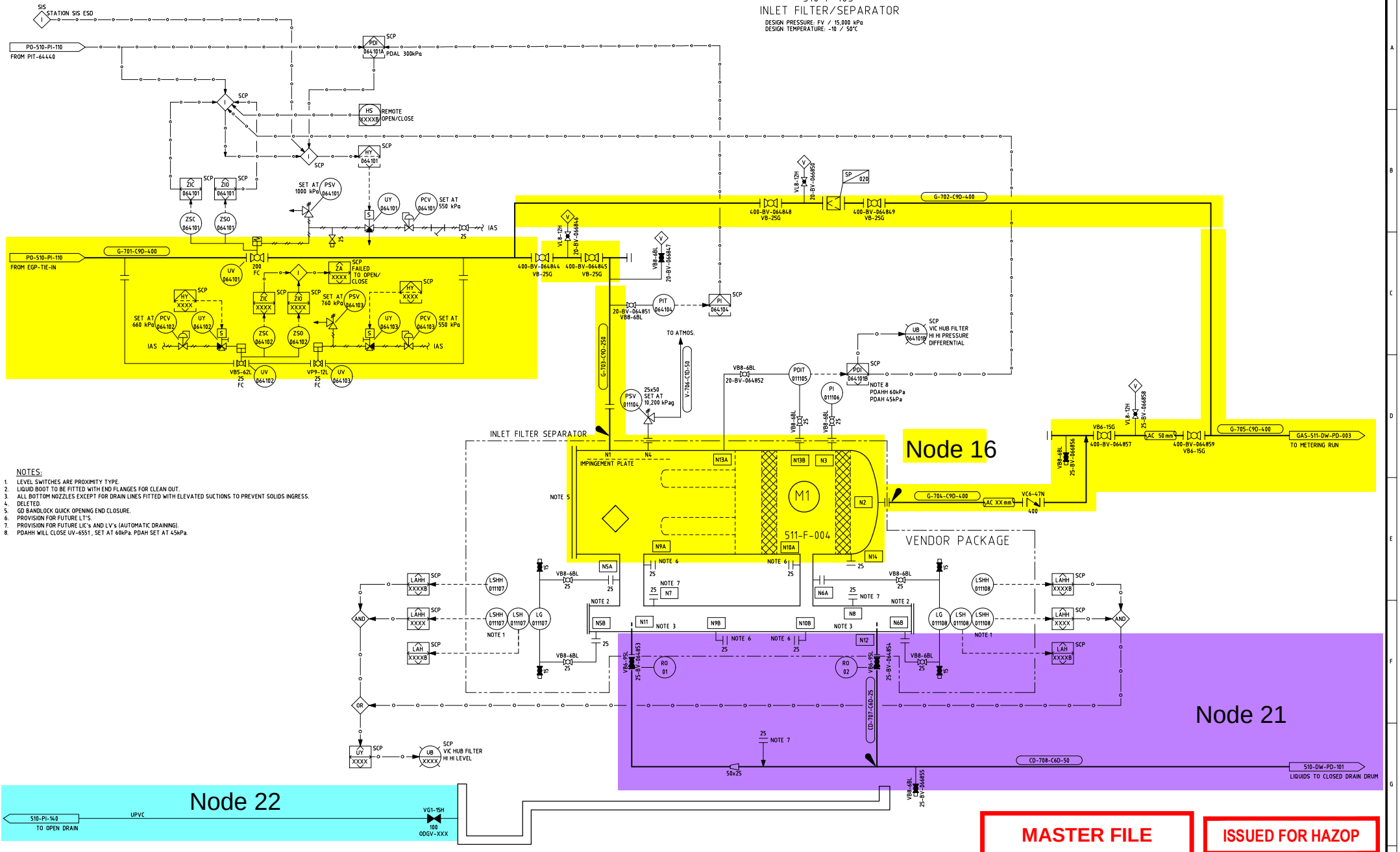
LONGFORD COMPRESSOR STATION
MAIN GAS SYSTEM
PROCESS FLOW DIAGRAM

DRAWN	EC	FACILTY	SUBJECT
DESIGN	GT	SCALE	N.T.S.
CHECKED	PR	SUPERSEDES	510-BF-101_3
APPROVED	PAC	DRAWING NUMBER	GAS-510-DW-PF-101
DATE	08/10/99		REV 3A

DRAWING No. | REFERENCE DRAWINGS

510-F-103
INLET FILTER/SEPARATOR

DESIGN PRESSURE: FV / 15,000 kPa
DESIGN TEMPERATURE: -10 / 50°C



NOTES:

1. LEVEL SWITCHES ARE PROXIMITY TYPE.
2. LIQUID BOOT TO BE FITTED WITH END FLANGES FOR CLEAN OUT.
3. ALL BOTTOM NOZZLES EXCEPT FOR DRAIN LINES FITTED WITH ELEVATED SUCTIONS TO PREVENT SOLIDS INGRESS.
4. DELETED.
5. GD BANDLOCK QUICK OPENING END CLOSURE.
6. PROVISION FOR FUTURE LT'S.
7. PROVISION FOR FUTURE LIC's AND LV's (AUTOMATIC DRAINING).
8. PDAHH WILL CLOSE UV-6551, SET AT 60kPa. PDAH SET AT 45kPa.

MASTER FILE

ISSUED FOR HAZOP

ASSET MANAGER

Jemena

Produced by
Jemena Asset Management (6) Pty Ltd
ABN 52 104 352 650

ASSET OWNER

Jemena

Jemena EGP(1) P/L
ABN 15 068 570 847
Jemena EGP(2) P/L
ABN 77 006 919 115

REV.	DATE	DESCRIPTION	DRAWN	CHECKED	ENG CHK	APPRV
B	2/11/20	ISSUED FOR HAZOP (20617)	GPA	SJH	PJB	NKH
A	17/09/20	ISSUED FOR INFORMATION ONLY	GPA			

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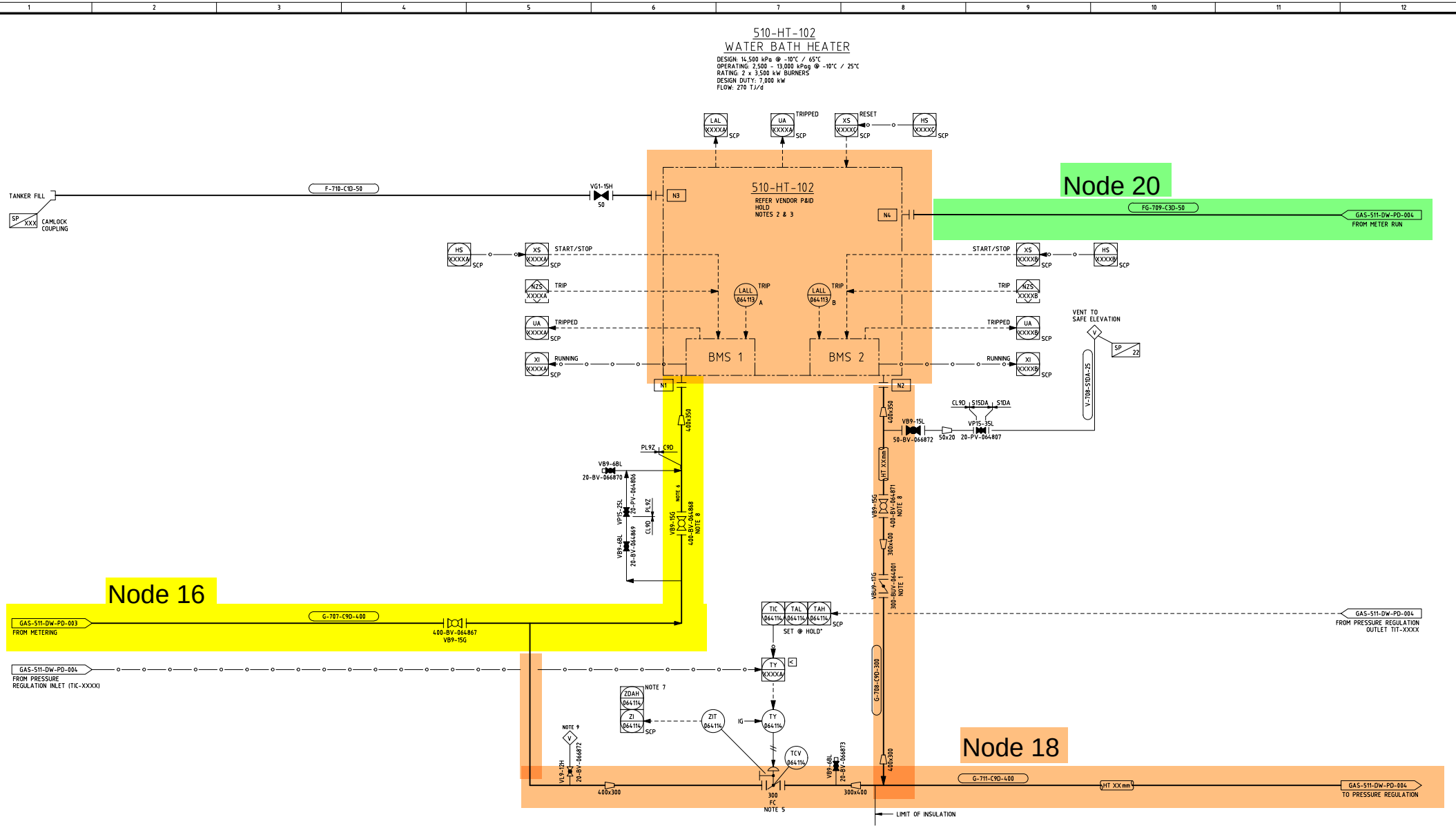
LONGFORD COMPRESSOR STATION
VIC HUB 2 - INLET FILTER SEPARATOR
PIPING & INSTRUMENTATION DIAGRAM

DRAWN	GPA	FACILITY	SUBJECT
DESIGN		SCALE	N.T.S.
CHECKED		SUPERSEDES	A1
APPROVED		DRAWING NUMBER	REV B
DATE	26/10/20	GAS-511-DW-PD-001	

DRAWING No. | REFERENCE DRAWINGS



NOTES:
1. VALVE ALLOWS SOME THROTTLING TO FURTHER INCREASE HEATER BYPASS FLOWRATE.
2. WATERBATH HEATER SHALL BE DESIGNED TO MINIMISE WATER LOSS BY EVAPORATION.
3. WATERBATH SHALL BE ADEQUATELY VENTED TO PREVENT PRESSURISATION SHOULD IT BOIL DUE TO INSTRUMENT TRIP FAILURE.
4. REFER PIPING CLASS DATASHEETS FOR IMPACT TESTING/HEAT TREATMENT REQUIREMENTS.
5. MANUAL OVERRIDE FURNISHED ON THE ACTUATOR.
6. LOW TEMPERATURE CARBON STEEL PRESSURISING VALVE/LINE FOR PRESSURISING WATER BATH HEATERS ONLY.
7. DISCREPANCY ALARM.
8. SINGLE BLOCK ISOLATION FOR WATERBATH HEATER REQUIRES OPERATION AT OR BELOW ASME CL300 FLANGE LIMIT WHILE ISOLATING FOR MAINTAINANCE.
9. PVC PIPE, 300mm LONG COMPLETE WITH CAP TO PREVENT RAIN INGRESS. VENT PIPE TO TERMINATE 2m ABOVE GRADE. PVC PIPE TO BE REMOVED PRIOR TO VENTING.

MASTER FILE

ISSUED FOR HAZOP

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENG CHK	APPRV
B	2/11/20	ISSUED FOR HAZOP (20617)	GPA	SJH	PJB	NKH
A	17/09/20	ISSUED FOR INFORMATION ONLY	GPA			

ASSET MANAGER
Jemena
Produced by
Jemena Asset Management (6) Pty Ltd
ABN 52 104 352 650

ASSET OWNER
Jemena
Jemena EGP(1) P/L
ABN 15 068 570 847
Jemena EGP(2) P/L
ABN 77 006 919 115

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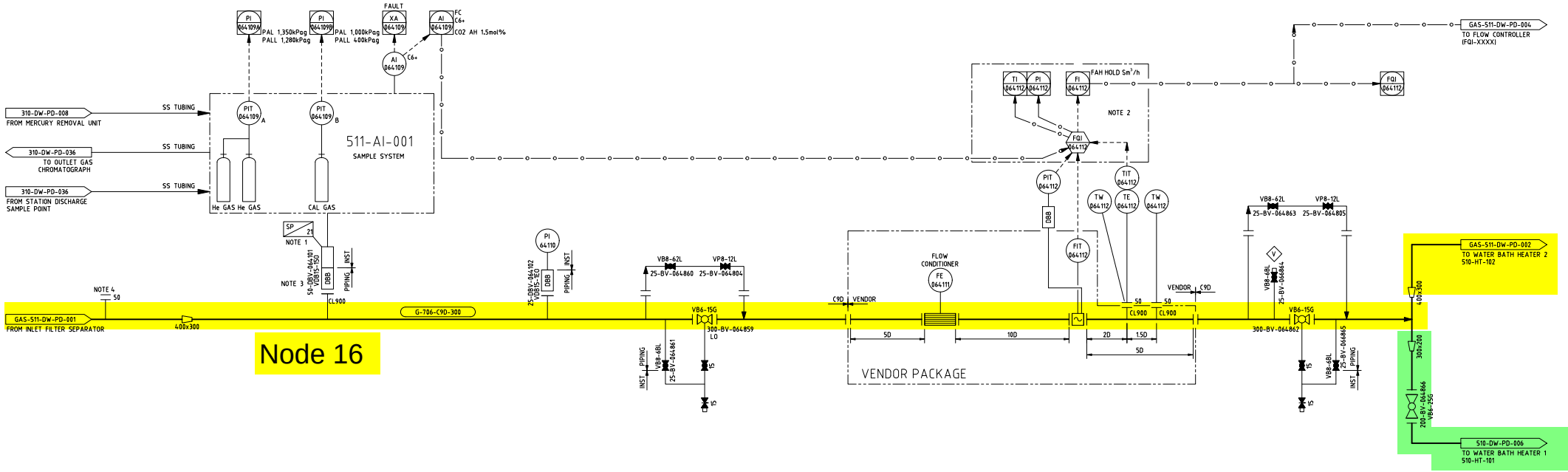
LONGFORD COMPRESSOR STATION
VIC HUB 2 - WATER BATH HEATER
PIPING & INSTRUMENTATION DIAGRAM

DRAWN	GPA	FACILTY	SUBJECT
DESIGN		SCALE	N.T.S.
CHECKED		SUPERSEDES	A1
APPROVED		DRAWING NUMBER	REV B
DATE	26/10/20	GAS-511-DW-PD-002	

DRAWING No. | REFERENCE DRAWINGS



NOTES:

1. SAMPLE PROBE.
2. PART OF FLOW COMPUTER PANEL.
3. VALVE TO HAVE A MINIMUM THROUGH BORE DIAMETER OF 20mm.
4. HIGH POINT VENT.

MASTER FILE

ISSUED FOR HAZOP

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENG CHK	APPRV
B	2/11/20	ISSUED FOR HAZOP (20617)	GPA	SJH	PJB	NKH
A	17/09/20	ISSUED FOR INFORMATION ONLY	GPA			

DRAWING No. | REFERENCE DRAWINGS

ASSET MANAGER

Jemena

Produced by
Jemena Asset Management (6) Pty Ltd
ABN 52 104 352 650

ASSET OWNER

Jemena

Jemena EGP(1) P/L
ABN 15 068 570 847
Jemena EGP(2) P/L
ABN 77 006 919 115

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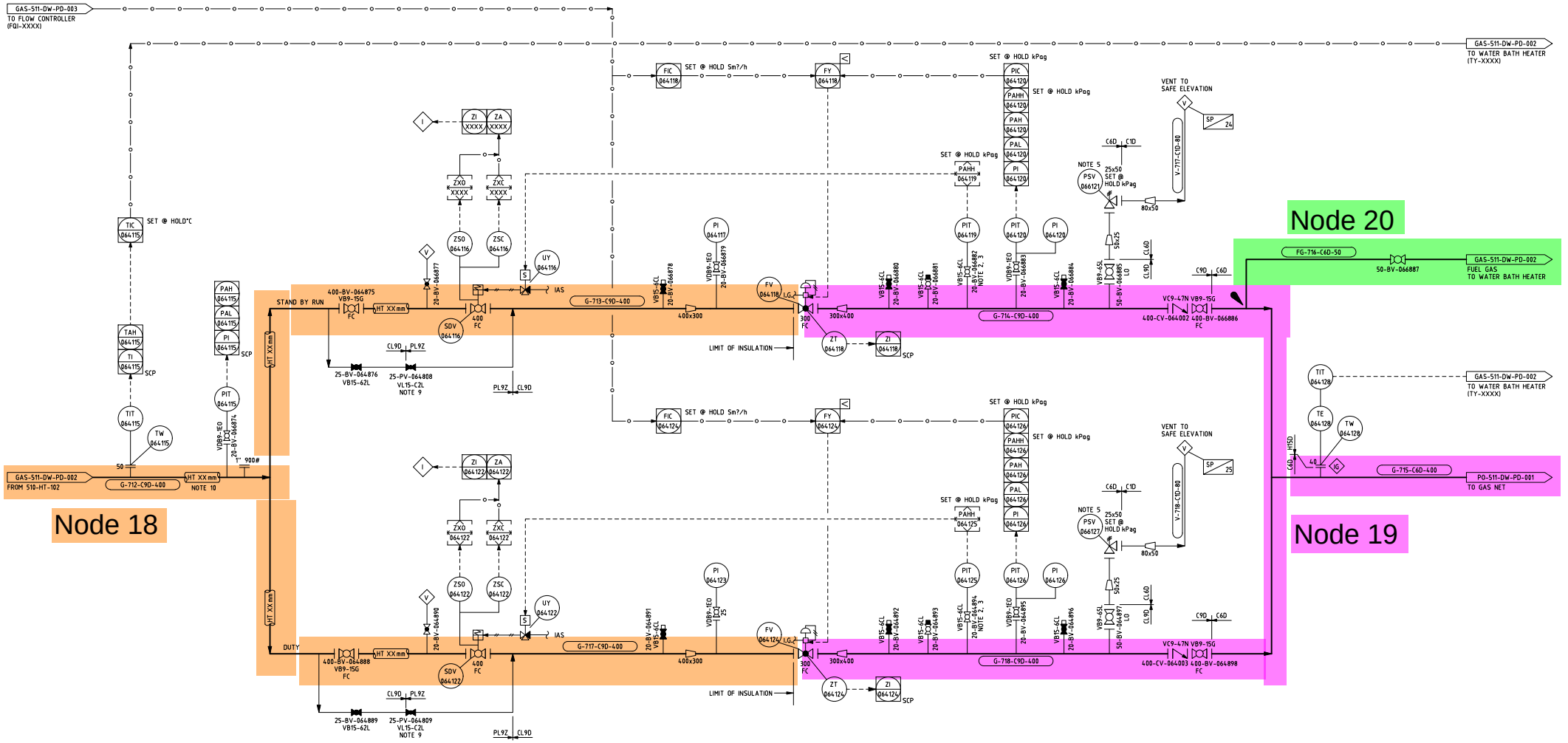
LONGFORD COMPRESSOR STATION
VIC HUB 2 - METERING RUN
PIPING & INSTRUMENTATION DIAGRAM

DRAWN	GPA	FACILTY	SUBJECT
DESIGN		SCALE	N.T.S.
CHECKED		SUPERSEDES	A1
APPROVED		DRAWING NUMBER	REV B
DATE	26/10/20	GAS-511-DW-PD-003	



NOTES:

1. DELETED.
2. PILOT SUPPLY LINE.
3. PRESSURE REGULATOR SENSING POINTS SHALL BE LOCATED DOWNSTREAM OF REGULATOR A MINIMUM DISTANCE AS REQUIRED BY VENDOR.
4. SOFT-SEATED CHECK VALVES.
5. TOKEN RELIEF SET AT JUST BELOW Hi PRESSURE PILOT AND PAHH TO ALLOW PSV TO RELIEVE LEAKAGE AND PREVENT "NO FLOW" OVER PRESSURE TRIPS.
6. DELETED.
7. DELETED.
8. DELETED.
9. LOW TEMPERATURE CARBON STEEL VALVE/LINE FOR PRESSURISING INDIVIDUAL PRESSURE REGULATION RUNS ONLY.
10. REFER TO PIPING DATASHEETS FOR IMPACT TESTING OR HEAT TREATMENT REQUIREMENTS.

