APPENDIX H QRA KAPUNI J WELLSITE – WORLEY

TODD ENERGY LTD

Kapuni J Wellsite
Quantitative Risk Assessment

620035-RPT-R0002
May 2019

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Rev	Description	Originator	Reviewer	WorleyParsons Approver	Date	Client Approval	Date
A	Issued for Review/Comment	A Setodewo	Y Lee	A Setodewo	05/2019		
0	Approved for Use	A Setodewo	Y Lee	A Setodewo	05/2019		

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Executive Summary

WorleyParsons New Zealand Limited (WorleyParsons) has been commissioned by Todd Petroleum Mining Company Ltd (Todd) to conduct a Quantitative Risk Assessment (QRA) for the Kapuni J Wellsite to support the land consent application process. This report presents the QRA method, modelling inputs, assumptions and risk results.

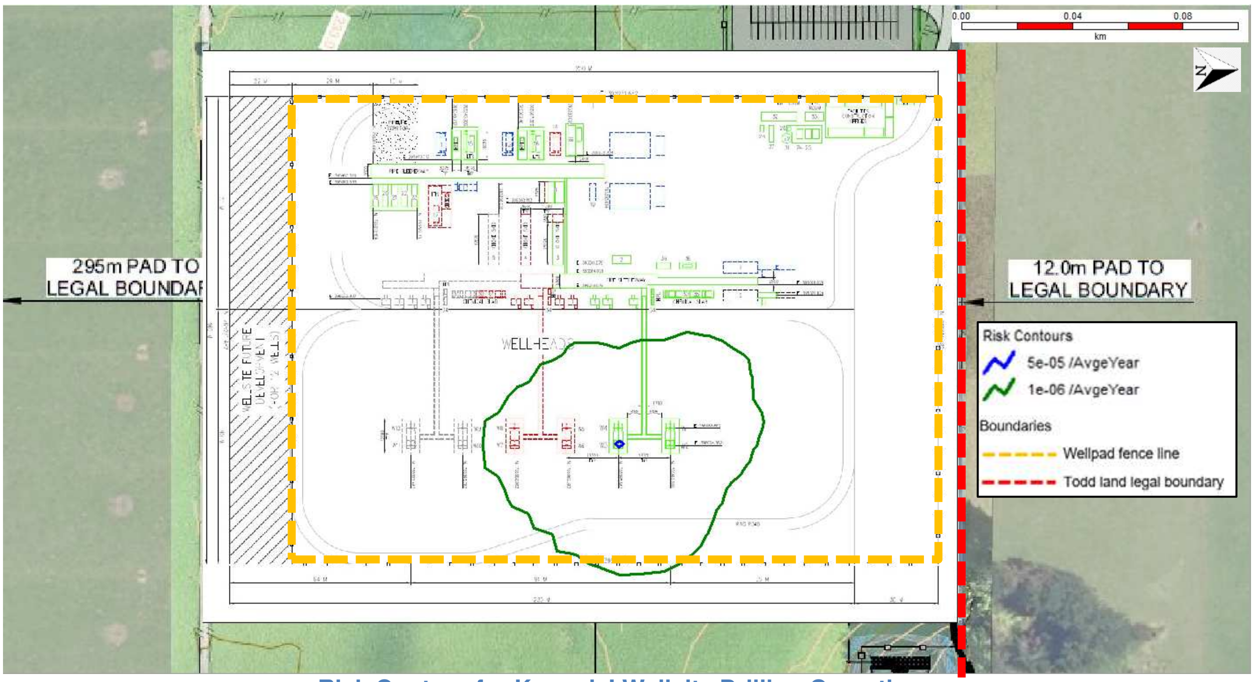
The assessment considers risks from the Kapuni J wellsite for the following cases:

- Drilling operations which considers only blowout events
- Normal operations/production for phase 1 wells. Phase 1 refer to the initial development of Kapuni J wellsite with 4 wells in operation along with the associated process equipment.
- Normal operations/production for all wells. This case refers to the eventual development of Kapuni J wellsite which will have 12 producing wells along with the associated process equipment.

The key deliverable of the QRA is the individual fatality risk contours which are assessed against the HIPAP4 criteria.

Drilling Operations Results

The risk contour for the Kapuni J Wellsite during drilling operation is presented in the figure below.



Risk Contour for Kapuni J Wellsite Drilling Operations

The LSIR results as assessed against the HIPAP4 criteria are given in the table below.

