HAZOP STUDY REPORT,

PORT KEMBLA ETHANOL TERMINAL, NSW

MANILDRA

Prepared by: Dean Shewring

5 October 2021

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HAZOP Report, Manildra, Port Kembla

Ethanol Terminal

Disclaimer

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Rev	Date	Description	Reviewed By
A	30/7/21	Draft for Comment	Manildra
B	7/8/21	Final Issue	Manildra
C	2/10/21	Updates with NSW Ports Comments	Manildra
D	5/10/21	Rev C Updates Accepted	Manildra

Contents

EXECUTIVE SUMMARY

The Shoalhaven Starches factory located on Bolong Road, Bomaderry, produces a range of products for the food, beverage, confectionary, paper and motor transport industries including starch, gluten, glucose and ethanol.

Shoalhaven Starches propose to construct a beverage grade ethanol storage and handling facility at Port Kembla, NSW. As part of the project requirements, a HAZOP study is required.

Shoalhaven Starches requested that Dean Shewring from Pinnacle Risk Management chair the HAZOP study. This report details the results of the HAZOP study in accordance with the requirements of the Department of Planning's HAZOP Guidelines.

In addition to the actions recorded in the minutes from this study (see Appendix C of this report), the following recommendations are made:

1. Manildra to perform an operability review of the final boiler and diesel system prior to construction; and

2. If any significant changes are made following the HAZOP then these changes should be reviewed by the Management of Change procedure which includes the need for further review via the HAZOP technique, e.g. potential significant changes to the slops tanks' inlet piping system as a result of the actions from this study.

Two significant potential events discussed during the study were:

- Tank-to-tank syphoning through the liquid outlet piping system. This could lead to tank damage due to excessive vacuum. This event will be protected by the installation of an additional vacuum relief valve on each tank; and

- The potential for pump fires, e.g. from seals failures. As the terminal is being designed to operate unmanned then leak and flame detection will be included in the pump bunds with automatic foam deluge.

The other more significant issues discussed included:

- General losses of containment scenarios, e.g. road tanker drive-away, road tanker or Isotank overfill and tank overflows;

- Bonding and earthing requirements;

- Issues associated with emergency response as the terminal is designed to be unmanned, e.g. response to the operation of a safety shower and communication to the Shoalhaven Starches operators;

- Product contamination (the ethanol is beverage grade);

- Security including product theft;

- Spill containment capacity for an Isotank at the load-out bay;
- Nitrogen atmosphere within enclosed spaces; and
- Hazardous area zoning at the berth.

None of the identified potential events pose high risk provided good industry practice is implemented (as discussed during the study).

GLOSSARY

API	American Petroleum Institute
AS	Australian Standard
HAZOP	Hazard and Operability Study
HIPAP	Hazardous Industry Planning Advisory Paper
LOPA	Layer of Protection Analysis

REPORT

1 INTRODUCTION

The Manildra Group is a wholly Australian owned business and the largest processor of wheat in Australia. It manufactures a wide range of wheat-based products for food and industrial markets both locally and internationally.

The Manildra Group owns the Shoalhaven Starches factory located on Bolong Road, Bomaderry, which produces a range of products for the food, beverage, confectionary, paper and motor transport industries including starch, gluten, glucose and ethanol.

Manildra propose to construct a beverage grade ethanol storage and handling facility at Port Kembla, NSW. The beverage grade ethanol will be transferred via road tankers from the Bomaderry facility to the Port Kembla facility and stored within six tanks. The beverage grade ethanol can then be transferred to a ship, or to Isotanks and road tankers for delivery to the market.

As part of the project requirements, a HAZOP study compliant with the Department of Planning's Hazardous Industry Planning Advisory Paper No. 8 - HAZOP Guidelines (Ref 1) is required.

This report details the results of the HAZOP study on the proposed ethanol terminal.

Manildra requested that Dean Shewring from Pinnacle Risk Management chair the required HAZOP study.

The aim of the HAZOP study is to identify potential hazardous events and significant operability problems associated with the proposed facility. This aim is inherent for all HAZOP studies. The scope for this study is detailed in Section 2 of this report.

2 PROCESS DESCRIPTION AND HAZOP SCOPE

Ethanol is a Dangerous Good Class 3, Packing Group 2, flammable liquid.

The facility is to include the following:

- In-loading of beverage grade ethanol into the storage tanks from road tankers (singles and doubles);
- Ethanol storage in 6 x 4 ML stainless steel, fixed roof tanks;
- Ethanol loadout to vessels moored at berth 206 at approximately 1,000 m^3 per hour. Typical shipments are 5 ML to 10 ML;
- Flushing and pigging of the wharf supply and return pipelines to the slops tanks; and
- Outloading to Isotanks and road tankers for local markets at up to 100 m^3 per hour.

The road tanker in-loading will be automated so that truck drivers can operate the system. The road tanker drivers will be inducted and have swipe cards to enter the site through the automatic entrance gate. The road tankers will be parked at the dedicated in-loading bay. This will include containment (for at least the largest compartment), an automatic foam deluge system, a safety shower / eyewash station, dry-break couplings, a transfer control system with a 3 minute deadman's button and a Scully system for earthing.

When the required preparation requirements and interlocks are complete then the transfer pumps can be operated to transfer the ethanol into the storage tanks. Road tanker drive-away protection includes gates and a traffic light system (green / red lights for go / no-go indication for the driver).

The design of the storage tanks includes the following:

- 16.5 m diameter with a 20 m wall height (designed to API 620);
- Stainless steel construction (painted exterior);
- Frangible roofs;
- Pressure and vacuum relief valves plus emergency fire relief as per the requirements of AS1940;
- Nitrogen padding above the liquid to minimise the risk of an internal explosion. The nitrogen will be supplied from a cryogenic tank and vaporiser;
- Foam piped into the tanks above max liquid level, i.e. via foam pourers;
- Radar level gauge with an independent high level trip (to prevent overfill);

- All tank control functions will be PLC (programmable logic controller) controlled;
- The tanks will be designed to operate within the under/over pressure range -2.0/+1.85kpa; and
- Concrete bunding (capacity as per AS1940).

In addition to the six ethanol storage tanks, there will be two slops tanks. Slops (waste ethanol streams) can be generated during road tanker transfers, maintenance, Isotank cleaning and pigging the wharflines. The slops tanks will be smaller than the main storage tanks (4.5 m diameter and 18 m high) but similarly designed. The slops will be transferred to a road tanker and reprocessed at the Shoalhaven Starches facility at Bomaderry.

Ethanol can be pumped from the storage tanks to the road tanker and Isotank loadout facility or to a ship. Tank-to-tank transfers and tank recirculation are also potential modes of operation.

The Isotanks are to be cleaned using steam from a package boiler.

Out-loading to road tankers and Isotanks is performed in a dedicated transfer bay adjacent to the in-loading transfer bay. The out-loading transfer bay will include containment (for at least the largest compartment), an automatic foam deluge system, a safety shower / eyewash station, dry-break couplings, a transfer control system with a 3 minute deadman's button and a Scully system for earthing as per the in-loading bay. It will also include a vapour connection to a scrubber so that ethanol vapours are not released to the environment during out-loading. Other feed streams to the scrubber are vapour from all eight tanks and from pigging of the wharf lines. Effluent from the scrubber will be sent to the slops system.

As out-loading to an Isotank involves connecting transfer spool pieces and separate high level protection then this operation will be performed by a Manildra operator.

Outloading to ships will require additional operators, e.g. to supervise the terminal and berth operations as well as performing line walking to check for leaks. The ship export pumps will be variable speed drive and ramp up and down when starting and stopping. The transfers to the ship at the berth will be via hoses. To avoid any potential ethanol losses, a return wharfline will also be included in the design to return waste ethanol to the slops tanks.

The wharfline and return line will be pigged to ensure the lines rest on nitrogen. These lines will be 300 mm diameter. They will run along the wharf and adjacent to the harbour to connect to the site.

All equipment in contact with ethanol will be manufactured from stainless steel. Non-destructive testing will be performed on all critical pipes, e.g. the wharflines.

The terminal design includes actuated, fail closed valves on the inlet and outlet lines for all tanks. These close on a terminal emergency.

The proposed fire detection and protection systems include:

- Leak detection at the pumps and in the switchroom;
- Foam pourers to the tanks (above liquid level);
- Fire extinguishers and hose reels;
- Automatic foam deluge at the transfer bays and over the pumps; and
- Two firewater pumps, each supplied by a dedicated tank, supplying firewater to hydrants, monitors and water sprinklers as per the Australian Standards for terminals and berths.

Firewater in the tank farm will be contained in the bunds and pumped to the slops tank for offsite disposal at the Shoalhaven Starches facility.

The potential transport movements are as follows:

- In-loading is approximately 250 million litres per year. If there is an average of 74,000 L per road tanker then this equates to approximately 3,380 loads into the facility per year or 65 loads per week;
- Isotanks and road tanker outloading is approximately 50 million litres per year or 1,000 loads out, i.e. approximately 20 loads per week; and
- A ship transfer every one to two weeks for the remaining ethanol (approximately 200 million litres per year).

The drawings used in the study which detail the process design are supplied in Appendix A. The HAZOP scope is the equipment shown on these drawings.

As there are common equipment items, e.g. the tanks, then HAZOP-by-difference was used in this study, i.e. HAZOP only the differences to an identical equipment item, e.g. a variation in how the material is fed to the second, identical equipment item. All actions associated with equipment items that are identical to any other equipment items should be equally applied.

3 METHODOLOGY

3.1 GENERAL

A HAZOP study is a hazard study which concentrates on how the design will cope with abnormal conditions, rather than on how it will perform under normal conditions. The study is comprised of a review of each unit operation, examining each for possible causes of a wide range of process abnormalities and their consequences.

HAZOP provides the opportunity for people to think creatively and examine ways in which hazards or operating problems might arise. To reduce the chance of missing something, a HAZOP is carried out in a systematic manner, using guide words to consider each system and each type of hazard in turn. The study is carried out by a team so that input from all areas of functional expertise can be provided.

The results of a HAZOP depend heavily upon the experience and attitudes of the team members and on the leadership style adopted. In this study, the members of the team had good experience, knowledge and skills with ethanol storage and handling (there are multiple ethanol plants and storages at the Shoalhaven Starches site) and had the authority to approve the actions decided upon.

3.2 MEETING PROCEDURES

The HAZOP study of each section of the plant followed the procedure given below:

- The design engineer outlined the broad purpose of the section of design under study and displayed on the relevant drawings on the wall. This outline included design features, operating conditions, description of fittings and details of equipment;
- Any general questions about the scope and intent of the design were answered;
- The first section or area of the design was highlighted for study;
- Any general questions about this area were then answered. Minutes may be generated during this discussion;
- The detailed ‘line by line’ study commenced at this point. The HAZOP leader led the group through the HAZOP guide words. Each guide word is a prompt, such as "HIGH FLOW", which identifies a deviation from normal operating conditions that may lead to a hazardous event or significant operability problem. This is used to prompt discussion of the possible causes and effects of flow at an undesirably high rate. If, in the opinion of the team, the safeguards for the combination of the likelihood of a credible event and the consequences are inadequate then an action is recorded in the minutes.

For major risk areas the need for action is assessed quantitatively (by Hazard or Reliability Analysis). For less significant risks the need for action can be based on experience and judgement. For this study, all actions could be appropriately addressed by the nominated HAZOP team members;

- The main aim of the meeting was to find problems needing solution, rather than the actual solution. When the group became tied down by trying to resolve a problem, the issue was minuted as requiring further review outside the meeting, and the study proceeded;

- All changes agreed at the meeting were minuted with some being marked on the HAZOP master drawings; and

- Note that all actions were recorded in the minutes as well as significant discussion points which did not result in any actions. The latter were recorded as a means to record the basis of safety for a potential hazardous event or operability problem.

The guide words used during the study are listed in Appendix B.

All actions from the study are listed in the HAZOP minutes, contained in Appendix C. It is noted that safeguards are only recorded by exception. It is assumed that the procedures within the Manildra safety management system will be used effectively (as discussed throughout the HAZOP study).

As the purpose of a HAZOP study is to *identify*, i.e. not necessarily solve, potential hazardous events and significant operability problems associated with the process under review, some of the actions require further review post the study. As a general rule, a HAZOP facilitator allows approximately 5 to 10 minutes to resolve any issues identified during the study. If a solution cannot be agreed to within this timeframe then the issue is minuted and the study proceeds.

The reason for this approach is that a positive, open, questioning mindset is required from the team members. This allows creative brainstorming to identify possible abnormal plant conditions that may lead to potential hazardous events and/or significant operability problems. Teams that become tied down trying to resolve all issues, in particular problems that require further calculations and assessment, lose their creativity and hence the basis for the study effectiveness is lost.

4 STUDY TEAM

The HAZOP study for the terminal was conducted during two sessions starting in June and finishing in July 2021. The HAZOP team participants had the appropriate level of experience in design and/or operation of ethanol storage and handling systems. The table in Appendix D shows the team members who participated in the HAZOP study.

5 DISCUSSION AND CONCLUSIONS

The study team participants had appropriate experience in the design and operation of ethanol storage and handling systems. This includes ship transfers. Therefore, the hazards were generally well known as well as the required control measures to reduce risk to acceptable levels.

Two significant potential events discussed during the study were:

- Tank-to-tank syphoning through the liquid outlet piping system. This could lead to tank damage due to excessive vacuum. This event will be protected by the installation of an additional vacuum relief valve on each tank; and
- The potential for pump fires, e.g. from seals failures. As the terminal is being designed to operate unmanned then leak and flame detection will be included in the pump bunds with automatic foam deluge.

The other more significant issues discussed included:

- General losses of containment scenarios, e.g. road tanker drive-away, road tanker or Isotank overfill and tank overflows;
- Bonding and earthing requirements;
- Issues associated with emergency response as the terminal is designed to be unmanned, e.g. response to the operation of a safety shower and communication to the Shoalhaven Starches operators;
- Product contamination (the ethanol is beverage grade);
- Security including product theft;
- Spill containment capacity for an Isotank at the load-out bay;
- Nitrogen atmosphere within enclosed spaces; and
- Hazardous area zoning at the berth.

None of the identified potential events pose high risk provided good industry practice is implemented (as discussed during the study).

There may be safety critical instrumented systems in this process, e.g. the tank high level trips. These are to be assessed via a Layer of Protection Study (LOPA) which will include the requirement for routine maintenance to ensure reliability.

As discussed in Section 2, there are common equipment items, e.g. the tanks, and therefore HAZOP-by-difference was used in this study, i.e. HAZOP only the differences to an identical equipment item, e.g. a variation in how the material is fed to the second, identical equipment item. All actions associated with

equipment items that are identical to any other equipment items should be equally applied.

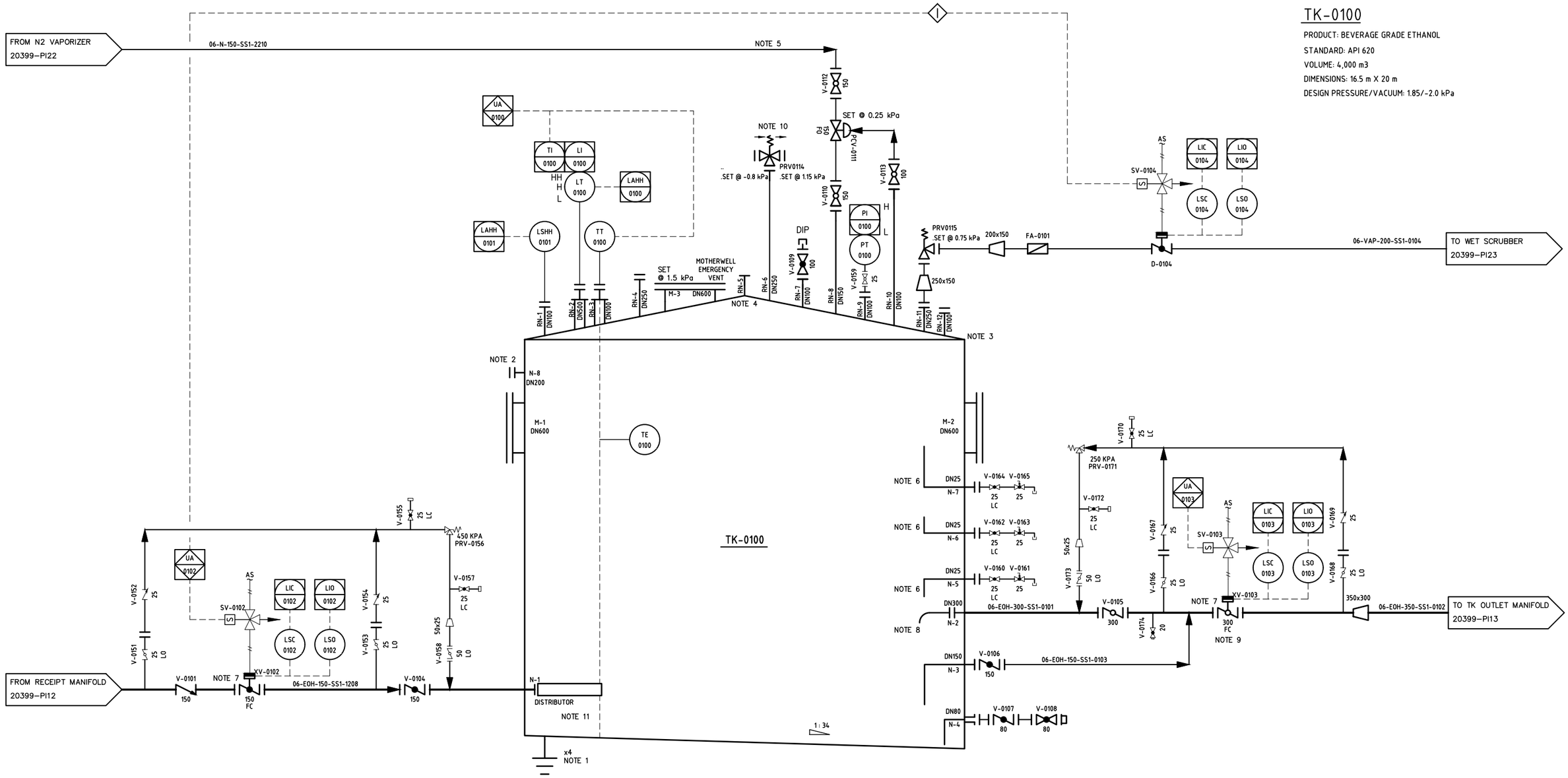
Any significant changes to the HAZOP design should be separately assessed for new potential hazardous events and operability problems. This is commonly achieved by utilising a management of change programme within the project and may require further review using the HAZOP technique.

Power failure (both total and local) was considered in every HAZOP node (both on the “Zero Flow” and “Electrical” HAZOP guide words). The terminal is designed to fail-safe on loss of power with an alarm being raised at Shoalhaven Starches.

HAZOP studies are, by definition, a qualitative risk assessment. The decisions made by the HAZOP team members are based on their experience and knowledge of the type of facility under review. If the HAZOP team members determined the existing control measures were adequate then no further action is required. Significant points of discussion (generally if significant consequential impacts are possible) were recorded even though the control measures were deemed acceptable by the HAZOP team. All issues requiring a response were included in the HAZOP minutes.

Completed HAZOP actions need to be tracked within the project’s HAZOP action register or equivalent. Regular project meetings should include a review of the progress of closing-out all of the actions. It is normally the responsibility of the project manager to ensure that all of the HAZOP actions are completed. The HAZOP drawings and a record of the completed actions should be retained with the plant files.

6 APPENDIX A - HAZOP DRAWINGS



NOTES:

1. EARTHING LUGS (4OFF) TO BE PROVIDED ON TANK
2. FOAM POURER CONNECTION WITH VAPOUR SEAL
3. TANK ROOF FRANGIBLE JOINT
4. SCAFFOLD HOOK
5. NITROGEN PRESSURE 1.8 kPa MAXIMUM PRIOR TO PCV
6. BOTTOM, MIDDLE, TOP SAMPLES
7. ACTUATOR CLOSE RATE MIN 30SEC (TBC AFTER SURGE REVIEW)
8. OUTLET ENLARGED TO DN400 IN TANK
9. PROGRAMMED LOCK OUT TO PREVENT TWO TANK OUTLET VALVES BEING OPEN AT THE SAME TIME
10. INTEGRAL FLAME ARRESTOR ON OUTLET
11. SLOTTED TO LIMIT FLOW TO 7 M/S & SELF DRAINING

PROJECT MANAGERS | PLANNERS | DESIGNERS | ENGINEERS

TfA Project Group

DRAWING ISSUE APPROVAL

NAME: DATE:

PROFESSIONAL QUALIFICATION:

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REV	DATE	BY	DESCRIPTION	CHK	APP
A	11.06.21	LCN	ISSUED FOR INFORMATION		
B	18.06.21	HE	GENERAL REVISION	BV	KS
C	25.06.21	HE	ISSUED FOR HAZOP	BV	KS
D	28.06.21	HE	REVISED FOR HAZOP	BV	KS

PROJECT DETAILS

MANILDRA GROUP
BULK LIQUIDS FACILITY
PORT KEMBLA

DRAWING TITLE

P&ID
PRODUCT STORAGE TANK
BEVERAGE GRADE ETHANOL TANK
TK-0100

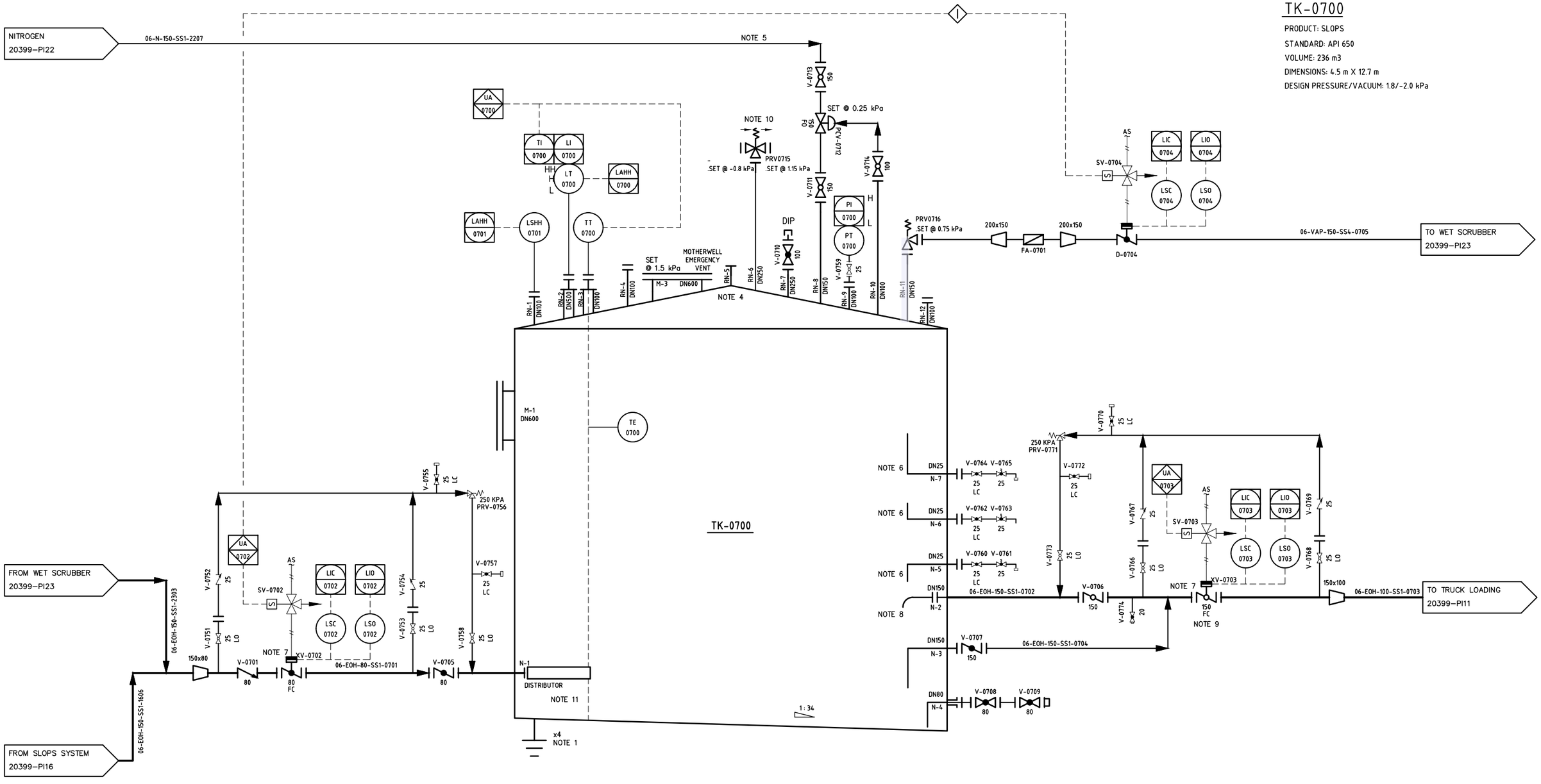
STATUS

HAZOP ISSUE

DATE CREATED	ORIGINAL SCALE	SHEET
31.05.21	NTS	A3

DO NOT SCALE THIS DRAWING. CONFIRM ALL DIMENSIONS ON SITE.

DRAWING NO	REV
20399-PI01	D



NOTES:

1. EARTHING LUGS (4OFF) TO BE PROVIDED ON TANK
2. REMOVED
3. REMOVED
4. SCAFFOLD HOOK
5. NITROGEN PRESSURE 1.8 kPa MAXIMUM PRIOR TO PCV
6. BOTTOM, MIDDLE, TOP SAMPLES
7. ACTUATOR CLOSE RATE MIN 30SEC (TBC AFTER SURGE REVIEW)
8. OUTLET ENLARGED TO DN200 IN TANK
9. PROGRAMMED LOCK OUT TO PREVENT TWO TANK OUTLET VALVES BEING OPEN AT THE SAME TIME
10. INTEGRAL FLAME ARRESTOR ON OUTLET
11. SLOTTED TO LIMIT FLOW TO 1 M/S & SELF DRAINING

PROJECT MANAGERS | PLANNERS | DESIGNERS | ENGINEERS

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DRAWING ISSUE APPROVAL

NAME: DATE:

PROFESSIONAL QUALIFICATION:

SIGNATURE:

REV	DATE	BY	DESCRIPTION	CHK	APP
A	22.06.21	HE	ISSUED FOR INFORMATION	BV	KS
B	28.06.21	HE	ISSUE FOR HAZOP	BV	KS

PROJECT DETAILS

MANILDRA GROUP
BULK LIQUIDS FACILITY
PORT KEMBLA

DRAWING TITLE

P&ID
PRODUCT STORAGE SYSTEM
SLOPS TANK
TK-0700

STATUS

HAZOP ISSUE

DATE CREATED	ORIGINAL SCALE	SHEET
22.07.21	NTS	A3

DO NOT SCALE THIS DRAWING. CONFIRM ALL DIMENSIONS ON SITE.

DRAWING NO	REV
20399-PI07	B

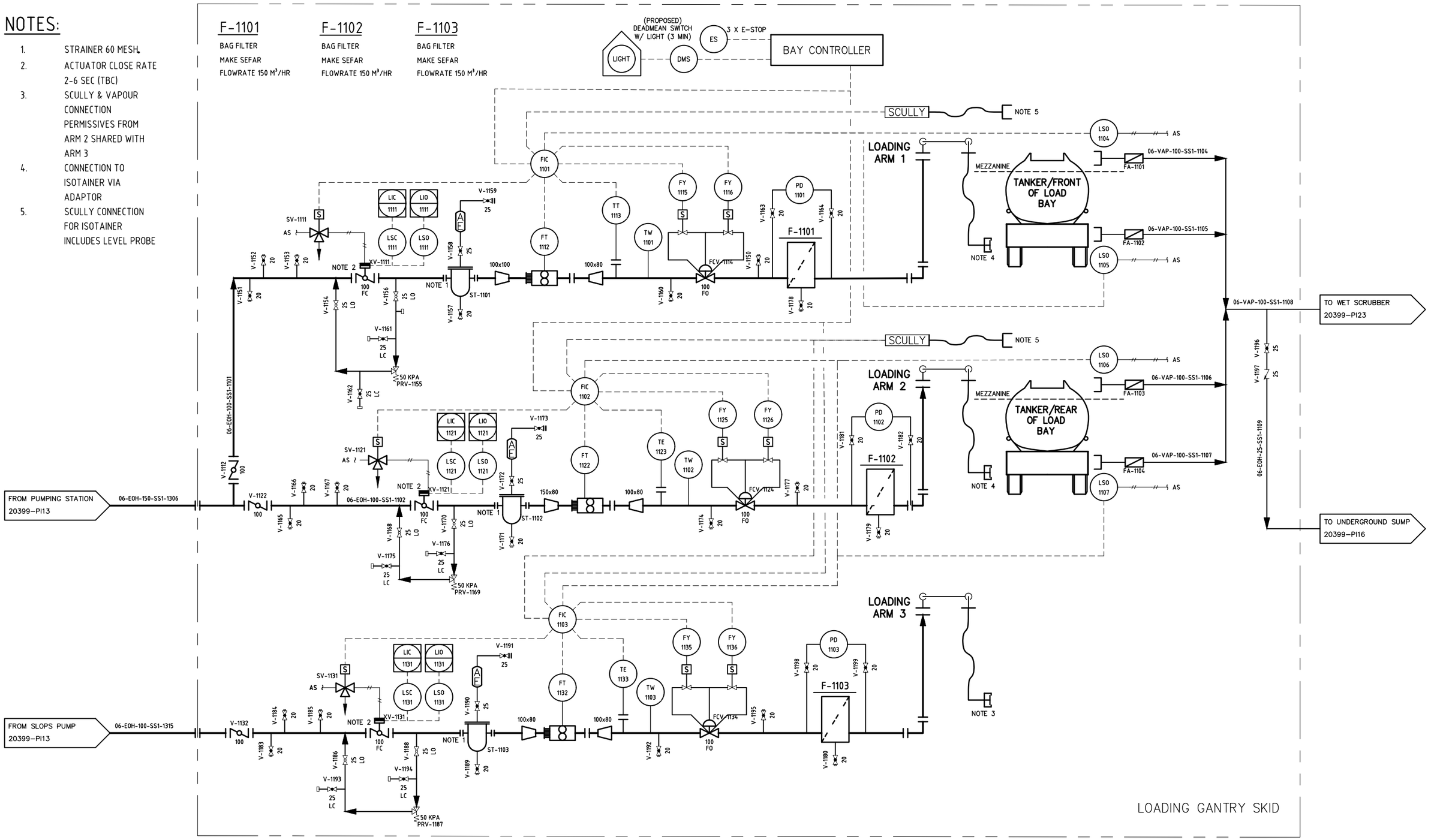
NOTES:

1. STRAINER 60 MESH.
2. ACTUATOR CLOSE RATE 2-6 SEC (TBC)
3. SCULLY & VAPOUR CONNECTION PERMISSIVES FROM ARM 2 SHARED WITH ARM 3
4. CONNECTION TO ISOTAINER VIA ADAPTOR
5. SCULLY CONNECTION FOR ISOTAINER INCLUDES LEVEL PROBE

F-1101
BAG FILTER
MAKE SEFAR
FLOWRATE 150 M^3/HR

F-1102
BAG FILTER
MAKE SEFAR
FLOWRATE 150 M^3/HR

F-1103
BAG FILTER
MAKE SEFAR
FLOWRATE 150 M^3/HR



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A	18.06.21	HE	ISSUE FOR INFORMATION	BV	KS
B	25.06.21	HE	ISSUED FOR HAZOP	BV	KS
C	28.05.21	HE	REVISED FOR HAZOP	BV	KS

PROJECT DETAILS

MANILDRA GROUP
BULK LIQUIDS FACILITY
PORT KEMBLA

DRAWING TITLE

P&ID
PRODUCT TRANSFER SYSTEM TRUCK LOADING

STATUS

HAZOP ISSUE

DATE CREATED	ORIGINAL SCALE	SHEET
09.06.21	NTS	A3

DO NOT SCALE THIS DRAWING. CONFIRM ALL DIMENSIONS ON SITE.