MASTER FILE

ISSUED FOR HAZOP

ASSET MANAGER

Jemena

Produced by
Jemena Asset Management (6) Pty Ltd
ABN 52 104 352 650

ASSET OWNER

Jemena

Jemena EGP(1) P/L
ABN 15 068 570 847
Jemena EGP(2) P/L
ABN 77 006 919 115

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENG CHK	APPRV
B	2/11/20	ISSUED FOR HAZOP (20617)	GPA	SJH	PJB	NKH
A	17/09/20	ISSUED FOR INFORMATION ONLY	GPA			

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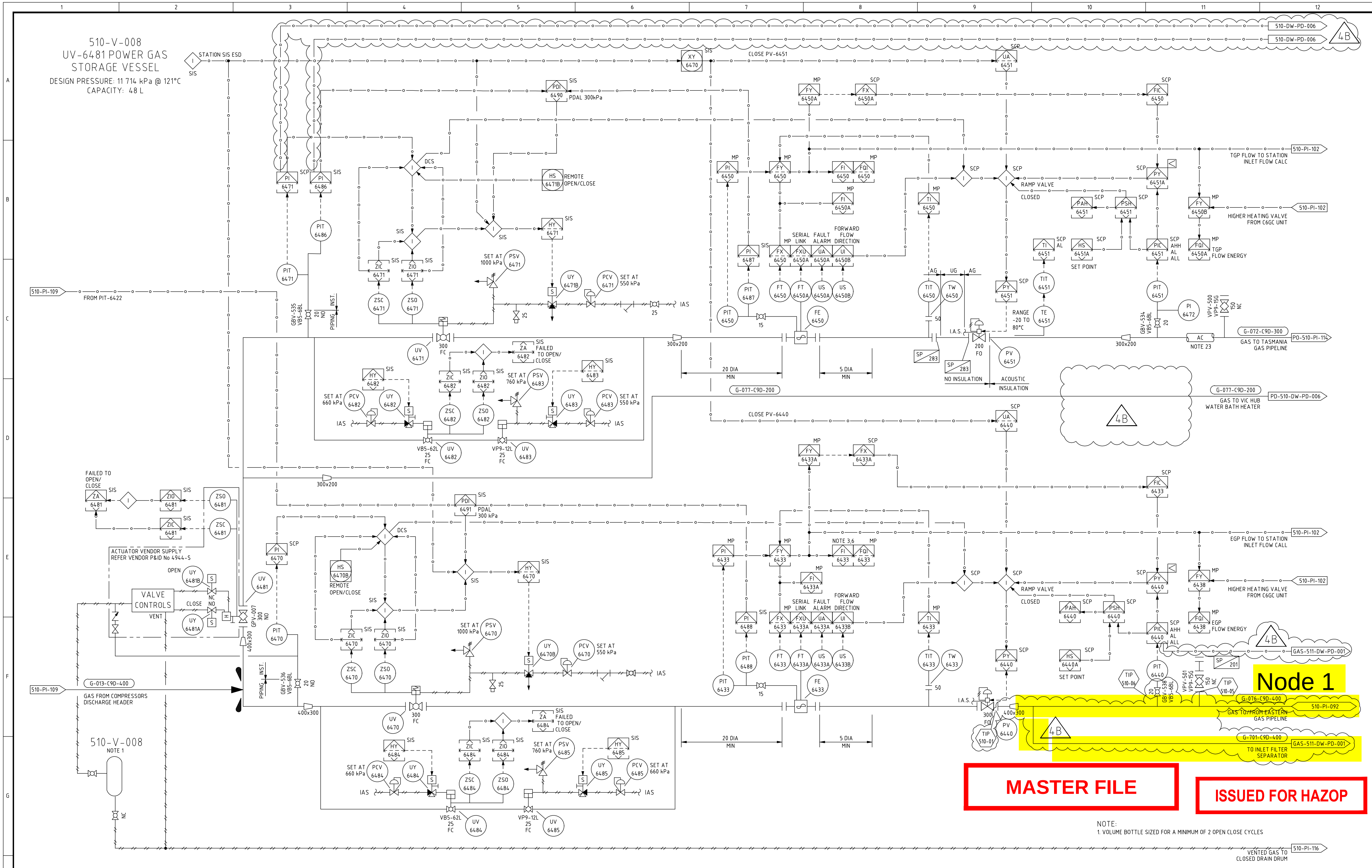
LONGFORD COMPRESSOR STATION
VIC HUB 2 - PRESSURE REGULATION
PIPING & INSTRUMENTATION DIAGRAM

DRAWN	GPA	FACILTY	SUBJECT
DESIGN		SCALE	N.T.S.
CHECKED		SUPERSEDES	A1
APPROVED		DRAWING NUMBER	REV
DATE	26/10/20	GAS-511-DW-PD-004	B

DRAWING No. | REFERENCE DRAWINGS



DRAWING No. | REFERENCE DRAWINGS

ASSET MANAGER
Jemena
Produced by Jemena Asset Management (6) Pty Ltd
ABN 52 104 352 650

ASSET OWNER
Jemena
Jemena EGP(1) P/L
ABN 15 068 570 847
Jemena EGP(2) P/L
ABN 77 006 919 115

REV	DATE	DESCRIPTION	PROJECT	DRAWN	DESIGNED	CHECKED	ENGINEER	APPROVED	CLIENT
4B	3/11/20	ISSUED FOR HAZOP (20617)		GPA		SJH	PJB	NKH	
4A	09/09/20	ISSUED FOR REVIEW (20617)		GPA	SLH				
4	24/05/12	ASBUILT		JB		AJ		WD	
3	19/05/09	ISSUED FOR CONSTRUCTION	25697	AP	DXB	KLM	DXB	DAE	
A	27/02/09	ISSUED FOR REVIEW (POST HAZOP)	25697	KLM	DXB	KLM	DXB	DXB	
2	12/03	AS BUILT		DMI	DMI	PFR	PFR	PAC	
1	03/03	ISSUED AS BUILT TO PROJECT	600	SS	RPK	KLM	AJK	PAC	GRM
0	2/11/20	ISSUED FOR CONSTRUCTION	600	DMI	GRT	PFR	GRT	PAC	GRM

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LONGFORD COMPRESSOR STATION
GAS MANIFOLD
PIPING & INSTRUMENTATION DIAGRAM

DRAWN	CEF	FACILTY	SUBJECT
DESIGN	GRT	SCALE	N.T.S.
CHECKED	JRW	SUPERSEDES	A1
APPROVED	PAC	DRAWING NUMBER	
DATE	02/01	PD-510-PI-110	REV 4B

Node 19

NOTES

1. BURIED VALVE WITH SPINDLE EXTENSION.
2. GASNET P&ID DRAWING 3141-PB-006

MASTER FILE

ISSUED FOR HAZOP

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENG CHK	APPRV
1B	2/11/20	ISSUED FOR HAZOP (20617)	GPA	SJH	PJB	NKH
1A	09/09/20	ISSUED FOR REVIEW (20617)	GPA		SLH	
1	05/03/03	AS BUILT	JS			
0	27/08/02	ISSUED FOR CONSTRUCTION	ML	DJ	PB	DLM

ASSET MANAGER

Jemena

Produced by
Jemena Asset Management (6) Pty Ltd
ABN 52 104 352 650

ASSET OWNER

Jemena

Jemena EGP(1) P/L
ABN 15 068 570 847
Jemena EGP(2) P/L
ABN 77 006 919 115

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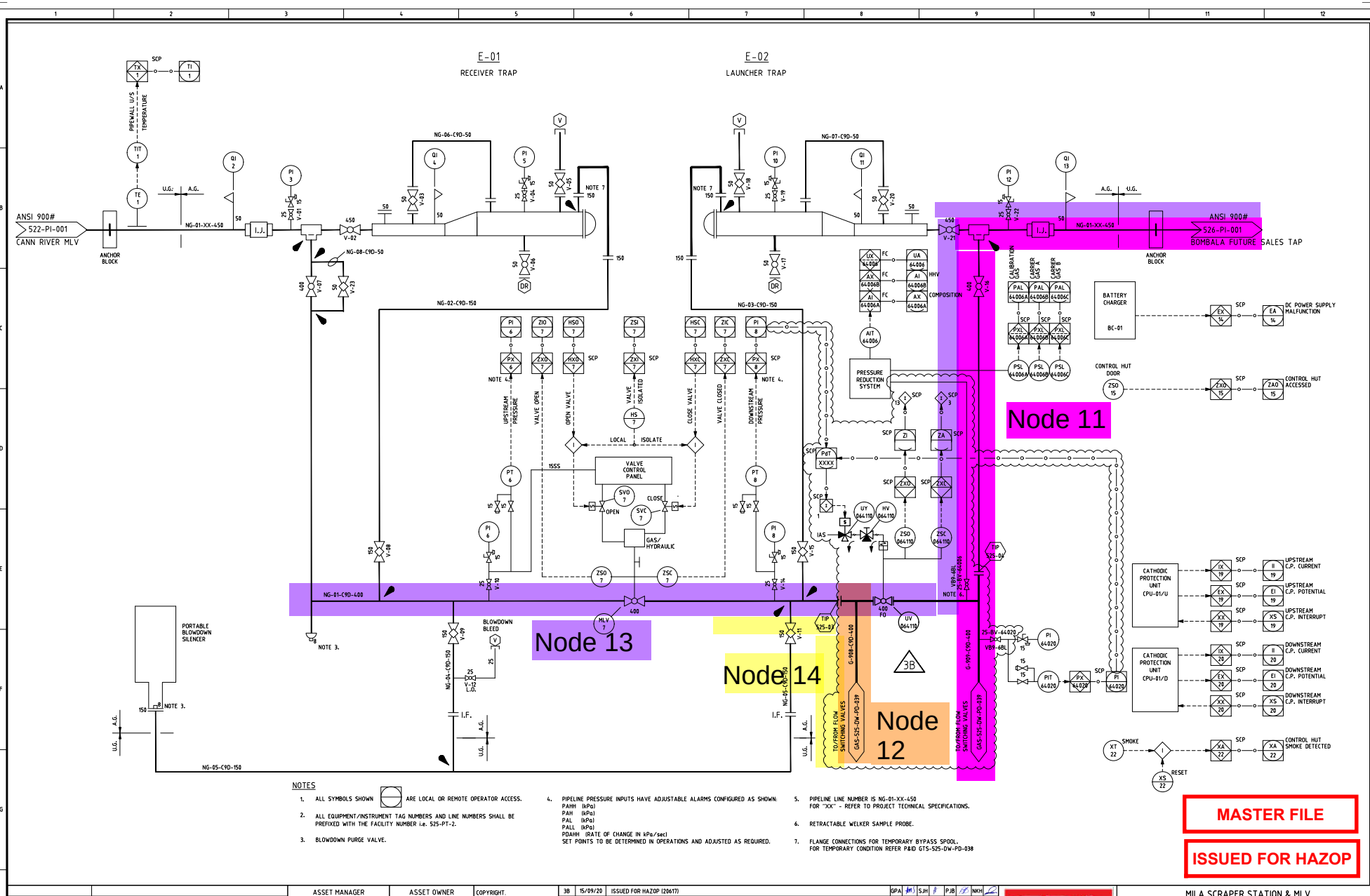
LONGFORD COMPRESSOR STATION
VIC HUB - BI-DIRECTIONAL PIPELINE
PIPING & INSTRUMENTATION DIAGRAM

DRAWN	ML	FACILITY	SUBJECT
DESIGN	P.BANNISTER	SCALE	N.T.S.
CHECKED	D.JENKIN	SUPERSEDES	A1
APPROVED	D.MITVALSKY	DRAWING NUMBER	REV 1B
DATE	27/02/02	PO-511-DW-PD-001	

PO-510-DW-PD-003	CONNECTION TO BI-DIRECTIONAL PIPELINE & FILTER/SEPARATOR
DRAWING No.	REFERENCE DRAWINGS



REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENG CHK	APPRV
3B	15/09/20	ISSUED FOR HAZOP (20617)	GPA	SJH	PJB	NKH
3A	15/09/20	ISSUED FOR REVIEW (20617)	GPA		SLH	
3	30/06/08	AS BUILT				
2	07/03/08	RE-ISSUED FOR CONSTRUCTION	SMR		CJS	DSY
1	07/02/08	RE-ISSUED FOR CONSTRUCTION	SMR		JM	DSY
0	20/12/07	ISSUED FOR CONSTRUCTION	SMR		PWF	DSY
F	27/08/07	ISSUED FOR DESIGN	JHA		JMU	DSY
E	27/08/07	ISSUED FOR HAZOP	JHA		PWF	DSY
D	16/08/07	ISSUED FOR REVIEW	JHA		PWF	DSY

DRAWING No. | REFERENCE DRAWINGS

ASSET MANAGER
Jemena
Produced by
Jemena Asset Management (6) Pty Ltd
ABN 52 104 352 650

ASSET OWNER
Jemena
Jemena EGP(1) P/L
ABN 15 068 570 847
Jemena EGP(2) P/L
ABN 77 006 919 115

GPA ENGINEERING
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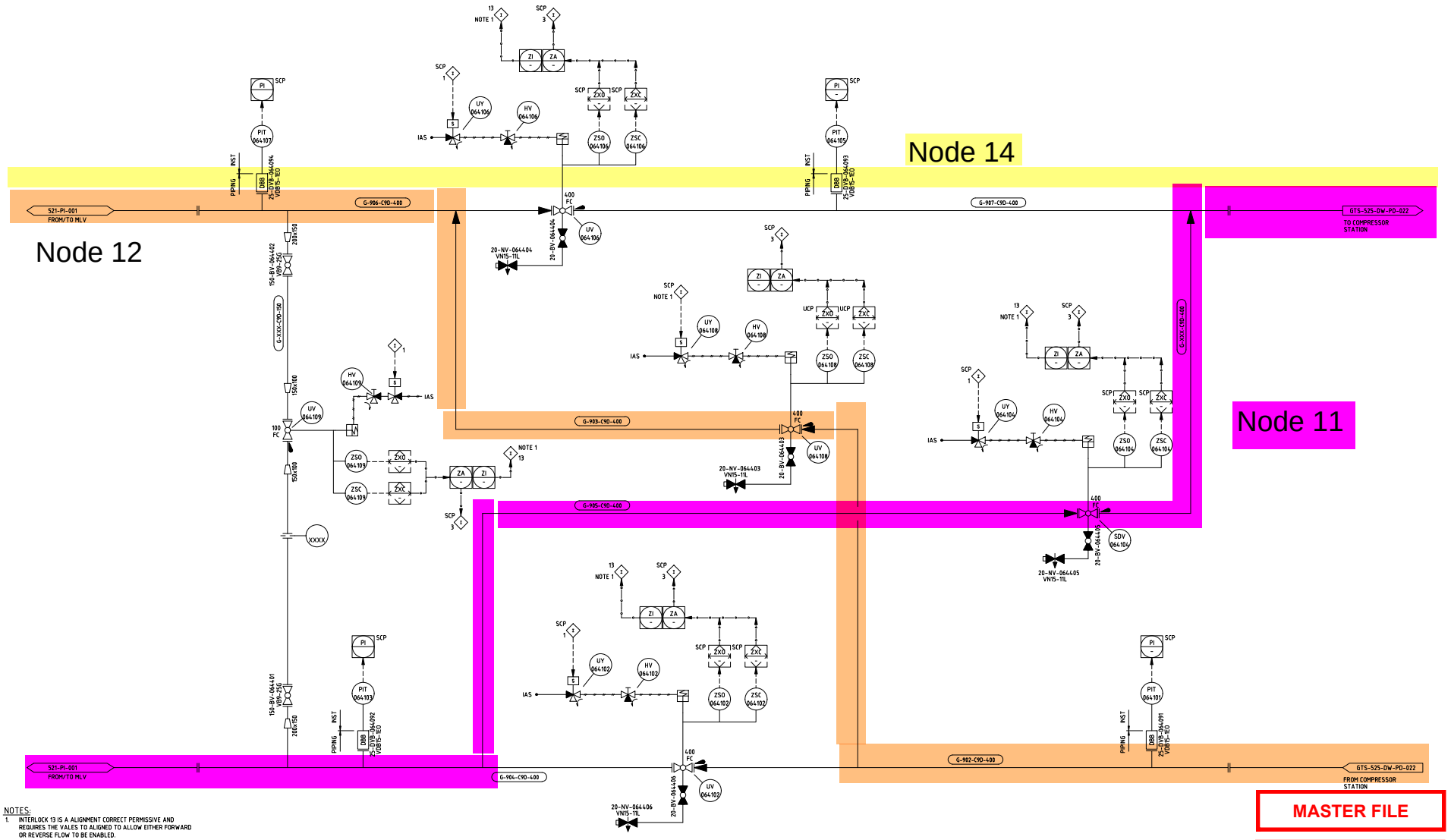
MILA SCRAPER STATION & MLV
INTERMEDIATE SCRAPER STATION
PIPING AND INSTRUMENT DIAGRAM

DRAWN	J.SHAFIQ	FACILITY	SUBJECT
DESIGN	C.SMITH	SCALE	NTS
CHECKED	D.YOUNG	SUPERSEDES	A1
APPROVED	P.FARRER	DRAWING NUMBER	REV 3A
DATE	20/12/07	525-PI-001	



NOTES:
1. INTERLOCK 13 IS A ALIGNMENT CORRECT PERMISSIVE AND REQUIRES THE VALES TO ALIGNED TO ALLOW EITHER FORWARD OR REVERSE FLOW TO BE ENABLED.