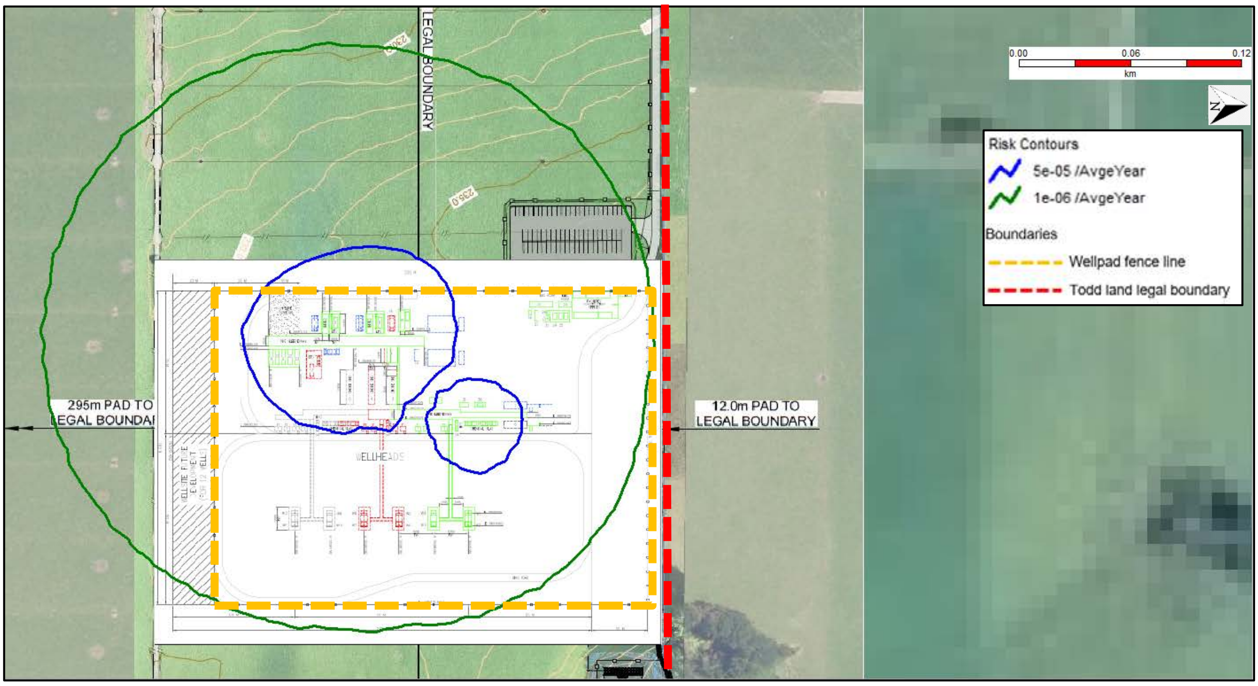
Drilling Operation LSIR Results as Assessed against the Risk Criteria

LSIR	Risk Contour	Risk Criteria	Result
5E-05 / year	Blue	Industrial 5E-05 / year risk contour should, as a target, be contained within the boundaries of the industrial site where applicable.	No impact. The 5E-05 / year risk contour is within the site boundary.
1E-06 / year	Green	Residential 1E-06 / year risk contour should not extend to residential, hotels, motels, tourist resorts	No impact. The contour does not encroach on any houses or other places of residence. The 1E-06 / year risk contour remains within the legal boundary of the land owned by Todd, although it extends slightly beyond the wellpad fence line on the East side.

The result shows that during drilling operations, the risk contours of 5E-05 / year and 1E-06 / year stay within plant boundaries.

Normal Operations for Phase 1 Wells

The overall risk contour during normal operations of Kapuni J wellsite for phase 1 is presented in the figure below.