DRAWING NO	REV
20399-PI11	C

PU-1201

DUTY PUMP
MAKE TBD
MODEL TBD
FLOWRATE 100 M3/HR
MOTOR 22 kW
PRESSURE BYPASS 400 kPa

PU-1202

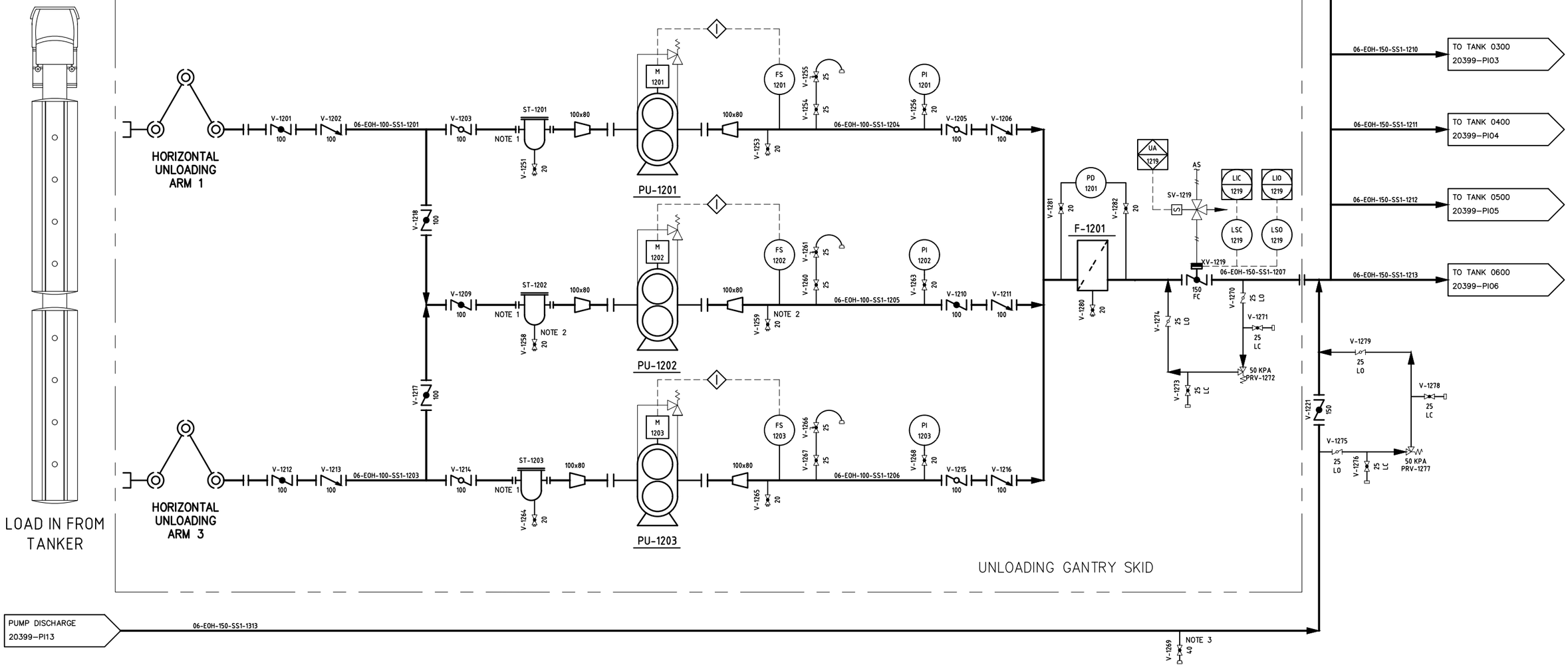
STANDBY PUMP
MAKE TBD
MODEL TBD
FLOWRATE 100 M3/HR
MOTOR 22 kW
PRESSURE BYPASS 400 kPa

PU-1203

DUTY PUMP
MAKE TBD
MODEL TBD
FLOWRATE 100 M3/HR
MOTOR 22 kW
PRESSURE BYPASS 400 kPa

F-1201

BAG FILTER
MAKE SEFAR
FLOWRATE 200 M^3/HR



NOTES:

1. STRAINER 60 MESH.
2. STANDBY PUMP PIPING DRAINED WHEN NOT IN USE
3. OPTION TO DRAIN TANK TO TANK TRANSFER PIPING WHEN NOT IN USE

PROJECT MANAGERS | PLANNERS | DESIGNERS | ENGINEERS

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NAME: DATE:
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SIGNATURE:

REV	DATE	BY	DESCRIPTION	CHK	APP
A	18.06.21	HE	ISSUE FOR INFORMATION	BV	KS
B	25.06.21	HE	ISSUED FOR HAZOP	BV	KS
C	28.06.21	HE	REVISION FOR HAZOP	BV	KS

PROJECT DETAILS
MANILDRA GROUP
BULK LIQUIDS FACILITY
PORT KEMBLA

DRAWING TITLE
P&ID
PRODUCT TRANSFER SYSTEM TRUCK UNLOADING

STATUS
HAZOP ISSUE

DATE CREATED	ORIGINAL SCALE	SHEET
07.06.21	NTS	A3

DO NOT SCALE THIS DRAWING. CONFIRM ALL DIMENSIONS ON SITE.

DRAWING NO	REV
20399-PI12	C

PU-1305
SLOPS PUMP
MAKE TBD
MODEL TBD
FLOWRATE 120 M3/HR
MOTOR 30 kW

PU-1301
LOADOUT DUTY
MAKE TBD
MODEL TBD
FLOWRATE 200 M3/HR
MOTOR 55 kW VSD TBC
HEAD 55 M

PU-1302
LOADOUT STANDBY
MAKE TBD
MODEL TBD
FLOWRATE 200 M3/HR
MOTOR 55 kW VSD TBC
HEAD 55 M

PU-1303
SHIP DUTY
MAKE TBD
MODEL TBD
FLOWRATE 1000 M3/HR
MOTOR 250 kW VSD TBC
HEAD 100 M

PU-1304
SHIP STANDBY
MAKE TBD
MODEL TBD
FLOWRATE 1000 M3/HR
MOTOR 250 kW VSD TBC
HEAD 100 M

FROM TK-0100 20399-PI01
FROM TK-0200 20399-PI02
FROM TK-0300 20399-PI03
FROM TK-0400 20399-PI04
FROM TK-0500 20399-PI05
FROM TK-0600 20399-PI06
FROM SLOPS TANK 20399-PI07
FROM SLOPS TK0800 20399-PI08

TANK INLET MANIFOLD 20399-PI12
TANK LOADING 20399-PI11
LOADING GANTRY 20399-PI11
WHARF PIPELINE 20399-PI14

PU-1301
PU-1302
PU-1303
PU-1304
PU-1305

NOTES:
1. COMMISSIONING CONE STRAINER SPOOL
2. OPTION TO DRAIN PUMP BYPASS PIPING WHEN NOT IN USE
3. STRAINER 60 MESH

PROJECT MANAGERS | PLANNERS | DESIGNERS | ENGINEERS

TfA Project Group

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SIGNATURE:

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REV	DATE	BY	DESCRIPTION	CHK	APP
A	21.06.21	HE	ISSUE FOR INFORMATION	BV	KS
B	23.06.21	HE	UPDATED POST DESIGN REVIEW	BV	KS
C	28.06.21	HE	REVISED FOR HAZOP	BV	KS

PROJECT DETAILS
MANILDRA GROUP
BULK LIQUIDS FACILITY
PORT KEMBLA

DRAWING TITLE
P&ID
PRODUCT TRANSFER SYSTEM
PUMPING STATION

STATUS
HAZOP ISSUE

DATE CREATED	ORIGINAL SCALE	SHEET
16.06.21	NTS	A3

DO NOT SCALE THIS DRAWING. CONFIRM ALL DIMENSIONS ON SITE.

DRAWING NO	REV
20399-PI13	C

EQ-1401

PIG HATCH
MAKE TBC
MODEL TBC
CLASS 150

EQ-1402

PIG HATCH
MAKE TBC
MODEL TBC
CLASS 150

TERMINAL | PIPELINE

NITROGEN
20399–PI22

06-N-80-SS1-2203

V-1417
80

PCV-1410
80
FC
SET @ 350 kPa

06-N-80-SS1-1409

NITROGEN TO WHARF
20399–PI15

FROM PUMPING STATION
20399–PI13

06-EOH-300-SS1-1312

V-1406
80

V-1407
80

V-1452
20

PI
1401

V-1453
20

EQ-1401

V-1451
40

PIG
SIG
1401

V-1454
20

PI
1402

V-1455
20

V-1401
300

NOTE 3

V-1405
300

NOTE 2

PI
1403

V-1456
40

V-1457
20

06-EOH-300-SS3-1401

WHARFLINE
20399–PI15

NOTE 1

NOTE 6

ZS
1402

PI
1404

V-1459
20

V-1460
20

EQ-1402

PIG
SIG
1402

V-1461
20

PI
1405

V-1462
20

V-1402
300

NOTE 3

NOTE 2

NOTE 5

ZS
1403

PI
1406

V-1470
40

V-1471
20

PIG
SIG
1403

06-EOH-300-SS3-1504

WHARF RETURN LINE
20399–PI15

V-1463
40

06-EOH-150-SS1-1403

LSO
1411

LIO
1411

LSC
1411

LIC
1411

150
NC

SV-1411

S

AS

VV-1411

06-SL-300-SS2-1404

LSO
1412

LIO
1412

LSC
1412

LIC
1412

300
NC

SV-1412

VV-1412

LSO
1413

LIO
1413

LSC
1413

LIC
1413

100
FC

SV-1413

VV-1413

UA
1414

FT
1414

FCV-1414

100
FO

V-1465
25

V-1467
25

100x50

FA-1401

100x50

06-SL-100-SS4-1408

TO WET SCRUBBER
20399–PI23

V-1415
300

06-EOH-300-SS1-1406

TO SLOPS TK0700
20399–PI07

V-1416
300

06-EOH-300-SS1-1407

TO SLOPS TK0800
20399–PI08

06-EOH-300-SS1-1405

NOTES:

1. FUTURE SHIP RECEIPT CONNECTION
2. BARRED TEE (PIGGING).
3. FULL BORE VALVE (PIGGABLE).
4. HIGH POINT VENTS AND LOW POINT DRAINS ARE NOT SHOWN ON THE P&ID, THEY ARE TO BE INSTALLED AS REQUIRED BY THE CONTRACTOR.
5. EARLY PIG SIG CLOSES MAIN LINE TO SLOPS
6. FINAL PIG SIG OPENS LINE TO WET SCRUBBER CLOSES PIG KICKER LINE

PROJECT MANAGERS | PLANNERS | DESIGNERS | ENGINEERS

TfA Project Group

Head office – Brisbane Ph: 61 7 3854 2900
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Email: enquiry@tfa.com.au Aust Wide: 1300 794 300

DRAWING ISSUE APPROVAL

NAME: DATE:

PROFESSIONAL QUALIFICATION:

SIGNATURE:

REV	DATE	BY	DESCRIPTION	CHK	APP
A	21.06.21	HE	ISSUE FOR INFORMATION	BV	KS
B	25.06.21	HE	ISSUED FOR HAZOP	BV	KS
C	28.06.21	HE	REVISED FOR HAZOP	BV	KS

PROJECT DETAILS

MANILDRA GROUP
BULK LIQUIDS FACILITY
PORT KEMBLA

DRAWING TITLE

P&ID
PIPELINE & TERMINAL PIGGING SYSTEM

STATUS

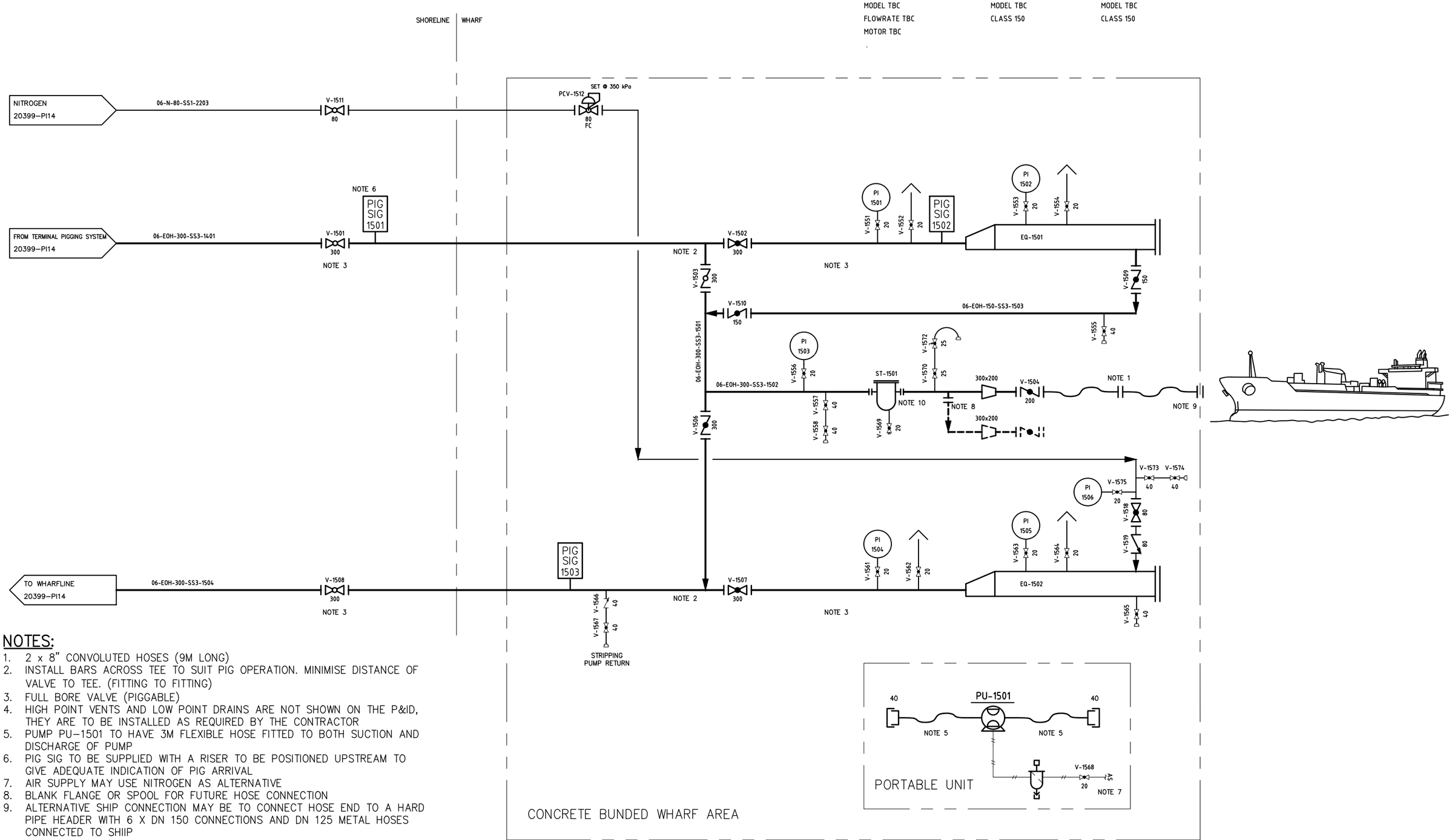
HAZOP ISSUE

DATE CREATED	ORIGINAL SCALE	SHEET
16.06.21	NTS	A3

DO NOT SCALE THIS DRAWING. CONFIRM ALL DIMENSIONS ON SITE.

DRAWING NO	REV
20399-PI14	C

PU-1501	EQ-1501	EQ-1502
DIAPHRAGM PUMP	PIG HATCH	PIG HATCH
MAKE TBC	MAKE TBC	MAKE TBC
MODEL TBC	MODEL TBC	MODEL TBC
FLOWRATE TBC	CLASS 150	CLASS 150
MOTOR TBC		



NOTES:

1. 2 x 8" CONVOLUTED HOSES (9M LONG)
2. INSTALL BARS ACROSS TEE TO SUIT PIG OPERATION. MINIMISE DISTANCE OF VALVE TO TEE. (FITTING TO FITTING)
3. FULL BORE VALVE (PIGGABLE)
4. HIGH POINT VENTS AND LOW POINT DRAINS ARE NOT SHOWN ON THE P&ID, THEY ARE TO BE INSTALLED AS REQUIRED BY THE CONTRACTOR
5. PUMP PU–1501 TO HAVE 3M FLEXIBLE HOSE FITTED TO BOTH SUCTION AND DISCHARGE OF PUMP
6. PIG SIG TO BE SUPPLIED WITH A RISER TO BE POSITIONED UPSTREAM TO GIVE ADEQUATE INDICATION OF PIG ARRIVAL
7. AIR SUPPLY MAY USE NITROGEN AS ALTERNATIVE
8. BLANK FLANGE OR SPOOL FOR FUTURE HOSE CONNECTION
9. ALTERNATIVE SHIP CONNECTION MAY BE TO CONNECT HOSE END TO A HARD PIPE HEADER WITH 6 X DN 150 CONNECTIONS AND DN 125 METAL HOSES CONNECTED TO SHIIP
10. STRAINER 60 MESH

PROJECT MANAGERS | PLANNERS | DESIGNERS | ENGINEERS

TfA Project Group

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PROJECT DETAILS

MANILDRA GROUP
BULK LIQUIDS FACILITY
PORT KEMBLA

DRAWING TITLE

P&ID
PRODUCT TRANSFER SYSTEM
WHARFLINE

STATUS

HAZOP ISSUE

DATE CREATED	ORIGINAL SCALE	SHEET
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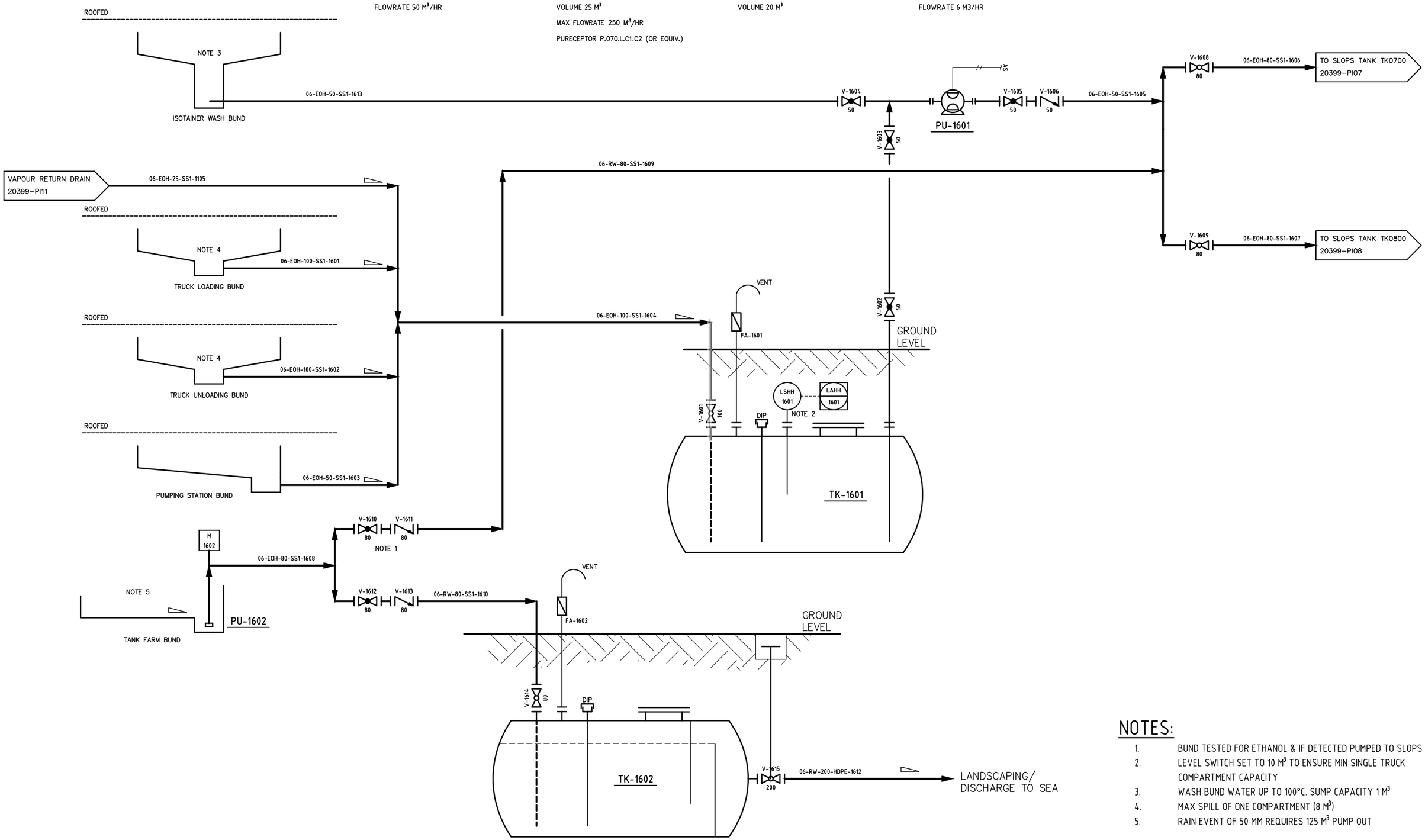
DRAWING NO	REV
20399-PI15	C

PU-1602
SUMP PUMP
VERTICAL TURBINE
FLOWRATE 50 M^3/HR

TK-1602
STORMWATER HOLDING TANK
SINGLE WALL FIBREGLASS
VOLUME 25 M^3
MAX FLOWRATE 250 M^3/HR
PURECEPTOR P.070.L.C1.C2 (OR EQUIV.)

TK-1601
SPILL CONTAINMENT TANK
DOUBLE WALL FIBREGLASS
VOLUME 20 M^3

PU-1601
GRACO HUSKY 1050 OR EQUIVILANT
SLOPS RETURN PUMP
FLOWRATE 6 M3/HR



NOTES:

1. BUND TESTED FOR ETHANOL & IF DETECTED PUMPED TO SLOPS
2. LEVEL SWITCH SET TO 10 M^3 TO ENSURE MIN SINGLE TRUCK COMPARTMENT CAPACITY
3. WASH BUND WATER UP TO 100°C. SUMP CAPACITY 1 M^3
4. MAX SPILL OF ONE COMPARTMENT (8 M^3)
5. RAIN EVENT OF 50 MM REQUIRES 125 M^3 PUMP OUT

PROJECT MANAGERS | PLANNERS | DESIGNERS | ENGINEERS

TfA Project Group

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DRAWING ISSUE APPROVAL

REV	DATE	BY	DESCRIPTION	CHK	APP
A	21.06.21	HE	ISSUE FOR INFORMATION	BV	KS
B	28.06.21	HE	ISSUE FOR HAZOP	BV	KS

PROJECT DETAILS
MANILDRA GROUP
BULK LIQUIDS FACILITY
PORT KEMBLA

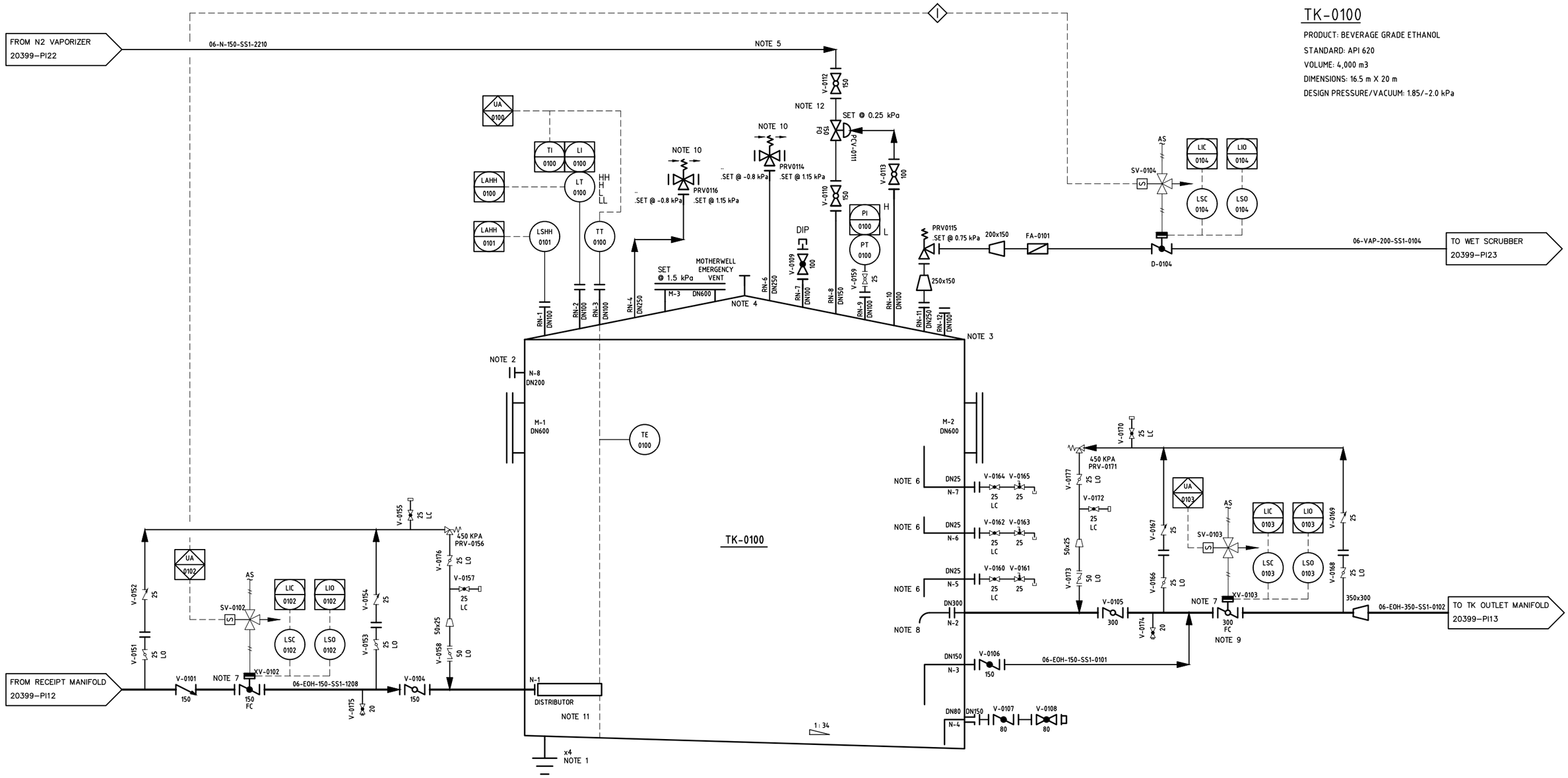
DRAWING TITLE
P&ID
PRODUCT TRANSFER SYSTEM
SLOPS AND DRAINAGE SYSTEM

STATUS: HAZOP ISSUE

DATE CREATED	ORIGINAL SCALE	SHEET
21.06.21	NTS	A3

DO NOT SCALE THIS DRAWING. CONFIRM ALL DIMENSIONS ON SITE.

DRAWING NO	REV
20399-PI16	B



NOTES:

1. EARTHING LUGS (4OFF) TO BE PROVIDED ON TANK
2. FOAM POURER CONNECTION WITH VAPOUR SEAL
3. TANK ROOF FRANGIBLE JOINT
4. SCAFFOLD HOOK
5. NITROGEN PRESSURE 1.8 kPa MAXIMUM PRIOR TO PCV
6. BOTTOM, MIDDLE, TOP SAMPLES
7. ACTUATOR CLOSE RATE MIN 30SEC (TBC AFTER SURGE REVIEW)
8. OUTLET ENLARGED TO DN400 IN TANK
9. PROGRAMMED LOCK OUT TO PREVENT TWO TANK OUTLET VALVES BEING OPEN AT THE SAME TIME
10. INTEGRAL FLAME ARRESTOR ON OUTLET
11. SLOTTED TO LIMIT FLOW TO 1 M/S & SELF DRAINING
12. NITROGEN PARTICULATE FILTER (TBC)

PROJECT MANAGERS | PLANNERS | DESIGNERS | ENGINEERS

TfA Project Group

DRAWING ISSUE APPROVAL

NAME: DATE:

PROFESSIONAL QUALIFICATION:

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REV	DATE	BY	DESCRIPTION	CHK	APP
A	11.06.21	LCN	ISSUED FOR INFORMATION		
B	18.06.21	HE	GENERAL REVISION	BV	KS
C	25.06.21	HE	ISSUED FOR HAZOP	BV	KS
D	28.06.21	HE	REVISED FOR HAZOP	BV	KS
E	09.07.21	HE	REVISED POST HAZOP 1	BV	
F	23.07.21	HE	ISSUE FOR HAZOP 2		

PROJECT DETAILS

MANILDRA GROUP
SHOALHAVEN STARCHES
PORT KEMBLA SITE
FORESHORE ROAD
PORT KEMBLA, NSW

DRAWING TITLE

P&ID
PRODUCT STORAGE TANK
BEVERAGE GRADE ETHANOL TANK
TK-0100

STATUS

HAZOP ISSUE

DATE CREATED	ORIGINAL SCALE	SHEET
31.05.21	NTS	A3

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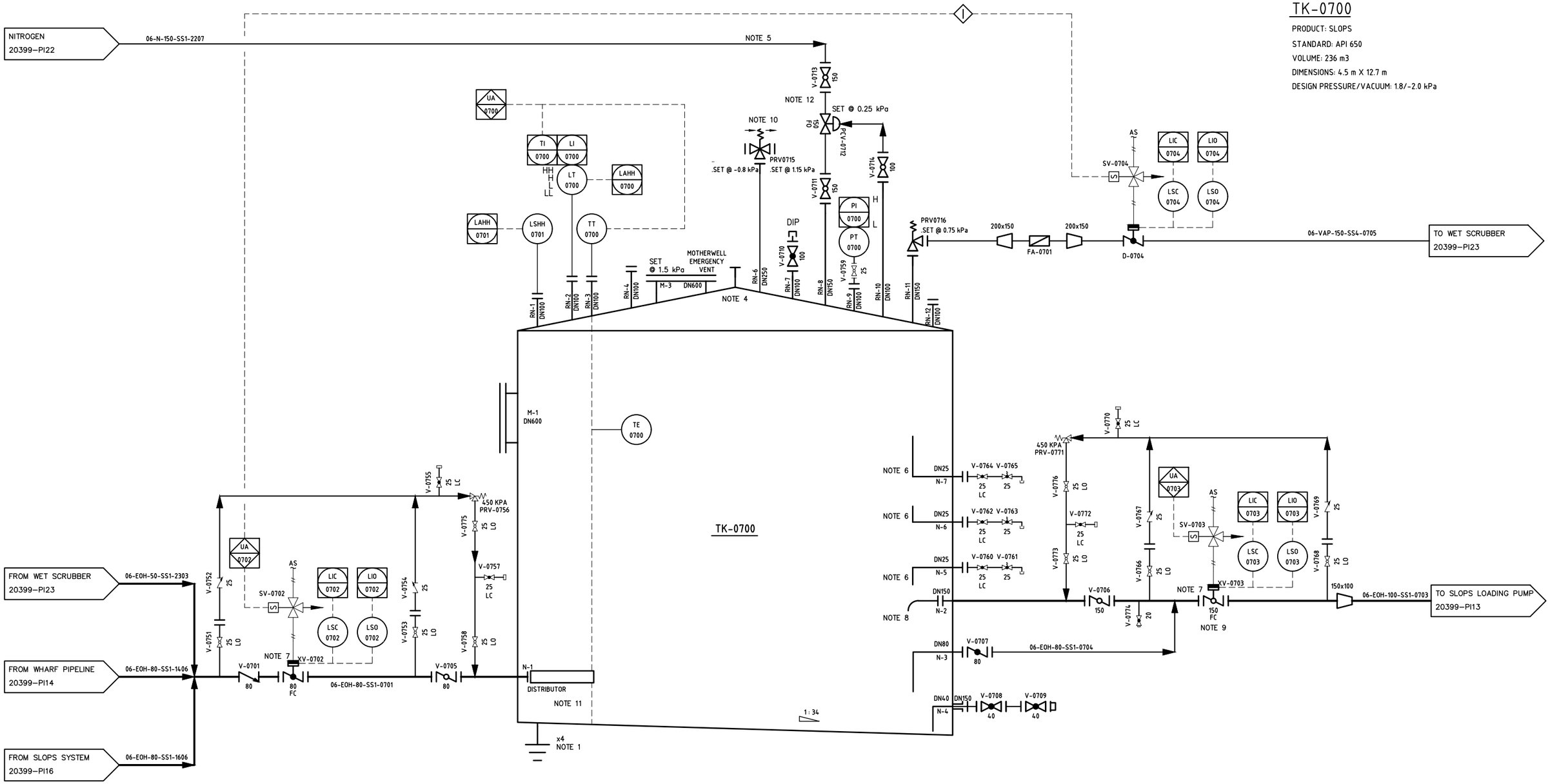
DRAWING NO	REV
20399-PI01	F



NOTES:

1. EARTHING LUGS (4OFF) TO BE PROVIDED ON TANK
2. REMOVED
3. REMOVED
4. SCAFFOLD HOOK
5. NITROGEN PRESSURE 1.8 kPa MAXIMUM PRIOR TO PCV
6. BOTTOM, MIDDLE, TOP SAMPLES
7. ACTUATOR CLOSE RATE MIN 30SEC (TBC AFTER SURGE REVIEW)
8. OUTLET ENLARGED TO DN200 IN TANK
9. PROGRAMMED LOCK OUT TO PREVENT TWO TANK OUTLET VALVES BEING OPEN AT THE SAME TIME
10. INTEGRAL FLAME ARRESTOR ON OUTLET
11. SLOTTED TO LIMIT FLOW TO 1 M/S & SELF DRAINING
12. NITROGEN PARTICULATE FILTER (TBC)

PROJECT MANAGERS | PLANNERS | DESIGNERS | ENGINEERS

TfA Project Group

DRAWING ISSUE APPROVAL

NAME: DATE:

PROFESSIONAL QUALIFICATION:

SIGNATURE:

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REV	DATE	BY	DESCRIPTION	CHK	APP
A	22.06.21	HE	ISSUED FOR INFORMATION	BV	KS
B	28.06.21	HE	ISSUE FOR HAZOP	BV	KS
C	09.07.21	HE	REVISED POST HAZOP 1	BV	
D	23.07.21	HE	ISSUE FOR HAZOP 2		

PROJECT DETAILS

MANILDRA GROUP
SHOALHAVEN STARCHES
PORT KEMBLA SITE
FORESHORE ROAD
PORT KEMBLA, NSW

DRAWING TITLE

P&ID
PRODUCT STORAGE SYSTEM
SLOPS TANK
TK-0700

STATUS

HAZOP ISSUE

DATE CREATED	ORIGINAL SCALE	SHEET
22.07.21	NTS	A3

DO NOT SCALE THIS DRAWING. CONFIRM ALL DIMENSIONS ON SITE.