MASTER FILE

ISSUED FOR HAZOP

REF. DRG. No	REF. DESCRIPTION
DRAWING No.	REFERENCE DRAWINGS

ASSET MANAGER

Jemena

Produced by
Jemena Asset Management (6) Pty Ltd
ABN 52 104 352 650

ASSET OWNER

Jemena

Jemena EGP(1) P/L
ABN 15 068 570 847
Jemena EGP(2) P/L
ABN 77 006 919 115

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENG CHK	APPRV
B	27.10.20	ISSUED FOR HAZOP (20617)	GPA	SJH	PJB	NKH
A	16.09.20	ISSUED FOR REVIEW (20617)	GPA	PJB		

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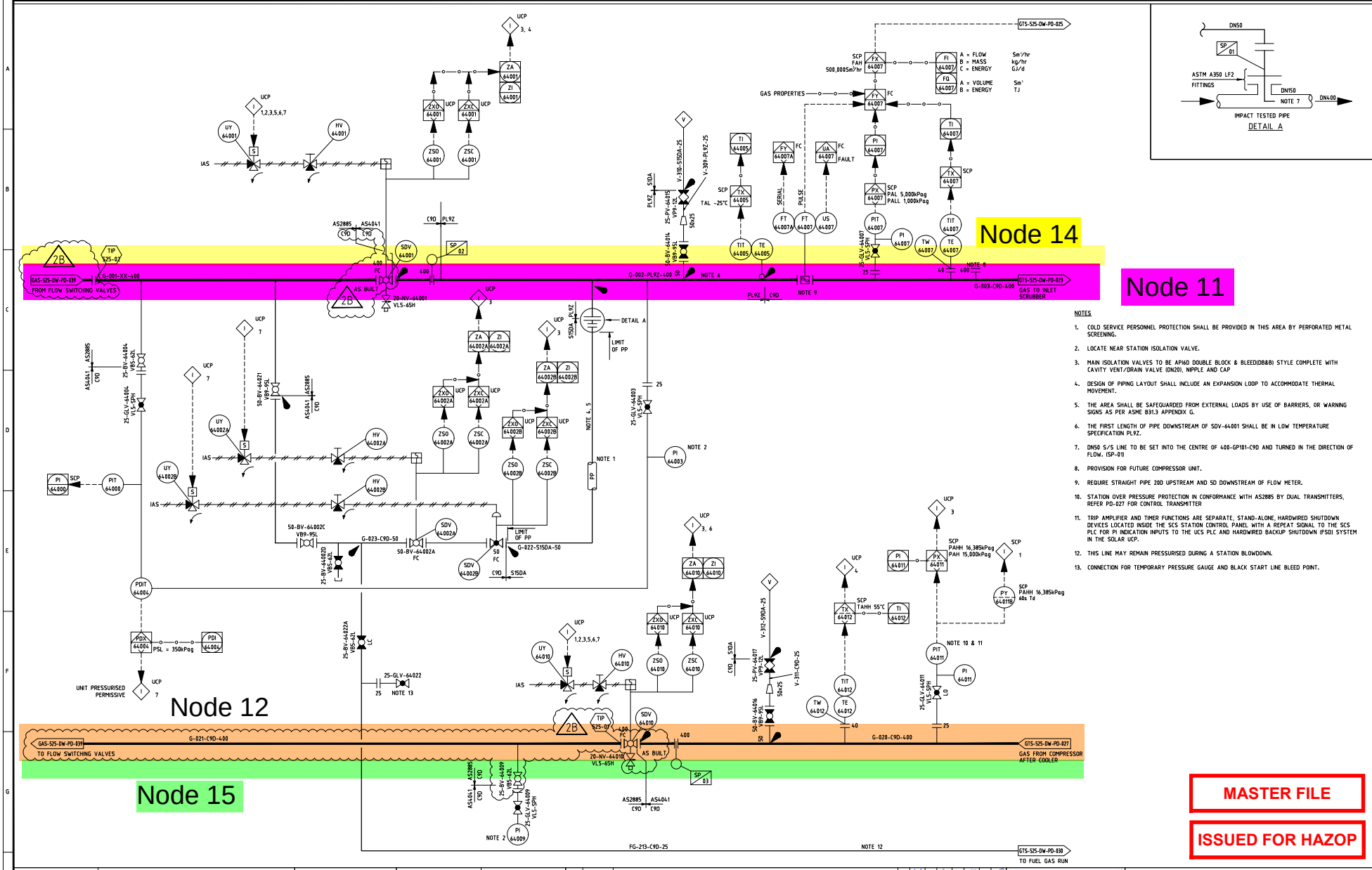
MILA COMPRESSOR STATION
FLOW SWITCHING VALVES
PIPING AND INSTRUMENTATION DIAGRAM

DRAWN	GPA	FACILTY	-
DESIGN	PJB	SCALE	-
CHECKED	SJH	SUPERSEDES	-
APPROVED	NKH	DRAWING NUMBER	GAS-525-DW-PD-039
DATE	27.10.20		REV B

A1



MASTER FILE

ISSUED FOR HAZOP

REF. DRG. No	REF. DESCRIPTION
DRAWING No.	REFERENCE DRAWINGS

ASSET MANAGER
Jemena
Produced by
Jemena Asset Management (6) Pty Ltd
ABN 52 104 352 650

ASSET OWNER
Jemena
Jemena EGP(1) P/L
ABN 15 068 570 847
Jemena EGP(2) P/L
ABN 77 006 919 115

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENG CHK	APPRV
2B	29/10/20	ISSUED FOR HAZOP (20617)	GPA	SJH	PJB	NKH
2A	15/09/20	ISSUED FOR REVIEW (20617)	GPA		PJB	
2	30/06/08	AS BUILT				
1	07/02/08	RE-ISSUED FOR CONSTRUCTION	SMR		PWF	DSY
0	20/12/07	ISSUED FOR CONSTRUCTION	SMR		PWF	DSY
D	30/11/07	ISSUED FOR FUEL GAS DESIGN REVIEW	PKA		PWF	DSY
C	09/10/07	ISSUED FOR DESIGN	JHA		JMJ	DSY
B	28/08/07	ISSUED FOR HAZOP	JHA		DSY	PWF
A	16/08/07	ISSUED FOR REVIEW	JHA		DSY	PWF

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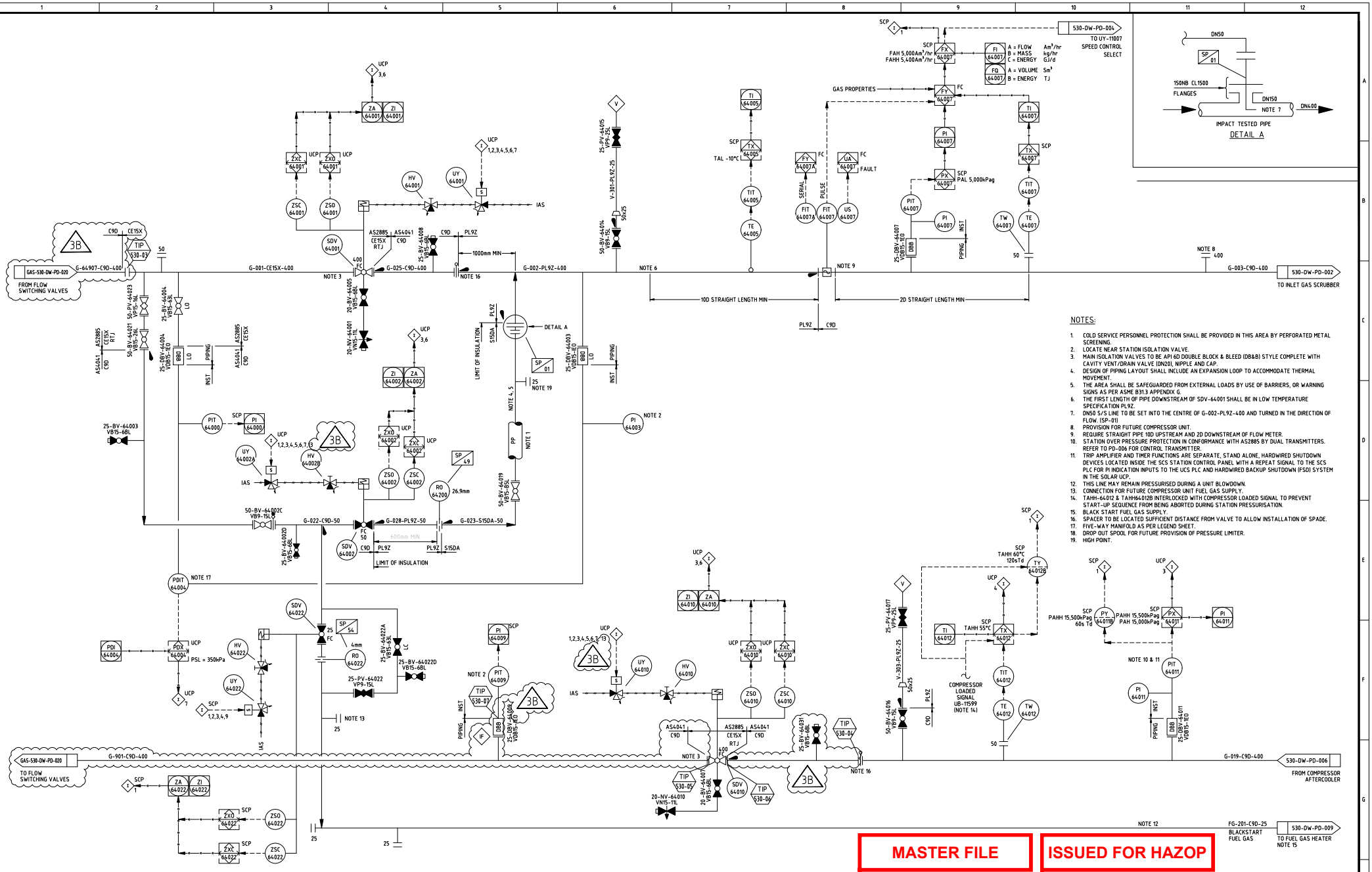
MILA COMPRESSOR STATION
STATION ISOLATION VALVES
PIPING AND INSTRUMENT DIAGRAM

DRAWN	J. SHAFIQ	FACILITY	SUBJECT
DESIGN	C. SMITH	SCALE	NTS
CHECKED	D. YOUNG	SUPERSEDES	A1
APPROVED	P. FARRER	DRAWING NUMBER	GTS-525-DW-PD-022
DATE	07/02/08	REV	2B



NOTES:

1. COLD SERVICE PERSONNEL PROTECTION SHALL BE PROVIDED IN THIS AREA BY PERFORATED METAL SCREENING.
2. LOCATE NEAR STATION ISOLATION VALVE.
3. MAIN ISOLATION VALVES TO BE API 6D DOUBLE BLOCK & BLEED (DB&B) STYLE COMPLETE WITH CAVITY VENT/DRAIN VALVE (DN20), NIPPLE AND CAP.
4. DESIGN OF PIPING LAYOUT SHALL INCLUDE AN EXPANSION LOOP TO ACCOMMODATE THERMAL MOVEMENT.
5. THE AREA SHALL BE SAFEGUARDED FROM EXTERNAL LOADS BY USE OF BARRIERS, OR WARNING SIGNS AS PER ASME B31.3 APPENDIX G.
6. THE FIRST LENGTH OF PIPE DOWNSTREAM OF SDV-64001 SHALL BE IN LOW TEMPERATURE SPECIFICATION PL9Z.
7. DN50 S/S LINE TO BE SET INTO THE CENTRE OF G-002-PL9Z-400 AND TURNED IN THE DIRECTION OF FLOW. (SP-01)
8. PROVISION FOR FUTURE COMPRESSOR UNIT.
9. REQUIRE STRAIGHT PIPE 10D UPSTREAM AND 2D DOWNSTREAM OF FLOW METER.
10. STATION OVER PRESSURE PROTECTION IN CONFORMANCE WITH AS2885 BY DUAL TRANSMITTERS. REFER TO PD-006 FOR CONTROL TRANSMITTER.
11. TRIP AMPLIFIER AND TIMER FUNCTIONS ARE SEPARATE, STAND ALONE, HARDWIRED SHUTDOWN DEVICES LOCATED INSIDE THE SCS STATION CONTROL PANEL WITH A REPEAT SIGNAL TO THE SCS PLC FOR PI INDICATION INPUTS TO THE UCS PLC AND HARDWIRED BACKUP SHUTDOWN (FSD) SYSTEM IN THE SOLAR UCP.
12. THIS LINE MAY REMAIN PRESSURISED DURING A UNIT BLOWDOWN.
13. CONNECTION FOR FUTURE COMPRESSOR UNIT FUEL GAS SUPPLY.
14. TAHH-64012 & TAHH64012B INTERLOCKED WITH COMPRESSOR LOADED SIGNAL TO PREVENT START-UP SEQUENCE FROM BEING ABORTED DURING STATION PRESSURISATION.
15. BLACK START FUEL GAS SUPPLY.
16. SPACER TO BE LOCATED SUFFICIENT DISTANCE FROM VALVE TO ALLOW INSTALLATION OF SPADE.
17. FIVE-WAY MANIFOLD AS PER LEGEND SHEET.
18. DROP OUT SPOOL FOR FUTURE PROVISION OF PRESSURE LIMITER.
19. HIGH POINT.