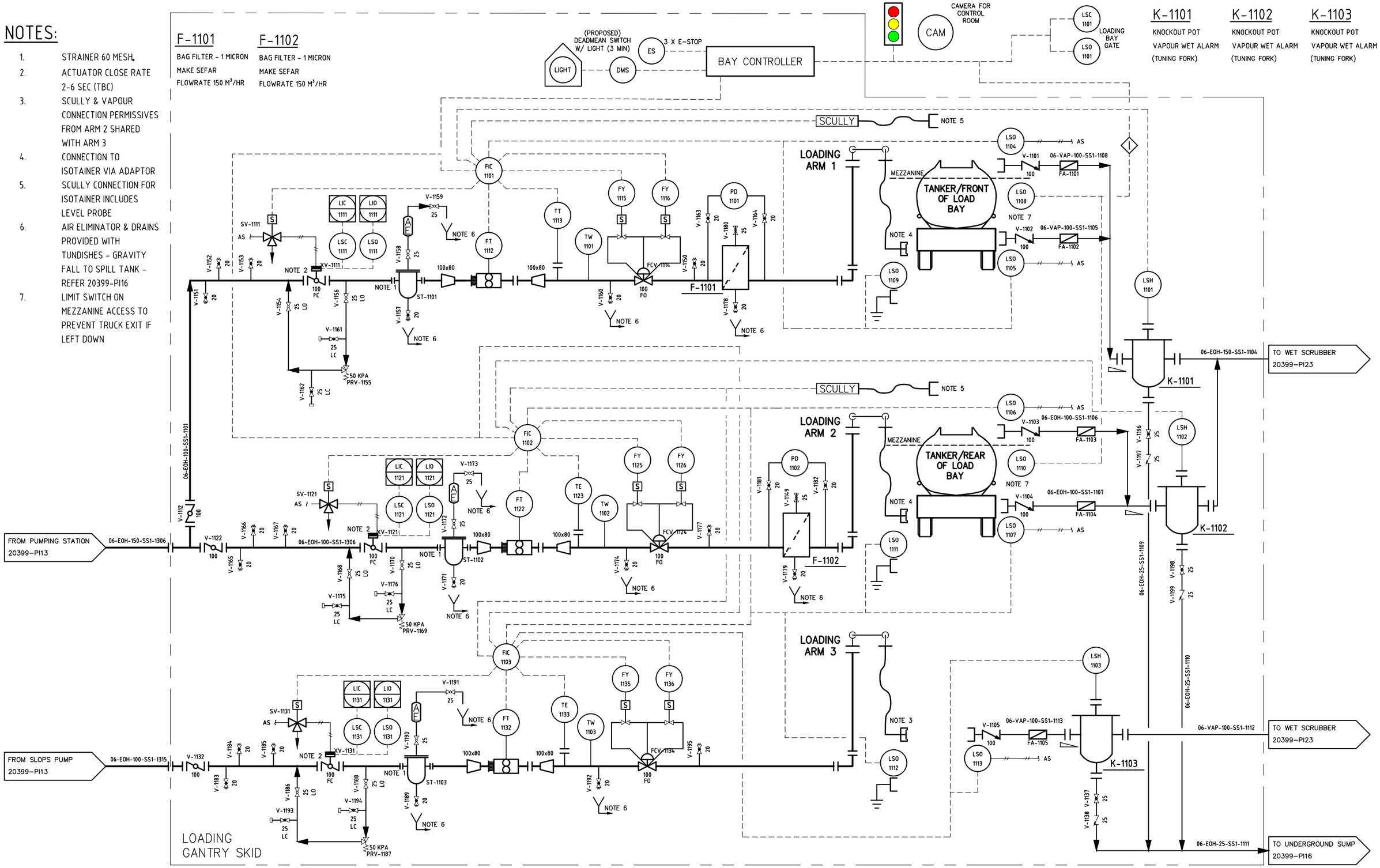
DRAWING NO	REV
20399-PI07	D

NOTES:

1. STRAINER 60 MESH.
2. ACTUATOR CLOSE RATE 2-6 SEC (TBC)
3. SCULLY & VAPOUR CONNECTION PERMISSIVES FROM ARM 2 SHARED WITH ARM 3
4. CONNECTION TO ISOTAINER VIA ADAPTOR
5. SCULLY CONNECTION FOR ISOTAINER INCLUDES LEVEL PROBE
6. AIR ELIMINATOR & DRAINS PROVIDED WITH TUNDISHES - GRAVITY FALL TO SPILL TANK - REFER 20399-PI16
7. LIMIT SWITCH ON MEZZANINE ACCESS TO PREVENT TRUCK EXIT IF LEFT DOWN

F-1101	F-1102
BAG FILTER - 1 MICRON	BAG FILTER - 1 MICRON
MAKE SEFAR	MAKE SEFAR
FLOWRATE 150 M³/HR	FLOWRATE 150 M³/HR

K-1101	K-1102	K-1103
KNOCKOUT POT	KNOCKOUT POT	KNOCKOUT POT
VAPOUR WET ALARM (TUNING FORK)	VAPOUR WET ALARM (TUNING FORK)	VAPOUR WET ALARM (TUNING FORK)



PROJECT MANAGERS | PLANNERS | DESIGNERS | ENGINEERS	DRAWING ISSUE APPROVAL	REV	DATE	BY	DESCRIPTION	CHK	APP	PROJECT DETAILS	DRAWING TITLE	STATUS
TfA Project Group	NAME: DATE:	A	18.06.21	HE	ISSUE FOR INFORMATION	BV	KS	MANILDRA GROUP	P&ID	HAZOP ISSUE
	PROFESSIONAL QUALIFICATION:	B	25.06.21	HE	ISSUED FOR HAZOP	BV	KS	SHOALHAVEN STARCHES	PRODUCT TRANSFER SYSTEM	DATE CREATED 09.06.21 / ORIGINAL SCALE NTS / SHEET A3
	SIGNATURE:	C	28.05.21	HE	REVISED FOR HAZOP	BV	KS	PORT KEMBLA SITE	TRUCK LOADING	DO NOT SCALE THIS DRAWING. CONFIRM ALL DIMENSIONS ON SITE.
Head office - Brisbane Ph: 61 7 3854 2900 166 Knapp Street, Fortitude Valley QLD 4006 Australia Email: enquiry@tfa.com.au Aust Wide: 1300 794 300		D	09.07.21	HE	REVISED POST HAZOP 1	BV		FORESHORE ROAD		DRAWING NO 20399-PI11 / REV E
		E	23.07.21	HE	ISSUE FOR HAZOP 2			PORT KEMBLA, NSW		

PU-1305	PU-1301	PU-1302	PU-1303	PU-1304
SLOPS PUMP	LOADOUT DUTY	LOADOUT STANDBY	SHIP DUTY	SHIP STANDBY
MAKE TBD	MAKE TBD	MAKE TBD	MAKE TBD	MAKE TBD
MODEL TBD	MODEL TBD	MODEL TBD	MODEL TBD	MODEL TBD
FLOWRATE 120 M3/HR	FLOWRATE 200 M3/HR	FLOWRATE 200 M3/HR	FLOWRATE 1000 M3/HR	FLOWRATE 1000 M3/HR
MOTOR 30 kW	MOTOR 55 kW VSD TBC	MOTOR 55 kW VSD TBC	MOTOR 250 kW VSD TBC	MOTOR 250 kW VSD TBC
	HEAD 55 M	HEAD 55 M	HEAD 100 M	HEAD 100 M

FROM TK-0100 20399-PI01
FROM TK-0200 20399-PI02
FROM TK-0300 20399-PI03
FROM TK-0400 20399-PI04
FROM TK-0500 20399-PI05
FROM TK-0600 20399-PI06
FROM SLOPS TANK 20399-PI07
FROM SLOPS TK0800 20399-PI08
TANK INLET MANIFOLD 20399-PI12
TANK LOADING 20399-PI11
LOADING GANTRY 20399-PI11
WHARF PIPELINE 20399-PI14

NOTES:

1. COMMISSIONING CONE STRAINER SPOOL
2. OPTION TO DRAIN PUMP BYPASS PIPING WHEN NOT IN USE
3. STRAINER 40 MESH (200 DIA)
4. SPOOL PIECE TO MATCH LENGTH OF SPOOL WITH 300 DIAMETER BUTTERFLY VALVE SHOWN IN MANIFOLD

PROJECT MANAGERS | PLANNERS | DESIGNERS | ENGINEERS

TfA Project Group

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DRAWING ISSUE APPROVAL
NAME: DATE:
PROFESSIONAL QUALIFICATION:
SIGNATURE:

REV	DATE	BY	DESCRIPTION	CHK	APP
A	21.06.21	HE	ISSUE FOR INFORMATION	BV	KS
B	23.06.21	HE	UPDATED POST DESIGN REVIEW	BV	KS
C	28.06.21	HE	REVISED FOR HAZOP	BV	KS
D	08.07.21	HE	REVSIED POST HAZOP 1	BV	
E	23.07.21	HE	ISSUE FOR HAZOP 2		

PROJECT DETAILS
MANILDRA GROUP
SHOALHAVEN STARCHES
PORT KEMBLA SITE
FORESHORE ROAD
PORT KEMBLA, NSW

DRAWING TITLE
P&ID
PRODUCT TRANSFER SYSTEM PUMPING STATION

STATUS
HAZOP ISSUE

DATE CREATED	ORIGINAL SCALE	SHEET
16.06.21	NTS	A3

DO NOT SCALE THIS DRAWING. CONFIRM ALL DIMENSIONS ON SITE.

DRAWING NO	REV
20399-PI13	E

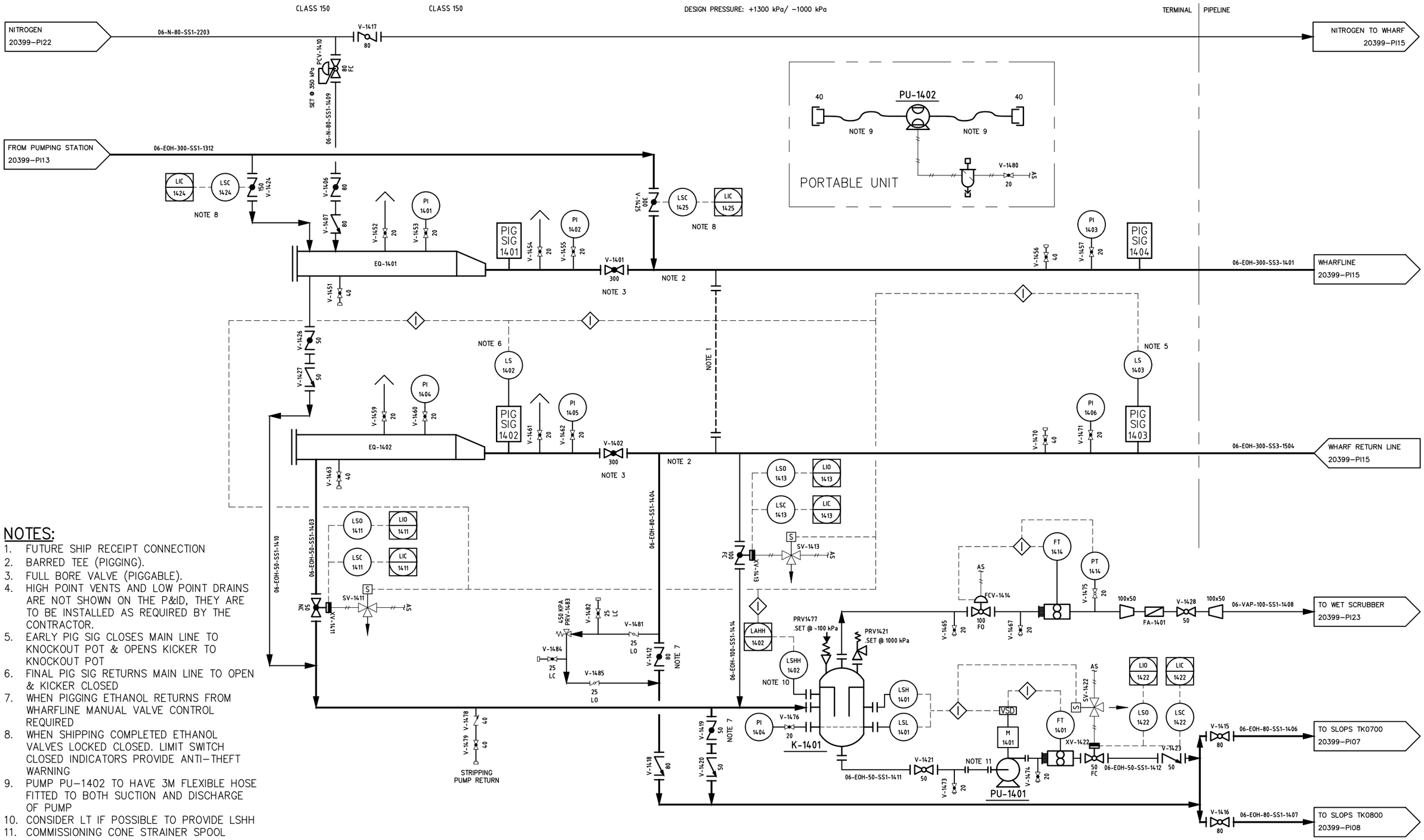
EQ-1401
PIG HATCH
MAKE TBC
MODEL TBC
CLASS 150

EQ-1402
PIG HATCH
MAKE TBC
MODEL TBC
CLASS 150

PU-1402
DIAPHRAGM PUMP
MAKE/MODEL TBC
FLOWRATE TBC

K-1401
KNOCKOUT POT
FLOWRATE 400 LPM
VOLUME 2000 L (TBC)
DESIGN PRESSURE: +1300 kPa/ −1000 kPa

PU-1401
CENTRIFUGAL PUMP
MAKE/MODEL TBC
FLOWRATE 400 LPM



NOTES:

1. FUTURE SHIP RECEIPT CONNECTION
2. BARRED TEE (PIGGING).
3. FULL BORE VALVE (PIGGABLE).
4. HIGH POINT VENTS AND LOW POINT DRAINS ARE NOT SHOWN ON THE P&ID, THEY ARE TO BE INSTALLED AS REQUIRED BY THE CONTRACTOR.
5. EARLY PIG SIG CLOSES MAIN LINE TO KNOCKOUT POT & OPENS KICKER TO KNOCKOUT POT
6. FINAL PIG SIG RETURNS MAIN LINE TO OPEN & KICKER CLOSED
7. WHEN PIGGING ETHANOL RETURNS FROM WHARFLINE MANUAL VALVE CONTROL REQUIRED
8. WHEN SHIPPING COMPLETED ETHANOL VALVES LOCKED CLOSED. LIMIT SWITCH CLOSED INDICATORS PROVIDE ANTI–THEFT WARNING
9. PUMP PU–1402 TO HAVE 3M FLEXIBLE HOSE FITTED TO BOTH SUCTION AND DISCHARGE OF PUMP
10. CONSIDER LT IF POSSIBLE TO PROVIDE LSHH
11. COMMISSIONING CONE STRAINER SPOOL

PROJECT MANAGERS | PLANNERS | DESIGNERS | ENGINEERS

TfA Project Group

DRAWING ISSUE APPROVAL
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A	21.06.21	HE	ISSUE FOR INFORMATION	BV	KS
B	25.06.21	HE	ISSUED FOR HAZOP	BV	KS
C	28.06.21	HE	REVISED FOR HAZOP	BV	KS
D	08.07.21	HE	REVISED POST HAZOP 1	BV	
E	23.07.21	HE	ISSUE FOR HAZOP 2		

PROJECT DETAILS
MANILDRA GROUP
SHOALHAVEN STARCHES
PORT KEMBLA SITE
FORESHORE ROAD
PORT KEMBLA, NSW

DRAWING TITLE
P&ID
PIPELINE & TERMINAL PIGGING SYSTEM

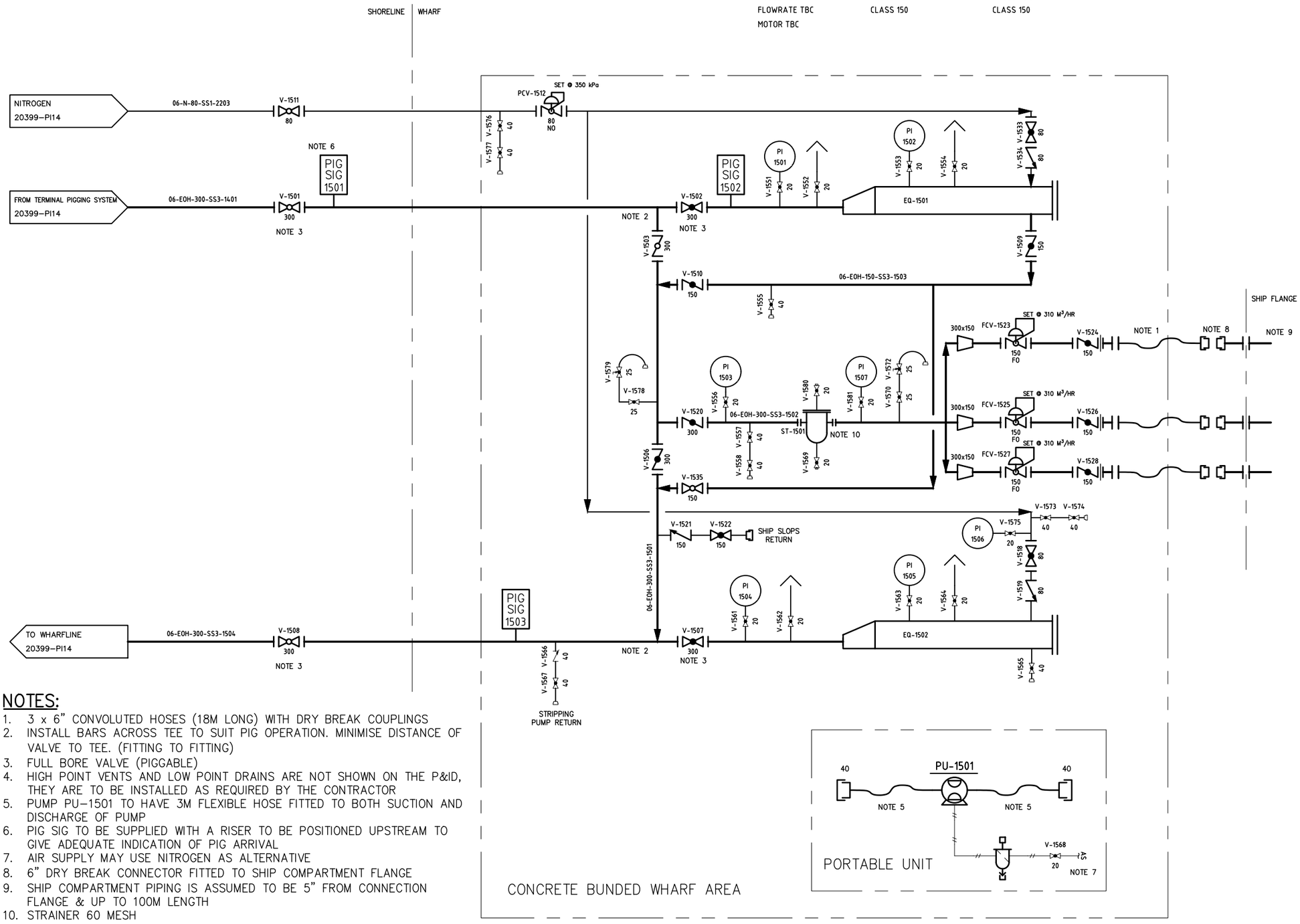
STATUS
HAZOP ISSUE

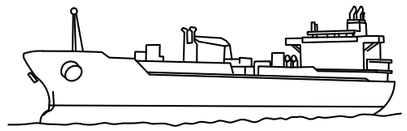
DATE CREATED	ORIGINAL SCALE	SHEET
16.06.21	NTS	A3

DO NOT SCALE THIS DRAWING. CONFIRM ALL DIMENSIONS ON SITE.

DRAWING NO	REV
20399-PI14	E

PU-1501	EQ-1501	EQ-1502
DIAPHRAGM PUMP	PIG HATCH	PIG HATCH
MAKE TBC	MAKE TBC	MAKE TBC
MODEL TBC	MODEL TBC	MODEL TBC
FLOWRATE TBC	CLASS 150	CLASS 150
MOTOR TBC		





NOTES:

1. 3 x 6" CONVOLUTED HOSES (18M LONG) WITH DRY BREAK COUPLINGS
2. INSTALL BARS ACROSS TEE TO SUIT PIG OPERATION. MINIMISE DISTANCE OF VALVE TO TEE. (FITTING TO FITTING)
3. FULL BORE VALVE (PIGGABLE)
4. HIGH POINT VENTS AND LOW POINT DRAINS ARE NOT SHOWN ON THE P&ID, THEY ARE TO BE INSTALLED AS REQUIRED BY THE CONTRACTOR
5. PUMP PU-1501 TO HAVE 3M FLEXIBLE HOSE FITTED TO BOTH SUCTION AND DISCHARGE OF PUMP
6. PIG SIG TO BE SUPPLIED WITH A RISER TO BE POSITIONED UPSTREAM TO GIVE ADEQUATE INDICATION OF PIG ARRIVAL
7. AIR SUPPLY MAY USE NITROGEN AS ALTERNATIVE
8. 6" DRY BREAK CONNECTOR FITTED TO SHIP COMPARTMENT FLANGE
9. SHIP COMPARTMENT PIPING IS ASSUMED TO BE 5" FROM CONNECTION FLANGE & UP TO 100M LENGTH
10. STRAINER 60 MESH

PROJECT MANAGERS | PLANNERS | DESIGNERS | ENGINEERS

TfA Project Group

DRAWING ISSUE APPROVAL

NAME: DATE:

PROFESSIONAL QUALIFICATION:

SIGNATURE:

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B	25.06.21	HE	ISSUED FOR HAZOP	BV	KS
C	28.06.21	HE	REVISED FOR HAZOP	BV	KS
D	09.07.21	HE	REVISED POST HAZOP 1	BV	
E	23.07.21	HE	ISSUE FOR HAZOP 2		

PROJECT DETAILS

MANILDRA GROUP
SHOALHAVEN STARCHES
PORT KEMBLA SITE
FORESHORE ROAD
PORT KEMBLA, NSW

DRAWING TITLE

P&ID
PRODUCT TRANSFER SYSTEM
WHARFLINE

STATUS

HAZOP ISSUE

DATE CREATED	ORIGINAL SCALE	SHEET
16.06.21	NTS	A3

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DRAWING NO	REV
20399-PI15	E

VA-2201

NITROGEN VAPORIZER SYSTEM

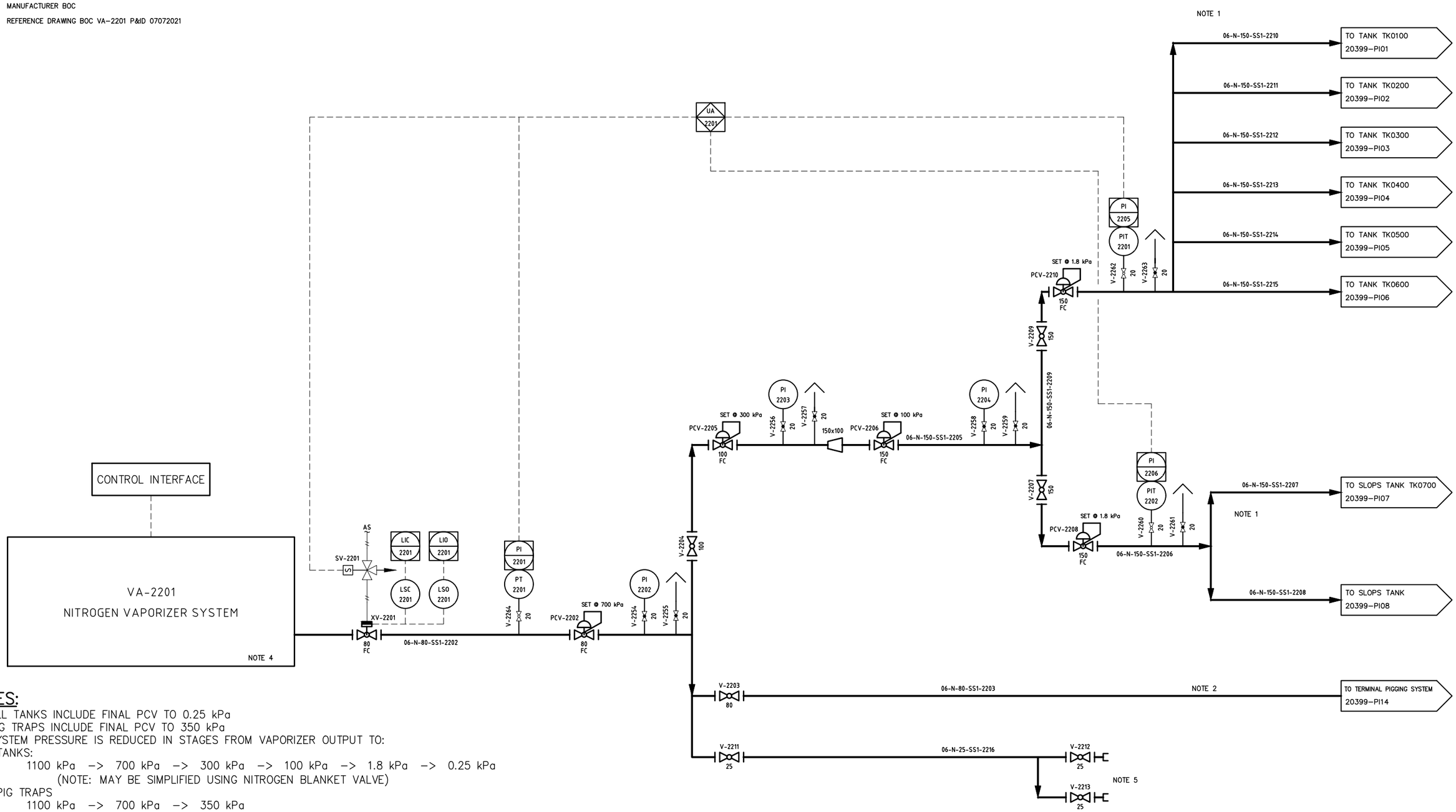
OUTLET PRESSURE 1500 to 1700 kPa

FLOWRATE 1200 M^3/HR

NITROGEN PURITY – TBC

MANUFACTURER BOC

REFERENCE DRAWING BOC VA-2201 P&ID 07072021



NOTES:

1. ALL TANKS INCLUDE FINAL PCV TO 0.25 kPa
2. PIG TRAPS INCLUDE FINAL PCV TO 350 kPa
3. SYSTEM PRESSURE IS REDUCED IN STAGES FROM VAPORIZER OUTPUT TO:
   A. TANKS:
      1100 kPa –> 700 kPa –> 300 kPa –> 100 kPa –> 1.8 kPa –> 0.25 kPa
      (NOTE: MAY BE SIMPLIFIED USING NITROGEN BLANKET VALVE)
   B. PIG TRAPS
      1100 kPa –> 700 kPa –> 350 kPa
4. SYSTEM TO BE DESIGNED BY SUPPLER. SIZING OF VALVES & PIPING MAY REQUIRE ADJUSTMENT. NO LOW TEMPERATURE TRIP PROPOSED. NO AIR FANS PROPOSED. INCL. FINAL FILTER
5. NITROGEN UTILITY FOR PURGING PIPING IN LOADING/UNLOADING TRUCK GANTRY

PROJECT MANAGERS | PLANNERS | DESIGNERS | ENGINEERS

TfA Project Group

Head office – Brisbane Ph: 61 7 3854 2900
166 Knapp Street, Fortitude Valley QLD 4006 Australia
Email: enquiry@tfa.com.au Aust Wide: 1300 794 300

DRAWING ISSUE APPROVAL

NAME: DATE:

PROFESSIONAL QUALIFICATION:

SIGNATURE:

REV	DATE	BY	DESCRIPTION	CHK	APP
A	23.06.21	HE	ISSUE FOR INFORMATION	BV	KS
B	25.06.21	HE	ISSUE FOR HAZOP	BV	KS
C	08.07.21	HE	REVISED POST HAZOP 1	BV	
D	23.07.21	HE	ISSUE FOR HAZOP 2		

PROJECT DETAILS

MANILDRA GROUP
SHOALHAVEN STARCHES
PORT KEMBLA SITE
FORESHORE ROAD
PORT KEMBLA, NSW

DRAWING TITLE

P&ID
ANCILLARY SERVICES
NITROGEN SYSTEM

STATUS

HAZOP ISSUE

DATE CREATED	ORIGINAL SCALE	SHEET
22.06.21	NTS	A3

DO NOT SCALE THIS DRAWING. CONFIRM ALL DIMENSIONS ON SITE.

DRAWING NO	REV
20399-PI22	D

CH-2301

CHILLER

DUTY 20kW

OUTLET TEMP 7°

HEX-2301

CHILLED/ TOWNS WATER HEX

MIN TEMP 7°

OUTLET TEMP 15°

WS-2301

WET SCRUBBER SYSTEM

MIN INLET PRESSURE −1 kPa (AT TANK)

FLOWRATE 200 M^3/HR

MANUFACTURER TAPC

REFERENCE DRAWING OP00277−711−01

PU-2301

DUTY CENTRIFUGAL PUMP

MAKE/MODEL TBC

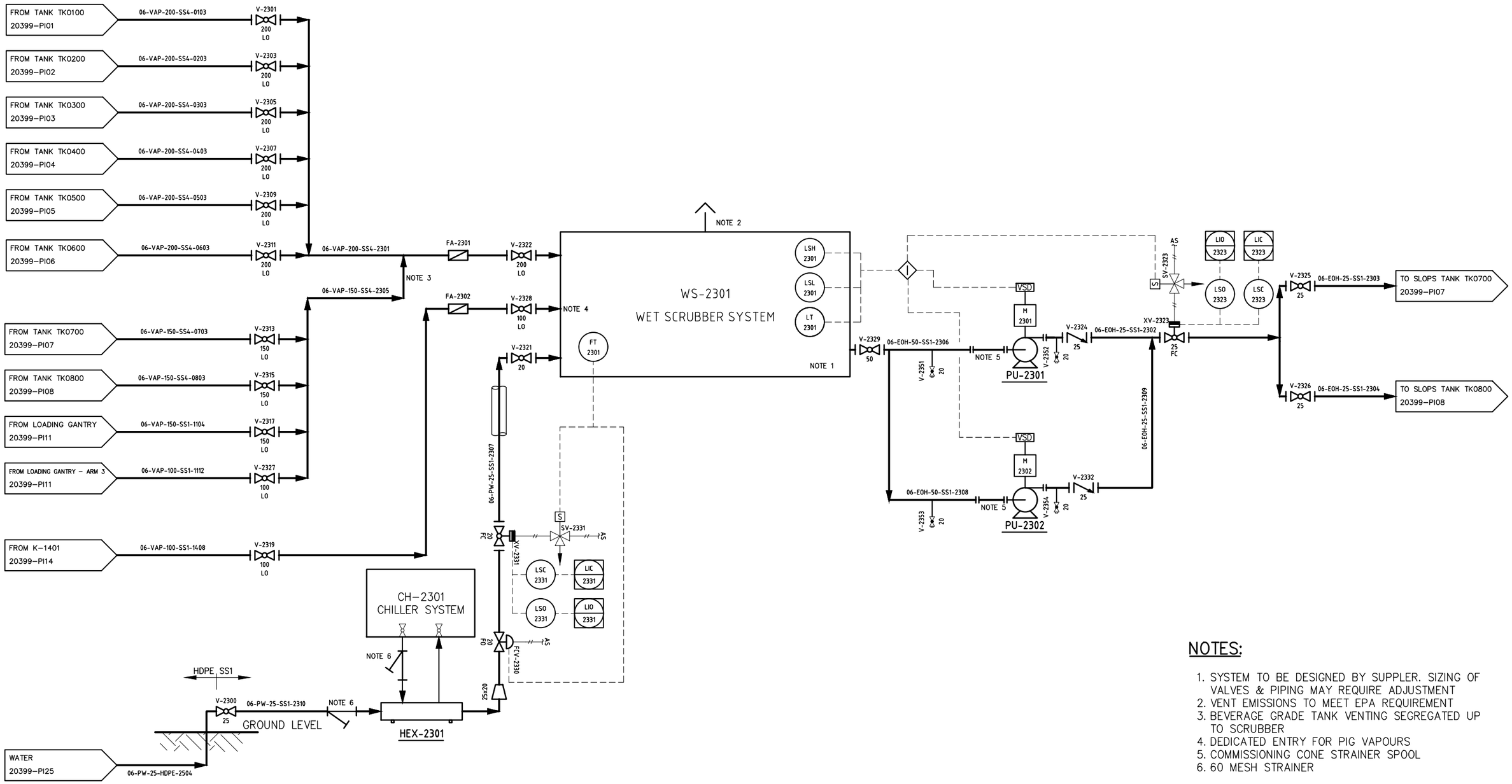
FLOWRATE 1000 LPH

PU-2302

STANDBY CENTRIFUGAL PUMP

MAKE/MODEL TBC

FLOWRATE 1000 LPH



NOTES:

1. SYSTEM TO BE DESIGNED BY SUPPLER. SIZING OF VALVES & PIPING MAY REQUIRE ADJUSTMENT
2. VENT EMISSIONS TO MEET EPA REQUIREMENT
3. BEVERAGE GRADE TANK VENTING SEGREGATED UP TO SCRUBBER
4. DEDICATED ENTRY FOR PIG VAPOURS
5. COMMISSIONING CONE STRAINER SPOOL
6. 60 MESH STRAINER

PROJECT MANAGERS | PLANNERS | DESIGNERS | ENGINEERS

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DRAWING ISSUE APPROVAL

NAME: DATE:

PROFESSIONAL QUALIFICATION:

SIGNATURE:

REV	DATE	BY	DESCRIPTION	CHK	APP
A	23.06.21	HE	ISSUE FOR INFORMATION	BV	KS
B	28.06.21	HE	ISSUE FOR HAZOP	BV	KS
C	13.07.21	HE	REVISED POST HAZOP 1	BV	
D	23.07.21	HE	ISSUE FOR HAZOP 2		

PROJECT DETAILS

MANILDRA GROUP
SHOALHAVEN STARCHES
PORT KEMBLA SITE
FORESHORE ROAD
PORT KEMBLA, NSW

DRAWING TITLE

P&ID
ANCILLARY SERVICES
WET SCRUBBER SYSTEM

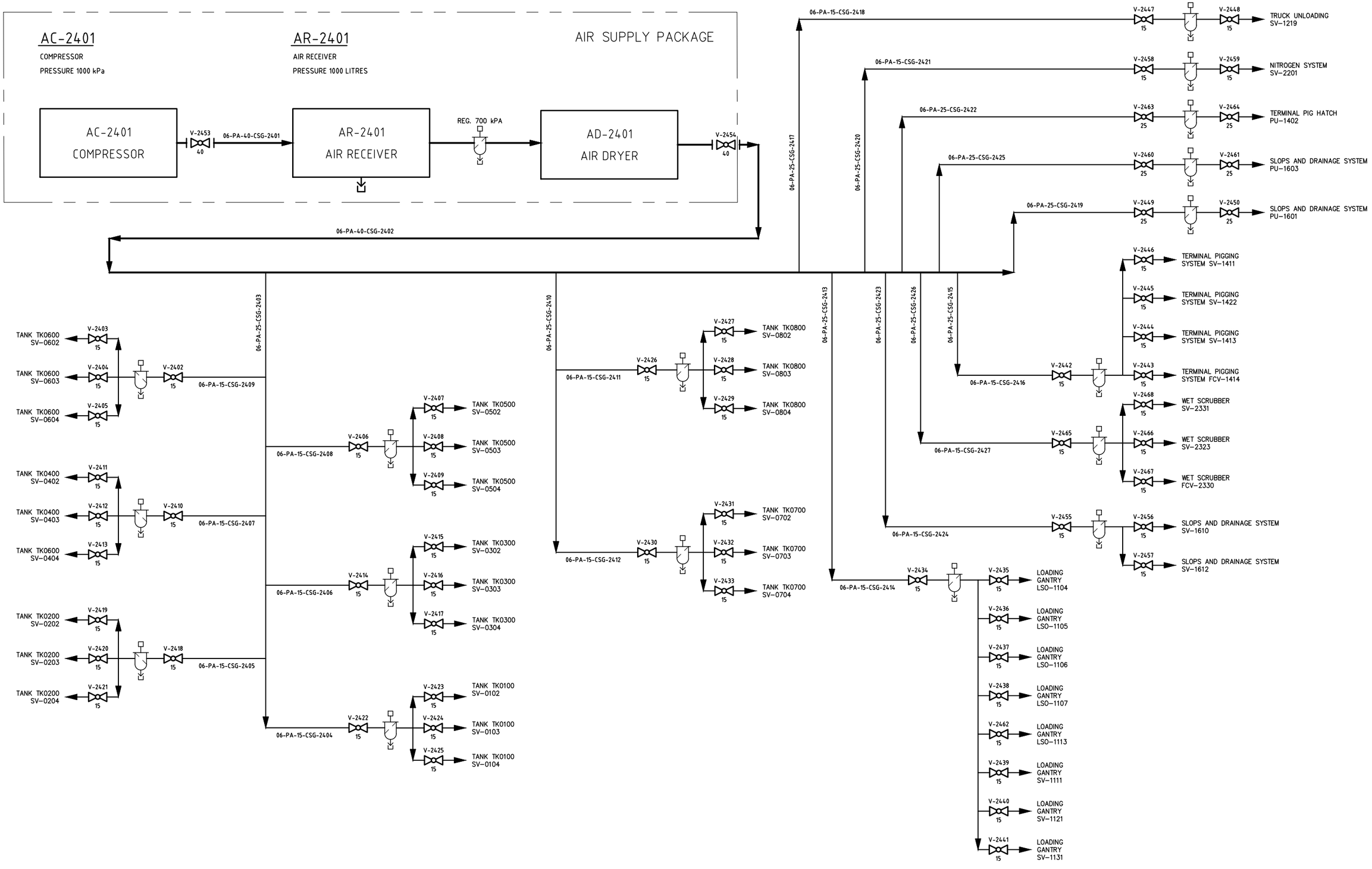
STATUS

HAZOP ISSUE

DATE CREATED	ORIGINAL SCALE	SHEET
23.06.21	NTS	A3

DO NOT SCALE THIS DRAWING. CONFIRM ALL DIMENSIONS ON SITE.

DRAWING NO	REV
20399-PI23	D



PROJECT MANAGERS | PLANNERS | DESIGNERS | ENGINEERS

TfA Project Group

DRAWING ISSUE APPROVAL

NAME: DATE:

PROFESSIONAL QUALIFICATION:

SIGNATURE:

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166 Knapp Street, Fortitude Valley QLD 4006 Australia
Email: enquiry@tfa.com.au Aust Wide: 1300 794 300

REV	DATE	BY	DESCRIPTION	CHK	APP
A	23.06.21	HE	ISSUE FOR INFORMATION	BV	KS
B	26.06.21	HE	ISSUE FOR HAZOP	BV	KS
C	12.07.21	HE	REVISED POST HAZOP 1	BV	
D	23.07.21	HE	ISSUE FOR HAZOP 2		

PROJECT DETAILS

MANILDRA GROUP
SHOALHAVEN STARCHES
PORT KEMBLA SITE
FORESHORE ROAD
PORT KEMBLA, NSW

DRAWING TITLE

P&ID
ANCILLARY SERVICES
AIR SYSTEM

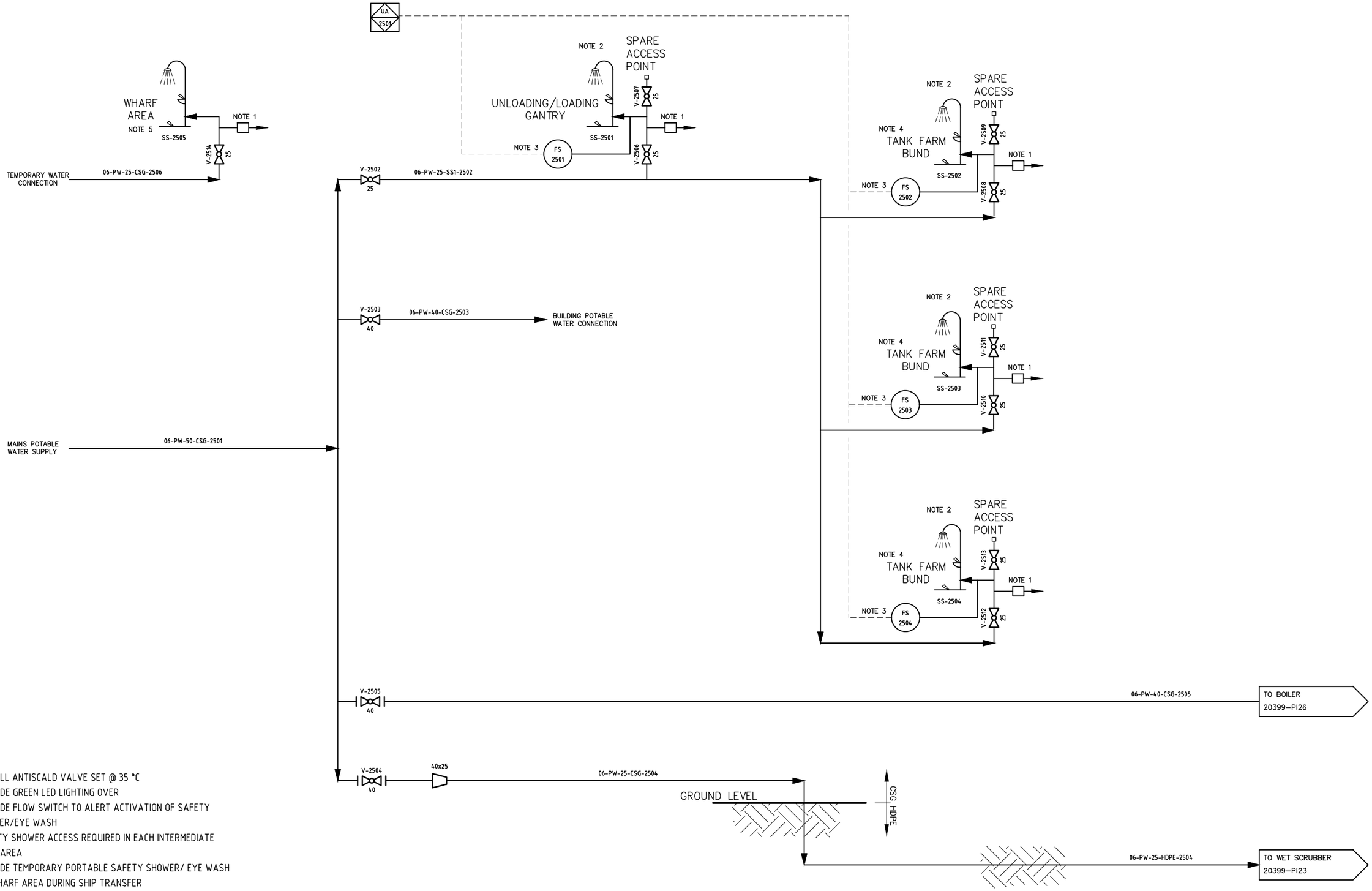
STATUS

HAZOP ISSUE

DATE CREATED	ORIGINAL SCALE	SHEET
23.06.21	NTS	A3

DO NOT SCALE THIS DRAWING. CONFIRM ALL DIMENSIONS ON SITE.

DRAWING NO	REV
20399-PI24	D



NOTES:

1. INSTALL ANTISCALD VALVE SET @ 35 °C
2. PROVIDE GREEN LED LIGHTING OVER
3. PROVIDE FLOW SWITCH TO ALERT ACTIVATION OF SAFETY SHOWER/EYE WASH
4. SAFETY SHOWER ACCESS REQUIRED IN EACH INTERMEDIATE BUND AREA
5. PROVIDE TEMPORARY PORTABLE SAFETY SHOWER/ EYE WASH AT WHARF AREA DURING SHIP TRANSFER

PROJECT MANAGERS | PLANNERS | DESIGNERS | ENGINEERS

TfA Project Group

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166 Knapp Street, Fortitude Valley QLD 4006 Australia
Email: enquiry@tfa.com.au Aust Wide: 1300 794 300

DRAWING ISSUE APPROVAL

NAME: DATE:

PROFESSIONAL QUALIFICATION:

SIGNATURE:

REV	DATE	BY	DESCRIPTION	CHK	APP
A	28.06.21	HE	ISSUE FOR HAZOP	BV	KS
B	13.07.21	HE	REVISED POST HAZOP 1	BV	
C	23.07.21	HE	ISSUE FOR HAZOP 2		

PROJECT DETAILS

MANILDRA GROUP
SHOALHAVEN STARCHES
PORT KEMBLA SITE
FORESHORE ROAD
PORT KEMBLA, NSW

DRAWING TITLE

P&ID
ANCILLARY SERVICES
POTABLE WATER

STATUS

HAZOP ISSUE

DATE CREATED	ORIGINAL SCALE	SHEET
28.06.21	NTS	A3

DO NOT SCALE THIS DRAWING. CONFIRM ALL DIMENSIONS ON SITE.

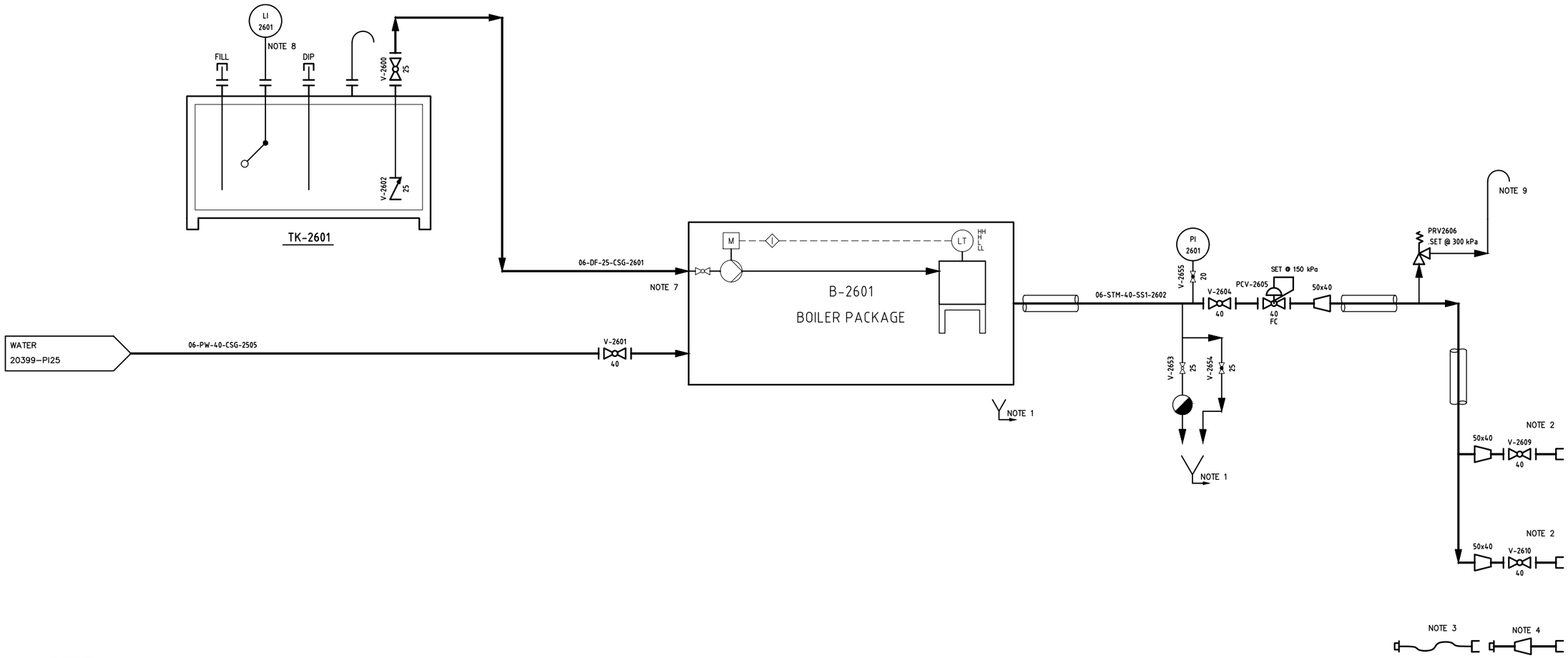
DRAWING NO	REV
20399-PI25	C

TK-2601

SELF BUNDED STEEL TANK
PRODUCT DIESEL
VOLUME 2500 L (TBC)
DIMENSIONS 2.3m L x 1.7m W x 1.3m x H

B-2601

BOILER PACKAGE
OUTPUT 50 KG PER ISOTANIER (TBC)
CAPACITY 1000 KG PER DAY
SIZE 200 kW
OUTLET PRESSURE: 500–600 kPa
MANUFACTURER TOMLINSON
REFERENCE DRAWING 1–23830



NOTES:

1. BLOWODWN & STEAM TRAPS DRAINED TO ISOTAINER SUMP. REFER 20399–PI16
2. STEAM CONNECTION POINTS LOCATED AT GROUND LEVEL AT BACK OF EACH B–DOUBLE POSITION OF ISOATAINER WASH BUND
3. 2 x 1 ½ "METAL BRAIDED HOSES 6M LONG WITH CAMLOCK CONNECTIONS & WHIPCHECKS (AS REQUIRED)
4. 2 x 1 ½ " CAMLOCK TO 3" BSP ADAPTOR FOR ISOTAINER BOTTOM CONNECTION
5. DIESEL TANK PROVIDED WITH SAFE ACCESS PLATFORM FOR FILL & DIP
6. ISOATINER TOP HATCH OPENED FOR ADEQUATE VENTING DURING STEAM OPERATION
7. BOILER DIESEL DAY TANK PROVIDED WITH AUTOMATIC TOP UP FROM TK–2601
8. MECHANICAL LEVEL GAUGE
9. VENT TO SAFE LOCATION (E.G. ROOF ACCESS)

PROJECT MANAGERS | PLANNERS | DESIGNERS | ENGINEERS

TfA Project Group

DRAWING ISSUE APPROVAL
NAME: DATE:
PROFESSIONAL QUALIFICATION:
SIGNATURE:

Head office - Brisbane Ph: 61 7 3854 2900
166 Knapp Street, Fortitude Valley QLD 4006 Australia
Email: enquiry@tfa.com.au Aust Wide: 1300 794 300

REV	DATE	BY	DESCRIPTION	CHK	APP
A	28.06.21	HE	ISSUE FOR HAZOP	BV	KS
B	12.07.21	HE	REVISED POST HAZOP 1	BV	
C	23.07.21	HE	ISSUE FOR HAZOP 2		

PROJECT DETAILS
MANILDRA GROUP
SHOALHAVEN STARCHES
PORT KEMBLA SITE
FORESHORE ROAD
PORT KEMBLA, NSW

DRAWING TITLE
P&ID
ANCILLARY SERVICES
BOILER & STEAM SYSTEM

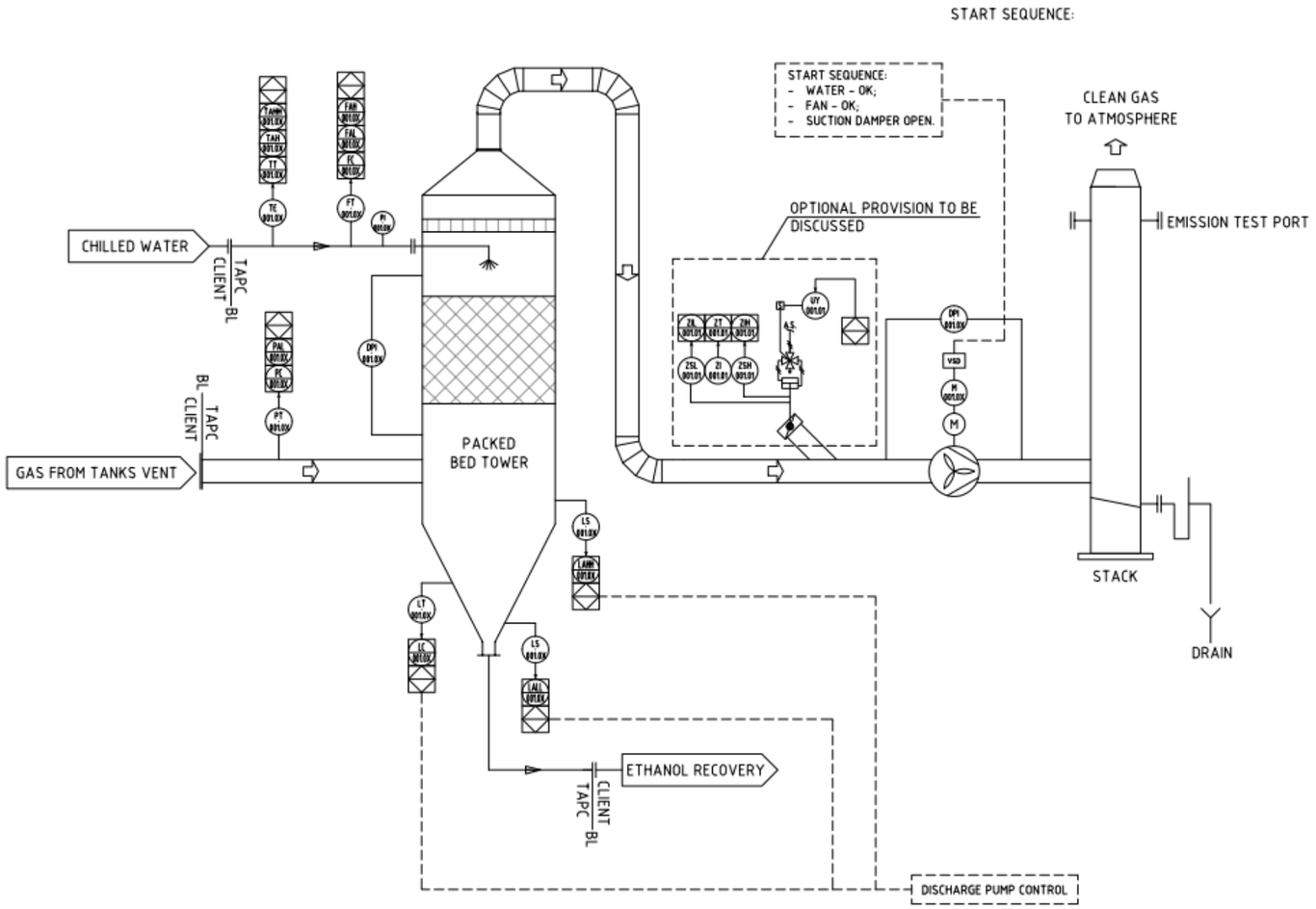
STATUS
HAZOP ISSUE

DATE CREATED	ORIGINAL SCALE	SHEET
28.06.21	NTS	A3

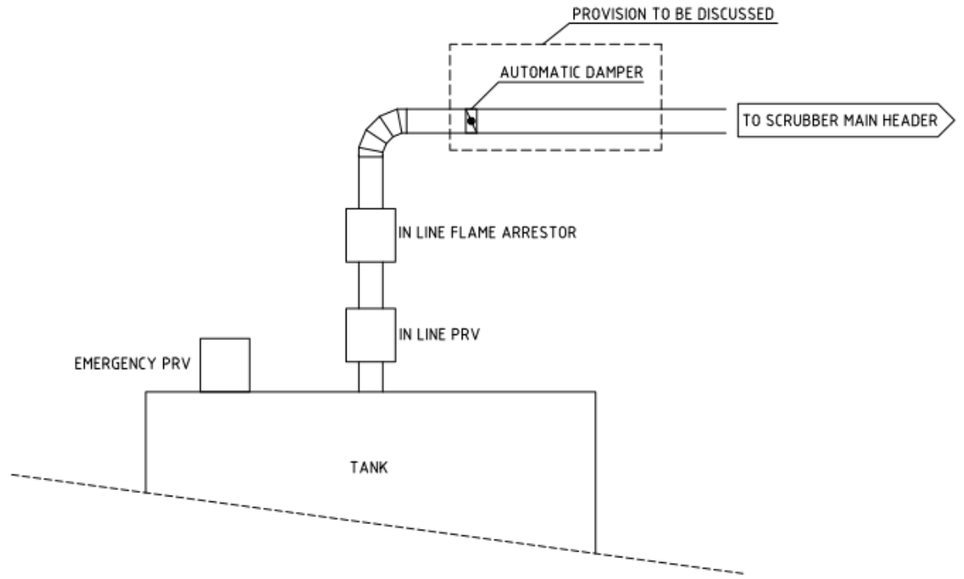
DO NOT SCALE THIS DRAWING. CONFIRM ALL DIMENSIONS ON SITE.

DRAWING NO	REV
20399-PI26	C

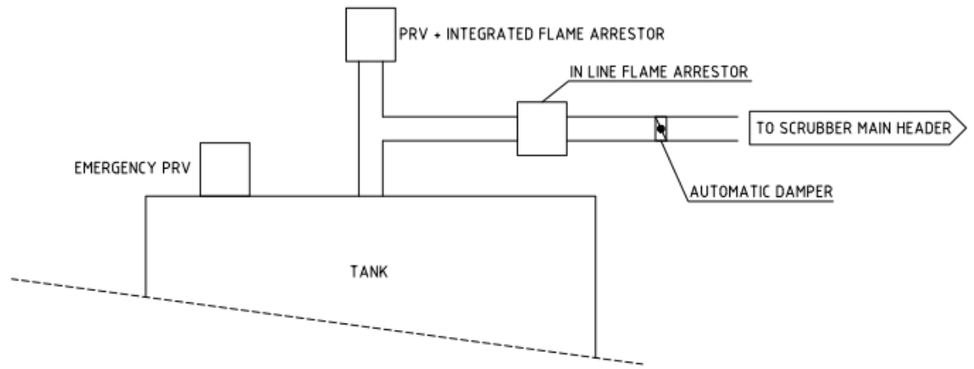
ETHANOL RECOVERY SCRUBBER



CONNECTION TO TANK - OPTION 1 (CLIENT SCOPE)



CONNECTION TO TANK - OPTION 2 (CLIENT SCOPE)



PACKED TOWER		
TAPC MODEL		c-SORB-24-40
MAIN DIM.S - Ø x L	[m]x[m]	TBC
INLET FLOW RATE	$Nm^3_{(wt)}/h$	TBC
INLET TEMPERATURE	°C	TBC
PACKING TYPE	-	TBC
EFFLUENTS BLEED	L/h	3
RECIRCULATION PUMP	kW	NA

INDUCED DRAFT FAN		
MAKE		TBC
TYPE	-	SWSI TYPE
INSTALLED/OPERATING	N°	1/1
DESIGN FLOW RATE	Am^3/h	TBC
FUME TEMPERATURE	°C	TBC
STATIC PRESSURE	Pa	TBC
CONTROL DEVICE	-	VSD (by others)
MOTOR POWER	kW	TBC

NOTES:

- DESIGN IS JUST PRELIMINARY, FOR PROPOSAL, AND MAY BE SUBJECT TO MODIFICATIONS DURING DERSIGN DEVELOPMENT;
- DESIGN IS BASED ON RAW GAS CONDITIONS INDICATED BY THE CLIENT;
- DESIGN BASIS TO BE REVIEWED AND CONFIRMED DURING ENGINEERING PHASE;
- FEED WATER, COMPRESSED AIR, POWER AND OTHER UTILITIES TO BE PROVIDED BY THE SITE.
- CHILLER FOR FEED WATER TO BE PROVIDED BY THE CLIENT.
- ALL INLET DUCTING AND DEVICES UPSTREAM OF THE SCRUBBER INLET BATTERY LIMIT ARE TO BE PROVIDED BY THE CLIENT.
- DISCHARGE PUMP FOR RECOVERED EFFLUENT TO BE PROVIDED BY CLIENT.
- OPTION 2, FOR TANK CONNECTION, PREVENTS FROM RISK OF HAVING PRESSURE BUILD UP WHEN THE VAPOUR EXTRACTION DAMPER IS CLOSED.
- TAPC BATTERY LIMIT IS CONNECTION TO INSTRUMENTS. CONTROL SYSTEM SOFTWARE, ELECTERICAL AND HARDWARE BY OTHERS.
- VSD AND DRIVES BY OTHERS.

PRELIMINARY
FOR QUOTATION ONLY

REV	DESCRIPTION	DESIGNER	DATE
A	PRELIMINARY FOR QUOTATION	TAPC	08/07/2021

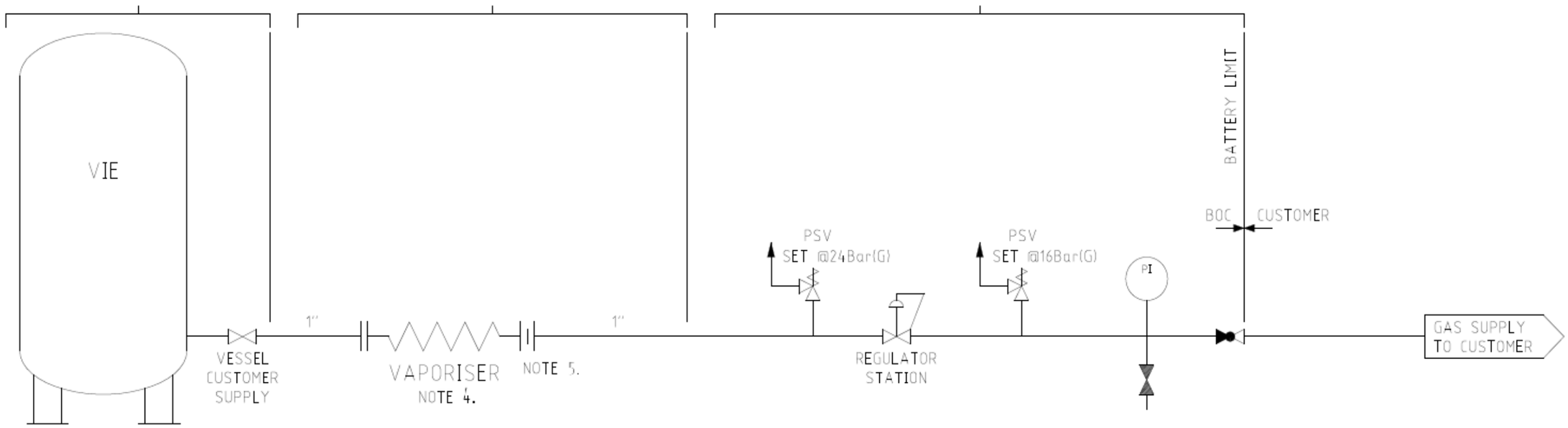
DRAWN	TAPC	08/07/2021
CHECKED		
APPROVED		
JINo.	-	

TOTAL AIR POLLUTION CONTROL PTY. LTD.
Suite 6/233 CROWN ST., WOLLONGONG NSW 2500
PH: +61 (0)2 42725233, FAX: +61 (0)2 42715633
WEB: www.tapc.com.au

PROJECT
TFA for Manildra Group
Port Kembla Ethanol Storage Facility
Tanks Vent Ethanol Recovery Scrubber
Preliminary P&Id

SIZE	DWG No.	REV
A1	OP00277-711-01	A

SCALE N/A SHEET1 OF 1



NOTES:

1. VESSEL COMPOUND IN ACCORDANCE WITH AS1894-1997.
2. POWER SUPPLY - 415V 32A
3. WATER SUPPLY - 3/4" TAP
4. VAPORISER ASSEMBLY C/W FLANGES, GASKETS AND ORIFICE.
5. RESTRICTIVE ORIFICE TO OUTLET FLANGE
6. FOR INSTALLATIONS HAVING WORKING CONDITIONS OF 10bar WITH MINIMUM TEMPERATURE 5°C AND 8 HOURS PRODUCT USE.
7. OVER PRESSURISATION PROTECTION DESIGNED FOR TANK COMPOUND ONLY.
   CUSTOMER TO BE ADVISED FOR OVER PRESSURISATION PROTECTION OF ITS PIPELINE.

CONFIENTIAL

*This diagram is reference ONLY. The pipeline design, size of vessels and vaporisers are determined by BOC Customer Engineering Services.

PROJECT | SCALE

BOC

10 JULIUS AVENUE, NORTH RYDE, NSW 2113

BOC VA-2201
P&ID 07072021

7 APPENDIX B - HAZOP GUIDE WORDS

Appendix B – HAZOP Guide Words

Note that the main headings are shown only. Some main headings included various sub-prompts as well.