REF. DRG. No	REF. DESCRIPTION
DRAWING No.	REFERENCE DRAWINGS

ASSET MANAGER: Jemena — Produced by Jemena Asset Management (6) Pty Ltd, ABN 52 104 352 650

ASSET OWNER: Jemena — Jemena EGP(1) P/L, ABN 15 068 570 847; Jemena EGP(2) P/L, ABN 77 006 919 115

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENG CHK	APPRV
3B	30.10.20	ISSUED FOR HAZOP (20617)	GPA	SJH	PJB	NKH
3A	09.09.20	ISSUED FOR REVIEW (20617)	GPA	SLH		
3	19.01.16	AS BUILT	MRM	JW		
2	10.06.16	RE-ISSUED FOR CONSTRUCTION	HWI	JW		
1	18.12.14	ISSUED FOR CONSTRUCTION	SLA	NH		
0	25.07.14	ISSUED FOR DESIGN	SLA	NH		
C	25.06.14	REISSUED FOR HAZOP	SLA	NH		
B	19.05.14	ISSUED FOR HAZOP	SLA	WHJW		
A	18.04.08	ISSUED FOR CLIENT REVIEW	SGP	CS		KM

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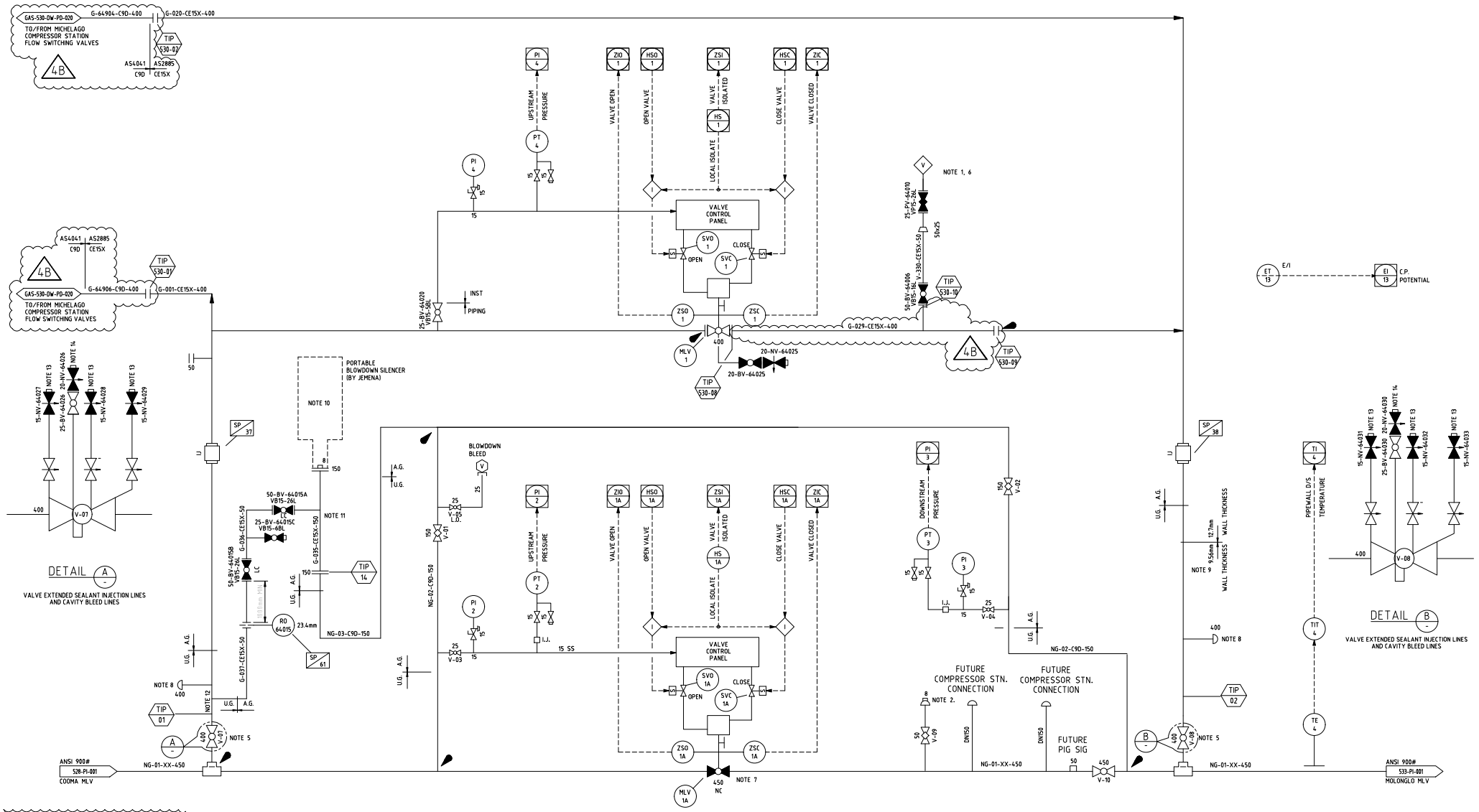
MICHELAGO COMPRESSOR STATION
STATION ISOLATION VALVES
PIPING AND INSTRUMENTATION DIAGRAM

DRAWN	SGP	FACILITY	SUBJECT
DESIGN		SCALE	NTS
CHECKED	CS	SUPERSEDES	A1
APPROVED	KM	DRAWING NUMBER	530-DW-PD-001
DATE	18.04.08	REV	3B



NOTES:

1.
2.
3.
4.
5.

HOLD - NOTES MISSING ON PREVIOUS DRAWING REVISION.

MASTER FILE

ISSUED FOR HAZOP

REF. DRG. No	REF. DESCRIPTION
DRAWING No.	REFERENCE DRAWINGS

ASSET MANAGER

Jemena

Produced by
Jemena Asset Management (6) Pty Ltd
ABN 52 104 352 650

ASSET OWNER

Jemena

Jemena EGP(1) P/L
ABN 15 068 570 847
Jemena EGP(2) P/L
ABN 77 006 919 115

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENG CHK	APPRV
4A	15.09.20	ISSUED FOR REVIEW (20617)	GPA	PJB		
4	19.01.16	AS BUILT	MRM	JW		
3	10.06.15	RE-ISSUED FOR CONSTRUCTION	HWJ	JW		
2	13.03.15	RE-ISSUED FOR CONSTRUCTION	SLA	NH		
1	18.12.14	ISSUED FOR CONSTRUCTION	SLA	NH		
0	25.07.14	ISSUED FOR DESIGN	SLA	NH		
C	25.06.14	REISSUED FOR HAZOP	SLA	NH		
B	14.05.14	ISSUED FOR HAZOP	SLA	HH/JW		
4B	23.10.20	ISSUED FOR HAZOP (20617)	GPA	PJB	SJH	NKH

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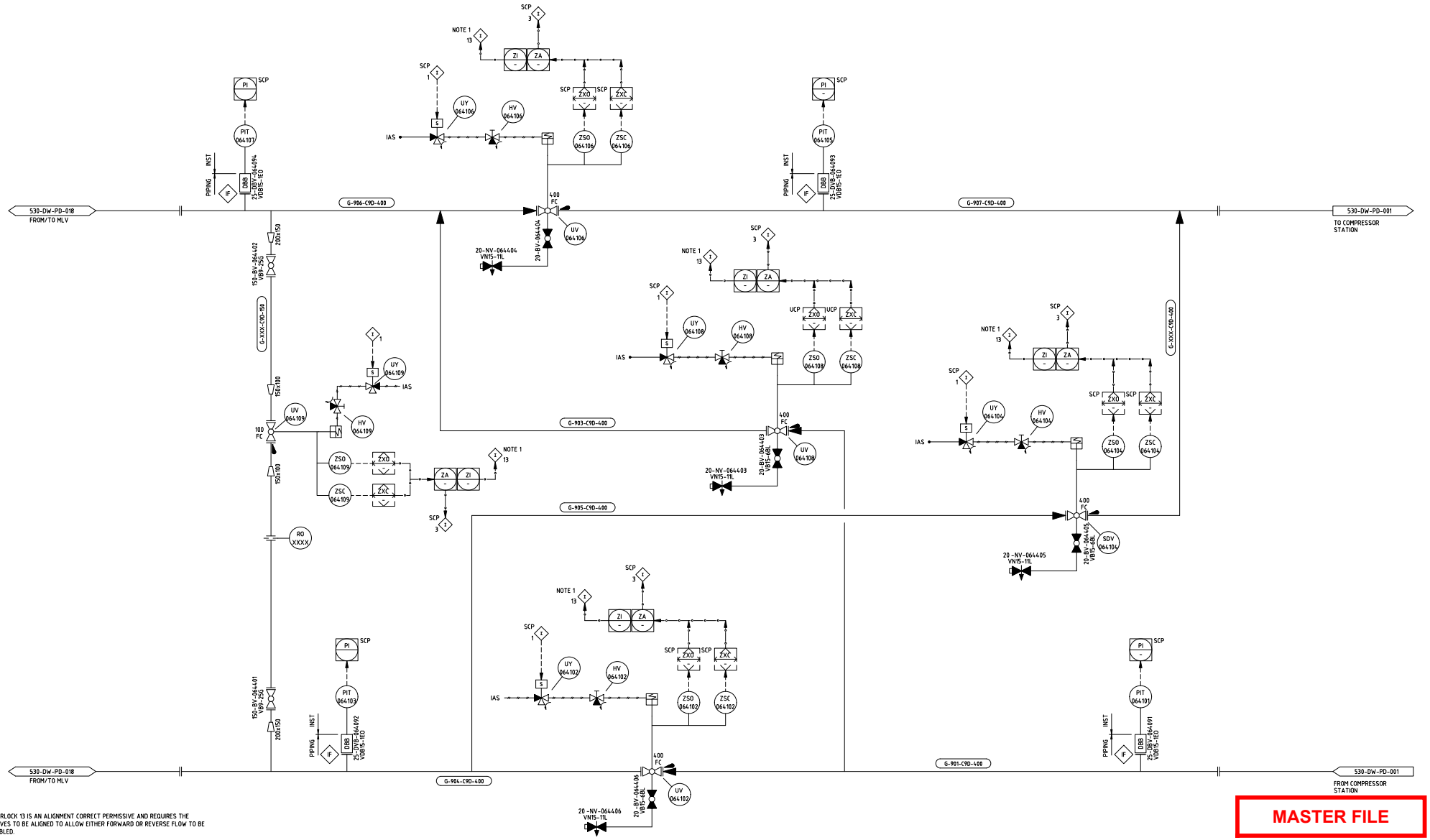
MICHELAGO COMPRESSOR STATION MAINLINE VALVE PIPING AND INSTRUMENTATION DIAGRAM

DRAWN	SGP	FACILITY	SUBJECT
DESIGN		SCALE	Scale
CHECKED	CS	SUPERSEDES	A1
APPROVED	KM	DRAWING NUMBER	
DATE	18.04.20	530-DW-PD-018	REV 4B



NOTES:

1. INTERLOCK 13 IS AN ALIGNMENT CORRECT PERMISSIVE AND REQUIRES THE VALVES TO BE ALIGNED TO ALLOW EITHER FORWARD OR REVERSE FLOW TO BE ENABLED.

MASTER FILE

ISSUED FOR HAZOP

B	22.10.20	ISSUED FOR HAZOP (20617)	GPA	AMS	SJH	PJB	NKH						
A	16.09.20	ISSUED FOR REVIEW (20617)	GPA		PJB								
REV	DATE	DESCRIPTION	DRAWN		CHECKED		ENG CHK		APPRV				

DRAWING No. | REFERENCE DRAWINGS

ASSET MANAGER

Jemena

Produced by
Jemena Asset Management (6) Pty Ltd
ABN 52 104 352 650

ASSET OWNER

Jemena

Jemena EGP(1) P/L
ABN 15 068 570 847
Jemena EGP(2) P/L
ABN 77 006 919 115

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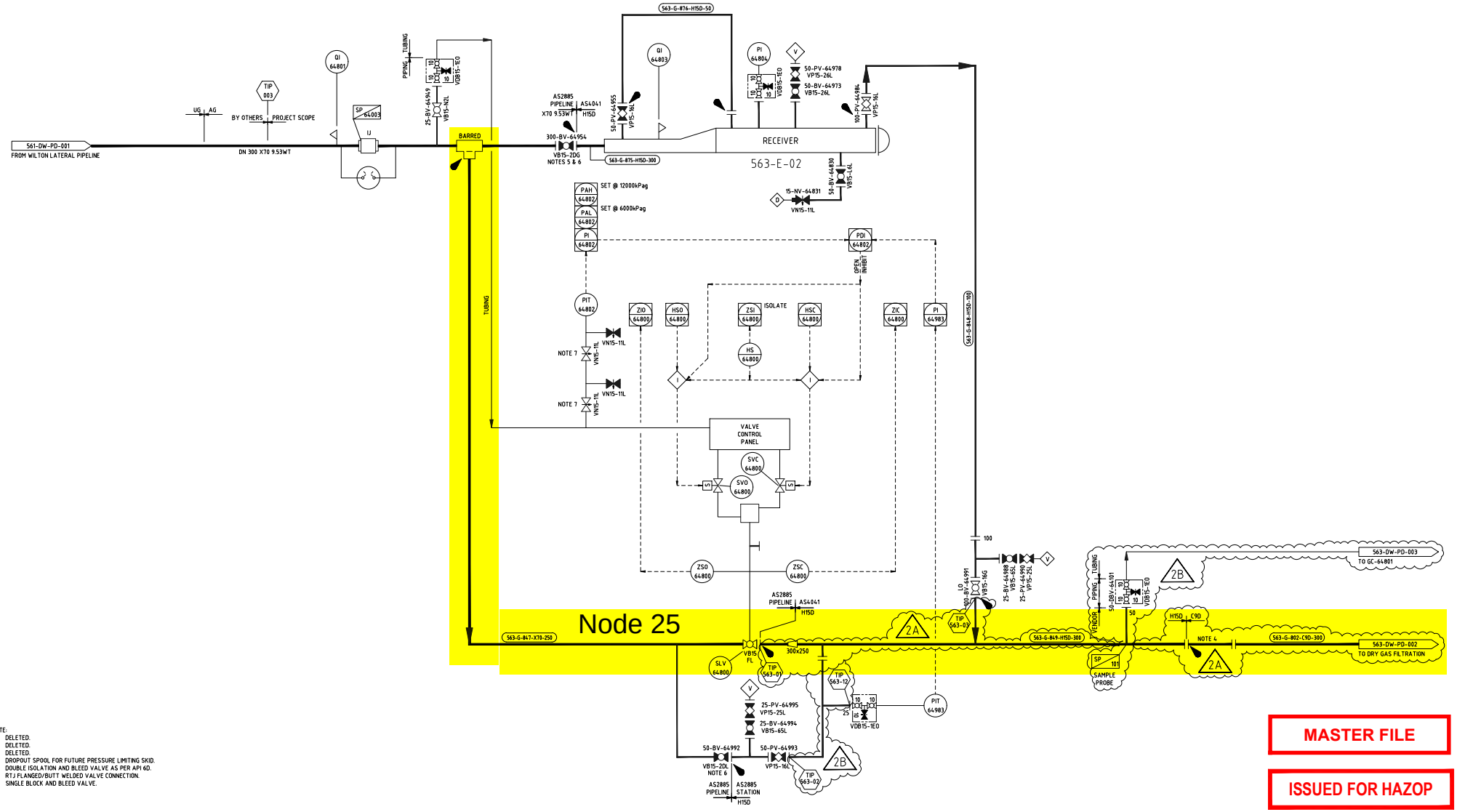
MICHELAGO COMPRESSOR STATION
FLOW SWITCHING VALVES
PIPING AND INSTRUMENTATION DIAGRAM
-

DRAWN	GPA		
DESIGN	-	SCALE	N/A
CHECKED	-	SUPERSEDES	-
APPROVED	-	DRAWING NUMBER	GAS-530-DW-PD-020
DATE	16.09.20	REV	B

A1

563-E-02
RECEIVER TRAP
DESIGN PRESSURE: 16550kPag
DESIGN TEMPERATURE: -6 TO 65°



NOTE:
1. DELETED.
2. DELETED.
3. DELETED.
4. DROPOUT SPOOL FOR FUTURE PRESSURE LIMITING SKID.
5. DOUBLE ISOLATION AND BLEED VALVE AS PER API 60.
6. RTJ FLANGED/BUTT WELDED VALVE CONNECTION.
7. SINGLE BLOCK AND BLEED VALVE.

MASTER FILE

ISSUED FOR HAZOP

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENG CHK	APPRV
2B	04/11/20	ISSUED FOR HAZOP (20617)	GPA	SJH	PJB	NKH
2A	16/09/20	ISSUED FOR REVIEW (20617)	GPA			
2	18/01/16	AS BUILT TO CLIENT MARKUPS	JB	NB		
1	13/02/15	REISSUED FOR CONSTRUCTION	JB	NB	WW	AH
0	12/12/14	ISSUED FOR CONSTRUCTION	JB	NB	WW	AH

DRAWING No. | REFERENCE DRAWINGS

ASSET MANAGER
Jemena
Produced by
Jemena Asset Management (6) Pty Ltd
ABN 52 104 352 650

ASSET OWNER
Jemena
Jemena EGP(1) P/L
ABN 15 068 570 847
Jemena EGP(2) P/L
ABN 77 006 919 115

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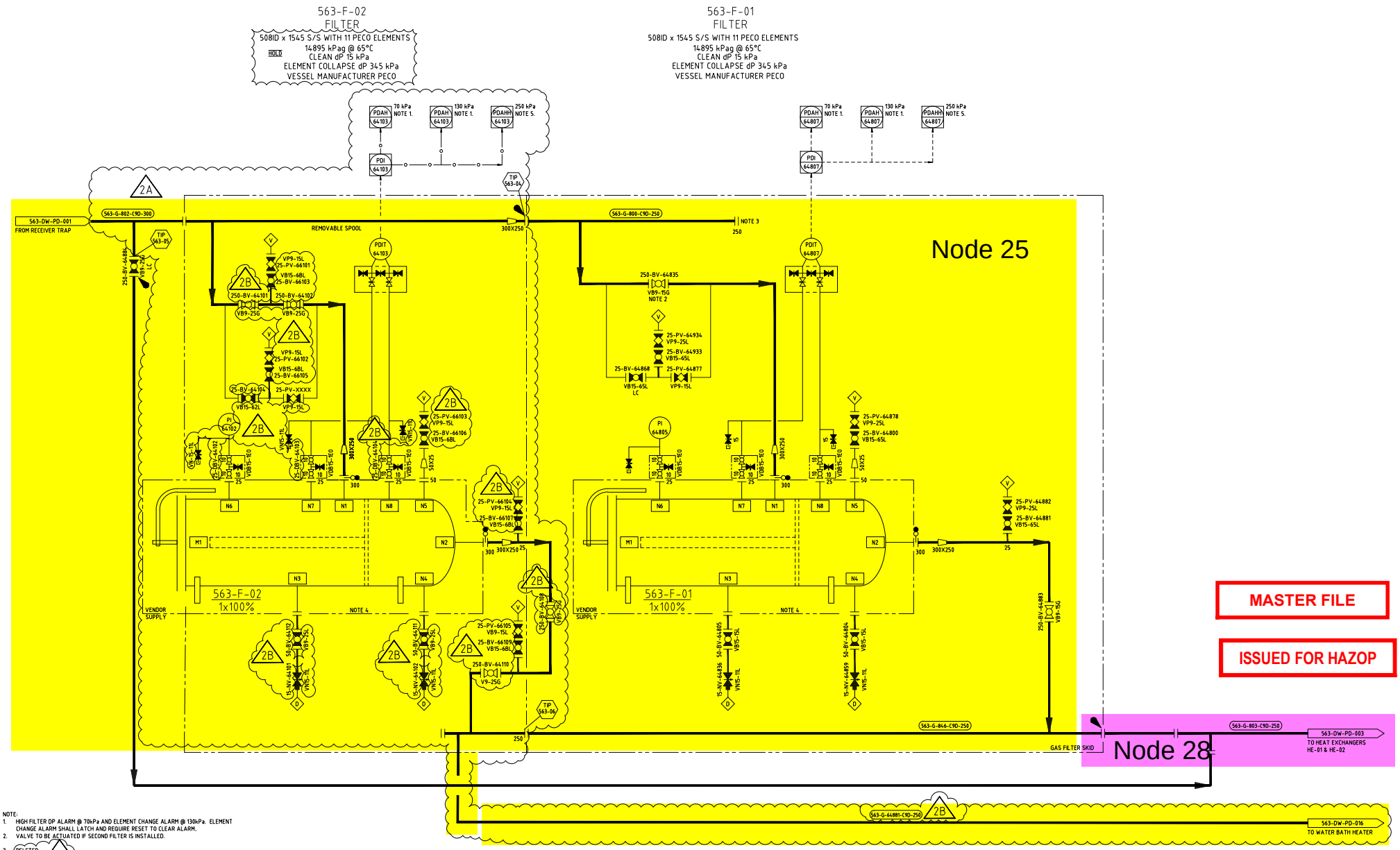
WILTON METER STATION
RECEIVER STATION
PIPING & INSTRUMENTATION DIAGRAM

DRAWN	FACILTY	SUBJECT	
DESIGN	SCALE N.T.S.		
CHECKED	SUPERSEDES		A1
APPROVED	DRAWING NUMBER		REV 2B
DATE	563-DW-PD-001		



NOTE:
1. HIGH FILTER DP ALARM @ 70kPa AND ELEMENT CHANGE ALARM @ 130kPa. ELEMENT CHANGE ALARM SHALL LATCH AND REQUIRE RESET TO CLEAR ALARM.
2. VALVE TO BE ACTUATED IF SECOND FILTER IS INSTALLED.
3. DELETED. 2A
4. HIGH-HIGH DP WILL TRIP INLET SLV-64800 AFTER 30 CONTINUOUS SECONDS.