Line-By-Line Guide Words – Continuous Fluid Systems

- High Level / High Flow
- Low Level / Low Flow
- Zero Flow / Empty
- Reverse Flow
- High Pressure
  - Venting, relief
- Low Pressure
  - Venting, relief
- High Temperature
- Low Temperature
- Impurities
  - Gaseous, liquid, solid
- Change in Concentration or Composition / Two Phase Flow / Reactions
- Testing
  - Equipment / product
- Plant Items
  - Operable / maintainable
- Electrical
- Instruments

Overview Guide Words

- Toxicity
- Commissioning
- Startup
- Shutdown (isolation, purging)
- Breakdown (including services failure)
- Effluent
- Fire and Explosion
- Safety Equipment
- Noise / Vibration
- Materials of Construction
- Simplicity

8 APPENDIX C – HAZOP MINUTES

HAZOP Report, Manildra, Port Kembla

Ethanol Terminal

Appendix C – HAZOP Minutes

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT:	**Manildra, Port Kembla Ethanol Terminal**	**TEAM MEMBERS:**	**Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Dyllan Ware, Ben van der Merwe (TfA), Gunter Kreilaus, Paul Whisson**	**DATE:**	**29/6/2021**
SYSTEM:	**Truck Unloading**	**LEADER:**	**Dean Shewring**		
DRAWING:	**20399-PI12 Rev C, 20399-PI01 Rev D**	**MINUTES BY:**	**Peter Nyvlt**		

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
1.	Design / Project Issue				Mark-up the P&ID to show an earth connection for road tanker unloading (either via a scully connection or a monitored earth lead per trailer)	TfA	Done
2.	Design / Project Issue				Swap the position of the unloading pumps' discharge isolation and non-return valves to allow maintenance of a non-return valve and keep the remaining pumping systems operation	TfA	Done
3.	Design / Project Issue				Mark-up the P&ID to show the high point vent on filter F-1201, i.e. to vent air when filling the filter	TfA	Done
4.	Design / Project Issue				Mark-up the P&ID to show the dead-man button for the unloading system, i.e. as per the tanker loading P&ID	TfA	Done

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT:	**Manildra, Port Kembla Ethanol Terminal**	**TEAM MEMBERS:**	**Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Dyllan Ware, Ben van der Merwe (TfA), Gunter Kreilaus, Paul Whisson**	**DATE:**	**29/6/2021**
SYSTEM:	**Truck Unloading**	**LEADER:**	**Dean Shewring**		
DRAWING:	**20399-PI12 Rev C, 20399-PI01 Rev D**	**MINUTES BY:**	**Peter Nyvlt**		

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
5.	Design / Project Issue				Specify the tank inlet actuated valves to be fire-safe noting that the manual tank isolation valves may be left open during operation, i.e. the actuated valves will need to close during a fire event	TfA	Done
6.	Design / Project Issue	Unloading arm 3 unavailable	The truck will need to move forward in the gantry to use unloading arm 1 for the rear barrel		Review the impact on the layout design for this scenario and vice versa if unloading arm 3 is only available, i.e. the rear of the tanker extends out of the unloading bay. Is there sufficient space for the trucks to partially park outside the transfer areas without impacting other site traffic or structures? Also, review the impact on the unloading permissives, e.g. gate position (is an override required if the gate is to be left open?)	TfA TfA	1/10/21 1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra, Port Kembla Ethanol Terminal**	**TEAM MEMBERS:**	**Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Dyllan Ware, Ben van der Merwe (TfA), Gunter Kreilaus, Paul Whisson**	**DATE: 29/6/2021**
SYSTEM: **Truck Unloading**	**LEADER:**	**Dean Shewring**	
DRAWING: **20399-PI12 Rev C, 20399-PI01 Rev D**	**MINUTES BY:**	**Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
7.	High Flow / High Level	Road tanker drive away	Potential damage to equipment connected to the road tanker as well as loss of residual ethanol in the transfer equipment	Brakes interlocked with the bar over the tanker valve manifold. Exit gate will be closed during transfers	Include in the road tanker design specification provision for an interlock for all connections to the road tanker to lower the likelihood of road tanker drive away, e.g. the liquid, vapour and earthing connections. Also, install a traffic light system as per the Nowra site. Include unloading permissives based on a closed gate, i.e. to allow transfer	TfA	Done

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra, Port Kembla Ethanol Terminal**		**TEAM MEMBERS:**	**Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Dyllan Ware, Ben van der Merwe (TfA), Gunter Kreilaus, Paul Whisson**	**DATE: 29/6/2021**
SYSTEM:	**Truck Unloading**	**LEADER:**	**Dean Shewring**	
DRAWING:	**20399-PI12 Rev C, 20399-PI01 Rev D**	**MINUTES BY:**	**Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
8.	High Flow / High Level	Loss of containment (LOC) in the unloading bay, e.g. leak from the unloading arm or pump seal failure	Fire if ignited resulting in damage to equipment and/or injury to people	PMs (preventative maintenance), hazardous area zoning, control of ignition sources in the area, contained area to the drainage system, automated foam deluge system, driver response to a LOC from the transfer system, e.g. press the emergency stop button	No further action required	-	-
9.	Zero Flow / Empty	Pump fails during unloading	Road tanker unloaded using a single arm	Call out to maintain the failed pump	No further action required	-	-

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra, Port Kembla Ethanol Terminal**	**TEAM MEMBERS:**	**Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Dyllan Ware, Ben van der Merwe (TfA), Gunter Kreilaus, Paul Whisson**	**DATE: 29/6/2021**
SYSTEM: **Truck Unloading**	**LEADER:**	**Dean Shewring**	
DRAWING: **20399-PI12 Rev C, 20399-PI01 Rev D**	**MINUTES BY:**	**Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
10.	High Pressure	Deadhead the road tanker unloading pump, e.g. discharge isolation valve left closed	Potential for piping system damage and loss of containment, fire if ignited	Procedural requirements to leave valves in their correct operational position. Limit switches on the actuated valves interlocked to pump operation. Operator monitoring the differential pressure across filter F-1201. Pump internal pressure relief valve. Pump trips on low flow (FSL on the pump discharge lines). PMs on equipment, e.g. pump relief valve. Motor overload trip	Change the pump discharge PIs to PITs with high pressure pump trips. To ensure integrity of these high pressure trips, lock open the inlet valves to the PITs	TfA	Done

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT:	**Manildra, Port Kembla Ethanol Terminal**	**TEAM MEMBERS:**	**Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Dyllan Ware, Ben van der Merwe (TfA), Gunter Kreilaus, Paul Whisson**	**DATE: 29/6/2021**	
SYSTEM:	**Truck Unloading**	**LEADER:**	**Dean Shewring**		
DRAWING:	**20399-PI12 Rev C, 20399-PI01 Rev D**	**MINUTES BY:**	**Peter Nyvlt**		

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
11.	High Pressure	Potential for hammer when the tank inlet actuated XV valves are closed	Pipe damage and the loss of containment, fire if ignited	The XVs are to be slow closing	No further action required	-	-
12.	Impurities	Potential for foreign objects and bugs to be drawn into the tanker via the vent line	Off-spec beverage grade ethanol		Review means to prevent contamination of the road tankers, e.g. install a temporary filter on the air inlet lines	GM/SF	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra, Port Kembla Ethanol Terminal**	**TEAM MEMBERS:**	**Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Dyllan Ware, Ben van der Merwe (TfA), Gunter Kreilaus, Paul Whisson**	**DATE: 29/6/2021**
SYSTEM: **Truck Unloading**	**LEADER:**	**Dean Shewring**	
DRAWING: **20399-PI12 Rev C, 20399-PI01 Rev D**	**MINUTES BY:**	**Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
13.	Impurities	Residual ethanol within the standby pump	Over time this ethanol can become off spec, e.g. contaminants from the piping system absorbing into the beverage grade ethanol such as from the seals and/or gaskets. This can cause odour problems for the beverage grade ethanol	Standby pump to be drained when not in use	Provide tundishes (or equivalent) in the drains from the pumps and pipe these drains to the underground drainage system. Also, provide a nitrogen utility point at the unloading pumps to allow the operators to nitrogen purge all 3 pumps when in standby (this will prevent biological growth in the standby pumps when not in use). Ensure all 3 pumps can be individually drained of all liquids (this will include the unloading pump casings) to prevent biogrowth over time	TfA	Done

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra, Port Kembla Ethanol Terminal	**TEAM MEMBERS:**	Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Dyllan Ware, Ben van der Merwe (TfA), Gunter Kreilaus, Paul Whisson	**DATE:** 29/6/2021
SYSTEM: Truck Unloading	**LEADER:**	Dean Shewring	
DRAWING: 20399-PI12 Rev C, 20399-PI01 Rev D	**MINUTES BY:**	Peter Nyvlt	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
14.	Impurities	Residual ethanol in dead legs, e.g. in the lines to / from the thermal relief valves, instrument tubing, drain valves and sample points	Potential for biogrowth and contaminants from the piping system absorbing into the beverage grade ethanol such as from the seals and/or gaskets. This can cause odour problems for the beverage grade ethanol		Review if the proposed deadlegs will provide off spec product and if so, what controls are required, e.g. routine flushing	GM/SF	1/10/21
15.	Impurities	Residual ethanol in the tank inlet lines	Potential for biogrowth and contaminants from the piping system absorbing into the beverage grade ethanol such as from the seals and/or gaskets. This can cause odour problems for the beverage grade ethanol		Review if the ethanol in the inlet lines can be off spec due to biogrowth or contaminants given the proposed frequency of tank turnover	GM/SF	1/10/21

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PROJECT: **Manildra, Port Kembla Ethanol Terminal**	**TEAM MEMBERS:**	**Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Dyllan Ware, Ben van der Merwe (TfA), Gunter Kreilaus, Paul Whisson**	**DATE: 29/6/2021**
SYSTEM: **Truck Unloading**	**LEADER:**	**Dean Shewring**	
DRAWING: **20399-PI12 Rev C, 20399-PI01 Rev D**	**MINUTES BY:**	**Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
16.	Impurities	Filter F-1201 internal failure	Solids through to the tank	Micron filtration and a 60# mesh strainer at the Nowra plant. Pump suction strainer 60# mesh. 1 micron filtration to the load out gantry. 60# mesh strainer to the ship. 2 weekly filter PMs	No further action required	-	-
17.	Change in Composition or Concentration / Two-Phase Flow / Reactions	Road tanker driver inadvertently transfers non beverage grade ethanol into tanks (e.g. confusion over the site location)	Off-spec beverage grade ethanol		Further controls are required for this scenario, e.g. full bay control with swipe cards and/or remote supervision of loads	TfA	Done

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT:	**Manildra, Port Kembla Ethanol Terminal**	**TEAM MEMBERS:**	**Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Dyllan Ware, Ben van der Merwe (TfA), Gunter Kreilaus, Paul Whisson**	**DATE: 29/6/2021**
SYSTEM:	**Truck Unloading**	**LEADER:**	**Dean Shewring**	
DRAWING:	**20399-PI12 Rev C, 20399-PI01 Rev D**	**MINUTES BY:**	**Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
18.	Plant Items	If there is a source of ignition near the air inlet to the road tanker there is potential for ignition of the flammable ethanol vapours	Potential for a confined explosion inside road tanker and hence injury / fatality	Hazardous area zoning. Control of ignition sources in the terminal	Review the need for a flame arrestor on the air inlet to the road tankers	GM/PR/ SF	1/10/21
19.	Plant Items				Install a drain valve between XV-0102 and V-0104 to allow draining for maintenance and to be consistent with the tank liquid outlet system	TfA	Done
20.	Plant Items	Potential theft of beverage grade ethanol, e.g. via the drain or vent valves	Loss of product and as the site is bonded, Manildra will be financially impacted by needing to pay for these losses	Video surveillance system. Gate access via security cards	Lock closed all drain, vent and sample points using a secure lock key system. Also, use a secure key lock system for the road tanker valves to prevent potential theft on route	GM/SF	1/3/22

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra, Port Kembla Ethanol Terminal**	**TEAM MEMBERS:**	**Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Dyllan Ware, Ben van der Merwe (TfA), Gunter Kreilaus, Paul Whisson**	**DATE: 29/6/2021**
SYSTEM: **Truck Unloading**	**LEADER:**	**Dean Shewring**	
DRAWING: **20399-PI12 Rev C, 20399-PI01 Rev D**	**MINUTES BY:**	**Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
21.	Plant Items				Provide a double block and bleed immediately downstream of filter F-1201 for routine filter maintenance, i.e. double isolation for the downstream tank that could be full. The valves need to be local to the filter for better control of isolation during maintenance as well as minimise the volume of ethanol lost during maintenance	TfA	Done
22.	Plant Items			The common inlet line to the tanks can be emptied via a 40 mm connection using a diaphragm pump (the location of this connection is yet to be determined)	No further action required	- TfA	- Done

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra, Port Kembla Ethanol Terminal	**TEAM MEMBERS:**	Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Dyllan Ware, Ben van der Merwe (TfA), Gunter Kreilaus, Paul Whisson	**DATE: 29/6/2021**
SYSTEM: Truck Unloading	**LEADER:**	Dean Shewring	
DRAWING: 20399-PI12 Rev C, 20399-PI01 Rev D	**MINUTES BY:**	Peter Nyvlt	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
23.	Plant Items				Provide an isolation valve between the tank inlet TRVs (thermal relief valves) and the downstream (i.e. tank side) bleed valves to provide double block and bleed isolation to the tank when maintaining the TRV	TfA	Done
24.	Plant Items				100 mm or larger manual butterfly valves are to have gearbox operation, e.g. to minimise the risk of hammer from fast closing	TfA	1/10/21
25.	Plant Items	Safety shower good practice			1. Provide means to alert Manildra operations personnel when a safety shower is activated, e.g. flow switch 2. Provide means to prevent hot water flowing from the safety shower when in use, e.g. buried lines 3. Provide green LED lights for all safety showers for ease of identification	TfA	Done
26.	Electrical	Lightning strike	Damage to equipment. Potential for a fire		Include in the project plan a lightning study for the site	TfA	1/10/21

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SYSTEM: **Truck Unloading**	**LEADER:**	**Dean Shewring**	
DRAWING: **20399-PI12 Rev C, 20399-PI01 Rev D**	**MINUTES BY:**	**Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
27.	Instruments				Include in the FD (functional description) means to detect which 2 of the 3 pumps are in use to allow permissives, interlocks, trips etc to be active	TfA	1/10/21
28.	Instruments				Include in the FD an absolute maximum level limit on the tank which will prevent further filling. This maximum level limit will result in an automatic changeover to the next tank. This level needs to be based on the largest volume that can be transferred from a road tanker	TfA	1/10/21
29.	Instruments	Emergency communication	Driver could be injured and therefore requires immediate response		Finalise the means of communication for the driver to Manildra operations at Nowra and also the emergency services, e.g. phone, radio, mobile etc	GM/SF/ PW	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra, Port Kembla Ethanol Terminal	**TEAM MEMBERS:**	Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Paul Whisson	**DATE: 29 June 2021**
SYSTEM: Beverage Grade Ethanol Tanks	**LEADER:**	Dean Shewring	
DRAWING: 20399-PI01 Rev D	**MINUTES BY:**	Peter Nyvlt	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
30.	Design / Project Issue				Given the current terminal design, road tanker loading and ship export can occur concurrently from the same tank. The disadvantage in doing this is the incorrect surveying measurement for ship export. Therefore, during ship export the road tanker loadout will not be performed. During this period customers can be supplied from the Nowra operations. Manildra to further review if this design philosophy meets their expected modes of operation at Port Kembla	TfA	Done

31.	High Flow / High Level	Potential to overfill a tank due to radar gauge malfunction, tank-to-tank transfers or too many road tankers being unloaded	Potential for ethanol to flow to the wet scrubber. If the wet scrubber inlet flow rate is higher than the wet scrubber capacity then it can overflow, i.e. fire if ignited. Potential for ethanol to flow out of the tank's emergency vent / PV (pressure / vacuum) vent into the bunded area and hence fire if ignited	PMs on the radar gauge. Self-checking radar gauge (double head). Independent high level trip (via a Safety Instrumented System). Routine tank dipping to cross-check the radar gauge. Bunded area with fire protection. 10 min filling time from the Hi to Hi Hi level to allow operator response. Tanks to be switched based on absolute high level prior to starting truck unloading. Tank design has the roof directing the liquid down the tank shell and hence not spraying from a height and therefore generating a mist	Ensure that the PRVs (pressure relief valves) to the wet scrubber are positioned high enough to prevent them from opening during high tank level, i.e. liquid would flow out from the emergency / PV vents first. Include in the LOPA (layer of protection analysis) study the high level tank trips to determine the required SIL (Safety Integrity Level)	TfA GM	1/10/21 1/10/21
32.	Low Flow / Low Level	Low level in the tank	Potential to dry run the pumps and hence damage. If the outlet valves for two tanks are open at the same time then tank-to-tank syphoning can occur which can lead to low pressure in a		Include in the FD the requirement to isolate an empty tank prior to changing over to a full tank during ship export (this is to prevent tank-to-tank syphoning which can lead to excessive vacuum generation in the tank). Also, include in the FD the requirement to automatically change over tanks when there is insufficient liquid to fill the	TfA TfA	1/10/21 1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra, Port Kembla Ethanol Terminal	**TEAM MEMBERS:**	Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Paul Whisson	**DATE:** 29 June 2021
SYSTEM: Beverage Grade Ethanol Tanks	**LEADER:**	Dean Shewring	
DRAWING: 20399-PI01 Rev D	**MINUTES BY:**	Peter Nyvlt	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
			tank and hence damage (see Item No. 34)		largest road tanker, i.e. to avoid needing to changeover tanks when loading a road tanker. Mark-up the P&ID to show a low level trip on the radar level gauges to protect the pumps	 TfA	 Done
33.	High Pressure	Failure of the nitrogen regulator. Bund fire or adjacent tank fire. Tank filling	High pressure within a tank and hence the potential for damage to the tank and loss of containment (fire if ignited)	Tanks designed to AS1940 with PV / emergency vents. Frangible roofs. PMs on the vents and nitrogen regulators. Operator response to tank high pressure alarms	No further action required	-	-

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra, Port Kembla Ethanol Terminal**	**TEAM MEMBERS:**	**Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Paul Whisson**	**DATE: 29 June 2021**
SYSTEM: **Beverage Grade Ethanol Tanks**	**LEADER:**	**Dean Shewring**	
DRAWING: **20399-PI01 Rev D**	**MINUTES BY:**	**Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
34.	Low Pressure	Potential to syphon from tank-to-tank via the common liquid outlet system	Potential to implode the tank with high level as the current nitrogen flowrate and vacuum relief are not designed to protect this tank. Note: The nitrogen and vacuum relief are designed for syphoning from a tank at high level to a tank at low level via the tanks' liquid inlet lines (150 mm DN that will restrict the flowrate)		Provide further controls to protect the tanks for this scenario. Options include larger vacuum relief capacity on the tanks and installing a non-return valve on the liquid outlet lines (however, standard non-return valves cannot be installed as import from ships is a future design option)	TfA	Done
35.	Low Pressure	Vacuum vent stuck closed	Potential to implode the tank, i.e. tank damage	Nitrogen supply sized for the maximum tank emptying rate	As above, additional vacuum protection is to be reviewed	TfA	Done

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT:	**Manildra, Port Kembla Ethanol Terminal**	**TEAM MEMBERS:**	**Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Paul Whisson**	**DATE: 29 June 2021**	
SYSTEM:	**Beverage Grade Ethanol Tanks**	**LEADER:**	**Dean Shewring**		
DRAWING:	**20399-PI01 Rev D**	**MINUTES BY:**	**Peter Nyvlt**		

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
36.	Low Pressure	Condensation of ethanol vapour within all 6 tanks, e.g. sudden vapour cooling from a rain event	Lower pressure in the tank with the potential for damage	Nitrogen padding and vacuum relief	Confirm that the nitrogen supply capacity is suitable for this scenario, e.g. it meets the requirements of API 2000	TfA	Done
37.	Plant Items	Loss of containment during sampling	Person may need to use a safety shower but the intermediate bund walls would impede access		Ensure the safety showers in the tanks' bunded area comply with the Australian Standard requirements	TfA	Done
38.	Plant Items				For the foam pourers in the top of tanks, provide a Teflon vapour seal as glass etc is unacceptable for beverage grade ethanol, e.g. it could break and fall into the product (food safety issue)	TfA	1/10/21
39.	Plant Items	Tank entry			Ensure compliance with Manildra confined space entry requirements for the tanks (e.g. spool pieces on all tank piping connections for a positive break as well as spade points)	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra, Port Kembla Ethanol Terminal**	**TEAM MEMBERS:**	**Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Paul Whisson**	**DATE: 29 June 2021**
SYSTEM: **Beverage Grade Ethanol Tanks**	**LEADER:**	**Dean Shewring**	
DRAWING: **20399-PI01 Rev D**	**MINUTES BY:**	**Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
40.	Plant Items	Condensation or rain on the tank roof	Slip hazard, i.e. potential for injury	Australian Standard compliant handrail to prevent a fall from height	Include grit in the tank roof paint to provide a non-slip surface	TfA	1/10/21
41.	Plant Items	Corrosion of the firewater cooling spray nozzles and piping	Inadequate cooling water density over the tank wall should an adjacent fire occur	Firewater can be applied from monitors and the fire brigade	Review the option of using stainless steel firewater spray nozzles and piping	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal	**TEAM MEMBERS:** Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Dyllan Ware, Ben van der Merwe (TfA), Gunter Kreilaus, Josh Coburn	**DATE:** 30 June 2021
SYSTEM: Road Tanker Loadout	**LEADER:** Dean Shewring	
DRAWING: 20399-PI01 Rev D, 20399-PI13 Rev C and 20399 PI11 Rev C	**MINUTES BY:** Peter Nyvlt	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
42.	Design / Project Issue				Review the need to retain V-1301 (P&ID PI13 – common suction line to all pumps) as this may not be required for maintenance isolation. Provide a 40mm drain valve on the common outlet line from the tanks to allow draining using a diaphragm pump	TfA	Done
43.	Design / Project Issue				The outlets from the air eliminators are to be left un-isolated to the drainage/slops system in case air or nitrogen flows through the batching flow meter. Mark-up the P&ID accordingly. Review the need for means to detect a failed air eliminator, e.g. tundish and/or sight glass in the air vent line. Also, pipe the drains from the gantry strainers and filters to the slops system to avoid ethanol draining across the transfer bay floor	TfA TfA TfA	Done Done Done

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Dyllan Ware, Ben van der Merwe (TfA), Gunter Kreilaus, Josh Coburn**	**DATE: 30 June 2021**
SYSTEM: **Road Tanker Loadout**	**LEADER:** **Dean Shewring**	
DRAWING: **20399-PI01 Rev D, 20399-PI13 Rev C and 20399 PI11 Rev C**	**MINUTES BY:** **Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
44.	Design / Project Issue				HAZOP note: The road tanker loadout system will be designed to allow the use of 1 or 2 loading arms (the latter for separate trailers) without the need for scully etc overrides	TfA	1/10/21
45.	Design / Project Issue				Redesign the export pumping system suction piping to allow 3 tanks to be selected to gantry and 3 tanks to be selected for ship export, i.e. this separates ship exports from tanker loading and hence the two operations can be done concurrently without impacting the tank / ship dips	TfA	Done

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SYSTEM: **Road Tanker Loadout**	**LEADER:** **Dean Shewring**	
DRAWING: **20399-PI01 Rev D, 20399-PI13 Rev C and 20399 PI11 Rev C**	**MINUTES BY:** **Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
46.	High Flow / High Level	Potential to overfill a road tanker or Isotank during loadout, e.g. batching flow meter failure or incorrect compartment volume entered	LOC of ethanol into the transfer bay, fire if ignited	PMs on the batching flowmeter. Limits on the road tanker safe fill within the loadout control system. Supervised Isotank loading. Independent high level connection via the scully. Contained area. Automatic foam deluge. Hazardous area zoning. Dead-man button	As per Nowra, include a knockout pot and high level trip in the vapour recovery lines as a means to provide additional protection to prevent an overfill of a tanker/Isotank leaving site	TfA	Done

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

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SYSTEM: **Road Tanker Loadout**	**LEADER:** **Dean Shewring**	
DRAWING: **20399-PI01 Rev D, 20399-PI13 Rev C and 20399 PI11 Rev C**	**MINUTES BY:** **Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
47.	High Flow / High Level	Road tanker drive away	Potential damage to equipment connected to the road tanker as well as loss of residual ethanol in the transfer equipment	Brakes interlocked with the bar over the tanker valve manifold. Exit gate will be closed during transfers	See Item No. 7 for additional actions. Review the location of the truck bill of lading printer shed as it may be possible to not print out the required paperwork based on the connections to the road tanker not being returned to their parked positions, i.e. the driver cannot get the required paperwork to leave the gantry area as the gate will remain closed. Include interlocks based on the gantry position (i.e. for the up and down gantry positions) to the exit gate and traffic lights to prevent exit when the gantry is in the down position	TfA TfA	Done Done

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Dyllan Ware, Ben van der Merwe (TfA), Gunter Kreilaus, Josh Coburn**	**DATE: 30 June 2021**
SYSTEM: **Road Tanker Loadout**	**LEADER:** **Dean Shewring**	
DRAWING: **20399-PI01 Rev D, 20399-PI13 Rev C and 20399 PI11 Rev C**	**MINUTES BY:** **Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
48.	High Flow / High Level	Loss of containment in the loading bay, e.g. leak from the loading arm or leak from the Isotank	Fire if ignited	PMs, hazardous area zoning, control of ignition sources, contained area to the drainage system, foam deluge system, driver response to a LOC from the transfer system	Include all ethanol hoses in the hose register for routine inspection and testing. This is to include the loading arms. As the largest Isotank is 26,000 L then redesign the spill containment system to hold this volume plus an appropriate margin in compliance with AS1940	GM/DO TfA	1/3/22 Done
49.	High Flow / High Level	Leak from a road tanker or Isotank in the transfer bay	The road tanker or Isotank will need to be unloaded	Road tankers and Isotanks can be unloaded at the unloading bay	Provide a spare 200 – 300 LPM diaphragm pump to enable a full Isotank to be pumped to the slops tank. A connection to the slops tanks will be required	TfA	1/10/21

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SYSTEM: **Road Tanker Loadout**	**LEADER:** **Dean Shewring**	
DRAWING: **20399-PI01 Rev D, 20399-PI13 Rev C and 20399 PI11 Rev C**	**MINUTES BY:** **Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
50.	High Flow / High Level	Gantry flow control valve fails open	Potential for high velocities causing electrostatic charge generation, in particular, during initial fill when splashing occurs. A confined explosion could occur, i.e. equipment damage and/or injury / fatality	PMs on the flow control valves. Batching XVs trip on high flow detection	Need to limit the maximum loading flow to 2,000 LPM to ensure the velocities in the Isotank 80 mm connection remain below 7 m/s	TfA	1/10/21

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SYSTEM: Road Tanker Loadout	**LEADER:** Dean Shewring	
DRAWING: 20399-PI01 Rev D, 20399-PI13 Rev C and 20399 PI11 Rev C	**MINUTES BY:** Peter Nyvlt	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
51.	High Flow / High Level	Potential for seal failure on a transfer pumps	LOC of ethanol and hence the potential for a pump fire. Note that the terminal is unmanned	Pump maintenance	Provide LEL detection in each pump bay, i.e. the ship export pumps are to be separated from the gantry/slops pumps by a bund wall. The control system response to the input from the LEL meters need to be determined, e.g. raise an alarm or result in a pump system trip. As the terminal is unmanned then immediate fire suppression is required, i.e. flame detection with automatic foam deluge over all pumps. Ensure there is a camera that covers the pump bays for remote viewing	TfA TfA TfA	1/10/21 1/10/21 1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Dyllan Ware, Ben van der Merwe (TfA), Gunter Kreilaus, Josh Coburn**	**DATE: 30 June 2021**
SYSTEM: **Road Tanker Loadout**	**LEADER:** **Dean Shewring**	
DRAWING: **20399-PI01 Rev D, 20399-PI13 Rev C and 20399 PI11 Rev C**	**MINUTES BY:** **Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
52.	Zero Flow / Empty	Pump operated with suction and discharge valves isolated	Potential for catastrophic pump failure due to high pressures / temperatures within the pump casing	Procedures and training to keep manual valves open. Pump operation interlocked to the limit switches on XVs. Low flow at the gantry will trip the transfer system. Pump discharge low flow switch (2 min delay)	Reduce the pump discharge low flow switch timer to a more sensible time setting, i.e. to prevent excessive heating within an isolated or deadheaded pump	TfA	1/10/21
53.	High Pressure	Potential for hammer when the XVs at the gantry close. Note that these only close quickly during road tanker / Isotank high level or emergency scenarios	Piping damage and LOC, fire if ignited	Closing speed for these XVs is 2 – 6 seconds. Velocity in the common transfer line to the gantry is low, i.e. approximately 2 m/s	No further action required	-	-

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Dyllan Ware, Ben van der Merwe (TfA), Gunter Kreilaus, Josh Coburn**	**DATE: 30 June 2021**
SYSTEM: **Road Tanker Loadout**	**LEADER:** **Dean Shewring**	
DRAWING: **20399-PI01 Rev D, 20399-PI13 Rev C and 20399 PI11 Rev C**	**MINUTES BY:** **Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
54.	Impurities	Potential for foreign objects and biogrowth in the Isotank liquid connection spool piece when not in use	Off-spec product beverage grade ethanol		Provide means to seal the Isotank liquid connection spool piece when stored, e.g. in an air-tight cabinet	GM/SF/ PR	1/10/21
55.	Impurities	Residual ethanol left in line 1307, i.e. the interconnection to wharf line	Over time this ethanol can become off spec, e.g. contaminants from the piping system absorbing into the beverage grade ethanol such as from the seals and/or gaskets. This can cause odour problems for the beverage grade ethanol		Include in the operating procedures the requirement to flush all deadlegs every 6 to 12 months in the terminal	GM/SF	1/3/22

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Dyllan Ware, Ben van der Merwe (TfA), Gunter Kreilaus, Josh Coburn**	**DATE: 30 June 2021**
SYSTEM: **Road Tanker Loadout**	**LEADER:** **Dean Shewring**	
DRAWING: **20399-PI01 Rev D, 20399-PI13 Rev C and 20399 PI11 Rev C**	**MINUTES BY:** **Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
56.	Testing	Sampling the Isotank following transfer	If a metal sample ladle is used there is the risk of static discharge and hence explosion/fire. Typically a glass sample container is used with a dip sample obtained from gantry level. If the glass breaks the Isotank will be quarantined. There is also the risk of contamination of product during sampling, e.g. impurities on the sample container or introduced via the operator's glove	Housekeeping and cleanliness prior to sampling. Sampling is proposed to be as per the Nowra operations	Agreement on the current sampling methodology is to be obtained including agreement by the QA Dept, e.g. use of glass containers which do not require earthing. Provide means at Port Kembla for storage and handling of the Isotank scully plate and sampling equipment to help ensure cleanliness is maintained	GM/SF/ PR GM/SF/ PR	1/3/22 1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal	**TEAM MEMBERS:** Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Dyllan Ware, Ben van der Merwe (TfA), Gunter Kreilaus, Josh Coburn	**DATE:** 30 June 2021
SYSTEM: Road Tanker Loadout	**LEADER:** Dean Shewring	
DRAWING: 20399-PI01 Rev D, 20399-PI13 Rev C and 20399 PI11 Rev C	**MINUTES BY:** Peter Nyvlt	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
57.	Testing				The current inspection frequency for the Nowra filters on loading bays 5 and, 6 and the strainers on bays 1 to 6 is once every 2 weeks. This frequency may be excessive for the Port Kembla terminal considering the quality of the product. Review the frequency of the filter / strainer inspections and whether this can be reduced at Port Kembla given the expected cleanliness of the product	GM/DO/ PR	1/3/22
58.	Testing				The preference for road tanker sampling at Port Kembla is from the bottom road tanker sample valve, however, it is noted that some clients will require a sample dip from the road tanker top sample hatch (as per the Isotanks, cleanliness and storage cabinets required)	GM/SF/ PR	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Dyllan Ware, Ben van der Merwe (TfA), Gunter Kreilaus, Josh Coburn**	**DATE: 30 June 2021**
SYSTEM: **Road Tanker Loadout**	**LEADER:** **Dean Shewring**	
DRAWING: **20399-PI01 Rev D, 20399-PI13 Rev C and 20399 PI11 Rev C**	**MINUTES BY:** **Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
59.	Plant Items	Emergency event when a person is on the gantry level	Two means of escape required as one means may not be possible, e.g. due to a spill / fire		Provide two means of egress for the gantry platform in case of emergency scenarios	TfA	1/10/21
60.	Plant Items				Include in the PMs the requirement that maintenance (e.g. on a failed pump) is to be done when there is no flow to the gantry. This will avoid installing double block and bleeds to the pump suctions	GM/DO	1/3/22
61.	Plant Items	Emptying the loading arm filter for maintenance	The batching meter will measure a flow when the filter is filling but there will be no ethanol entering a road tanker or Isotank at this time		Include in the FD a requirement for the road tanker loadout system to pump to an IBC / slops tank to allow filling of the filter following inspection	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal	**TEAM MEMBERS: Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Josh Coburn**	**DATE: 30 June 2021**
SYSTEM: Tank-to-Tank Transfer or Tank Recirculation	**LEADER: Dean Shewring**	
DRAWING: 20399-PI01 Rev D, 20399 PI13 Rev C, 20399 PI12 Rev C	**MINUTES BY: Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
62.	High Flow / High Level	Potential overfill of the receiving tank	Potential for ethanol to flow to the wet scrubber. If the wet scrubber inlet flow rate is higher than the wet scrubber capacity then it can overflow, i.e. fire if ignited. Potential for ethanol to flow out of the tank's emergency vent / PV (pressure / vacuum) vent into the bunded area and hence fire if ignited	PMs on the radar gauges. Self-checking radar gauge (double head). Independent high level trip (SIS). Routine tank dipping to cross-check the radar gauges. Bunded area with fire protection. 10 min filling time from Hi to Hi Hi level to allow operator response. Tank design has the roof directing the liquid down the tank shell and hence not spraying from a height and generating a mist.	No further action required	-	-

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

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SYSTEM: Tank-to-Tank Transfer or Tank Recirculation	**LEADER: Dean Shewring**	
DRAWING: 20399-PI01 Rev D, 20399 PI13 Rev C, 20399 PI12 Rev C	**MINUTES BY: Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
				Terminal shutdown on Hi Hi level			
63.	High Flow / High Level	Potential to use a loadout pump and a ship export pump for tank-to-tank transfer	Exceed the design 7 m/s in the recirculation line 1313, i.e. potential for static generation which is an ignition source		Provide a non-return valve (NRV) in line 1307 to prevent ship export pump transfer to the tank inlets (i.e. install the NRV on the upstream / truck side of V-1309)	TfA	Done
64.	High Flow / High Level	Tank-to-tank transfer and road tanker unloading simultaneously	Design velocities less than 7 m/s in the tank fill lines and higher flowrate into the tanks – potential for high pressure?		Confirm that the tank venting capacity is adequate for this scenario and also the wet scrubber can handle the expected vapour load	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal	**TEAM MEMBERS: Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Josh Coburn**	**DATE: 30 June 2021**
SYSTEM: Tank-to-Tank Transfer or Tank Recirculation	**LEADER: Dean Shewring**	
DRAWING: 20399-PI01 Rev D, 20399 PI13 Rev C, 20399 PI12 Rev C	**MINUTES BY: Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
65.	Instruments	HAZOP note: Tank-to-tank transfer or tank recirculation is to be performed using only one truck loading pump and hence all protections will be available via the control system			Include in the FD programming the requirement to only allow one truck loading pump during tank-to-tank transfers or tank recirculation. This will ensure the pump instrumented protections are active (not the case if the pumps are operated in manual). Also, include in the FD a ramped decrease speed function for the transfer pump based on tank level to avoid losing pump prime too early	TfA TfA	1/10/21 1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Josh Coburn, Paul Whisson**	**DATE: 30 June 2021**
SYSTEM: **Ship Loading – Filling the Ship Transfer Line with Ethanol**	**LEADER:** **Dean Shewring**	
DRAWING: **20399-PI01 Rev D ,20399-PI13 Rev C, 20399 PI14 Rev C, 20399 PI15 Rev C**	**MINUTES BY:** **Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
66.	Design / Project Issue				Provide an ethanol kicker line to pig hatch EQ-1401 to avoid using nitrogen to initially launch the pig when filling the ship transfer line (i.e. this will avoid moving the pig with two-phase flow behind it)	TfA	Done
67.	Design / Project Issue				The vents and drains at the berth are to be locked closed given the risk of third party interference, e.g. opening valves when the system is not in use (see Item No. 20)	GM/SF/ PR	1/10/21
68.	Design / Project Issue				Ensure that the pig materials of construction are compatible with beverage grade ethanol, i.e. to avoid off-spec product	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