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENG CHK	APPRV
2B	04/11/20	ISSUED FOR HAZOP (20617)	GPA	SJH	PJB	NKH
2A	16/09/20	ISSUED FOR REVIEW (20617)	GPA			
2	18/01/16	AS BUILT TO CLIENT MARKUPS	JB	NB		
1	13/02/15	REISSUED FOR CONSTRUCTION	JB	NB	WW	AH
0	12/12/14	ISSUED FOR CONSTRUCTION	JB	NB	WW	AH

DRAWING No. | REFERENCE DRAWINGS

ASSET MANAGER
Jemena
Produced by
Jemena Asset Management (6) Pty Ltd
ABN 52 104 352 650

ASSET OWNER
Jemena
Jemena EGP(1) P/L
ABN 15 068 570 847
Jemena EGP(2) P/L
ABN 77 006 919 115

GPA ENGINEERING
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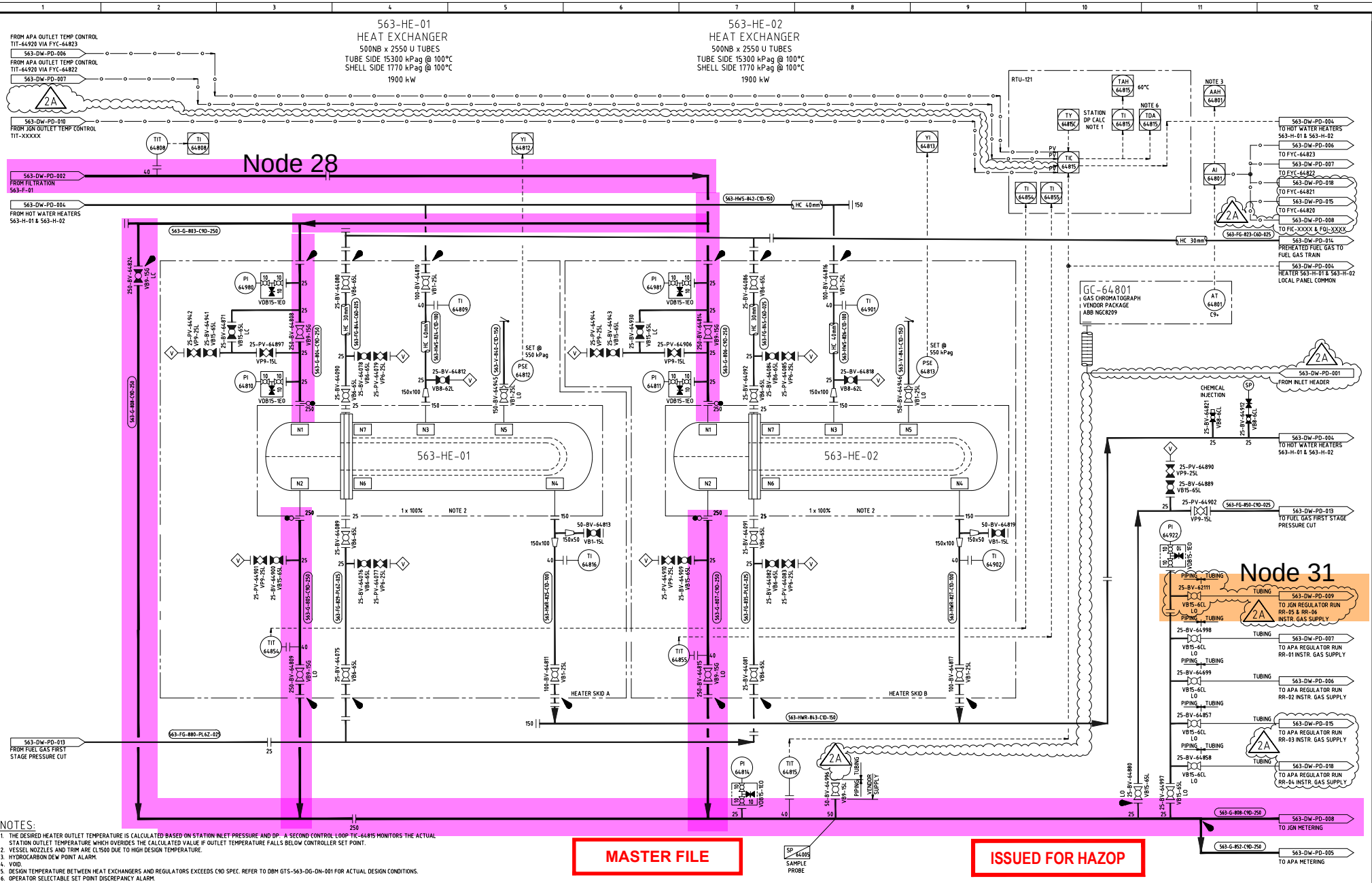
WILTON METER STATION
DRY GAS FILTERS
PIPING & INSTRUMENTATION DIAGRAM

DRAWN	FACILITY	SUBJECT	
DESIGN	SCALE N.T.S.		
CHECKED	SUPERSEDES		A1
APPROVED	DRAWING NUMBER		REV 2B
DATE	563-DW-PD-002		



NOTES:

1. THE DESIRED HEATER OUTLET TEMPERATURE IS CALCULATED BASED ON STATION INLET PRESSURE AND DP. A SECOND CONTROL LOOP TIC-64815 MONITORS THE ACTUAL STATION OUTLET TEMPERATURE WHICH OVERIDES THE CALCULATED VALUE IF OUTLET TEMPERATURE FALLS BELOW CONTROLLER SET POINT.
2. VESSEL NOZZLES AND TRIM ARE CL1500 DUE TO HIGH DESIGN TEMPERATURE.
3. HYDROCARBON DEW POINT ALARM.
4. VOID.
5. DESIGN TEMPERATURE BETWEEN HEAT EXCHANGERS AND REGULATORS EXCEEDS C9D SPEC. REFER TO DBM GTS-563-DG-DN-001 FOR ACTUAL DESIGN CONDITIONS.
6. OPERATOR SELECTABLE SET POINT DISCREPANCY ALARM.

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENG CHK	APPRV
2A	04/11/20	ISSUED FOR HAZOP (20617)	GPA	SJH	PJB	NKH
2	18/01/16	AS BUILT TO CLIENT MARKUPS	JB	NB		
1	13/02/15	REISSUED FOR CONSTRUCTION	JB	NB	WW	AH
0	12/12/14	ISSUED FOR CONSTRUCTION	JB	NB	WW	AH

DRAWING No. | REFERENCE DRAWINGS

ASSET MANAGER
Jemena
Produced by
Jemena Asset Management (6) Pty Ltd
ABN 52 104 352 650

ASSET OWNER
Jemena
Jemena EGP(1) P/L
ABN 15 068 570 847
Jemena EGP(2) P/L
ABN 77 006 919 115

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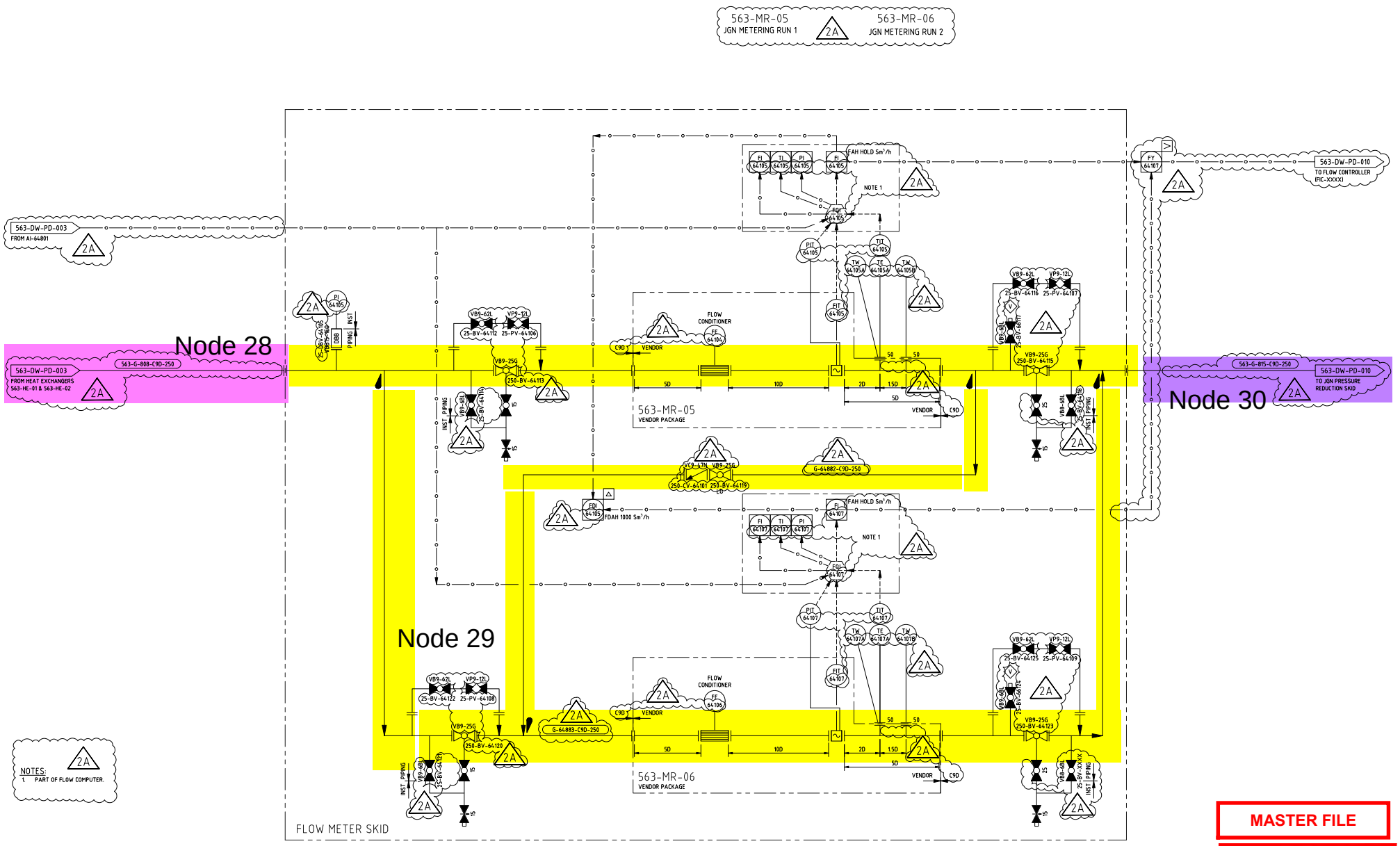
WILTON METER STATION
HEAT EXCHANGERS
PIPING & INSTRUMENTATION DIAGRAM

DRAWN	FACILTY	SUBJECT
DESIGN	SCALE N.T.S.	
CHECKED	SUPERSEDES	A1
APPROVED	DRAWING NUMBER	REV 2A
DATE	563-DW-PD-003	



MASTER FILE

ISSUED FOR HAZOP

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENG CHK	APPRV
2B	04/11/20	ISSUED FOR HAZOP (20617)	GPA	SJH	PJB	NKH
2	18/01/16	AS BUILT TO CLIENT MARKUPS	JB	NB		
1	13/02/15	REISSUED FOR CONSTRUCTION	JB	NB	WW	AH
0	12/12/14	ISSUED FOR CONSTRUCTION	JB	NB	WW	AH

ASSET MANAGER
Jemena
Produced by
Jemena Asset Management (6) Pty Ltd
ABN 52 104 352 650

ASSET OWNER
Jemena
Jemena EGP(1) P/L
ABN 15 068 570 847
Jemena EGP(2) P/L
ABN 77 006 919 115

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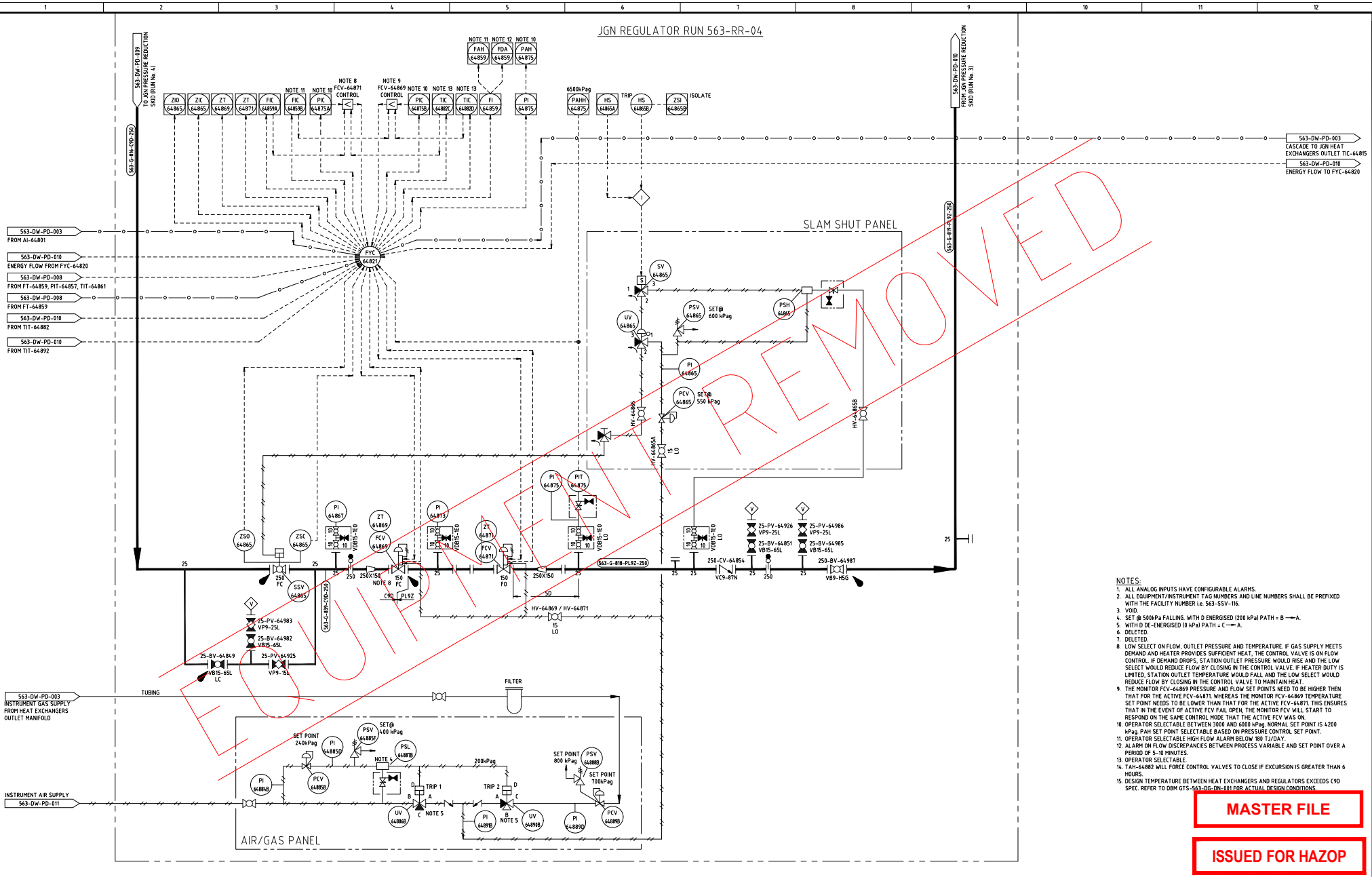
WILTON METER STATION
JGN FLOW METERING
PIPING & INSTRUMENTATION DIAGRAM

DRAWN	FACILTY	SUBJECT	
DESIGN	SCALE N.T.S.		
CHECKED	SUPERSEDES		A1
APPROVED	DRAWING NUMBER		REV 2A
DATE	563-DW-PD-008		

DRAWING No. | REFERENCE DRAWINGS



MASTER FILE

ISSUED FOR HAZOP

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENG CHK	APPRV
3A	04/11/20	ISSUED FOR HAZOP (20617)	GPA	SJH	PJB	NKH
3	10/02/16	AS BUILT TO CLIENT MARKUPS	LC	JB		
2	18/01/16	AS BUILT TO CLIENT MARKUPS	JB	NB		
1	13/02/15	REISSUED FOR CONSTRUCTION	JB	NB	WW	AH
0	12/12/14	ISSUED FOR CONSTRUCTION	JB	NB	WW	AH

ASSET MANAGER

Jemena

Produced by
Jemena Asset Management (6) Pty Ltd
ABN 52 104 352 650

ASSET OWNER

Jemena

Jemena EGP(1) P/L
ABN 15 068 570 847
Jemena EGP(2) P/L
ABN 77 006 919 115

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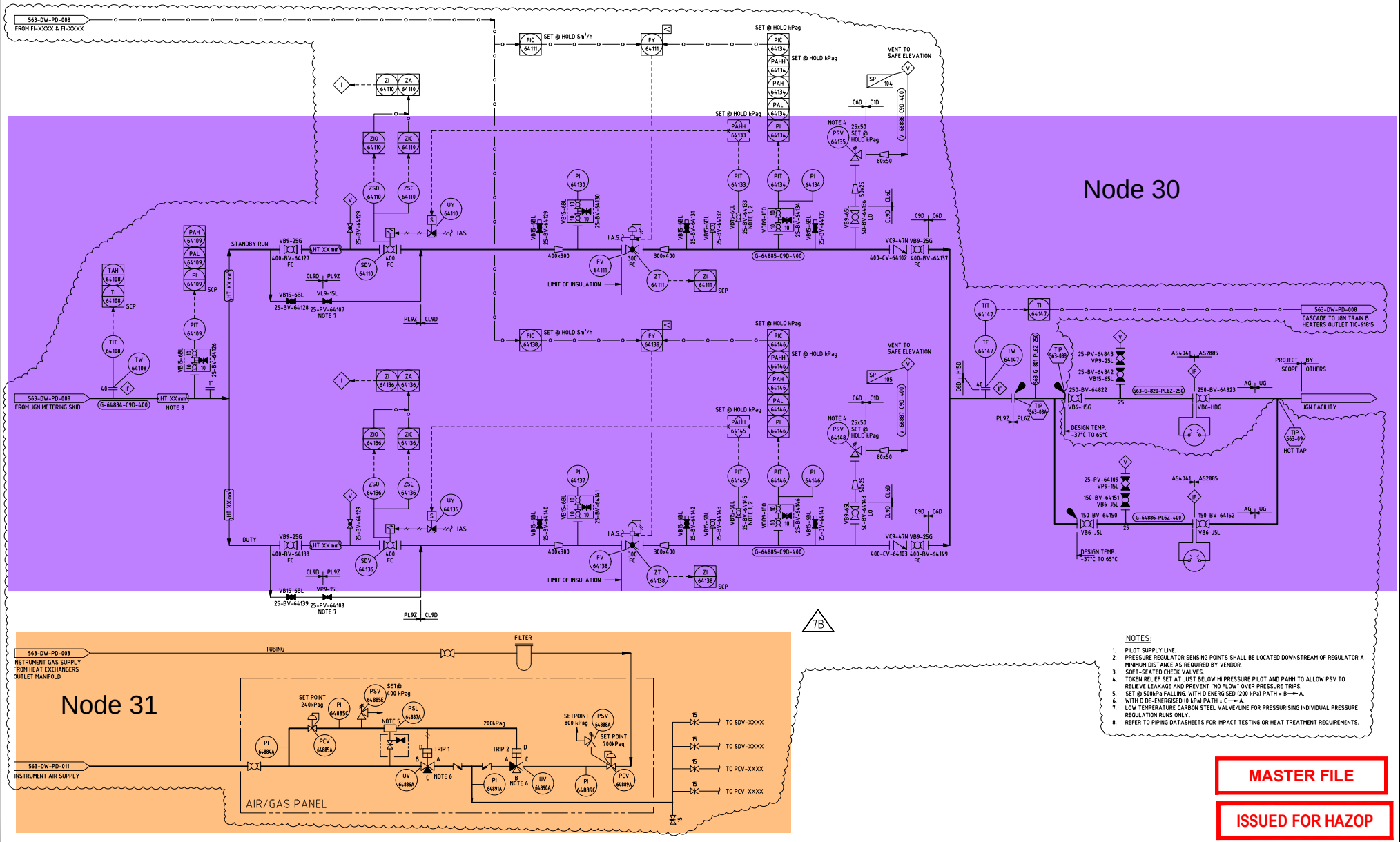
WILTON METER STATION
JGN PRESSURE REDUCTION SKID (RUN No. 4)
PIPING & INSTRUMENTATION DIAGRAM

DRAWN	FACILTY	SUBJECT	
DESIGN	SCALE N.T.S.		
CHECKED	SUPERSEDES		A1
APPROVED	DRAWING NUMBER		REV 3A
DATE	563-DW-PD-009		

DRAWING No.	REFERENCE DRAWINGS
PO-510-DW-PD-003	CONNECTION TO BI-DIRECTIONAL PIPELINE & FILTER/SEPARATOR

JGN REGULATOR RUN 563-RR-06



NOTES:

1. PILOT SUPPLY LINE.
2. PRESSURE REGULATOR SENSING POINTS SHALL BE LOCATED DOWNSTREAM OF REGULATOR A MINIMUM DISTANCE AS REQUIRED BY VENDOR.
3. SOFT-SEATED CHECK VALVES.
4. TOKEN RELIEF SET AT JUST BELOW Hi PRESSURE PILOT AND PAHH TO ALLOW PSV TO RELIEVE LEAKAGE AND PREVENT "NO FLOW" OVER PRESSURE TRIPS.
5. SET @ 500kPa FALLING. WITH D ENERGISED (200 kPa) PATH = B—A.
6. WITH D DE-ENERGISED (0 kPa) PATH = C—A.
7. LOW TEMPERATURE CARBON STEEL VALVE/LINE FOR PRESSURISING INDIVIDUAL PRESSURE REGULATION RUNS ONLY.
8. REFER TO PIPING DATASHEETS FOR IMPACT TESTING OR HEAT TREATMENT REQUIREMENTS.

MASTER FILE

ISSUED FOR HAZOP

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENG CHK	APPRV
7A	17/09/20	ISSUED FOR REVIEW (20617)	GPA			
7	10/02/16	AS BUILT TO CLIENT MARKUPS	LC	JB		
6	18/01/16	AS BUILT TO CLIENT MARKUPS	JS	NB		
5	01/09/15	REISSUED FOR CONSTRUCTION	JB	GH	WW	AH
4	18/08/15	REISSUED FOR CONSTRUCTION	JB	NB	WW	AH
3	21/07/15	REISSUED FOR CONSTRUCTION	JB	NB	WW	AH
2	27/03/15	REISSUED FOR CONSTRUCTION	JB	NB	WW	AH
7B	04/11/20	ISSUED FOR HAZOP (20617)	GPA	SJH	PJB	NKH

ASSET MANAGER

Jemena

Produced by Jemena Asset Management (6) Pty Ltd
ABN 52 104 352 650

ASSET OWNER

Jemena

Jemena EGP(1) P/L
ABN 15 068 570 847
Jemena EGP(2) P/L
ABN 77 006 919 115

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WILTON METER STATION
JGN PRESSURE REDUCTION SKID (RUN No. 3)
PIPING & INSTRUMENTATION DIAGRAM

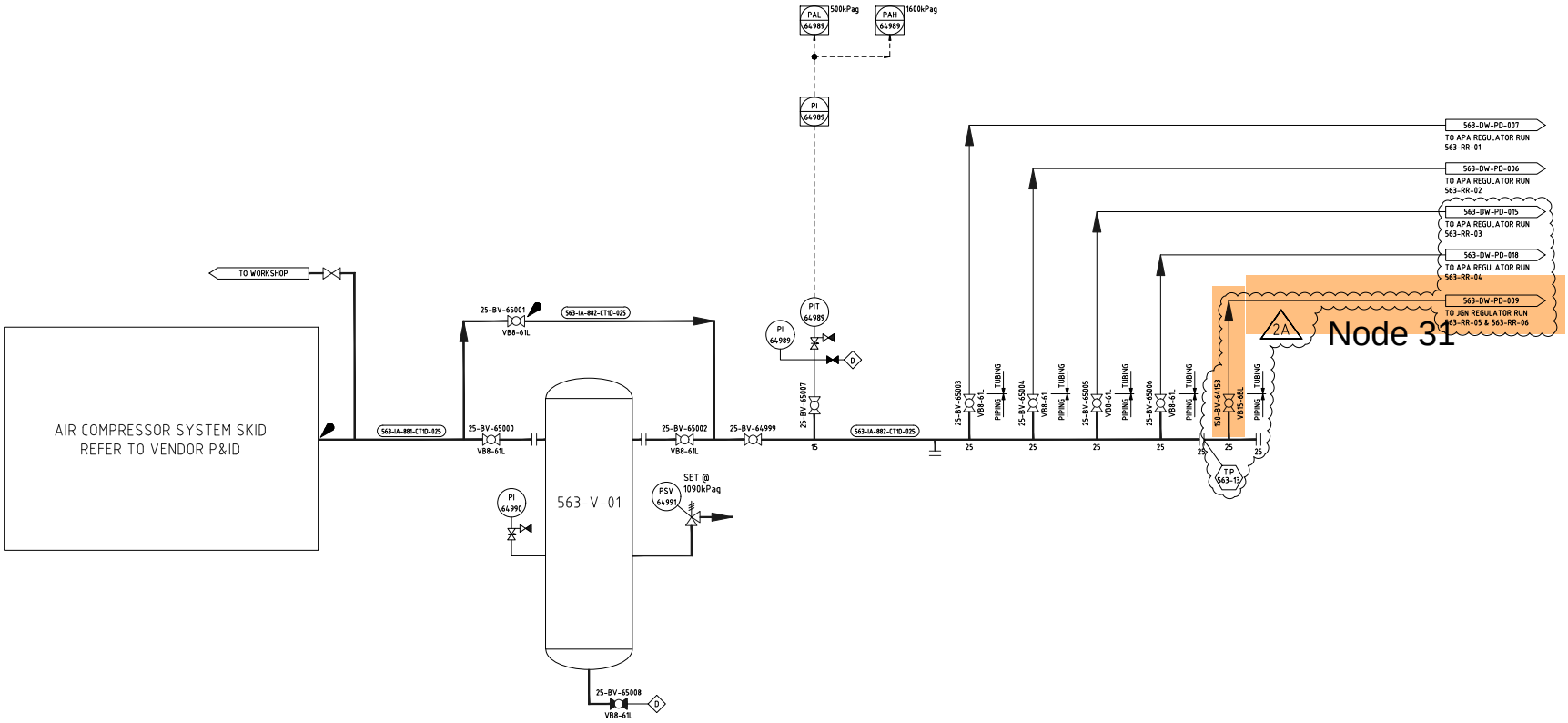
DRAWN	FACILTY	SUBJECT	
DESIGN	SCALE N.T.S.		
CHECKED	SUPERSEDES		A1
APPROVED	DRAWING NUMBER		REV 7B
DATE	563-DW-PD-010		

DRAWING No.	REFERENCE DRAWINGS
PO-510-DW-PD-003	CONNECTION TO BI-DIRECTIONAL PIPELINE & FILTER/SEPARATOR

563-AC-01
AIR COMPRESSOR PACKAGE

563-V-01
INSTRUMENT AIR RECEIVER

RECEIVER CAPACITY: 1500L
DESIGN PRESSURE: 1750kPag



MASTER FILE

ISSUED FOR HAZOP

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENG CHK	APPRV
2A	04/11/20	ISSUED FOR HAZOP (20617)	GPA	SJH	PJB	NKH
2	18/01/16	AS BUILT TO CLIENT MARKUPS	JB	NB		
1	13/02/15	REISSUED FOR CONSTRUCTION	JB	NB	WW	AH
0	12/12/14	ISSUED FOR CONSTRUCTION	JB	NB	WW	AH

DRAWING No. | REFERENCE DRAWINGS

ASSET MANAGER
Jemena
Produced by
Jemena Asset Management (6) Pty Ltd
ABN 52 104 352 650

ASSET OWNER
Jemena
Jemena EGP(1) P/L
ABN 15 068 570 847
Jemena EGP(2) P/L
ABN 77 006 919 115

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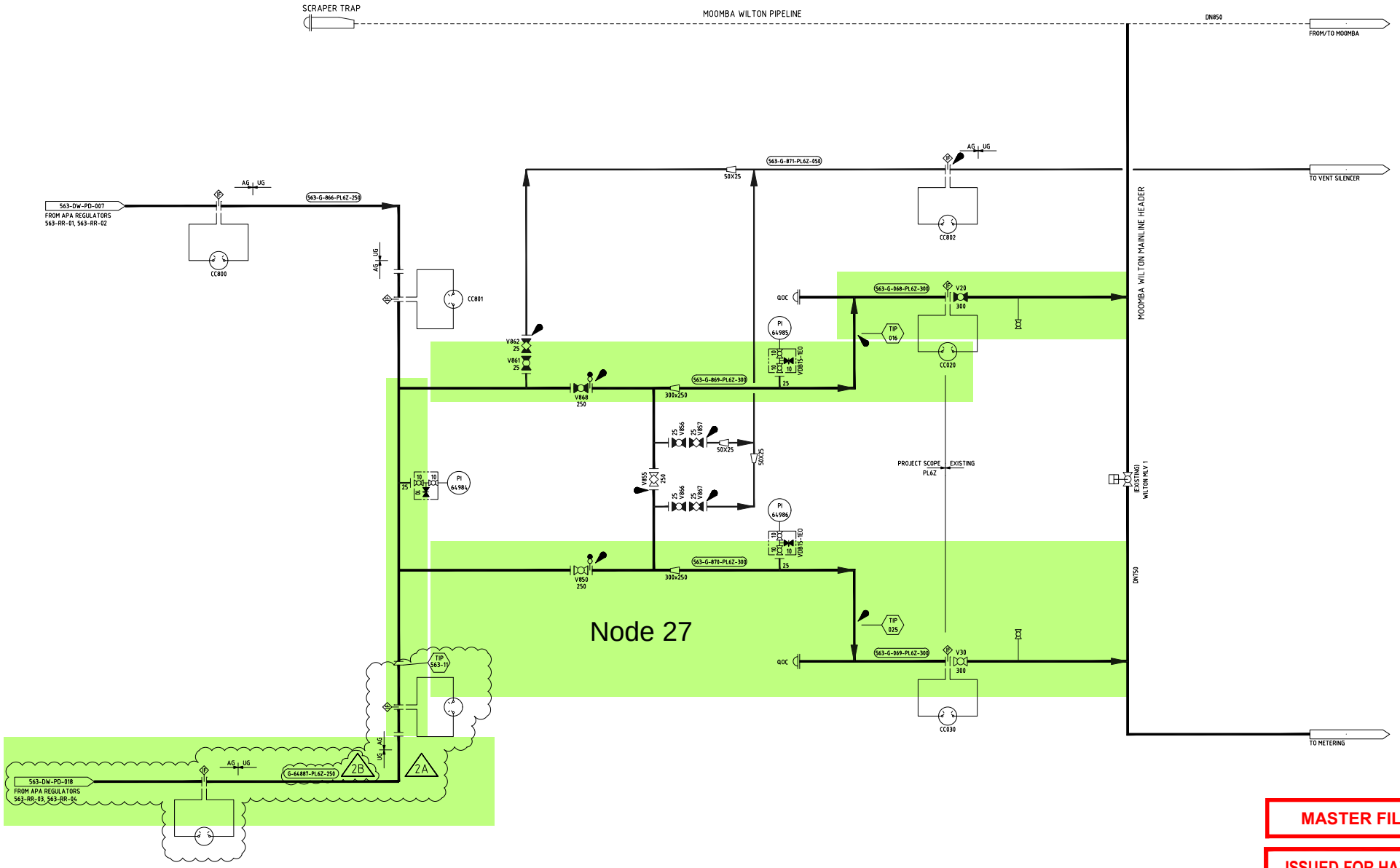
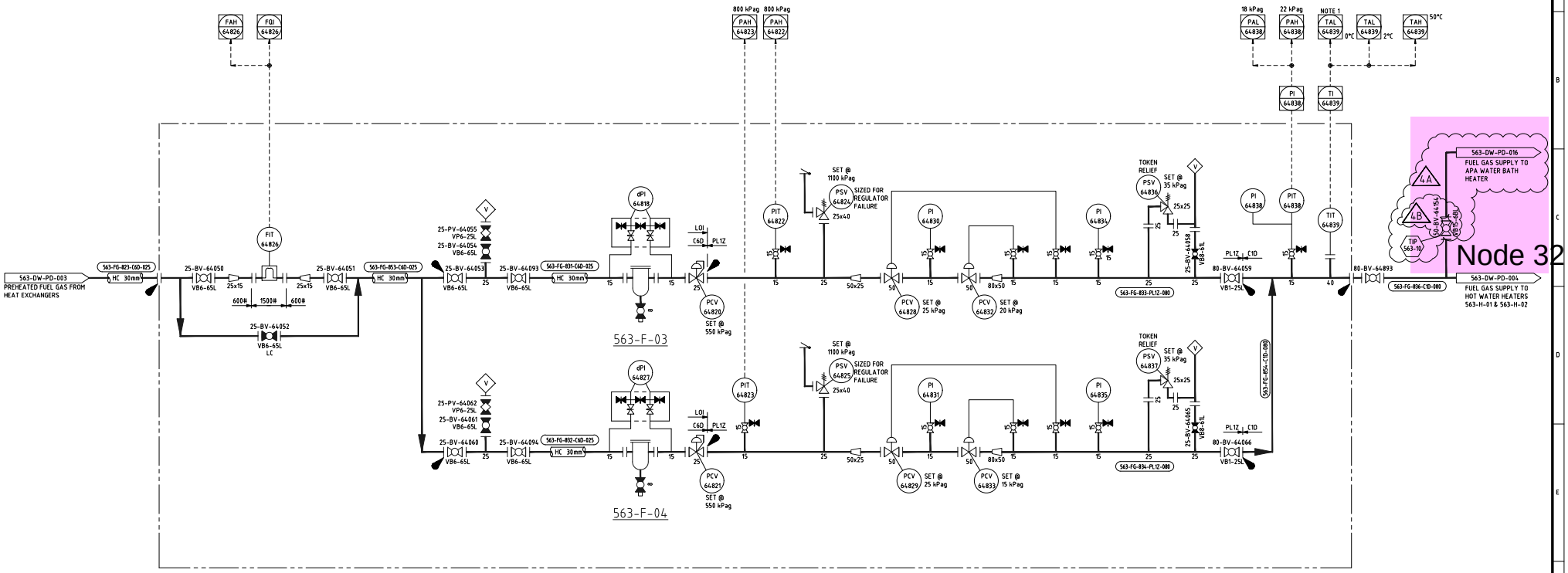
WILTON METER STATION
INSTRUMENT AIR PACKAGE
PIPING & INSTRUMENTATION DIAGRAM