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SYSTEM: Ship Loading – Filling the Ship Transfer Line with Ethanol	**LEADER: Dean Shewring**	
DRAWING: 20399-PI01 Rev D ,20399-PI13 Rev C, 20399 PI14 Rev C, 20399 PI15 Rev C	**MINUTES BY: Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
69.	Design / Project Issue				Review the option of using one pig hatch at the berth. Advantages include cost, minimal pig handling and draining, and minimising the layout space requirements at the berth. An alternate option is to not have pig hatches at the berth, i.e. catch the pig in the return line which will allow flow to the ship via another branch. Following ship loading, the pig can be pushed back to the terminal. This has the advantage of reduced manual handling at the berth and reducing the likelihood of impurities entering via the pig hatches	TfA TfA	1/10/21 1/10/21
70.	High Flow / High Level	Potential LOC from the wharfline due to: 1. Vehicle impact 2. Failed gaskets 3. Valve leaks 4. Corrosion	LOC can occur either on or offsite. If the LOC occurs offsite then there will be impact to the company's reputation and potential fines.	1. Barriers to prevent vehicle impact along berth, minimal vehicle traffic 2. Fully welded line and flanges only at	Provide containment for the shore isolation valves. This is to include a drain valve that can be left open to prevent rain water buildup and closed during transfers.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Josh Coburn, Paul Whisson**	**DATE: 30 June 2021**
SYSTEM: **Ship Loading – Filling the Ship Transfer Line with Ethanol**	**LEADER:** **Dean Shewring**	
DRAWING: **20399-PI01 Rev D ,20399-PI13 Rev C, 20399 PI14 Rev C, 20399 PI15 Rev C**	**MINUTES BY:** **Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
		5. Lightning strike 6. Hammer/surge 7. Spills from the pig hatch 8. Sabotage	Potential for fires if ignited. Potential for the ethanol to impact the environment	valves, all valves within bunded areas 3. Ethanol compatible valves, e.g. all valves are lugged 4. SAF2205 piping suitable for marine environment 5. Pipeline earthed 6. Surge study on pipeline, tank outlet XVs closing speed approximately 30 seconds 7. Training to ensure the pig hatch drain and vent valves left closed, containment under the pig hatch 8. Line walking, pipeline will be	Perform an AS2885 threat analysis once the final pipeline layout is known	TfA	1/12/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

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SYSTEM: **Ship Loading – Filling the Ship Transfer Line with Ethanol**	**LEADER:** **Dean Shewring**	
DRAWING: **20399-PI01 Rev D ,20399-PI13 Rev C, 20399 PI14 Rev C, 20399 PI15 Rev C**	**MINUTES BY:** **Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
				fenced for the above ground sections. Underground sections will be in a culvert with concrete lids			
71.	High Flow / High Level	Once the pig is received in hatch EQ-1501 then manual valve V-1503 is opened	Potential for excessive ethanol to flow into the wharf return line and ultimately into the wet scrubber, i.e. potential to overload the scrubber	Procedural control to stop the ship export pump once the pig has been received and close V-1506 to prevent syphoning from the supply tank through the export pump into the wharf return line	Install a level instrument in line 1408 before FCV-1414 that will be used to detect liquid in this mode of operation. If liquid is detected then an alarm will be raised and XV-1412 will be opened and XV-1413 will be closed, i.e. to allow liquid to flow to slops. Review the option of further automation of the berth valve sequences. The justification for the review is to lower the likelihood of sending excessive ethanol to the berth return line and hence to the slops system	TfA TfA	Done 1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal	**TEAM MEMBERS: Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Josh Coburn, Paul Whisson**	**DATE: 30 June 2021**
SYSTEM: Ship Loading – Filling the Ship Transfer Line with Ethanol	**LEADER: Dean Shewring**	
DRAWING: 20399-PI01 Rev D ,20399-PI13 Rev C, 20399 PI14 Rev C, 20399 PI15 Rev C	**MINUTES BY: Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
72.	High Flow / High Level	FCV-1414 open too much during this wharfline filling step	Higher flow to the wet scrubber with the potential for ethanol vapour release	The wet scrubber is designed for this scenario	No further action required	-	-
73.	High Flow / High Level	LOC of ethanol from the pig hatches at the berth	Given the current design the ethanol will spread across the berth to the existing containment walls. This will potentially increase the hazardous zoning requirements		Further review this scenario to determine if local bunding for the pig hatches is required. Also, review the option of installing a tray under the pig hatch doors to contain any residual ethanol within the pig hatch that may be released when the doors are opened	TfA	1/10/21
74.	High Flow / High Level	Nitrogen flow to the slops tanks during this mode of operation, e.g. XV-1412 open	Potential to overpressure the slops tanks and hence failure. This could lead to a fire in the bunded area	The slops tanks are vented to the wet scrubber. PV / emergency vents on the slops tanks	Confirm that the existing slops tanks' vents are adequately sized for this scenario	TfA	Done
75.	Zero Flow / Empty	Stuck pig	The pig needs to be located and moved	Standard pigging procedures to be used	Review if it is possible to use a pig with a locator to determine the point at which the pig is stuck	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal	**TEAM MEMBERS: Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Josh Coburn, Paul Whisson**	**DATE: 30 June 2021**
SYSTEM: Ship Loading – Filling the Ship Transfer Line with Ethanol	**LEADER: Dean Shewring**	
DRAWING: 20399-PI01 Rev D ,20399-PI13 Rev C, 20399 PI14 Rev C, 20399 PI15 Rev C	**MINUTES BY: Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
76.	High Pressure	Nitrogen pressure regulator failure (e.g. on the nitrogen inlet line to a pig hatch) or maximum ship export pump pressure (e.g. due to the pump being deadheaded)	If one of the final isolation valves (V-2322 and V-2319) on the line to the wet scrubber are closed then the ducting can be overpressured and fail	V-2322 and V-2319 are locked open. Nitrogen is isolated to the pig hatches when not in use	Provide a dedicated entry to the wet scrubber for any vapour flows that can be from high pressure sources, e.g. the pig hatches. This line is to be pipe and not ducting so that the maximum pressure from the nitrogen system and pump discharge pressure is below the maximum allowable working pressure of the piping	TfA	Done
77.	High Pressure	During this step in ship loadout there can be a number of hours delay as part of the ship qualification activities, e.g. sampling and line flushing	If ethanol is isolated anywhere in the wharf pipeline system and heated by the sun then there can be thermal overpressure and potentially a LOC, i.e. fire if ignited and/or environmental impact		Finalise the ship export plan / procedure including the sequence of valve operation. Given the duration for various ship checks / qualification activities required then review the need for further thermal relief, e.g. an additional valve maybe required to be closed during qualification that could isolate ethanol which can be subsequently heated by the sun. This review should include the need for thermal relief for the pig hatches	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Josh Coburn, Paul Whisson**	**DATE: 30 June 2021**
SYSTEM: **Ship Loading – Filling the Ship Transfer Line with Ethanol**	**LEADER:** **Dean Shewring**	
DRAWING: **20399-PI01 Rev D ,20399-PI13 Rev C, 20399 PI14 Rev C, 20399 PI15 Rev C**	**MINUTES BY:** **Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
78.	High Pressure	Potential for the wharf return line to be hydraulically full with ethanol	If ethanol is isolated anywhere in the wharf return pipe and heated by the sun then there can be thermal overpressure and potentially a LOC, i.e. fire if ignited and/or environmental impact		Provide thermal relief around XV-1412 to the slops tanks	TfA	Done
79.	Impurities	Disintegrating pig	Off spec product to ship	60# mesh strainer on the transfer line (at the berth) to the ship	Review the pipeline welding procedure to ensure the quality of welds (e.g. no welding dags that can catch the pig) and means to confirm the quality of the welds, e.g. x-ray inspections. Include in the commissioning plan the requirement to initially use a gauging pig to confirm the quality of welds	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal	**TEAM MEMBERS: Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Josh Coburn, Paul Whisson**	**DATE: 30 June 2021**
SYSTEM: Ship Loading – Filling the Ship Transfer Line with Ethanol	**LEADER: Dean Shewring**	
DRAWING: 20399-PI01 Rev D ,20399-PI13 Rev C, 20399 PI14 Rev C, 20399 PI15 Rev C	**MINUTES BY: Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
80.	Impurities	Potential for impurities to enter the pig hatch EQ-1501 when the door is open	Potential for off-spec product to enter the ship		Review the option for relocating the tie-in for line 1503 from upstream to downstream of V-1506. This will ensure any impurities in the trap will flow through the wharf return line to the slops tank / wet scrubber. If this option is chosen then line 1503 will need to be split to tee into before and after V-1506, i.e. it will need to still tie into upstream of V-1506 to allow wharf line clearing to the ship	TfA	Done

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal	**TEAM MEMBERS: Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Josh Coburn, Paul Whisson**	**DATE: 30 June 2021**
SYSTEM: Ship Loading – Filling the Ship Transfer Line with Ethanol	**LEADER: Dean Shewring**	
DRAWING: 20399-PI01 Rev D ,20399-PI13 Rev C, 20399 PI14 Rev C, 20399 PI15 Rev C	**MINUTES BY: Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
81.	Testing	Need to test the ethanol at the berth at the end of this wharfline filling step			Provide an additional sample point on line 1501 immediately downstream of the piping tee to V-1510.	TfA	Done
					Provide an isolation valve on line 1502 (min distance to line 1501) to avoid potential off-spec ethanol flowing into the ship transfer line.	TfA	Done
					Provide a facility for ethanol testing at the wharf, e.g. trailer / use the existing lunch room	GM/SF/ PR	1/3/22
82.	Testing	LOC of ethanol during sampling	Potential hazard to personnel, in particular, if the ethanol ignites	Standard Manildra ethanol sampling point and procedures to be used	Confirm there is a safety shower at the berth	TfA	Done

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal	**TEAM MEMBERS: Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Josh Coburn, Paul Whisson**	**DATE: 30 June 2021**
SYSTEM: Ship Loading – Filling the Ship Transfer Line with Ethanol	**LEADER: Dean Shewring**	
DRAWING: 20399-PI01 Rev D ,20399-PI13 Rev C, 20399 PI14 Rev C, 20399 PI15 Rev C	**MINUTES BY: Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
83.	Plant Items	Suitably trained personnel are required for the pigging operations as well as ship loading			Manildra to review how these personnel will be resourced and trained, e.g. use Manildra personnel or specialised contractors. If Manildra personnel are required then approximately 4 people will be required	GM/SF	1/3/22
84.	Plant Items	Opening the pig hatch door with pressure inside the hatch	Injury / fatality if the person is struck by the door	Mechanical interlock on the door	Review the option of using a Castell key type system for the pig hatch valves to ensure the correct order of use is followed	TfA	1/10/21
85.	Plant Items	Person places their head inside the hatch, e.g. to move a pig	Potential for asphyxiation if nitrogen is present	350 mm diameter pig trap limits the ability to be inside the pig hatch. A push rod will be used for pig placement and retrieval	Install signage at each pig hatch to warn of the hazards of a potential nitrogen atmosphere	GM	1/4/22
86.	Plant Items	Draining of the pig hatches	Need to avoid draining ethanol to a bunded area, i.e. a loss of ethanol for the business and an ignition risk		Provide a portable diaphragm pump to pump the drained ethanol to the slops tank / wharf return line	TfA	Done

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Josh Coburn, Paul Whisson**	**DATE: 30 June 2021**
SYSTEM: **Ship Loading – Filling the Ship Transfer Line with Ethanol**	**LEADER:** **Dean Shewring**	
DRAWING: **20399-PI01 Rev D ,20399-PI13 Rev C, 20399 PI14 Rev C, 20399 PI15 Rev C**	**MINUTES BY:** **Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
87.	Plant Items				To prevent beverage grade ethanol flow to the wharf line during non-shipping periods (and hence the risk of theft) and also to prevent tank syphoning to the wharf line when the ship export pump is stopped then lock closed V-1405 and the kicker line valve to pig hatch EQ-1401. Include limit switches on both these valves. If these valves are not closed then raise an alarm (at least)	TfA	Done
88.	Electrical	There will be new hazardous areas on the berth as a result of the ethanol piping system	The existing electrics and instruments may not be intrinsically safe		The project team is to develop an electrical isolation procedure (all non-rated cabling and equipment to be earthed and ignition sources removed) and/or move the existing lunch room out of the hazardous zone. The berth and wharf lighting and electrical equipment need to be modified to suit the hazardous zone requirements	GM/SF/ PW	1/3/22

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal	**TEAM MEMBERS: Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Josh Coburn, Paul Whisson**	**DATE: 30 June 2021**
SYSTEM: Ship Loading – Filling the Ship Transfer Line with Ethanol	**LEADER: Dean Shewring**	
DRAWING: 20399-PI01 Rev D ,20399-PI13 Rev C, 20399 PI14 Rev C, 20399 PI15 Rev C	**MINUTES BY: Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
89.	Electrical	Loss of mains power during ship transfers	Increased time the ship is at the berth, i.e. cost to the business	Syphoning from the supply tank to the ship may continue the transfer if there is sufficient head	Include in the electrical design a connection for a portable generator to be used in case of loss of mains power	TfA	1/10/21
90.	Instruments	Emergency event at the berth, e.g. hose failure or fire	Need to stop the transfer as quickly as possible	Standard shipping procedures require the crew members to communicate via radios	Review the option of installing a process shutdown button at the berth to stop the ship loading pumps and shut the supply tank's outlet valve	GM/SF/ PW	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal	**TEAM MEMBERS: Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Paul Whisson**	**DATE: 1 July 2021**
SYSTEM: Ship Loading – Ethanol Ship Loading System	**LEADER: Dean Shewring**	
DRAWING: 20399-PI01 Rev D ,20399-PI13 Rev C, 20399 PI14 Rev C, 20399 PI15 Rev C	**MINUTES BY: Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
91.	Design / Project Issue				Mark-up the P&ID to show the high point vent on ST-1501 and a downstream pressure indicator (the latter to show differential pressure across the strainer)	TfA	Done
92.	Design / Project Issue	Potential contamination of a ship's tank, e.g. due to residual material in the tank	Need to pump the ship's tank back to the slops tank. Typically this requires a 100 mm hose		Include in the design a connection to the wharf return line to allow returns from the ship to the slops tank. Review all sloping and qualification activities with the shipping company to ensure the design can meet the expected effluent transfers	TfA	Done
93.	High Flow / High Level	If the export pump is operated at high speed then there can be velocities in the ship's transfer hose exceeding 7 m/s	Potential for static generation and hence ignition of flammable vapours		Provide an upper speed limit clamp for the ship export pumps. Note: The final hose manifold connection system to the ship is currently being finalised to ensure that velocities stay below 7 m/s	TfA	Done

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal	**TEAM MEMBERS: Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Paul Whisson**	**DATE: 1 July 2021**
SYSTEM: Ship Loading – Ethanol Ship Loading System	**LEADER: Dean Shewring**	
DRAWING: 20399-PI01 Rev D ,20399-PI13 Rev C, 20399 PI14 Rev C, 20399 PI15 Rev C	**MINUTES BY: Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
94.	High Flow / High Level	Ship hose failure due to wear and tear, or the ship pulling away from the berth	Potential for LOC to the harbour hence environmental impact and fines	Shipping hoses to be included in the hose register for routine testing and inspection. Standard good practice for berthing a ship, e.g. securing the ship to the berth using ropes. Hoses pressure tested prior to ethanol transfer (see Item No. 96). Emergency response by the supervisors using radios and the process shutdown button	No further action required	-	-

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal	**TEAM MEMBERS: Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Paul Whisson**	**DATE: 1 July 2021**
SYSTEM: Ship Loading – Ethanol Ship Loading System	**LEADER: Dean Shewring**	
DRAWING: 20399-PI01 Rev D ,20399-PI13 Rev C, 20399 PI14 Rev C, 20399 PI15 Rev C	**MINUTES BY: Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
95.	Impurities	Potential for impurities to enter the shipping hoses when not in use			Provide capping plates for each hose to prevent foreign objects entering each hose when not in use. These should not be heavy given the overall weight of the capped hose which needs to be returned to the terminal. Need to determine how the hoses will be transported to and from the berth given the expected length (up to 12m?). Further design assessment is required for the hose design (including length), handling, transport and storage system	GM/SF/ PR GM/SF/ PR	1/10/21 1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal	**TEAM MEMBERS: Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Paul Whisson**	**DATE: 1 July 2021**
SYSTEM: Ship Loading – Ethanol Ship Loading System	**LEADER: Dean Shewring**	
DRAWING: 20399-PI01 Rev D ,20399-PI13 Rev C, 20399 PI14 Rev C, 20399 PI15 Rev C	**MINUTES BY: Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
96.	Testing	Ship transfer hoses flanges not adequately connected	Release of ethanol into the harbour, i.e. environmental impact and fine	Trained personnel. Hoses in-test	Include in the design a means to perform a hose leak test (using nitrogen) prior to transfers to a ship. Include in the design anti-whip protection on the nitrogen hoses (e.g. in case a nitrogen hose fails and strikes a person) and non-return valves for reverse flow protection (i.e. to prevent ethanol flowing into the nitrogen system)	TfA TfA	1/10/21 1/12/21
97.	Electrical				Review the need for an insulating joint prior to connection to the ship, e.g. cathodic protection on the wharf piles with current passing to the ship or induced current from the wharfline passing to the ship	TfA	Done

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman**	**DATE: 2 July 2021**
SYSTEM: **Ship Loading – Ship Supply Wharfline Clearing to Ship**	**LEADER:** **Dean Shewring**	
DRAWING: **20399 PI14 Rev C, 20399 PI15 Rev C**	**MINUTES BY:** **Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
98.	High Flow / High Level	Nitrogen regulator PCV-1410 fails open	Higher pressure in the wharf line and therefore higher nitrogen blow-through to the ship once the ethanol has been cleared. This may overpressure the ships tanks. Note: The maximum nitrogen supply pressure is 700 kPag		Review this scenario with the shipping companies to check if further protection is required, e.g. overpressure protection downstream of the nitrogen pressure regulator. Include in the pigging procedure the requirement to close V-1509 once the pig has been received at the berth. This is to avoid uncontrolled nitrogen blow through to the ship. Following this step, the terminal operator is to isolate the nitrogen flow to pig hatch EQ-1401. V-1509 can then be used to control the nitrogen blow-through rate to partially clear the hose to the ship	GM/PR GM/SF/ PR	1/10/21 1/3/22

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal	**TEAM MEMBERS: Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman**	**DATE: 2 July 2021**
SYSTEM: Ship Loading – Ship Supply Wharfline Clearing to Ship	**LEADER: Dean Shewring**	
DRAWING: 20399 PI14 Rev C, 20399 PI15 Rev C	**MINUTES BY: Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
99.	Reverse Flow	V-1405 or the isolation valve in the new kicker line to EQ-1401 passing	Potential for reverse flow of nitrogen to the export pumps and possible through the pump discharge TRVs to the road tanker loadout pumps. Potential for reverse flow of nitrogen to the storage tanks via the tank outlet TRVs as these are set at 250 kPa. Potential to pump two-phase flow and hence damage to the pump	Procedures and training to keep these valves on EQ-1401 shut. Air eliminator at the road tanker loadout	Raise the tank outlet TRVs set pressure to 450 kPa to avoid nitrogen reverse flow into the tanks	TfA	Done

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman**	**DATE: 2 July 2021**
SYSTEM: **Ship Loading – Ship Supply Wharfline Clearing to Ship**	**LEADER:** **Dean Shewring**	
DRAWING: **20399 PI14 Rev C, 20399 PI15 Rev C**	**MINUTES BY:** **Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
100.	Low Pressure	Loss of the nitrogen supply system	Unable to use the stripping pump at the berth and hence the ship cannot be disconnected		Provide a portable air compressor for use at the berth (to be compliant with any hazardous area requirements)	GM/PR	1/3/22

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman**	**DATE: 2 July 2021**
SYSTEM: **Ship Loading – Berth Stripping Pump Operation**	**LEADER:** **Dean Shewring**	
DRAWING: **20399 PI15 Rev C**	**MINUTES BY:** **Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
101.	Design / Project Issue				Include an additional nitrogen connection upstream of PCV-1512 to allow 7 bar nitrogen to be used for hose pressure testing and stripping pump operation (this connection is to include two isolation valves)	TfA	Done
102.	High Flow / High Level	Hose failure (stripping pump suction / discharge)	LOC of ethanol at the berth, fire if ignited. Potential for the hose to strike person and cause injury	Hoses to be included in the hose register. Hose connections are to be dry breaks. Bunding at the berth. Hazardous area compliance. Braided hoses. Note: The nitrogen hose connection to the stripping pump will have whipping protection	No further action required	-	-

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman**	**DATE: 2 July 2021**
SYSTEM: **Ship Loading – Berth Stripping Pump Operation**	**LEADER:** **Dean Shewring**	
DRAWING: **20399 PI15 Rev C**	**MINUTES BY:** **Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
103.	Plant Items				The stripping pump discharge hose connection is to be a different size to the suction hose side connection to avoid the pump potentially being installed in reverse, i.e. not clearing the shipping hoses of ethanol which can lead to a spill when these hoses are disconnected	TfA	1/10/21
104.	Electrical	Potential for static accumulation on the stripping pump	Static is a source of ignition, i.e. potential for a fire		Confirm that the portable stripping pump will be provided with adequate means for earthing	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal	**TEAM MEMBERS: Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman**	**DATE: 2 July 2021**
SYSTEM: Ship Loading – Pigging the Ship Supply Wharfline back to the Ethanol Tanks	**LEADER: Dean Shewring**	
DRAWING: 20399-PI01 Rev D ,20399-PI13 Rev C, 20399 PI14 Rev C, 20399 PI15 Rev C	**MINUTES BY: Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
105.	Design / Project Issue				For both wharf lines, review the location of the pig sigs to ensure that the operators get sufficient warning to operator valves, e.g. to control flow prior to the pig entering the hatches	TfA	1/10/21
106.	High Flow / High Level	Potential to overfill the ethanol tank		The wharf line will only be pigged to the tank that was used to supply the ship, therefore, overfill is not credible	Include in the FD the requirement to shut the tank outlet valve based on high level and also there will need to be a mode of operation to accept reverse flow of ethanol from the wharf pipeline when the export pumps are offline	TfA	1/10/21
107.	High Flow / High Level	Nitrogen blowby from the ship supply wharfline to the tank, e.g. V-1405 left open on EQ-1401	Potential to overpressure the receiving tank	Pressure relief to the scrubber. PV and emergency vents	Confirm that the tank vents are adequately sized for this scenario	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

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SYSTEM: Ship Loading – Pigging the Ship Supply Wharfline back to the Ethanol Tanks	**LEADER: Dean Shewring**	
DRAWING: 20399-PI01 Rev D ,20399-PI13 Rev C, 20399 PI14 Rev C, 20399 PI15 Rev C	**MINUTES BY: Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
108.	High Flow / High Level	Thermal relief valve on the liquid outlet on another, off-line empty tank stuck open or passing	Misdirected flow to the off-line tank. If this tank is empty then there can be splash filling and static generation, i.e. a source of ignition	PMs on TRVs. Passing TRVs will be detected via tank level monitoring during no in/out flow periods. Nitrogen padded tanks. Low flow through the TRVs to minimise static generation	No further action required	-	-
109.	Reverse Flow	Potential for reverse flow from the tank to the wharf line once the pig has been received at EQ-1401	Refill the wharf line with ethanol (the project requirement is to leave the wharflines resting on nitrogen only)	Procedural control to isolate EQ-1401 once the pig has been received	Review the need to install a NRV immediately downstream of V-1319 (PI13) as an additional control to prevent reverse flow from the tank to the wharfline	TfA	1/10/21
110.	Impurities	Degradation of pig	Foreign objects entering the bulk tanks which can lead to blockages, e.g. TRVs	Product ethanol is filtered prior to road tanker and ship loading. Maintenance of the TRVs	No further action required	-	-

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

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SYSTEM: Ship Loading – Pigging the Ship Supply Wharfline back to the Ethanol Tanks	**LEADER: Dean Shewring**	
DRAWING: 20399-PI01 Rev D ,20399-PI13 Rev C, 20399 PI14 Rev C, 20399 PI15 Rev C	**MINUTES BY: Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
111.	Impurities	Third parties placing foreign objects / opening the pig hatches at the berth during non-operational periods	Potential for off-spec product when ethanol is returned to the tanks	Pig hatches can be cleaned when opened by the operators	Lock closed the pig hatch doors when not in use. Review the option of installing a fence around the Manildra equipment at the berth. Review with NSW Ports the option of the installing a video camera for remote observation of berth activities	GM/SF/ PR GM GM	1/10/21 1/10/21 1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT:	**Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:**	**Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman**	**DATE: 2 July 2021**
SYSTEM:	**Drainage Systems to the Slops Tanks**	**LEADER:**	**Dean Shewring**	
DRAWING:	**20399-PI16 Rev B ,20399-PI07 Rev B**	**MINUTES BY:**	**Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
112.	Design / Project Issue				To avoid the tankfarm bund sump pump PU-1602 running dry for too long and being damaged then include a low level cut-out switch. To provide redundancy of protection, provide a second low level switch cut out as per good practice for sumps	TfA	Done
113.	Design / Project Issue				Mark-up the P&ID to show the sample point(s) on the outlet of TK-1602	TfA	Done
114.	Design / Project Issue				Review if a foot valve is required for the liquid outlet dip pipe for TK-1601, i.e. to maintain suction	TfA	1/10/21
115.	Design / Project Issue				Confirm that the bulk tanks' bunded area is not a confined / restricted space given the bund walls will be relatively high, e.g. approximately 1.8 m	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT:	**Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:**	**Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman**	**DATE: 2 July 2021**
SYSTEM:	**Drainage Systems to the Slops Tanks**	**LEADER:**	**Dean Shewring**	
DRAWING:	**20399-PI16 Rev B ,20399-PI07 Rev B**	**MINUTES BY:**	**Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
116.	Design / Project Issue				Install a manual isolation valve immediately downstream of PRV-0756 at the inlet to TK-0700 (apply this action to TK-0800 as well). This is to allow double block and bleed isolation of the PRV for maintenance, i.e. improved isolation protection from the contents in the slops tanks	TfA	Done
117.	Design / Project Issue				Modify the tank inlet and outlet TRVs to match the bulk tank set pressures, i.e. to avoid installing a valve with an incorrect set pressure on the wrong tank	TfA	Done
118.	Design / Project Issue				Mark-up the P&ID to show the interstitial leak detection for the double walled tank TK-1601	TfA	Done
119.	High Flow / High Level	LOC of ethanol into the tank bunded area when the site is unmanned	Potential fire if ignited		Provide a high level alarm on the sump for PU-1602. Also provide a camera over the sump for remote monitoring	TfA	Done

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT:	**Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:**	**Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman**	**DATE: 2 July 2021**
SYSTEM:	**Drainage Systems to the Slops Tanks**	**LEADER:**	**Dean Shewring**	
DRAWING:	**20399-PI16 Rev B ,20399-PI07 Rev B**	**MINUTES BY:**	**Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
120.	High Flow / High Level	LOC of ethanol into an intermediate bund without a sump pump	Potential fire if ignited. If the intermediate bund wall drain valve is open then the ethanol fire risk can be propagated to the next bund		Check AS1940 with regards to allowing flammable liquids to be drained from one area to another bunded area. Review the need to install dedicated sump pumps in the remaining intermediate bunds as a result of this AS1940 check	TfA	Done
121.	High Flow / High Level	Potential to overfill the slops tank	Potential for ethanol to flow to the wet scrubber. If the wet scrubber inlet flow rate is higher than the wet scrubber capacity then it can overflow, i.e. fire if ignited. Potential for ethanol to flow out of the tank's emergency vent / PV (pressure / vacuum) vent into the bunded	PMs on the radar gauge. Self-checking radar gauge (double head). Independent high level trip (via a Safety Instrumented System). Routine tank dipping to cross-check the radar gauge. Bunded area with fire protection. 10 min filling time from the Hi to Hi Hi level to	Ensure there is means to trip PU-1601 on if high level occurs in the slops tank	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:**	**Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman**	**DATE: 2 July 2021**
SYSTEM: **Drainage Systems to the Slops Tanks**	**LEADER:**	**Dean Shewring**	
DRAWING: **20399-PI16 Rev B ,20399-PI07 Rev B**	**MINUTES BY:**	**Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
			area and hence fire if ignited	allow operator response. Tank design has the roof directing the liquid down the tank shell and hence not spraying from a height and therefore generating a mist			
122.	High Flow / High Level	Significant liquid flow into TK-1601 and LSHH-1601 has failed	Loss of the required spill capacity (26,000 L) for an Isotank. Back flooding the inlet sumps, e.g. the loading / unloading areas (fire risk at these areas)	PMs on LSHH-1601. Provision for tank dipping (note: unmanned terminal)	Provide level monitoring of TK-1601	TfA	Done
123.	High Flow / High Level	Potential for high level in TK-1602, e.g. V-1615 left closed or outlet pipe blocked (sand)	Overfilling TK-1602 (no significant consequences as this is rain water)		No further action required	-	-

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT:	**Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:**	**Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman**	**DATE: 2 July 2021**
SYSTEM:	**Drainage Systems to the Slops Tanks**	**LEADER:**	**Dean Shewring**	
DRAWING:	**20399-PI16 Rev B ,20399-PI07 Rev B**	**MINUTES BY:**	**Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
124.	High Flow / High Level	Potential for failure of the underground pipes, e.g. due to biological corrosion of the stainless steel	Impact to the environment due to release of ethanol		Review the materials of construction for the underground pipes and whether pipe-in-pipe is required	TfA	1/10/21
125.	Low Flow / Low Level	Potential to block line 1613 from the isotainer wash bund as the diameter is only 50 mm	Inability to drain this sump		Install a flush point immediately upstream of V-1604. Note: The line size cannot be increased too much as the pump PU-1601 may have difficulties achieving prime	TfA	Done
126.	Low Flow / Low Level	Potential to block line 1603 from the pumping station bund as the diameter is only 50 mm	Inability to drain this sump		Increase this line size to 80 mm minimum	TfA	Done
127.	Low Flow / Low Level	Potential to block the flame arrestors on TK-1601 and TK-1602	Damage to the tanks due to high / low pressure		Include these flame arrestors in the PMs	GM/DO	1/3/22

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT:	**Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:**	**Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman**	**DATE: 2 July 2021**
SYSTEM:	**Drainage Systems to the Slops Tanks**	**LEADER:**	**Dean Shewring**	
DRAWING:	**20399-PI16 Rev B ,20399-PI07 Rev B**	**MINUTES BY:**	**Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
128.	Zero Flow / Empty	PU-1602 fails	Unable to pump the tank farm bund dry		Project to purchase a spare PU-1602. This pump can be changed over from the platform above the sump	GM/DO	1/3/22
129.	Reverse Flow	The current design philosophy is that the XV on the inlet to the receiving slops tank is left open	Potential for reverse flow from the tank when the effluent pumps (PU-1601 and PU-1602 stop), e.g. to the bunds and underground tanks. Potential for tank-to-tank syphoning via the common slops inlet line	NRV on each slops tank inlet line. NRV on the discharge of PU-1601 and PU-1602. The XV on the inlet to the offline slops tank is to be interlocked closed	Include in the FD if PU-1602 and PU-1601 are not running then close the XV to the inlet to the online slops tank. Therefore, the control system requires confirmation when the air driven diaphragm pump PU-1601 is operating	TfA	1/10/21 Done
130.	Reverse Flow	PRV-0756 (inlet to the slops tank TK-0700) passing / stuck open. Note: This scenario applies equally to TK-0800 as well	Potential for reverse flow from the tank, e.g. to bunds and underground tanks	NRVs in the inlet lines to the TRVs. PMs on the TRVs. NRV on the discharge of PU-1601 and PU-1602	No further action required	-	-

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT:	**Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:**	**Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman**	**DATE: 2 July 2021**
SYSTEM:	**Drainage Systems to the Slops Tanks**	**LEADER:**	**Dean Shewring**	
DRAWING:	**20399-PI16 Rev B ,20399-PI07 Rev B**	**MINUTES BY:**	**Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
131.	Reverse Flow	V-1603 and V-1602 open (normal positions) on the liquid outlet line from TK-1601	Potential for hot condensate from the isotainer bund to flow to TK-1601. As TK-1601 is made from fibreglass then there is potential for damage to the fibreglass	Line 1613 rises to PU-1601 (however, high level in the isotainer bund could lead to syphoning into TK-1601). PU-1601 is to be operated during isotainer washing. Leak detection on the double walled tank (TK-1601)	Provide a dedicated pump for the isotainer wash bund (rated for up to 100°C). Therefore PU-1601 will be dedicated to TK-1601. This also avoids the need for the operators to open and close V-1603 and V-1604 when choosing the pump suction choice	TfA	Done
132.	Reverse Flow	Inlet to both slops tanks isolated and PU-1601 operated	Potential for reverse flow to the tank bund	NRV-1611. V-1610 will be actuated (see Item No. 136) and left in the closed position	No further action required	-	-

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT:	**Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:**	**Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman**	**DATE: 2 July 2021**
SYSTEM:	**Drainage Systems to the Slops Tanks**	**LEADER:**	**Dean Shewring**	
DRAWING:	**20399-PI16 Rev B ,20399-PI07 Rev B**	**MINUTES BY:**	**Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
133.	Reverse Flow	Ethanol vapour travelling through the drainage piping	If the ethanol vapour is ignited then there can be propagation explosions in the drainage system	Hazardous area compliance. Control of ignition sources at the site	Include a vapour trap (e.g. wet sump or P trap) in line 1604 to prevent reverse flow of vapours from TK-1601. Apply this action to any other similar drain lines where vapours can travel backwards to a potential area where sources of ignition can be present	TfA	1/10/21
134.	Impurities	Foreign objects entering the tank farm bund sump	Damage to PU-1602	Sump to have a mesh cover. Strainer on the pump suction	No further action required	-	-
135.	Impurities	Foreign objects, silt entering the slops tanks	Layer of silt in the bottom of the slops tank over time	Strainer and filter on the slops tank loading arm	Review the need for a strainer and/or filter on the inlet to the slops tank and/or after the drainage pumps	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT:	**Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:**	**Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman**	**DATE: 2 July 2021**
SYSTEM:	**Drainage Systems to the Slops Tanks**	**LEADER:**	**Dean Shewring**	
DRAWING:	**20399-PI16 Rev B ,20399-PI07 Rev B**	**MINUTES BY:**	**Peter Nyvlt**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
136.	Change in Composition or Concentration / Two-Phase Flow / Reactions	V-1612 (inlet line to TK-1602) open or passing when ethanol is in the tank bund sump	Ethanol release to the sea, i.e. environmental impact and fine	Procedures and training require the liquid in the tank farm bund sump to be tested before operating PU-1602	Actuate V-1610 and V-1612 (these will both have open and closed limit switches and both valves are to fail closed). Provide a local selection button for the operator to choose the destination tank. Include in the FD the requirement to reset the flow path to V-1610 once PU-1602 stops, i.e. the default flow path is to TK-1601 which is the ethanol effluent tank	TfA TfA	Done 1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT:	**Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:**	**Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Josh Coburn**	**DATE: 26 July 2021**	
SYSTEM:	**Slops Tanks**	**LEADER:**	**Dean Shewring**		
DRAWING:	**20399-PI07 Rev D, 20399-PI08 Rev D**	**MINUTES BY:**	**Marcus Rosella**		

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
137.	Zero Flow / Empty	Potential for fine solids / silt to be in the slops tanks, i.e. pumped from the site drainage system.	Fouling of equipment at the terminal and when returned to Shoalhaven Starches.	40 and 60 mesh strainers on the road tanker transfer line to the loading bay.	Preference is to use a half pipe outlet trough (on the liquid outlet nozzle of the tank) which will allow solids to settle in the bottom of the slops tanks and these can then be removed at a later date when the tanks are emptied for maintenance.	TfA	1/10/21
138.	Low Pressure	Tank empty with only nitrogen and ethanol vapour present.	If water is pumped from the drainage system into the tank then the ethanol in the vapour can be absorbed into the water (i.e. to reach equilibrium concentration) and therefore lower the pressure in the tank.	Vacuum relief and nitrogen padding.	Confirm that the tank low pressure protection is adequately sized for this scenario.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT:	**Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:**	**Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Josh Coburn**	**DATE: 26 July 2021**
SYSTEM:	**Slops Tanks**	**LEADER:**	**Dean Shewring**	
DRAWING:	**20399-PI07 Rev D, 20399-PI08 Rev D**	**MINUTES BY:**	**Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
139.	High Temperature	Higher temperature effluent from Isotank cleaning operation flowing to the slops tanks.	Increased ethanol vapour pressure in the tanks – no significant consequences identified.	Tank breathing to the scrubber. Overpressure relief valve. Emergency tank vent.	No further action required	-	-
140.	Impurities	Potential for foreign objects containing metal to enter the tank and float on the liquid surface.	Potential for static discharge between the non-earthed metal and the tank, i.e. ignition risk.	Nitrogen padded tank, i.e. normally there is not enough oxygen to support combustion. Tank earthing. Ethanol is a conductive fluid, i.e. charge is normally dissipated.	As per HAZOP Item Number 135, install a strainer on the inlet of the slops tanks to prevent foreign objects from entering. The strainers should be installed on the common inlet lines to each of the slops tanks, e.g. upstream of NRV V-0701 for TK-0700.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal		**TEAM MEMBERS:**	**Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Josh Coburn**
SYSTEM:	**Slops Tanks**	**LEADER:**	**Dean Shewring**
DRAWING:	**20399-PI07 Rev D, 20399-PI08 Rev D**	**MINUTES BY:**	**Marcus Rosella**

DATE: 26 July 2021

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
141.	Plant Items				Develop a critical spares list. This is to include the nitrogen regulators to the product tanks and slops tanks. Once the critical spares list has been generated then ensure these can be kept in the lockable maintenance storage building on site.	TfA	1/3/22
142.	Plant Items				Include a note on the P&ID to indicate that the emergency fire vents on all tanks are hinged and will re-seal once the venting has stopped (self-guiding).	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Josh Coburn**	**DATE: 26 July 2021**
SYSTEM: **Slops Tanks Loadout to a Road Tanker**	**LEADER:** **Dean Shewring**	
DRAWING: **20399-PI07 Rev D ,20399-PI08 Rev D, 20399 PI11 Rev E, 20399 PI13 Rev E**	**MINUTES BY:** **Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
143.	Zero Flow / Empty	PU-1305 deadheaded or run dry.	Pump damage (possible seal failure and a fire).	Low flow trip FS1305. Interlocks to prevent the pump running when the actuated valves are closed.	To be consistent with the other pumps on site, change PI131 to a PIT and also this will allow remote monitoring of PU-1305, e.g. to detect any pressure - flow problems.	TfA	1/10/21
144.	Zero Flow / Empty	Low level in the slops tank.	Potential for excess nitrogen flow to the road tanker and meter inaccuracy.	Air eliminator included in the loadout equipment.	Include in the FD the requirement to have the tank low-level setpoint for tripping the pump PU-1035 above the level where a syphon occurs and hence nitrogen can flow to the slops transfer road tanker arm. This will avoid excessive nitrogen being vented from the air eliminator.	TfA	1/10/21
145.	Reverse Flow	Both tank outlet actuated valves open at the same time.	Potential to syphon from a tank with high level to a tank with low level. This can lead to low pressure in the tank being drained and potential damage.	The actuated tank outlet valves are interlocked so that only one valve is open at any one time. Tank vacuum relief sized for this scenario.	Install NRVs in the liquid outlet lines from the slops tanks, e.g. immediately downstream of the tank liquid outlet actuated valves. These NRVs need to have means to externally lock the NRVs in the open position, e.g. if tank-to-tank transfer is required.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal	**TEAM MEMBERS: Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Josh Coburn**	**DATE: 26 July 2021**
SYSTEM: Slops Tanks Loadout to a Road Tanker	**LEADER: Dean Shewring**	
DRAWING: 20399-PI07 Rev D ,20399-PI08 Rev D, 20399 PI11 Rev E, 20399 PI13 Rev E	**MINUTES BY: Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
146.	Impurities	ENA road tanker incorrectly connects to load arm 3.	Off spec ENA as the slops within loading arm 3 can flow into the road tanker once the dry break connections are open.		Provide dedicated couplings for loading arms 1 and 2. This will require a special adapter for the infrequent road tanker filling operation and hence supervised transfers will be required.	GM/SF/ PR	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal	**TEAM MEMBERS: Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Josh Coburn**	**DATE: 26 July 2021**
SYSTEM: Slops Tanks Loadout to a Road Tanker	**LEADER: Dean Shewring**	
DRAWING: 20399-PI07 Rev D ,20399-PI08 Rev D, 20399 PI11 Rev E, 20399 PI13 Rev E	**MINUTES BY: Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
147.	Impurities	Road tanker arrives to site to be filled with slops and it contains other hydrocarbon products, e.g., diesel or petrol.	Potential for the other liquid hydrocarbon products to enter the slops system when the vehicle is emptied via the site drainage system. The other product vapours will flow through to the scrubber and hence be vented to atmosphere as they may not be soluble in water. This leads to environmental impact and a potential licence breach.		Only accept tankers for slops removal which have been cleaned elsewhere or are known to have a previous load of ethanol. If the road tanker is cleaned at an offsite facility then confirmation via a certificate is required to the Shoalhaven Starches control room so that slops transfer can be permitted remotely via the control system.	GM/SF	1/3/22
148.	Instruments				All transmitters in the terminal are to be trended in the control system to allow for remote fault finding.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT:	**Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:**	**Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Josh Coburn**	**DATE: 26 July 2021**	
SYSTEM:	**Wharf Return Line Pigging System**	**LEADER:**	**Dean Shewring**		
DRAWING:	**20399-PI14 Rev E, 20399-PI15 Rev E**	**MINUTES BY:**	**Marcus Rosella**		

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
149.	Design / Project Issue				Further review whether FCV-1414 should be closed or open in-between shipping operations, i.e. if it is open then K-1401 will always be open to the scrubber – are there any adverse consequences for this?	GM/Ops	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT:	**Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:**	**Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Josh Coburn**	**DATE: 26 July 2021**
SYSTEM:	**Wharf Return Line Pigging System**	**LEADER:**	**Dean Shewring**	
DRAWING:	**20399-PI14 Rev E, 20399-PI15 Rev E**	**MINUTES BY:**	**Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
150.	High Flow / High Level	Abnormal mode of operation during shipping transfer resulting in excess liquid in the wharf return line.	When the wharf return line is pigged, the increased volume of liquid ethanol can exceed the capacity of PU-1401 and hence result in high level in K-1401. This will result in the need to cycle XV-1413 open/close to allow clearing of the wharf return line, i.e. an unwanted means to operate the system requiring an operator's time.		Review means to control the flow into K-1401, e.g. install a manual globe valve or flow control valve in line 1414.	GM/SF/ PR	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:**	**Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Josh Coburn**	**DATE: 26 July 2021**
SYSTEM: **Wharf Return Line Pigging System**	**LEADER:**	**Dean Shewring**	
DRAWING: **20399-PI14 Rev E, 20399-PI15 Rev E**	**MINUTES BY:**	**Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
151.	High Flow / High Level	Initially, FCV-1414 could be mechanically stuck closed or manually shut. Therefore, the pressure in the wharf return line will increase to 350 kPa(g) (the nitrogen supply pressure).	When FCV-1414 is opened then there can be high flow to the scrubber with the potential to exceed the scrubber capacity, i.e. emit ethanol vapour to atmosphere. This leads to environmental impact and a potential licence breach.	FCV-1414 is closed on high pressure from PT-1414. Flow will be controlled via FT-1414. PT-1414 will close XV-1414 and XV-1411 on high pressure.	Mark-up the P&ID to show FT-1414 as an FIT-1414, i.e. to allow the flow to be monitored locally.	TfA	1/10/21
152.	High Pressure	V-1419 or V-1412 open during pigging of the return wharf line.	Potential for high volumetric flow of nitrogen to the slops tanks and hence high tank pressure (potential for damage and possible failure).	Tank vent to the scrubber. Tank pressure safety valve. Tank emergency fire vent.	Confirm that the slops tank over pressure protection is adequate for nitrogen flow through V-1412 (the larger valve).	TfA	1/10/21
153.	Impurities	Pig pieces or foreign objects entering via the pig hatch.	Potential for blockages.		Replace the commissioning strainer with a permanent strainer on the suction of PU-1401.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT:	**Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:**	**Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Josh Coburn**	**DATE: 26 July 2021**	
SYSTEM:	**Wharf Return Line Pigging System**	**LEADER:**	**Dean Shewring**		
DRAWING:	**20399-PI14 Rev E, 20399-PI15 Rev E**	**MINUTES BY:**	**Marcus Rosella**		

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
154.	Plant Items				Develop a procedure for wharf lines flushing and this is to be reviewed with regards to operability.	GM/SF/ PR	1/3/22
155.	Electrical	If K-1401 has undergone maintenance, there can be air within the vessel.	If liquid ethanol enters K-1401 there can be splashing and hence static generation. Potential for ignition and an internal explosion.	Bonding and earthing. Ethanol is a conductive fluid. The vessel is normally full with nitrogen and liquid.	Further protection is required; options include: Purging K01491 with nitrogen prior to use and/or Redesigning the inlet nozzle system (e.g. dip pipe).	GM/SF/ PR	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman, Peter Nyvlt**	**DATE: 27 July 2021**
SYSTEM: **Scrubber Inlet Piping System**	**LEADER:** **Dean Shewring**	
DRAWING: **20399-PI23 Rev D, 20399-PI01 Rev F, 20399-PI07 Rev D, 20399-PI11 Rev E, 20399-PI14 Rev E**	**MINUTES BY:** **Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
156.	Design / Project Issue				Review the required maintenance frequencies for the tank relief valves, in particular, the relief valves to the scrubber (e.g. see AS3788(?) for a risk-based approach to relief valve testing). Note that Manildra has experience with relief valve testing at Shoalhaven Starches and hence the frequency of testing can be determined using historical Starches data.	GM/DO	1/3/22

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal	**TEAM MEMBERS:** Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman, Peter Nyvlt	**DATE:** 27 July 2021
SYSTEM: Scrubber Inlet Piping System	**LEADER:** Dean Shewring	
DRAWING: 20399-PI23 Rev D, 20399-PI01 Rev F, 20399-PI07 Rev D, 20399-PI11 Rev E, 20399-PI14 Rev E	**MINUTES BY:** Marcus Rosella	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
157.	Design / Project Issue				Scrubber design basis discussion: - The scrubber design basis will be vapour flow from road tanker unloading + vapour flow from two Isotanks being loaded, i.e. 200 + (2 x 120) = 440 m^3/h. - When pigging the wharf return line there will be interlocks placed on use of the gantry to prevent exceeding the above design basis of the scrubber. Note that the wharf return line pigging operation is a relatively short duration event (approximately 15 minutes).	TfA	1/10/21
158.	Design / Project Issue				Mark-up the P&IDs to show the damper actuated valves on the vapour outlet lines from the tanks as fail closed.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal	**TEAM MEMBERS:** Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman, Peter Nyvlt	**DATE:** 27 July 2021
SYSTEM: Scrubber Inlet Piping System	**LEADER:** Dean Shewring	
DRAWING: 20399-PI23 Rev D, 20399-PI01 Rev F, 20399-PI07 Rev D, 20399-PI11 Rev E, 20399-PI14 Rev E	**MINUTES BY:** Marcus Rosella	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
159.	Design / Project Issue				Relocate the manual isolation valves that are downstream of each tank actuated damper valve to the tanks' P&IDs as these valves will be located at the top of the tank for local isolation for maintenance, e.g. maintenance of the flame arrestors at the vapour outlets of each tank.	TfA	1/10/21
160.	Design / Project Issue				Review if its possible to have only one vapour recovery flame arrestor per loading arm with the flame arrestor supplier, i.e. to minimise the maintenance requirements. Concern is that if there is only one flame arrestor closer to the vapour wet alarm pots then they may not stop a flame front due to the increased distance to the road tankers / Isotanks	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman, Peter Nyvlt**	**DATE: 27 July 2021**
SYSTEM: **Scrubber Inlet Piping System**	**LEADER:** **Dean Shewring**	
DRAWING: **20399-PI23 Rev D, 20399-PI01 Rev F, 20399-PI07 Rev D, 20399-PI11 Rev E, 20399-PI14 Rev E**	**MINUTES BY:** **Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
161.	Design / Project Issue				Review if it is possible to delete one of the flame arrestors and corresponding isolation valve in the vapour stream from K-1401 as the two existing flame arrestors are relatively close together.	TfA	1/10/21
162.	Zero Flow / Empty	Tank vent actuated valve stuck closed. Blocked flame arrestor on the tanks' vapour outlet stream. Tank PRV (pressure relief valve) to the scrubber stuck closed.	When the tank is filled, or the nitrogen regulator fails, then ethanol will be vented to atmosphere via the tank relief valves and possibly the emergency vent, i.e. environmental impact.		Review with the environmental consultants whether an infrequent event of this nature is acceptable or if further controls are required, e.g. switching tanks on high tank pressure.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman, Peter Nyvlt**	**DATE: 27 July 2021**
SYSTEM: **Scrubber Inlet Piping System**	**LEADER:** **Dean Shewring**	
DRAWING: **20399-PI23 Rev D, 20399-PI01 Rev F, 20399-PI07 Rev D, 20399-PI11 Rev E, 20399-PI14 Rev E**	**MINUTES BY:** **Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
163.	Reverse Flow	The liquid drain valve on a vapour wet alarm pot left open.	Potential for reverse flow of air from TK-1601 and hence the potential for a flammable atmosphere in the inlet piping of wet scrubber. Explosion risk if ignited.	Vapour wet alarm pots drains are bottom entry to TK-1601. NRV after the drain valves. Procedural requirement to keep the drain valves closed.	No further action required	-	-
164.	Reverse Flow	Filling two Isotanks at the same time and the wet scrubber fan stops.	Potential for reverse flow of ethanol / nitrogen from one Isotank to the other Isotank. If the operator is fitting the top lid then there is potential for exposure to ethanol / nitrogen.	NRVs included in all vapour recovery hose connections.	Include in PMs the requirement to check the vapour recovery hose NRVs when the adjacent flame arrestors are inspected. Note: These NRVs will also prevent potential reverse flow from the slops tanks or the slops vapour wet alarm pots which could cause the ENA tankers / Isotanks to be off-spec.	GM/DO	1/3/22

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman, Peter Nyvlt**	**DATE: 27 July 2021**
SYSTEM: **Scrubber Inlet Piping System**	**LEADER:** **Dean Shewring**	
DRAWING: **20399-PI23 Rev D, 20399-PI01 Rev F, 20399-PI07 Rev D, 20399-PI11 Rev E, 20399-PI14 Rev E**	**MINUTES BY:** **Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
165.	High Pressure				Confirm that the vapour wet alarm pots are piping items and not pressure vessels, i.e. overpressure relief is not required as per AS1210.	TfA	1/10/21
166.	High Pressure	Potential for the flame arrestors to block in the vapour return lines from the gantry.	Back pressure the road tankers / Isotanks during filling and hence a release via the road tankers' relief valves, i.e. a release of ethanol vapour at the gantry (ignition and exposure risk).	Routine maintenance and inspection of all flame arrestors.	Include a 15mm nipple immediately downstream of the vapour recovery hose connections for future pressure gauge use if required, i.e. to detect blocked flame arrestors.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman, Peter Nyvlt**	**DATE: 27 July 2021**
SYSTEM: **Scrubber Inlet Piping System**	**LEADER:** **Dean Shewring**	
DRAWING: **20399-PI23 Rev D, 20399-PI01 Rev F, 20399-PI07 Rev D, 20399-PI11 Rev E, 20399-PI14 Rev E**	**MINUTES BY:** **Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
167.	Low Pressure	Scrubber fan operating at maximum speed.	Lowest possible suction pressure, in particular, when no other vapour streams are flowing to the scrubber. This may open the road tanker vacuum vent and let air into the system i.e. potential for an explosive atmosphere and impurities to enter the system.	Flame arrestors installed in the vapour return lines to prevent flame propagation. Control of ignition sources at the gantry including hazardous area assessment.	Install an actuated on / off valve on the inlet to K-1101, K-1102 and K-1103. These valves are to be interlocked to the loading arm flow control, i.e., they will only be open when there is flow to the road tanker / Isotank.	TfA	1/10/21
168.	Low Temperature	Cooling of the vapour within the scrubber inlet pipes.	Potential for liquid ethanol formation which can accumulate at low points and hence cause blockages.		Mark up the P&IDs to show free drain no pockets on all scrubber inlet vapour lines.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman, Peter Nyvlt**	**DATE: 27 July 2021**
SYSTEM: **Scrubber Inlet Piping System**	**LEADER:** **Dean Shewring**	
DRAWING: **20399-PI23 Rev D, 20399-PI01 Rev F, 20399-PI07 Rev D, 20399-PI11 Rev E, 20399-PI14 Rev E**	**MINUTES BY:** **Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
169.	Impurities	Failure of a tank nitrogen regulator, i.e. it is stuck closed.	Air can be drawn into the tanks via the vacuum relief valve and hence form a flammable atmosphere. Tank explosion risk if a source of ignition is present. Note that air can also enter the scrubber inlet piping system via a road tanker or Isotank.	PMs on equipment. Operator response to low tank pressure alarm. Detonation arrestors downstream of each tank scrubber relief valves.	No further action required	-	-
170.	Plant Items				Provide an isolation valve immediately upstream of FA-2301 (PI23) to allow local isolation for maintenance and hence avoid the need to close the ten upstream maintenance isolation valves.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman, Peter Nyvlt**	**DATE: 27 July 2021**
SYSTEM: **Scrubber Inlet Piping System**	**LEADER:** **Dean Shewring**	
DRAWING: **20399-PI23 Rev D, 20399-PI01 Rev F, 20399-PI07 Rev D, 20399-PI11 Rev E, 20399-PI14 Rev E**	**MINUTES BY:** **Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
171.	Plant Items	The flame arrestors could contain aluminium internals.	Historically, the aluminium can oxidise, create white deposits and block the flame arrestors.		Preference is to use SS316 internals for the flame arrestors.	TfA	1/10/21
172.	Instruments				Include in the FD the requirement to keep FCV-1414 (PI14) closed when XV-1413 and XV-1411 are closed (no significant consequence identified if it passes or left open), however, it avoids a slight vacuum within K-1401 and possible the wharf return line when not in use.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman, Peter Nyvlt**	**DATE: 27 July 2021**
SYSTEM: **Wet Scrubber, Scrubber Fan and Stack System**	**LEADER:** **Dean Shewring**	
DRAWING: **OP00277-711-01 Rev A**	**MINUTES BY:** **Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
173.	Design / Project Issue				Replace the differential pressure indicator across the scrubber with a transmitter to allow remote monitoring, i.e. to detect scrubber flooding.	TfA	1/10/21
174.	Design / Project Issue				Mark-up the P&ID to show the tubing from the emission test ports so that sampling can be performed from ground level, i.e. to avoid sampling at heights.	TfA	1/10/21
175.	Design / Project Issue	Condensate formation in the piping upstream of the scrubber fan, e.g. due to cold ambient temperatures.			Confirm there will be a low point drain for any potential liquid accumulation within the fan casing or immediately upstream.	TfA	1/10/21
176.	Design / Project Issue				Confirm that the SS ducting is adequately rated for the lowest pressure the scrubber fan can generate, e.g. when there is no vapour flow from the process.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman, Peter Nyvlt**	**DATE: 27 July 2021**
SYSTEM: **Wet Scrubber, Scrubber Fan and Stack System**	**LEADER:** **Dean Shewring**	
DRAWING: **OP00277-711-01 Rev A**	**MINUTES BY:** **Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
177.	High Flow / High Level	Potential to block the lute at the base of the stack, e.g. due to solids falling into the stack when not in use.	Liquid build-up in the stack.		Install a low point drain from the bottom of the lute in the stack drain.	TfA	1/10/21
178.	High Flow / High Level	Running the scrubber fan at maximum speed.	Potential for scrubber flooding and hence increased ethanol emissions (potential licence breach and fines).		Confirm with the supplier that the scrubber is rated for the maximum flow through the fan. If not, then provide further controls to avoid scrubber flooding and ethanol breakthrough.	TfA	1/10/21
179.	Low Flow / Low Level	Potential for biological growth on the packing in the scrubber, e.g. when the scrubber is offline.	Maintenance is required to clean the packing, i.e. business impact.		Review this scenario with this supplier to check if it is credible and if so, what controls are required, e.g. intermittent flushing with Towns Water that contains residual chlorine.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman, Peter Nyvlt**	**DATE: 27 July 2021**
SYSTEM: **Wet Scrubber, Scrubber Fan and Stack System**	**LEADER:** **Dean Shewring**	
DRAWING: **OP00277-711-01 Rev A**	**MINUTES BY:** **Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
180.	Zero Flow / Empty	Loss of chilled water flow when the scrubber is operating.	Release of ethanol to the atmosphere, i.e. environmental impact and potential licence breach. If there is a source of ignition and oxygen is present in the vapour stream then there may be ignition and flame front propagation in the stack and upstream of the scrubber system.	Low flow chilled water trip.	Include in the FD the requirement to shut down all transfer operations that result in vapour flow to the scrubber containing ethanol, i.e. on loss of the chilled water flow.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman, Peter Nyvlt**	**DATE: 27 July 2021**
SYSTEM: **Wet Scrubber, Scrubber Fan and Stack System**	**LEADER:** **Dean Shewring**	
DRAWING: **OP00277-711-01 Rev A**	**MINUTES BY:** **Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
181.	Zero Flow / Empty	Fan failure during scrubber operation.			Further review this scenario with the scrubber designer as it may be possible to operate the scrubber with a pressurised vapour feed inlet, however, the back-pressure at the tank relief valves and road tankers / Isotanks may result in emissions at these locations. Flow – pressure modelling this scenario to determine the back-pressure in the system may be required.	TfA	1/10/21
182.	Zero Flow / Empty	Fan failure during scrubber operation.	As above, it may not be possible to operate the transfers, i.e. the road tanker / Isotank operations, the wharf return line pigging system and the slops tanks feed pumps (note: shipping can be performed).		Further redundancy is required, e.g. installing a parallel fan.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman, Peter Nyvlt**	**DATE: 27 July 2021**
SYSTEM: **Wet Scrubber, Scrubber Fan and Stack System**	**LEADER:** **Dean Shewring**	
DRAWING: **OP00277-711-01 Rev A**	**MINUTES BY:** **Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
183.	Impurities	Potential for birds to enter the stack when the fan is offline.	Blockage of the stack drain.		Include a mesh over the stack outlet. Provide a hand hole (blanked flange) at the bottom of the stack to allow for maintenance access for cleaning.	TfA	1/10/21
184.	Instruments	The scrubber will need to be operational prior to any transfers that generate vapour streams that flow to the scrubber.			Include in the FD the need to identify and include the triggers that start the scrubber operation prior to any ethanol transfers taking place.	TfA	1/10/21
185.	Instruments				Review with the scrubber vender what controls will be included to prevent blockage in the scrubber DP impulse lines, e.g. flush points or diaphragm connections.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal	**TEAM MEMBERS: Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Jack Stuart, Peter Nyvlt, Peter Rankin**	**DATE: 28 July 2021**
SYSTEM: Water Supply to the Feed Water Tank including the Water Softener and Dosing Chemical	**LEADER: Dean Shewring**	
DRAWING: 20399-PI25 Rev C, 20399-PI26 Rev C, 1-23830 (Tomlinson)	**MINUTES BY: Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
186.	Design / Project Issue				Include a boiler ready light on the control panel to allow the operators to check that the boiler is ready to supply steam to the Isotank from outside the container.	TfA	1/10/21
187.	High Flow / High Level	Potential for the feedwater tank sight glass to break, e.g. impact or mechanical stresses.	Potential burn hazard as the water is 80^{o}C.	Self-sealing bearing (check valve) within the site glass assembly.	No further action required	-	-
188.	High Flow / High Level	Potential for loss of containment, i.e. the brine or dosing chemical.	Potential for operator exposure, e.g. injury to eyes.	PPE when handling chemicals. Procedures and training for chemical handling.	Review the need for a safety shower / eyewash to satisfy Australian Standards or provide local eyewash capability.	TfA	1/10/21
189.	Reverse Flow				Mark-up the P&ID to show the dosing chemical top entry into the feed water tank to minimise the risk of reverse flow.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal	**TEAM MEMBERS: Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Jack Stuart, Peter Nyvlt, Peter Rankin**	**DATE: 28 July 2021**
SYSTEM: Water Supply to the Feed Water Tank including the Water Softener and Dosing Chemical	**LEADER: Dean Shewring**	
DRAWING: 20399-PI25 Rev C, 20399-PI26 Rev C, 1-23830 (Tomlinson)	**MINUTES BY: Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
190.	High Temperature	Failure of the feed water tank temperature control.	Loss of heating does not adversely affect the boiler (boilers can be operated with cold feed water but they typically have a reduced life). Potential to boil the feed water, e.g. steam out the feed water tank vent and pump cavitation.		Mark-up the P&ID to show a temperature gauge on the feed water tank for local temperature indication, i.e. to allow the operators to check the tank's heating control system.	TfA	1/10/21
191.	Testing				Provide a sample cooler (portable) in the event that the boiler water treatment company requires sampling the 80^{o}C feed water tank.	GM/PR	1/3/22
192.	Electrical	Electrical fault.	Potential for an electric shock or electrocution.		Review the need for earth leakage protection on the 240V supply to the boiler package.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

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SYSTEM: Water Supply to the Feed Water Tank including the Water Softener and Dosing Chemical	**LEADER: Dean Shewring**	
DRAWING: 20399-PI25 Rev C, 20399-PI26 Rev C, 1-23830 (Tomlinson)	**MINUTES BY: Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
193.	Instruments				Confirm the instrument voltages within the boiler package and therefore what level of protection, e.g., earth leakage, and back-up power supplies are required. Also, review the need for a UPS (uninterruptible power supply) in the event of a local electrical failure.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Jack Stuart, Peter Nyvlt, Peter Rankin**	**DATE: 28 July 2021**
SYSTEM: **Boiler Feed Water Pump, Boiler and Steam System**	**LEADER:** **Dean Shewring**	
DRAWING: **20399-PI26 Rev C, 1-23830 (Tomlinson)**	**MINUTES BY:** **Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
194.	Design / Project Issue				TFA to provide the proposed steam hose specifications to Manildra for review and acceptance.	TfA	1/10/21
195.	Design / Project Issue	Scale from the carbon steel piping system in the steam supply line.	Potential to enter the Isotanks and hence off-spec product.		Install a clean steam filter to avoid contamination in the Isotanks (this is understood to be a code requirement for the food and beverage industry for boilers).	TfA	1/10/21
196.	Design / Project Issue				Relocate PI2601 to downstream of PCV2505 (i.e. to monitor the steam pressure within the hoses) and provide on the local outside control panel a pressure indicator to allow the operator to monitor boiler pressure from outside the container.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Jack Stuart, Peter Nyvlt, Peter Rankin**	**DATE: 28 July 2021**
SYSTEM: **Boiler Feed Water Pump, Boiler and Steam System**	**LEADER:** **Dean Shewring**	
DRAWING: **20399-PI26 Rev C, 1-23830 (Tomlinson)**	**MINUTES BY:** **Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
197.	Design / Project Issue				Delete the manual valve to the inlet to PSHH01, i.e. to comply with the boiler code (loss of protection if the valve is left closed), and mark-up the P&ID to show the pressure instruments' (PSHH01 and the adjacent PT) blowdown valve.	TfA	1/10/21
198.	High Flow / High Level	Tube failure in the boiler.	Potential for steam to be emitted from the flue exhaust, i.e. impact to production due to the downtime for maintenance.	Operator response to the steam emission. Furnace flue system rated for the back pressure generated when the steam flows out the vent.	No further action required	-	-

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

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SYSTEM: Boiler Feed Water Pump, Boiler and Steam System	**LEADER: Dean Shewring**	
DRAWING: 20399-PI26 Rev C, 1-23830 (Tomlinson)	**MINUTES BY: Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
199.	High Flow / High Level	Failure of the boiler level control transmitter, e.g. reading too low.	Potential to overfill the boiler and hence boiler water enters the Isotanks. This could cause the steam hoses that connect to the Isotanks to move, possibly flay.	Anti-flay protection on the steam hoses. Level transmitter routinely checked against the boiler sight glasses.	No further action required	-	-
200.	Zero Flow / Empty	Feedwater pump failure.	Low level in the boiler leading to boiler damage. Downtime for maintenance.	Boiler protection compliant with the Australian Standards including redundant low level switches to trip the boiler.	Include in the spares list a feedwater pump to avoid impacting the business due to excessive downtime for repairs.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal	**TEAM MEMBERS: Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Jack Stuart, Peter Nyvlt, Peter Rankin**	**DATE: 28 July 2021**
SYSTEM: Boiler Feed Water Pump, Boiler and Steam System	**LEADER: Dean Shewring**	
DRAWING: 20399-PI26 Rev C, 1-23830 (Tomlinson)	**MINUTES BY: Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
201.	Reverse Flow	Potential for higher pressure steam to flow to the feedwater tank via the feed water pump when the pump stops.	Damage to the pump due to reverse rotation.	Two check valves in series on the pump discharge (regularly checked). Feedwater tank vented and therefore overpressure not expected.	No further action required	-	-
202.	High Pressure	Failure of the boiler pressure control, i.e. pressure transmitter reading too low.	Potential to rupture the boiler, i.e. harm to people and damage to equipment.	Routine maintenance. High pressure trip from PSHH01. Two 100% pressure safety valves.	No further action required	-	-
203.	Impurities				Provide a mesh on top of the feed water tank vent to minimise any foreign objects from entering.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Jack Stuart, Peter Nyvlt, Peter Rankin**	**DATE: 28 July 2021**
SYSTEM: **Boiler Feed Water Pump, Boiler and Steam System**	**LEADER:** **Dean Shewring**	
DRAWING: **20399-PI26 Rev C, 1-23830 (Tomlinson)**	**MINUTES BY:** **Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
204.	Impurities				Provide a hose parking station with blank connections to prevent foreign objects from entering the hoses when not in use.	TfA	1/10/21
205.	Plant Items				Include a flashing light outside the container as an additional means to alert the operator of a malfunction associated with the boiler. Note that an audible alarm will be provided within the container).	TfA	1/10/21
206.	Plant Items	Loss of containment of flue gas into the container and a person enters.	Hazard material exposure to personnel.	Ventilation on container provided as per the Australian Standards.	No further action required	-	-
207.	Plant Items	Potential for the trucks carrying the Isotanks to drive away with the hoses still connected.	Damage to equipment, i.e. business impact due to the time required for repairs.	Isotank cleaning is performed by the operators, i.e. a supervised activity.	Include an interlock with accompanying traffic light system on the steam hose parking positions in the wash bay area, to ensure that Isotanks do not drive off with the hoses still connected.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal		**TEAM MEMBERS:**	**Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Jack Stuart, Peter Nyvlt, Peter Rankin**
SYSTEM:	**Boiler Blowdown System**	**LEADER:**	**Dean Shewring**
DRAWING:	**1-23830 (Tomlinson)**	**MINUTES BY:**	**Marcus Rosella**

DATE: 28 July 2021

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
208.	Design / Project Issue				Following assessment in the HAZOP, the cooling of the blowdown tank is not required and therefore can be deleted from the design. The hot blowdown is to cool via the drainage system and when it is mixed with other liquid effluent in the slops tanks.	TfA	1/10/21
209.	High Temperature	Person contacts the blowdown tank surface when it is hot.	Potential burn injury.		Provide mesh guard around the blowdown tank where a person could inadvertently touch a hot surface.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT:	**Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:**	**Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Jack Stuart, Peter Nyvlt, Peter Rankin**	**DATE: 28 July 2021**
SYSTEM:	**Diesel Supply, Burner and Flue Gas**	**LEADER:**	**Dean Shewring**	
DRAWING: (Tomlinson)	**20399-PI26 Rev C, 1-23830**	**MINUTES BY:**	**Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
210.	Design / Project Issue				Ensure that the pump downstream of TK-2601 is a self-priming pump as it needs to draw suction from TK-20601 from a top entry.	TfA	1/10/21
211.	High Flow / High Level	Potential loss of containment of diesel inside the container, e.g. pump seal leak or tank overflow.	Fire if ignited, i.e. harm to people and damage to equipment. Potential for any leaks to flow into the slops system and hence contamination when the slops are returned to Shoalhaven Starches for reprocessing.	Maintenance of equipment to lower the likelihood of leaks, e.g. level instrument calibration checks. Diesel tank / pump to be in a self-contained area in the container.	To avoid contamination of the slops system, diesel spills within the container will not be drained to slops, therefore, ensure there will be a spill kit local to the boiler for any potential diesel spills.	GM/SF	1/3/21
212.	Zero Flow / Empty	Loss of diesel, e.g. empty feed tank, valve shut or pump failure.	Loss of flame and therefore steam generation.	Flame out instrument detects loss of diesel flow and trips the boiler.	No further action required	-	-