DRAWN	FACILTY	SUBJECT
DESIGN	SCALE N.T.S.	
CHECKED	SUPERSEDES	A1
APPROVED	DRAWING NUMBER	REV
DATE	563-DW-PD-011	2A



		ASSET MANAGER	ASSET OWNER	COPYRIGHT.										GPA ENGINEERING	WILTON METER STATION CONNECTION TO APA PIPING & INSTRUMENTATION DIAGRAM
		Jemena Produced by Jemena Asset Management (6) Pty Ltd ABN 52 104 352 650	Jemena Jemena EGP(1) P/L ABN 15 068 570 847 Jemena EGP(2) P/L ABN 77 006 919 115	THIS DRAWING AND THE INFORMATION ON THIS DRAWING (MATERIAL) ARE PROTECTED BY THE COPYRIGHT LAWS OF AUSTRALIA. ALL RIGHTS ARE RESERVED. NO PART OF THE MATERIAL MAY IN ANY FORM BE REPRODUCED (IN WHOLE OR IN PART) OR MODIFIED IN ANY WAY WITHOUT THE EXPRESS PRIOR PERMISSION OF JEMENA LIMITED.										www.gpaeng.com.au	DRAWN | FACILITY | SUBJECT DESIGN | SCALE N.T.S. | A1 CHECKED | SUPERSEDES APPROVED | DRAWING NUMBER 563-DW-PD-012 | REV 2B DATE
PO-510-DW-PD-003	CONNECTION TO BI-DIRECTIONAL PIPELINE & FILTER/SEPARATOR				REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENG CHK	APPRV				
DRAWING No.	REFERENCE DRAWINGS				2B	04/11/20	ISSUED FOR HAZOP (20617)	GPA		SJH		PJB		NKH	
					2A	17/09/20	ISSUED FOR REVIEW (20617)	GPA							
					2	18/01/16	AS BUILT TO CLIENT MARKUPS	JB		NB			WW		AH
					1	13/02/15	REISSUED FOR CONSTRUCTION	JB		NB			WW		AH
					0	12/12/14	ISSUED FOR CONSTRUCTION	JB		NB			WW		AH



NOTES
1. TWO LEVELS OF ALARMS, LOW ALARM AT 2°C AND URGENT ALARM AT 0°C

MASTER FILE

ISSUED FOR HAZOP

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENG CHK	APPRV
4B	04/11/20	ISSUED FOR HAZOP (20617)	GPA	SJH	PJB	NKH
4A	17/09/20	ISSUED FOR REVIEW (20617)	GPA			
4	10/02/16	AS BUILT TO CLIENT MARKUPS	LC	JB		
3	18/01/16	AS BUILT TO CLIENT MARKUPS	JS	NB		
2	22/04/15	AS BUILT	SE	JB	WW	AH
1	13/02/15	REISSUED FOR CONSTRUCTION	JB	NB	WW	AH
0	12/12/14	ISSUED FOR CONSTRUCTION	JB	NB	WW	AH

DRAWING No. | REFERENCE DRAWINGS

ASSET MANAGER
Jemena
Produced by
Jemena Asset Management (6) Pty Ltd
ABN 52 104 352 650

ASSET OWNER
Jemena
Jemena EGP(1) P/L
ABN 15 068 570 847
Jemena EGP(2) P/L
ABN 77 006 919 115

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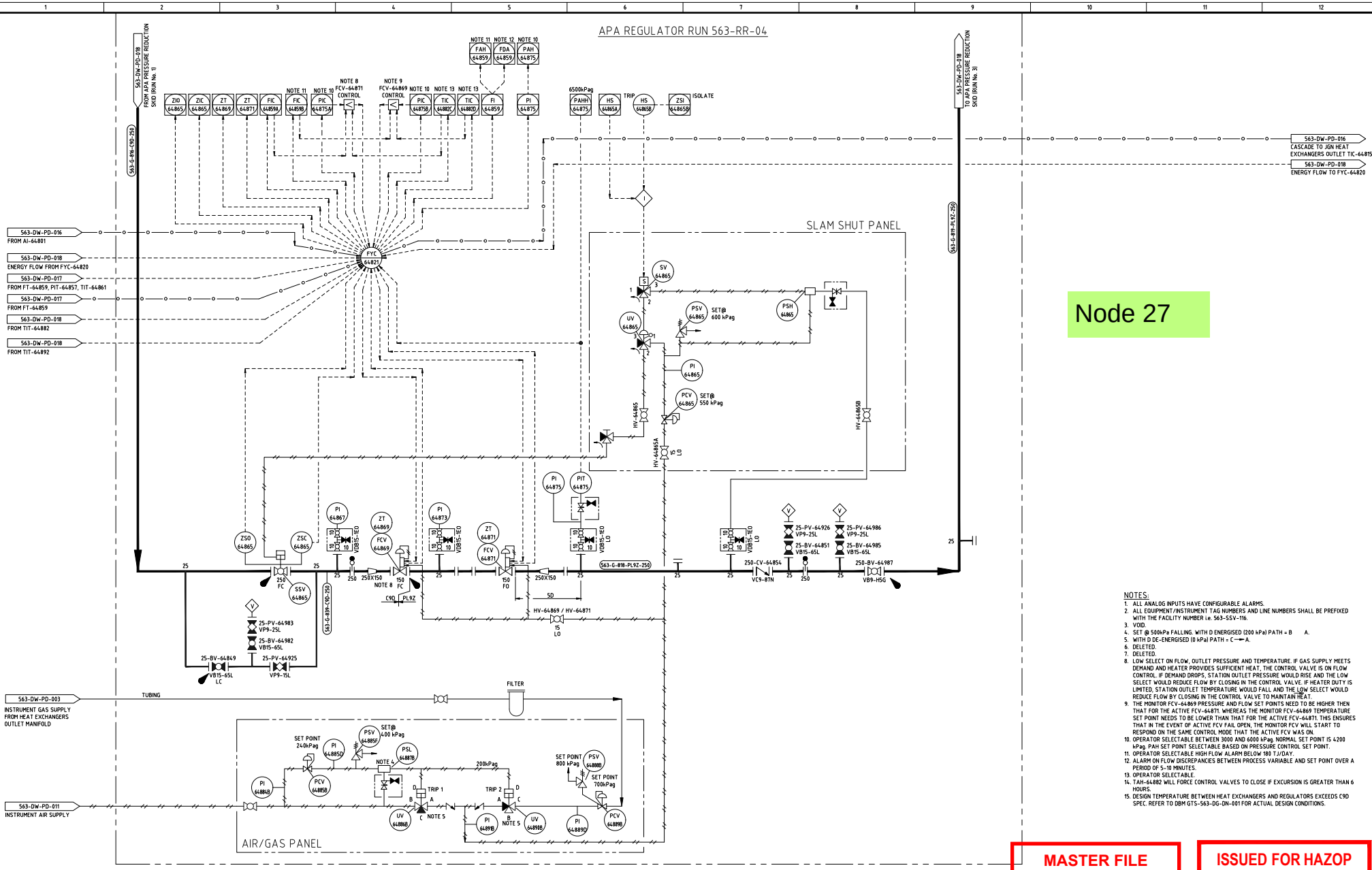
WILTON METER STATION
HOT WATER HEATER FUEL GAS TRAIN
PIPING & INSTRUMENTATION DIAGRAM

DRAWN	FACILTY	SUBJECT	
DESIGN	SCALE N.T.S.		
CHECKED	SUPERSEDES		A1
APPROVED	DRAWING NUMBER		REV 4B
DATE	563-DW-PD-014		



NOTES:
1. ALL ANALOG INPUTS HAVE CONFIGURABLE ALARMS.
2. ALL EQUIPMENT/INSTRUMENT TAG NUMBERS AND LINE NUMBERS SHALL BE PREFIXED WITH THE FACILITY NUMBER i.e. 563-SSV-116.
3. VOID.
4. SET @ 500kPa FALLING. WITH D ENERGISED (200 kPa) PATH = B A.
5. WITH D DE-ENERGISED (0 kPa) PATH = C A.
6. DELETED.
7. DELETED.
8. LOW SELECT ON FLOW, OUTLET PRESSURE AND TEMPERATURE. IF GAS SUPPLY MEETS DEMAND AND HEATER PROVIDES SUFFICIENT HEAT, THE CONTROL VALVE IS ON FLOW CONTROL. IF DEMAND DROPS, STATION OUTLET PRESSURE WOULD RISE AND THE LOW SELECT WOULD REDUCE FLOW BY CLOSING IN THE CONTROL VALVE. IF HEATER DUTY IS LIMITED, STATION OUTLET TEMPERATURE WOULD FALL AND THE LOW SELECT WOULD REDUCE FLOW BY CLOSING IN THE CONTROL VALVE TO MAINTAIN HEAT.
9. THE MONITOR FCV-64869 PRESSURE AND FLOW SET POINTS NEED TO BE HIGHER THEN THAT FOR THE ACTIVE FCV-64871. WHEREAS THE MONITOR FCV-64869 TEMPERATURE SET POINT NEEDS TO BE LOWER THAN THAT FOR THE ACTIVE FCV-64871. THIS ENSURES THAT IN THE EVENT OF ACTIVE FCV FAIL OPEN, THE MONITOR FCV WILL START TO RESPOND ON THE SAME CONTROL MODE THAT THE ACTIVE FCV WAS ON.
10. OPERATOR SELECTABLE BETWEEN 3000 AND 6000 kPag. NORMAL SET POINT IS 4200 kPag. PAH SET POINT SELECTABLE BASED ON PRESSURE CONTROL SET POINT.
11. OPERATOR SELECTABLE HIGH FLOW ALARM BELOW 188 TJ/DAY.
12. ALARM ON FLOW DISCREPANCIES BETWEEN PROCESS VARIABLE AND SET POINT OVER A PERIOD OF 5-10 MINUTES.
13. OPERATOR SELECTABLE.
14. TAH-64882 WILL FORCE CONTROL VALVES TO CLOSE IF EXCURSION IS GREATER THAN 6 HOURS.
15. DESIGN TEMPERATURE BETWEEN HEAT EXCHANGERS AND REGULATORS EXCEEDS C9D SPEC. REFER TO DBM GTS-563-DG-DN-001 FOR ACTUAL DESIGN CONDITIONS.

MASTER FILE

ISSUED FOR HAZOP

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENG CHK	APPRV
B	04/11/20	ISSUED FOR HAZOP (20617)	GPA	SJH	PJB	NKH
A	22/09/20	ISSUED FOR REVIEW (20617)	GPA			

ASSET MANAGER
Jemena
Produced by
Jemena Asset Management (6) Pty Ltd
ABN 52 104 352 650

ASSET OWNER
Jemena
Jemena EGP(1) P/L
ABN 15 068 570 847
Jemena EGP(2) P/L
ABN 77 006 919 115

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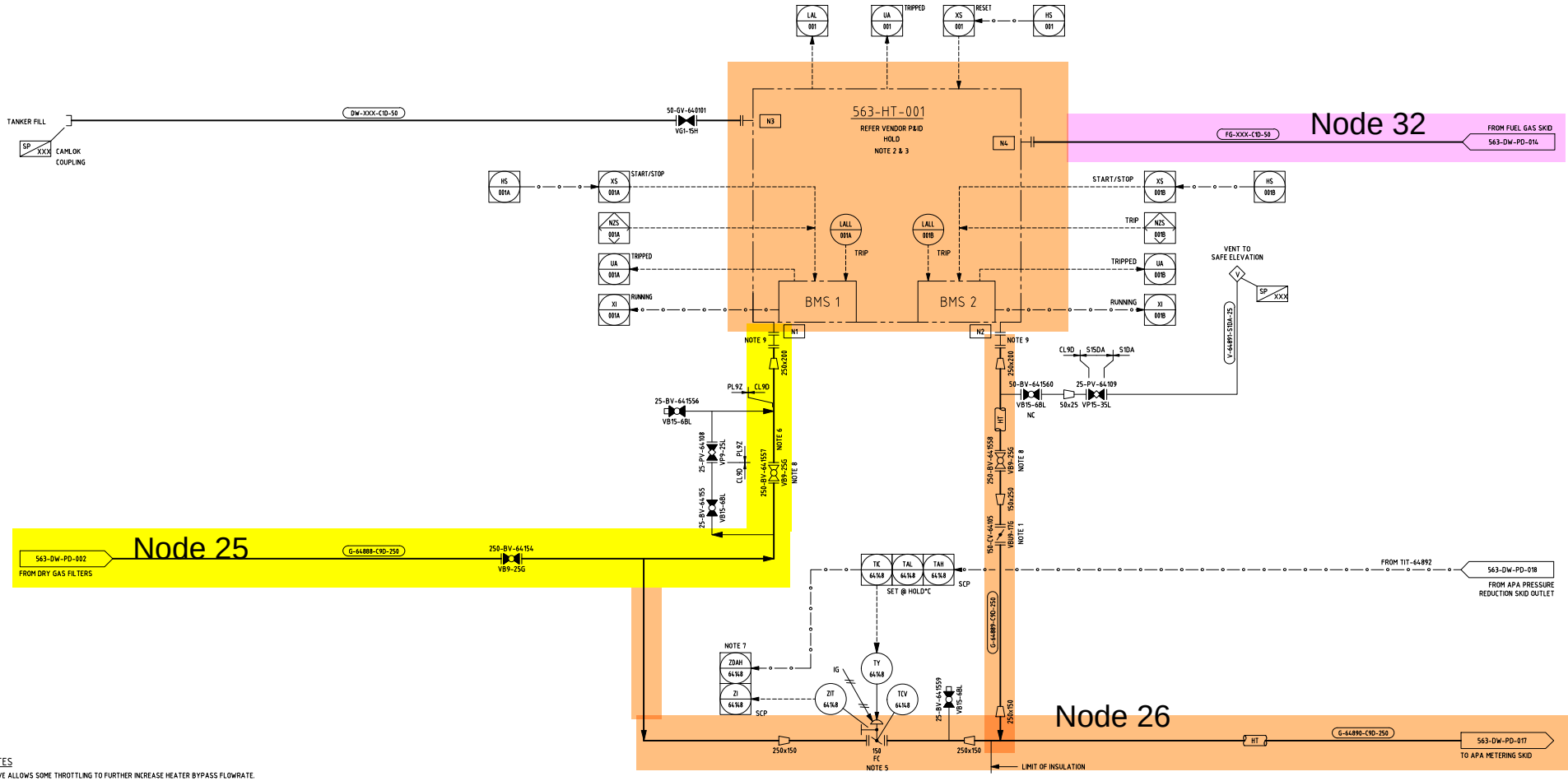
WILTON METER STATION
APA PRESSURE REDUCTION SKID (RUN No. 4)
PIPING & INSTRUMENTATION DIAGRAM

DRAWN	FACILITY	SUBJECT	
DESIGN	SCALE N.T.S.		
CHECKED	SUPERSEDES		A1
APPROVED	DRAWING NUMBER		REV
DATE	563-DW-PD-015		B

DRAWING No. | REFERENCE DRAWINGS

563-HT-001

WATER BATH HEATER
DESIGN: HOLD kPag @ HOLD °C
OPERATING: HOLD kPag @ HOLD°C
RATING: HOLD kW
DESIGN DUTY: HOLD kW
FLOW: HOLD TJ/hr



NOTES

1. VALVE ALLOWS SOME THROTTLING TO FURTHER INCREASE HEATER BYPASS FLOWRATE.
2. WATER BATH HEATER SHALL BE DESIGNED TO MINIMISE WATER LOSS BY EVAPORATION.
3. WATER BATH SHALL BE ADEQUATELY VENTED TO PREVENT PRESSURISATION SHOULD IT BOIL DUE TO INSTRUMENT TRIP FAILURE.
4. REFER PIPING CLASS DATASHEETS FOR IMPACT TESTING/HEAT TREATMENT REQUIREMENTS.
5. MANUAL OVERRIDE FURNISHED ON THE ACTUATOR.
6. LOW TEMPERATURE CARBON STEEL PRESSURISING VALVE/LINE FOR PRESSURISING WATER BATH HEATERS ONLY.
7. DISCREPANCY ALARM.
8. SINGLE BLOCK ISOLATION FOR WATER BATH HEATER REQUIRES OPERATION AT OR BELOW ASME CL300 FLANGE LIMIT WHILE ISOLATING FOR MAINTENANCE.
9. DROP OUT SPOOL FOR WATER BATH HEATER PROCESS BUNDLE REMOVAL.