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:**	**Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Jack Stuart, Peter Nyvlt, Peter Rankin**	**DATE: 28 July 2021**
SYSTEM: **Diesel Supply, Burner and Flue Gas**	**LEADER:**	**Dean Shewring**	
DRAWING: **20399-PI26 Rev C, 1-23830 (Tomlinson)**	**MINUTES BY:**	**Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
213.	Plant Items	Potential for an explosion within the furnace, e.g. diesel continues to flow into a hot furnace but the burner is not alight.	Damage to the boiler.	AS2593 compliant equipment including air purging of the furnace at startup and flame out trip.	No further action required	-	-
214.	Plant Items	Faulty ignitor.	If there are repeated ignition commands during start-up then there can be liquid diesel pooling in the bottom of the furnace. If the burner is ignited then there can be rapid combustion of the liquid diesel in the furnace (typically leads to excess smoke / soot being emitted from the vent and damage from the pool fire inside the furnace)..	Routine maintenance, i.e. PMs on equipment such as the ignition system.	Review if it is possible to provide a limit on the number of failed starts per hour to prevent this scenario.	TfA	1/10/21

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PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Jack Stuart, Peter Nyvlt, Peter Rankin**	**DATE: 28 July 2021**
SYSTEM: **Diesel Supply, Burner and Flue Gas**	**LEADER:** **Dean Shewring**	
DRAWING: **20399-PI26 Rev C, 1-23830 (Tomlinson)**	**MINUTES BY:** **Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
215.	Plant Items	Air / diesel mixture being pumped into the burner, e.g. due to low level in the diesel feed tank.	Potential for flashback into the diesel piping system, i.e. combustion within the diesel feed piping.	Low level trip on the diesel feed tank. Loss of flame trip. The Weishaupt gas separator prevents flash back from the burner into the diesel system as it vents air prior to the burner.	No further action required	-	-

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal	**TEAM MEMBERS:**	Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Jack Stuart, Peter Nyvlt, Peter Rankin	**DATE:** 28 July 2021
SYSTEM: Diesel Supply, Burner and Flue Gas	**LEADER:**	Dean Shewring	
DRAWING: 20399-PI26 Rev C, 1-23830 (Tomlinson)	**MINUTES BY:**	Marcus Rosella	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
216.	Plant Items	Security issues.			To prevent theft of diesel, provide locks for the fill and dip connections on TK-2601.	GM/SF	1/3/22
					To prevent malicious damage, provide means to lock closed the container door for when the boiler is not in use.	TfA	1/10/21
					Provide an E-stop outside the container for the event when the doors are locked closed and an emergency event, e.g., fire, has occurred within the container.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal	**TEAM MEMBERS:**	Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Jack Stuart, Peter Nyvlt, Peter Rankin	**DATE:** 28 July 2021
SYSTEM: Diesel Supply, Burner and Flue Gas	**LEADER:**	Dean Shewring	
DRAWING: 20399-PI26 Rev C, 1-23830 (Tomlinson)	**MINUTES BY:**	Marcus Rosella	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
217.	Plant Items	Potential of loss of containment (LOC) from the diesel truck during transfer, e.g. leak from a truck fitting or hose failure.	LOC of diesel into the grated driveway area which flows to slops, i.e. contamination in slops tanks.		Diesel transfers are to be performed at the Isotank wash bay area. Provide a utility washdown point at the Isotank wash bay area for washing any spills with water. Ensure flush point V-1651 is a minimum distance to V-1604 and develop a procedure for diesel transfers where V-1604 is to be closed and then any spills can be removed directly from the Isotank wash bund and/or V-1651 (e.g. using a vacuum liquid effluent truck).	GM/SF TfA TfA GM/SF	1/3/22 1/10/21 1/10/21 1/3/22
218.	Plant Items				Tomlinson to provide a critical spares list. This is to include a diesel pump (i.e. the pump at the burner) and safety relief valves on the boiler (as relief valve testing is done off-site and can take a number of days or more).	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman**	**DATE: 29 July 2021**
SYSTEM: **Chilled Water to the Wet Scrubber**	**LEADER:** **Dean Shewring**	
DRAWING: **20399-PI23 Rev D, 20399-PI25 Rev C, OP00277-711-01 Rev A**	**MINUTES BY:** **Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
219.	High Flow / High Level	Plate cracking in HEX-2301.	Intermediate cooling fluid may pass through the scrubber system, i.e. potential for contaminants in the slops tanks.	Stainless steel plates. As below (Item No. 225), food grade intermediate cooling fluid to be used. Low level alarm on the intermediate cooling fluid tank.	No further action required	-	-
220.	High Flow / High Level	FCV-2330 fails open.	Higher flow through HEX-2301 with the potential for higher temperature to the scrubber, i.e. increased ethanol emissions and possibly exceeding the licence emission limit.		Confirm that the maximum flow of chilled water is within the design case of the chiller system / HEX-2301.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

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SYSTEM: **Chilled Water to the Wet Scrubber**	**LEADER:** **Dean Shewring**	
DRAWING: **20399-PI23 Rev D, 20399-PI25 Rev C, OP00277-711-01 Rev A**	**MINUTES BY:** **Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
221.	High Flow / High Level	Potential for the spray nozzle to fall off / unscrew.	Less than adequate water distribution across the scrubber packing and hence the potential for channelling. This can result in higher ethanol emissions to atmosphere (possibly exceeding the licence emission limit).		Replace the PI at the inlet to the scrubber to an indicating pressure transmitter (PIT) to help with fault finding using the Shoalhaven Starches SCADA system as well as locally at the terminal.	TfA	1/10/21
222.	Zero Flow / Empty	Chiller system failure.	Loss of cooling to the scrubber water supply. This may result in ethanol emissions above the licence limit.	As agreed upon in the design review, the chiller system is to include redundancy, e.g. duty / standby pump and compressor.	TAPC to model the scrubber operating with 20 and 25^{o}C water to determine if the licence limits will be breached and therefore if it is a reportable offence. The modelling for both these temperatures will also help to set the temperature alarms and trip points. If the modelling predicts ethanol release higher than the licence limit then the response needs to be determined, e.g. stop selected feeds to the scrubber.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman**	**DATE: 29 July 2021**
SYSTEM: **Chilled Water to the Wet Scrubber**	**LEADER:** **Dean Shewring**	
DRAWING: **20399-PI23 Rev D, 20399-PI25 Rev C, OP00277-711-01 Rev A**	**MINUTES BY:** **Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
223.	Zero Flow / Empty	Bad signal from FT-2301 or local loss of air to XV-2331 and FCV-2330.	XV-2331 fails closed and hence a scrubber failure.	As per the FD, low flow from FT-2301 will trip all activities that generate vapour streams that flow to the scrubber.	No further action required	-	-
224.	Reverse Flow				As the Towns Water is directly connected to a process unit operation which includes ethanol then provide an RPZ in the Towns Water supply line to the scrubber to prevent possible reverse flow to the safety shower eyewash units and amenities. The RPZ should be adjacent to V-2504 on drawing PI25 (this location will also protect against reverse flow due to a crack in a plate in HEX-2301, i.e. potential for reverse flow of the intermediate cooling fluid.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal	**TEAM MEMBERS:** Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman	**DATE:** 29 July 2021
SYSTEM: Chilled Water to the Wet Scrubber	**LEADER:** Dean Shewring	
DRAWING: 20399-PI23 Rev D, 20399-PI25 Rev C, OP00277-711-01 Rev A	**MINUTES BY:** Marcus Rosella	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
225.	Low Temperature	Failure of the chiller system, i.e. generating too much cold.	Potential to freeze the intermediate cooling fluid (possibly water). As water expands when it freezes then there can be damage to the chiller heat exchanger and possibly HEX-2301. A cracked plate could lead to non-food safe chemicals flowing to the slops system and then returned to Shoalhaven Starches.		Review with the chiller supplier the means for low temperature protection and whether an additional temperature element is required on the intermediate cooling fluid supply to HEX-2301. Also, review if it is required to have a food safe chemical in the intermediate cooling water loop, e.g. ethanol or food safe glycol.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal	**TEAM MEMBERS:** Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman	**DATE:** 29 July 2021
SYSTEM: Chilled Water to the Wet Scrubber	**LEADER:** Dean Shewring	
DRAWING: 20399-PI23 Rev D, 20399-PI25 Rev C, OP00277-711-01 Rev A	**MINUTES BY:** Marcus Rosella	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
226.	Impurities	Potential for release of oil from the chiller system.	Environmental impact as the oil could soak into the ground.		Request from the chiller system supplier secondary containment within the chiller system to collect potential oil spills. Also, check with the chiller system supplier how atmospheric moisture that can be condensed, or frozen and then remelted, is handled / contained as part of the chiller system design.	TfA	1/10/21
227.	Plant Items	Potential for fouling within HEX-2301.			HEX-2301 is to be a plate and frame heat exchanger to allow disassembly and cleaning if required.	TfA	1/10/21
228.	Plant Items				As per Manildra plant standards, provide means to back flush HEX-2301 using Towns Water, e.g. have a bypass around the exchanger to reverse flush with Towns Water.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman**	**DATE: 29 July 2021**
SYSTEM: **Chilled Water to the Wet Scrubber**	**LEADER:** **Dean Shewring**	
DRAWING: **20399-PI23 Rev D, 20399-PI25 Rev C, OP00277-711-01 Rev A**	**MINUTES BY:** **Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
229.	Plant Items	Identification of the underground HDPE pipe for future excavations.	Potential to rupture the HDPE pipe on impact during the excavation work and hence a scrubber trip.		Provide means to allow aboveground line tracing of the underground HDPE pipe, e.g. steel wire along the HDPE pipe.	TfA	1/10/21
230.	Plant Items				Mark-up the P&ID to include a drain valve on the Y-type strainer on the Towns Water inlet to HEX-2301 (to allow on-line flushing). Apply this action to all Y-type strainers in the water system.	TfA	1/10/21
231.	Instruments				To detect potential failures within the chiller system, provide means to connect to the terminal PLC to indicate the chiller system ready, run and fault conditions.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman**	**DATE: 29 July 2021**
SYSTEM: **Wet Scrubber Ethanol Recovery System to the Slops Tanks**	**LEADER:** **Dean Shewring**	
DRAWING: **20399-PI23 Rev D, OP00277-711-01 Rev A, 20399-PI07 Rev D**	**MINUTES BY:** **Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
232.	High Flow / High Level	Failure of the level control system and the independent level switch in the scrubber base.	Once the level rises above the vapour inlet nozzle then there will be two phase flow up through the packing and this has historically lead to damage.		Review the need for an overflow from the scrubber to the effluent system.	TfA	1/10/21
233.	High Flow / High Level	High level in the slops tank.	Potentially automatically change the receiving slops tank via the PLC – this is dependent on how the slops tanks will be operated.		Further review is required on how the slops tanks are to be operated. There are two options: 1. Operate one tank dedicated to low strength ethanol streams that can be returned directly to the farm at Starches and the other tank dedicated to higher strength ethanol streams that can be reprocessed at Starches. OR 2. The two slops tanks will accept any concentration slops, i.e. no	GM/Ops	Done

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal	**TEAM MEMBERS:** Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman	**DATE:** 29 July 2021
SYSTEM: Wet Scrubber Ethanol Recovery System to the Slops Tanks	**LEADER:** Dean Shewring	
DRAWING: 20399-PI23 Rev D, OP00277-711-01 Rev A, 20399-PI07 Rev D	**MINUTES BY:** Marcus Rosella	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
					tank selection based on ethanol strength. Option 1 will require a redesign of the liquid effluent feed streams to the slops tanks to ensure segregation of the low strength and higher strength ethanol streams. This is likely to include further actuated valves. Need to resolve which option is to be used at the terminal prior to finalising the design basis. The current design is option 2 and the HAZOP is proceeding on this basis. Therefore, include in the FD the requirement to automatically change slops tanks on high level.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal	**TEAM MEMBERS: Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman**	**DATE: 29 July 2021**
SYSTEM: Wet Scrubber Ethanol Recovery System to the Slops Tanks	**LEADER: Dean Shewring**	
DRAWING: 20399-PI23 Rev D, OP00277-711-01 Rev A, 20399-PI07 Rev D	**MINUTES BY: Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
234.	Zero Flow / Empty	Potential for foreign objects to enter the pumps, e.g., nuts, bolts and failed packing.	Pump damage.	Standby pump.	Install permanent strainers upstream of PU-2301 and PU-2302.		

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman**	**DATE: 29 July 2021**
SYSTEM: **Wet Scrubber Ethanol Recovery System to the Slops Tanks**	**LEADER:** **Dean Shewring**	
DRAWING: **20399-PI23 Rev D, OP00277-711-01 Rev A, 20399-PI07 Rev D**	**MINUTES BY:** **Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
235.	Reverse Flow	There are 3 main inlet lines to each slops tanks, i.e. from the scrubber, from the wharf return line and from the drainage system. It is possible for one of these systems to reverse flow through the slops tanks inlet lines into the other slops tank.	No significant consequences with respects to slops quality. However, if one slops tank has high level and the other slops tank has low level then the back pressure from the tank with the high level will be higher. Therefore, some pumps will have higher discharge pressures than others. This can lead to flows going to the wrong location and possibly stalling a pump.	Procedural control to only have one of the two isolation valves in the dedicated slops tank inlet lines open, e.g. V-2325 or V-2326 for the scrubber effluent.	Actuate (with limit switches): - V-2325, V-2326 (and delete the actuator on XV-2323 – for the wet scrubber), and - V-1415, V-1416 (for the wharf return line system), and - V-1608, V-1609 (for the drainage system) Install NRVs immediately upstream of these actuated valves to prevent reverse flows through the slops tanks' inlet piping system.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal	**TEAM MEMBERS: Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman**	**DATE: 29 July 2021**
SYSTEM: Wet Scrubber Ethanol Recovery System to the Slops Tanks	**LEADER: Dean Shewring**	
DRAWING: 20399-PI23 Rev D, OP00277-711-01 Rev A, 20399-PI07 Rev D	**MINUTES BY: Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
236.	High Pressure				Review the need for thermal relief between NRVs V-2324 / V-2332 and V-2325 / V-2326 (PI23).	TfA	1/10/21
237.	Instruments	Failure of a limit switch on an actuated valve in the terminal.			Need to determine on a case-by-case basis what transfers and processes will continue to operate and what transfers need to be tripped. For example, is an override required via the PLC (such as based on acceptable flow being measured even though a limit switch has failed to confirm that a valve has stroked fully)?	TfA	1/10/21
238.	Instruments				Provide a local PI immediately upstream of XV-2323 to allow pump performance monitoring and fault finding.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman**	**DATE: 29 July 2021**
SYSTEM: **Wharf Return Line Knockout Pot to the Slops Tanks**	**LEADER:** **Dean Shewring**	
DRAWING: **20399-PI07 Rev D ,20399-PI14 Rev E**	**MINUTES BY:** **Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
239.	Design / Project Issue				V-1420 and V-1419 can be deleted as the relatively small quantity in this line can be disposed of via the K-1401.	TfA	1/10/21
240.	Design / Project Issue				Line 1404 is to be separately piped to the slops tanks inlet manifold (to avoid flow/ pressure interactions with the PU-1401 system). This will require two pipes, i.e. one to TK-0700 and one to TK-0800. Provide an isolation valve on these two lines to the slops tanks with NRVs immediately upstream of these valves. Therefore, delete V-1418 and V-1412 and its associated thermal relief.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman**	**DATE: 29 July 2021**
SYSTEM: **Wharf Return Line Knockout Pot to the Slops Tanks**	**LEADER:** **Dean Shewring**	
DRAWING: **20399-PI07 Rev D ,20399-PI14 Rev E**	**MINUTES BY:** **Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
241.	Design / Project Issue	The design basis for the wharf lines was to allow a mode of operation using the ship export pumps to flush the wharf supply and therefore return lines to a slops tank at 1000m^3/h, i.e. to provide quick cleaning if contaminants are in these lines.	High velocities in line 1404 (currently 80 mm DN) and hence static generation (source of ignition). The 80 mm line will also restrict the transfer rate.	Bonding and earthing for static dissipation.	Further assessment of this scenario is required as increasing the line size for line 1404 to allow 1000m^3/h flow will require an increase in the sizing case for the scrubber (i.e. due to higher vapour flow from the slops tank). Note: The current scrubber design capacity is 440 m^3/h and therefore line 1404 will need to be increased to at least 150 mm.	TfA	1/10/21
242.	Design / Plant Issue				Review the implications of ship discharge through FCV-1523 / 1525 / 1527 and also reverse flow through strainer ST-1501 (PI15). Can flow pass backwards through these valves?	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman**	**DATE: 29 July 2021**
SYSTEM: **Wharf Return Line Knockout Pot to the Slops Tanks**	**LEADER:** **Dean Shewring**	
DRAWING: **20399-PI07 Rev D ,20399-PI14 Rev E**	**MINUTES BY:** **Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
243.	Zero Flow / Empty	PU-1401 failure.	Unable to remove liquid ethanol from the return wharf line.		Use a portable pump to clear the return wharf line. This will require V-1473 to be increased to 40 mm and install an additional 40 mm drain connection downstream of V-1422, i.e. the suction and discharge connections to the portable pump that will bypass PU-1401.	TfA	1/10/21
244.	High Pressure				Provide thermal relief for line 1404 for the section downstream of V-1412 which can be isolated at the slops tanks inlet manifold. This should be to both slops tanks as one slops tank can be off-line for major maintenance or inspections	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Gunter Kreilaus, Hamish Chapman**	**DATE: 29 July 2021**
SYSTEM: **Wharf Return Line Knockout Pot to the Slops Tanks**	**LEADER:** **Dean Shewring**	
DRAWING: **20399-PI07 Rev D ,20399-PI14 Rev E**	**MINUTES BY:** **Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
245.	Impurities	Ethanol transfer to a ship, however, due to contaminants in the ships tank the ethanol needs to be returned to the slops tanks.	If the ships pumps are operating too fast then the vapour load from the slops tanks can exceed the design basis of the scrubber and also exceed the velocity into the slops tanks (potential static generation and hence ignition risk).		Develop a procedure for ship-to-shore transfers to ensure the scrubber is not overloaded, i.e., the maximum ship discharge pump pressure can be estimated based on hydraulic modelling of the return wharf line to the slops tanks.	GM/SF/ PR	1/10/21
246.	Instruments				Provide a pressure gauge immediately downstream of PU-1401 for performance monitoring purposes and fault finding.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: **Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:** **Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Aaron Haley**	**DATE: 30 July 2021**
SYSTEM: **Nitrogen System**	**LEADER:** **Dean Shewring**	
DRAWING: **20399-PI22 Rev D, 20399-PI01 Rev F, 20399-PI07 Rev D, 20399-PI14 Rev E, 20399-PI15 Rev E, BOC P&ID 07072021**	**MINUTES BY:** **Marcus Rosella**	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
247.	Design / Project Issue				The nitrogen isolation valves on the nitrogen supply lines to the pig hatches can be ball valves as the risk of ethanol hold-up in these valves is acceptably low. PTFE seat ball valves to be used (i.e. food safe).	TfA	1/10/21
248.	High Pressure	Failure of PCV-2202 (fails open) on PI22.	The maximum pressure in the downstream piping system can be up to 16 bar(g). This will include the nitrogen transfer hoses, i.e. greater risk of failure and injury to personnel.	Maintenance of the regulator.	Install a relief valve downstream of PCV-2202 (maximum set point of 10 bar(g) to limit the pressure within the downstream nitrogen hoses.	TfA	1/10/21
249.	High Pressure	Tank inlet regulator failing open.	Potential for higher pressure nitrogen from PCV-2210, i.e. 1.8 kPa(g).	Tank PV vent and emergency vent. Operator response to high tank pressure alarms.	No further action required	-	-

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal	**TEAM MEMBERS:** Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Aaron Haley	**DATE:** 30 July 2021
SYSTEM: Nitrogen System	**LEADER:** Dean Shewring	
DRAWING: 20399-PI22 Rev D, 20399-PI01 Rev F, 20399-PI07 Rev D, 20399-PI14 Rev E, 20399-PI15 Rev E, BOC P&ID 07072021	**MINUTES BY:** Marcus Rosella	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
250.	Low Temperature	Potential for the nitrogen supply vaporiser to ice up.	Cryogenic liquid flowing to downstream users. If the liquid nitrogen enters a tank then there will be vaporisation and potential tank overpressure.	Typically, companies that supply cryogenic vessels install low temperature trips immediately after their vaporiser to prevent cryogenic liquid flowing to the downstream piping system and uses.	Further review if a low temperature trip will be provided with the vaporiser / VIE system and if so, ensure that there is sufficient over-capacity to prevent loss of supply. Ensure the nitrogen vapour supply temperature is available via the terminal PLC / SCADA system to allow remote monitoring and fault finding. Also, include the VIE (vacuum insulated expander) level as an input to the terminal PLC / SCADA system (with alarms to indicate loss of supply).	TfA TfA	1/10/21 1/10/21
251.	Impurities	Residual materials within the nitrogen piping system.	Potential for off-spec beverage grade ethanol.		Discuss with BOC the requirement that the nitrogen and nitrogen supply piping system needs to be beverage grade compatible as the tanks are storing beverage grade ethanol.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal	**TEAM MEMBERS:** Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Aaron Haley	**DATE:** 30 July 2021
SYSTEM: Nitrogen System	**LEADER:** Dean Shewring	
DRAWING: 20399-PI22 Rev D, 20399-PI01 Rev F, 20399-PI07 Rev D, 20399-PI14 Rev E, 20399-PI15 Rev E, BOC P&ID 07072021	**MINUTES BY:** Marcus Rosella	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
252.	Impurities				Provide caps for all nitrogen hoses to prevent contaminants from entering the hoses when not in use.	TfA	1/10/21
253.	Impurities	Potential for foreign objects / solid impurities from the liquid nitrogen supply.	Potential for off-spec beverage grade ethanol.		Further review with BOC the requirement for square cartridge type filters upstream of XV-2301 as these have been provided for other beverage grade facilities using nitrogen.	TfA	1/10/21
254.	Plant Items	Potential to connect an instrument air hose to the nitrogen system.	Nitrogen flowing to a confined space / restricted area that normally contains air and hence the risk of asphyxiation.	Signage at the utility station indicating the type of utility at each connection point. Pipeline markers with colour coding.	Provide dedicated (i.e. different designs) hose connections for the steam, instrument air and nitrogen hoses. This will require a dedicated diaphragm pump that will be driven by nitrogen for use at the berth, i.e. the nitrogen diaphragm pump is to have the unique nitrogen connection. Apply these controls to the Shoalhaven Starches nitrogen system, i.e. as per AS1345 identification of contents of pipes, conduits, and ducts.	TfA GM/SF/ PR	1/3/22 1/3/22

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal	**TEAM MEMBERS:** Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Aaron Haley	**DATE:** 30 July 2021
SYSTEM: Nitrogen System	**LEADER:** Dean Shewring	
DRAWING: 20399-PI22 Rev D, 20399-PI01 Rev F, 20399-PI07 Rev D, 20399-PI14 Rev E, 20399-PI15 Rev E, BOC P&ID 07072021	**MINUTES BY:** Marcus Rosella	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
255.	Plant Items	Potential for reverse flow of ethanol into the nitrogen systems at the gantry nitrogen system. Also, the hose will need to be depressurised prior to disconnection.		Whip checks to be including on all nitrogen hoses.	The nitrogen utility station at the gantry is to be designed as follows, i.e. in the order as shown from the nitrogen supply: Nitrogen isolation valve, NRV, bleed valve to atmosphere and then the hose connection. Include NRVs and bleed points for the two nitrogen connections at the berth in case these are used to blow clear any section of the birth piping (i.e. install these NRVs downstream of V-1577 and V-1574).	TfA	1/10/21
256.	Plant Items	Use of nitrogen for purging the loading arm equipment items, e.g. the filter and strainer.	Potential for misdirected flows through the thermal relief valves around the loading arms XV's and therefore into the pumping system.		Develop maintenance procedures for all nitrogen purging operations to ensure adequate isolation is provided to prevent misdirected flows.	GM/DO/ PR	1/3/22

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal	**TEAM MEMBERS:** Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Aaron Haley	**DATE:** 30 July 2021
SYSTEM: Nitrogen System	**LEADER:** Dean Shewring	
DRAWING: 20399-PI22 Rev D, 20399-PI01 Rev F, 20399-PI07 Rev D, 20399-PI14 Rev E, 20399-PI15 Rev E, BOC P&ID 07072021	**MINUTES BY:** Marcus Rosella	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
257.	Plant Items	Potential for malicious damage by a third party on the wharf / berth nitrogen system between shipping transfers.	As the pressure in this line is 7 bar(g) then there is potential for injuries such as skin injection hazards and impact from projectiles.		Include in the shipping procedures the requirement to close V-1417 following wharf line pigging operations and allow the nitrogen pipe downstream of this valve to vent down through K-1401 through to the scrubber. Install a PIT immediately downstream of V-1417 to allow the nitrogen pipeline pressure to be monitored between shipping transfers.	GM/SF/ PR TfA	1/3/22 1/10/21
258.	Plant Items	Potential for malicious damage by a third party on the wharf lines between shipping transfers.		The wharf and berth are not open to public access.	The wharf lines are to rest with a slight positive pressure (e.g. approximately 50 kPa(g)). To allow pipeline integrity monitoring between shipping transfers, change PI1403 and PI1406 to pressure transmitters (PITs). These can raise an alarm if the pressure drops, e.g. due to malicious activity causing a pipe breach.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT:	**Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:**	**Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Aaron Haley**	**DATE: 30 July 2021**	
SYSTEM:	**Modification to Tank Outlet Manifold**	**LEADER:**	**Dean Shewring**		
DRAWING:	**20399-PI13 Rev E**	**MINUTES BY:**	**Marcus Rosella**		

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
259.	Design / Project Issue				No significant issues were identified with the proposed modification. No further action required.	-	-

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT:	**Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:**	**Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Aaron Haley**	**DATE: 30 July 2021**	
SYSTEM:	**Ship Transfer Hoses**	**LEADER:**	**Dean Shewring**		
DRAWING:	**20399-PI15 Rev E**	**MINUTES BY:**	**Marcus Rosella**		

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
260.	High Flow / High Level	Potential for the flow control valves, e.g. FCV-1523, to fail open.	Higher flow rates through to the ships. As some ships have 5 inch manifold connections then the velocity can exceed 7 m/s, i.e., non-compliance with the recommended good practice for hydrocarbon transfers with the risk of static generation (a potential source of ignition).	The ships monitor the tank filling rate with communication to Manildra operators to restrict flow.	Further investigate the credible causes for these valves to fail open and whether further protection is required. Request from the valve supplier, integral differential pressure monitoring for additional means for fault finding and flow monitoring.	TfA	1/10/21
261.	Zero Flow / Empty	Potential for the ship transfer flow control valves to close too quickly(?)	Potential for surge in the wharf line and therefore possible damage and loss of containment, fire if ignited.		Review with the berth flow control valves' supplier if there is a credible cause for the flow control valve to close too quickly and therefore result in surge problems in the wharf line, e.g. if there is a sudden increase in pressure on the upstream side (from an increase in pump pressure?) will this valve respond by quickly closing.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT:	**Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:**	**Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Aaron Haley**	**DATE: 30 July 2021**	
SYSTEM:	**Ship Transfer Hoses**	**LEADER:**	**Dean Shewring**		
DRAWING:	**20399-PI15 Rev E**	**MINUTES BY:**	**Marcus Rosella**		

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
262.	Impurities				Check with the berth flow control valves' supplier if residual air in the system prior to use can cause the flow control valves any problems, e.g. vapour locked in the impulse tubing that could cause higher than required flow.	TfA	1/10/21
263.	Plant Items				Include in the critical spares list an additional ship transfer flow control valve as delivery time is typically 3 – 4 months.	TfA	1/10/21
264.	Plant Items	Hose disconnected from ship's manifold without prior depressurisation.	Potential inability to connect to another ship flange to open the dry break.		Include in the shipping procedure the requirement to depressurise the hose prior to disconnecting the hose at the ship, however, if this is not completed then depressurisation is to be done via V-1570 and V-1572.	GM/SF/ PR	1/3/22

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT:	**Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:**	**Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Aaron Haley**	**DATE: 30 July 2021**	
SYSTEM:	**Ship Transfer Hoses**	**LEADER:**	**Dean Shewring**		
DRAWING:	**20399-PI15 Rev E**	**MINUTES BY:**	**Marcus Rosella**		

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
265.	Plant Items			HAZOP Note: The dry break couplings for the shipping hoses are to have the addition locking pin to lower the likelihood of disconnection during transfer.	No further action required	-	-

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal	**TEAM MEMBERS:**	Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Aaron Haley	**DATE: 30 July 2021**
SYSTEM: Compressed Air System	**LEADER:**	Dean Shewring	
DRAWING: 20399-PI24 Rev D	**MINUTES BY:**	Marcus Rosella	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
266.	Design / Project Issue				Design issues associated with instrument air systems: 1. Provide a standby air compressor to improve reliability, e.g. in case the single air compressor fails and therefore all terminal operations will be stopped. 2. Ensure there is a NRV upstream of the air receiver to prevent loss of air if the compressors fail, i.e. due to reverse flow. 3. Pipe the liquid effluent from the air receiver to the oil water separator (the air compressors are to be oil flooded). 4. The instrument air dew point should be as low as possible to avoid corrosion and excessive maintenance of the actuators. 5. Include an oil filter to prevent oil carryover from the receiver into the dryer.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal	**TEAM MEMBERS:**	Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Aaron Haley	**DATE: 30 July 2021**
SYSTEM: Compressed Air System	**LEADER:**	Dean Shewring	
DRAWING: 20399-PI24 Rev D	**MINUTES BY:**	Marcus Rosella	

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
					6. Provide a pressure transmitter with a low alarm (i.e. to alarm a supply problem).		
267.					Design issues associated with instrument air systems (continued): 7. Include in the FD the need to receive a fault signal from the air compressor supply package to the terminal PLC. 8. Review the need for a cooler after the compressors to prevent overloading the dryer. 9. Review upgrading the current air supply system pipework material of construction as internal and /or external corrosion may occur due to the terminal location near the harbour and hence rust entering the tanks causing off-spec beverage grade ethanol.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT:	**Manildra Port Kembla Ethanol Terminal**	**TEAM MEMBERS:**	**Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Aaron Haley**	**DATE: 30 July 2021**	
SYSTEM:	**Compressed Air System**	**LEADER:**	**Dean Shewring**		
DRAWING:	**20399-PI24 Rev D**	**MINUTES BY:**	**Marcus Rosella**		

No.	GUIDE WORDS	CREDIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY WHO	BY WHEN
268.	Design / Project Issue				Other instrument air users / project issues: 1. Provide instrument air at the workshop. 2. If a forklift truck requires instrument air for starting then review the locations where instrument air supply is required. 3. Review the need to seal the area to the south of the fire water pumps for a diesel truck to park to transfer diesel to the fire water pumps and therefore not obstruct traffic onto the site.	TfA	1/10/21

PINNACLE RISK MANAGEMENT - HAZOP RECORD SHEET

PROJECT: Manildra Port Kembla Ethanol Terminal	**TEAM MEMBERS:**	Greg Murphy, Graham Anderson, Paul Richards, Brad Shaw, Ben van der Merwe (TfA), Aaron Haley	**DATE: 30 July 2021**
SYSTEM: Overview	**LEADER:**	Dean Shewring	
DRAWING: All Drawings	**MINUTES BY:**	Marcus Rosella	

No.	GUIDE WORDS	POSSIBLE CAUSES	CONSEQUENCES	EXISTING SAFEGUARDS	ACTION RECOMMENDED	BY	DONE
269.	Breakdown	Failure of the communications system between the terminal PLC and Shoalhaven Starches.	Loss of remote monitoring.		The Project Team is to review and detail the appropriate response for loss of remote monitoring.	GM/SF/ PW/PR	1/10/21

9 APPENDIX D – HAZOP STUDY TEAM

Appendix D – HAZOP Study Team

HAZOP Role	Name	Company	Experience
HAZOP Chair	Dean Shewring	Pinnacle Risk Management	Chemical engineer with 35 years experience. Process safety since 1996
HAZOP Secretary	Peter Nyvlt	ME Engineering	Chemical engineer with 35+ years experience in process design and operation
Design Representative	Ben van der Werwe	TfA Project Group	Mechanical engineer with 35 years experience in the oil industry and 20 years experience in fuel terminal design
Project Management	Greg Murphy	Manildra	Mechanical engineer with 40 years experience in steel, aluminium, construction and food industries. 20+ years Engineering Manager at Manildra
Electrical / Control Representative	Paul Whisson	Manildra	Electrical engineer with 26 years experience
Electrical / Control Representative	Josh Coburn	Manildra	Electrical / maintenance for 15 years. Electrical projects for 5 years
Electrical / Control Representative	Hamish Chapman	Manildra	Electrical engineer with 15 years experience in electrical projects and 10 years experience in software engineering
Electrical / Control Representative	Dylan Ware	Manildra	Electrical Engineering for the last 15 years with experience in both installation and maintenance on process control / programming, high voltage and instrumentation, and 10 years as an electrical contractor with domestic, commercial and industrial works
Operations Representative	Graham Anderson	Manildra	30 years experience with ethanol storage and handling operations. Previous experience in mechanical engineering and trade toolmaking
Operations Representative	Paul Richards	Manildra	25 years experience as a chemical engineer in fuels and refining. 12+ years as an RPEQ (Registered Professional Engineer Queensland)
Operations Representative	Gunter Kreilaus	Manildra	Ethanol distilling and terminal operations for 30 years
Maintenance Representative	Brad Shaw	Manildra	Fitter / maintenance for 30 years. Boiler house leading hand for 12 years. Manildra employee for 23 years
Boiler Representative	Peter Rankin	Tomlinson	30 plus years experience in industry with boilers and similar equipment

10 REFERENCES

1 Department of Planning, *Hazardous Industry Planning Advisory Paper No. 8, HAZOP Guidelines*, 2011