MASTER FILE

ISSUED FOR HAZOP

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENG CHK	APPRV
B	04/11/20	ISSUED FOR HAZOP (20617)	GPA	SJH	PJB	NKH
A	22/09/20	ISSUED FOR REVIEW (20617)	GPA			

DRAWING No. | REFERENCE DRAWINGS

ASSET MANAGER: Jemena — Produced by Jemena Asset Management (6) Pty Ltd ABN 52 104 352 650

ASSET OWNER: Jemena — Jemena EGP(1) P/L ABN 15 068 570 847, Jemena EGP(2) P/L ABN 77 006 919 115

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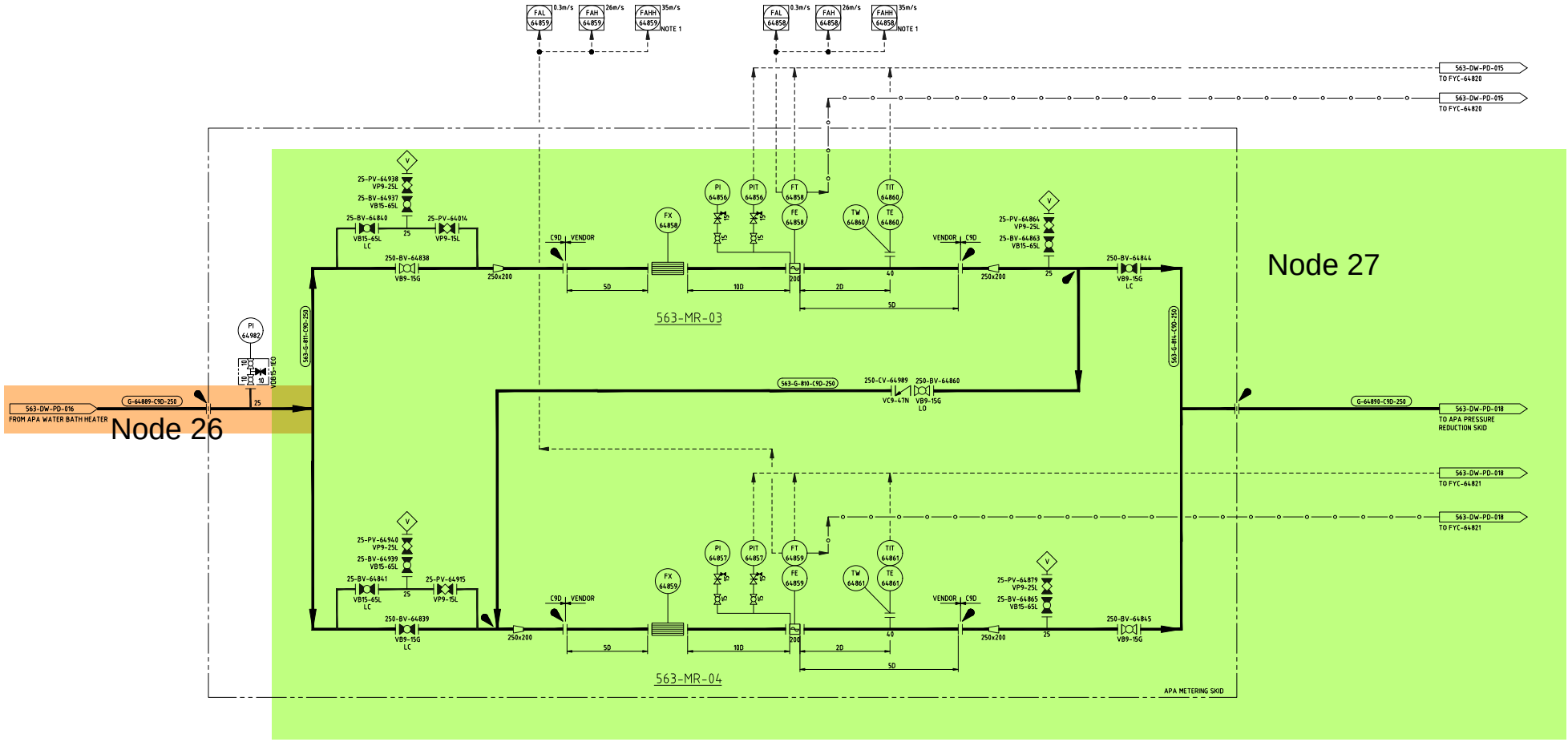
WILTON METER STATION
APA WATER BATH HEATER
PIPING & INSTRUMENTATION DIAGRAM

DRAWN	FACILTY	SUBJECT	
DESIGN	SCALE N.T.S.		
CHECKED	SUPERSEDES		A1
APPROVED	DRAWING NUMBER		REV
DATE	563-DW-PD-016		B

APA METER RUN 563-MR-03

APA METER RUN 563-MR-04



NOTES:

1. HIGH FLOW WILL TRIP INLET SLV-64800 AFTER 30 CONTINUOUS SECONDS.
2. DESIGN TEMPERATURE BETWEEN HEAT EXCHANGERS AND REGULATORS EXCEEDS C9D SPEC. REFER TO DBM GTS-563-DG-DN-001 FOR ACTUAL DESIGN CONDITIONS.

MASTER FILE

ISSUED FOR HAZOP

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENG CHK	APPRV
B	04/11/20	ISSUED FOR HAZOP (20617)	GPA	SJH	PJB	NKH
A	17/09/20	ISSUED FOR REVIEW (20617)	GPA			

DRAWING No. | REFERENCE DRAWINGS

ASSET MANAGER

Jemena

Produced by
Jemena Asset Management (6) Pty Ltd
ABN 52 104 352 650

ASSET OWNER

Jemena

Jemena EGP(1) P/L
ABN 15 068 570 847
Jemena EGP(2) P/L
ABN 77 006 919 115

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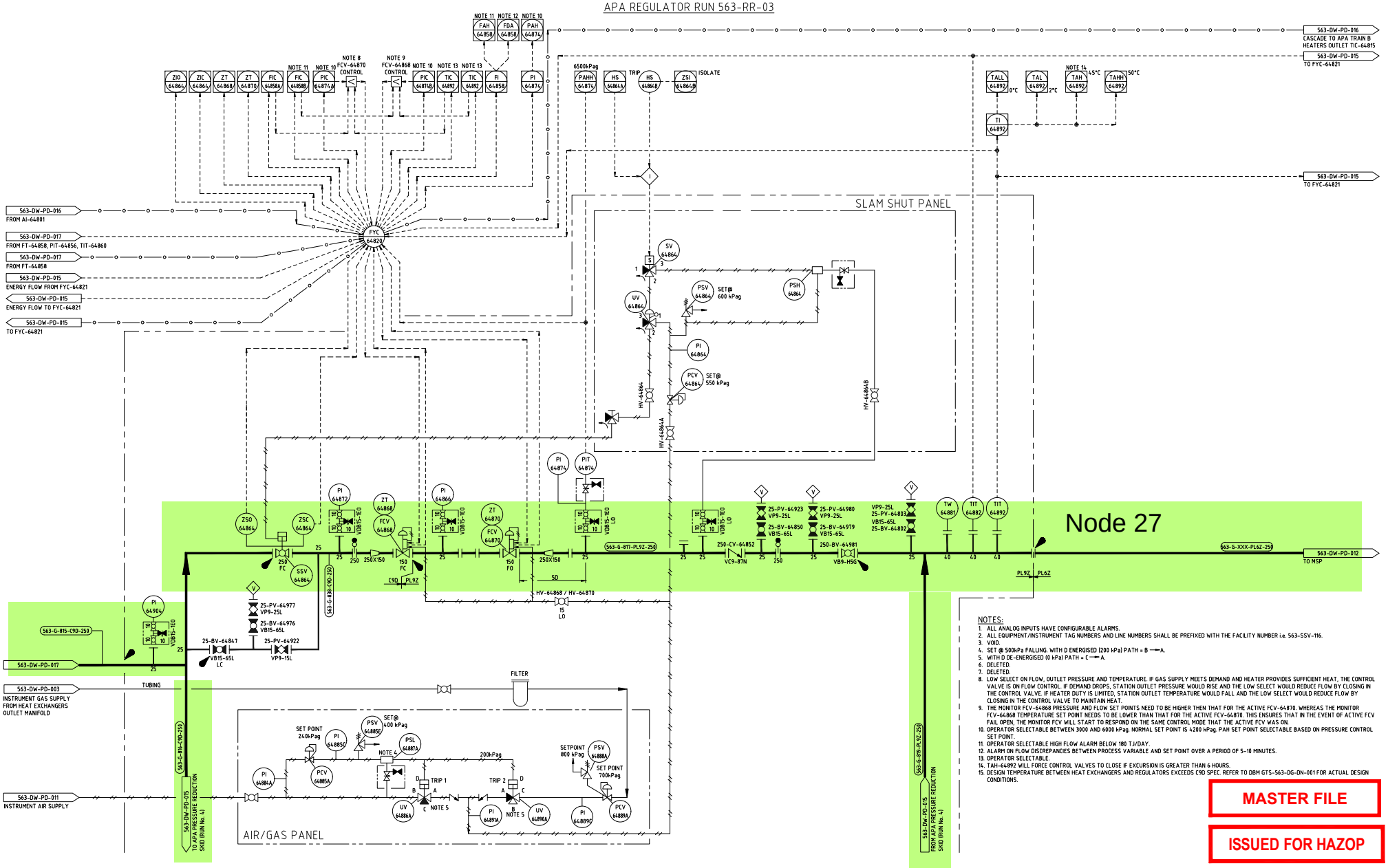
WILTON METER STATION
APA FLOW METERING
PIPING & INSTRUMENTATION DIAGRAM

DRAWN	FACILTY	SUBJECT
DESIGN	SCALE N.T.S.	
CHECKED	SUPERSEDES	A1
APPROVED	DRAWING NUMBER	REV
DATE	563-DW-PD-017	B



NOTES:

1. ALL ANALOG INPUTS HAVE CONFIGURABLE ALARMS.
2. ALL EQUIPMENT/INSTRUMENT TAG NUMBERS AND LINE NUMBERS SHALL BE PREFIXED WITH THE FACILITY NUMBER i.e. 563-SSV-116.
3. VOID.
4. SET @ 500kPa FALLING. WITH D ENERGISED (200 kPa) PATH = B ⟶A.
5. WITH D DE-ENERGISED (0 kPa) PATH = C ⟶ A.
6. DELETED.
7. DELETED.
8. LOW SELECT ON FLOW, OUTLET PRESSURE AND TEMPERATURE. IF GAS SUPPLY MEETS DEMAND AND HEATER PROVIDES SUFFICIENT HEAT, THE CONTROL VALVE IS ON FLOW CONTROL. IF DEMAND DROPS, STATION OUTLET PRESSURE WOULD RISE AND THE LOW SELECT WOULD REDUCE FLOW BY CLOSING IN THE CONTROL VALVE. IF HEATER DUTY IS LIMITED, STATION OUTLET TEMPERATURE WOULD FALL AND THE LOW SELECT WOULD REDUCE FLOW BY CLOSING IN THE CONTROL VALVE TO MAINTAIN HEAT.
9. THE MONITOR FCV-64868 PRESSURE AND FLOW SET POINTS NEED TO BE HIGHER THEN THAT FOR THE ACTIVE FCV-64870. WHEREAS THE MONITOR FCV-64868 TEMPERATURE SET POINT NEEDS TO BE LOWER THAN THAT FOR THE ACTIVE FCV-64870. THIS ENSURES THAT IN THE EVENT OF ACTIVE FCV FAIL OPEN, THE MONITOR FCV WILL START TO RESPOND ON THE SAME CONTROL MODE THAT THE ACTIVE FCV WAS ON.
10. OPERATOR SELECTABLE BETWEEN 3000 AND 6000 kPag. NORMAL SET POINT IS 4200 kPag. PAH SET POINT SELECTABLE BASED ON PRESSURE CONTROL SET POINT.
11. OPERATOR SELECTABLE HIGH FLOW ALARM BELOW 180 TJ/DAY.
12. ALARM ON FLOW DISCREPANCIES BETWEEN PROCESS VARIABLE AND SET POINT OVER A PERIOD OF 5-10 MINUTES.
13. OPERATOR SELECTABLE.
14. TAH-64892 WILL FORCE CONTROL VALVES TO CLOSE IF EXCURSION IS GREATER THAN 6 HOURS.
15. DESIGN TEMPERATURE BETWEEN HEAT EXCHANGERS AND REGULATORS EXCEEDS C9D SPEC. REFER TO DBM GTS-563-DG-DN-001 FOR ACTUAL DESIGN CONDITIONS.

MASTER FILE

ISSUED FOR HAZOP

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENG CHK	APPRV
B	04/11/20	ISSUED FOR HAZOP (20617)	GPA	SJH	PJB	NKH
A	17/09/20	ISSUED FOR REVIEW (20617)	GPA			

DRAWING No. | REFERENCE DRAWINGS

ASSET MANAGER: Jemena — Produced by Jemena Asset Management (6) Pty Ltd ABN 52 104 352 650

ASSET OWNER: Jemena — Jemena EGP(1) P/L ABN 15 068 570 847 Jemena EGP(2) P/L ABN 77 006 919 115

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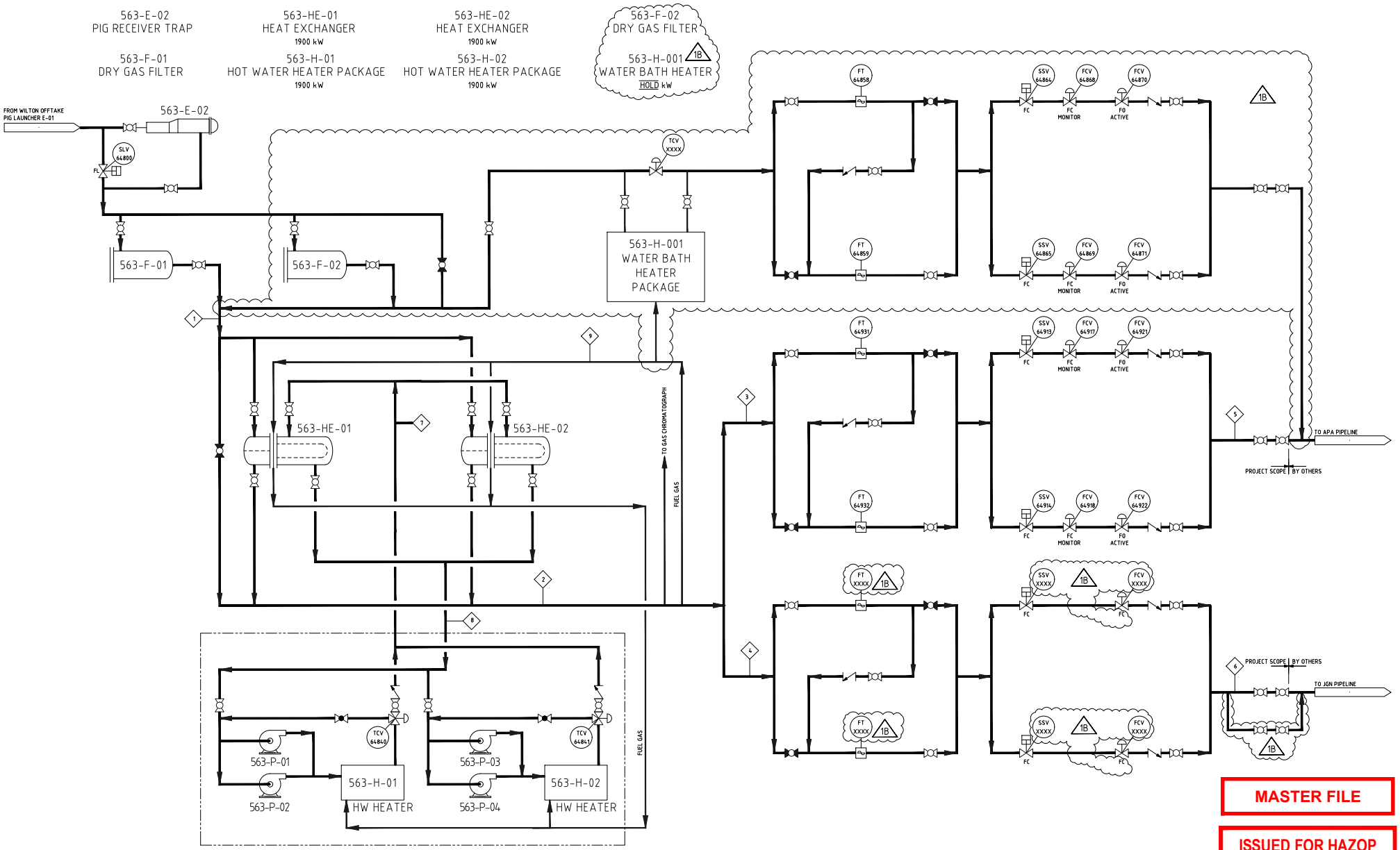
WILTON METER STATION
APA PRESSURE REDUCTION SKID (RUN No. 3)
PIPING & INSTRUMENTATION DIAGRAM

DRAWN	FACILTY	SUBJECT	
DESIGN	SCALE N.T.S.		
CHECKED	SUPERSEDES		A1
APPROVED	DRAWING NUMBER		REV
DATE	563-DW-PD-018		B



MASTER FILE

ISSUED FOR HAZOP

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENG CHK	APPRV
1B	04/11/20	ISSUED FOR HAZOP (20617)	GPA	SJH	PJB	NKH
1A	23/09/20	ISSUED FOR REVIEW (20617)	GPA			
1	08/02/16	AS BUILT TO CLIENT MARKUPS	JB	JS		
0	13/02/15	ISSUED FOR CONSTRUCTION	JB	NB	WW	AH

DRAWING No. | REFERENCE DRAWINGS

ASSET MANAGER
Jemena
Produced by
Jemena Asset Management (6) Pty Ltd
ABN 52 104 352 650

ASSET OWNER
Jemena
Jemena EGP(1) P/L
ABN 15 068 570 847
Jemena EGP(2) P/L
ABN 77 006 919 115

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WILTON METER STATION
PROCESS SCHEMATIC
PROCESS FLOW DIAGRAM

DRAWN	FACILITY	SUBJECT
DESIGN	SCALE N.T.S.	
CHECKED	SUPERSEDES	A1
APPROVED	DRAWING NUMBER	REV 1B
DATE	563-DW-PF-001	