Kapuni J Normal Operations for Phase 1 Contour

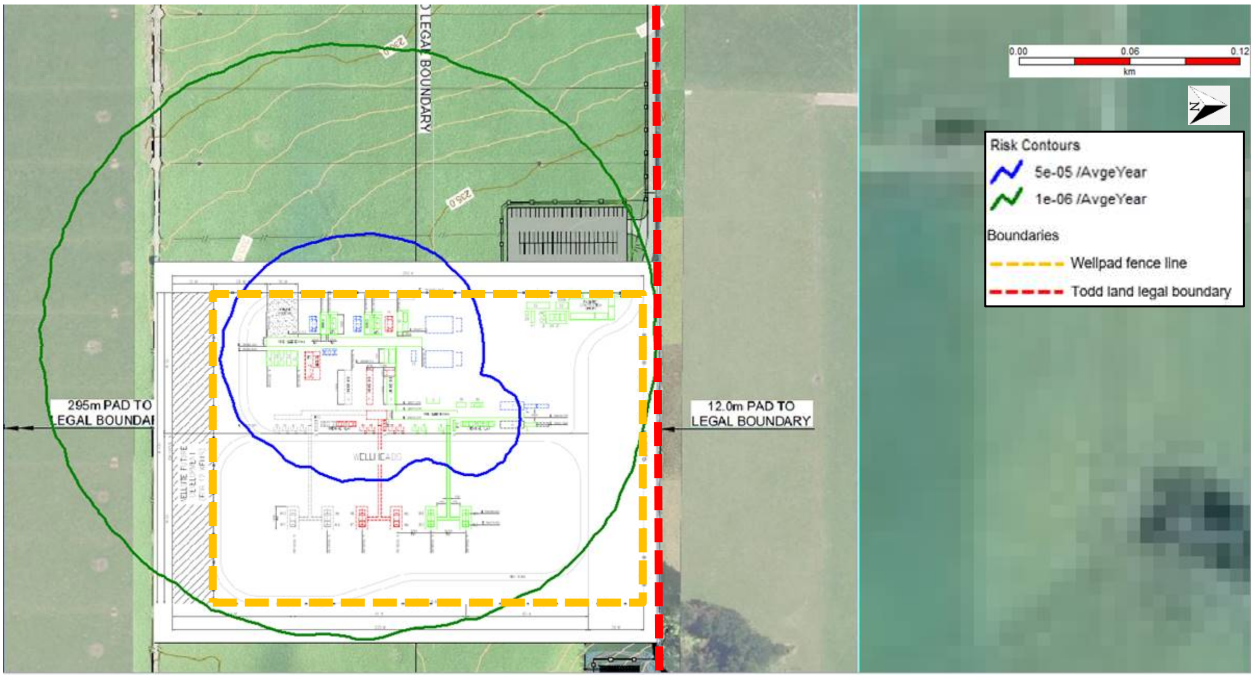
The LSIR results as assessed against the HIPAP4 criteria are given in the table below.

Normal Operations for Phase 1 LSIR Results as Assessed against the Risk Criteria

LSIR	Risk Contour	Risk Criteria	Result
5E-05 / year	Blue	Industrial 5E-05 / year risk contour should, as a target, be contained within the boundaries of the industrial site where applicable.	No impact. The 5E-05 / year risk contour remains within the legal boundary of the land owned by Todd although it extends beyond the wellpad fence line on the West side.
1E-06 / year	Green	Residential 1E-06 / year risk contour should not extend to residential, hotels, motels, tourist resorts	No impact. The contour does not encroach on any houses or other places of residence. The 1E-06 / year risk contour remains within the legal boundary of the land owned by Todd although it extends beyond the wellpad fence line on all sides.

Normal Operations with All Wells in Production

The overall risk contour during normal operations with all wells in Production for Kapuni J wellsite is presented in the figure below.



Kapuni J Normal Operations with All Wells Contour

The LSIR results as assessed against the HIPAP4 criteria are given in the table below.

Normal Operations for Phase 1 LSIR Results as Assessed against the Risk Criteria

LSIR	Risk Contour	Risk Criteria	Result
5E-05 / year	Blue	Industrial 5E-05 / year risk contour should, as a target, be contained within the boundaries of the industrial site where applicable.	No impact. The 5E-05 / year risk contour remains within the legal boundary of the land owned by Todd although it extends beyond the wellpad fence line on the West side.
1E-06 / year	Green	Residential 1E-06 / year risk contour should not extend to residential, hotels, motels, tourist resorts	No impact. The contour does not encroach on any houses or other places of residence. The 1E-06 / year risk contour remains within the legal boundary of the land owned by Todd although it extends beyond the wellpad fence line on all sides.

The risk contours for normal operations, both phase 1 operations and with all wells in operations, are within the land boundary owned by Todd. The main risk contributors at the North boundary of the Kapuni J wellsite are the horizontal jet fire events from large size releases. It should be noted that the QRA model cannot take into account the topography of the site. The risk calculation results are based on flat land with no obstructions.

The Kapuni J site is not flat and in order to achieve a flat building pad a significant cut and fill redistribution will be implemented. Once completed, the pad will be around 2.6 m lower than the ground level at the North boundary. This will provide a physical barrier between the Kapuni J wellsite facilities and outside parties beyond the North boundary. As jet fire events are directional, this barrier would help mitigate the effects of a jet fire on the adjoining land.

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1. ABBREVIATIONS

AWS	Automatic Weather Station
BLEVE	Boiling Liquid Expanding Vapour Explosion
BOP	Blowout Preventer
EDP	Emergency Depressurization
ERS	Environmental Risk Solutions
ESDV	Emergency Shutdown Valve
HCRD	Hydrocarbon Release Database
HIPAP4	NSW Hazardous Industry Planning Advisory Paper No. 4
HIPPS	High Integrity Pressure Protection System
HMB	Heat and Material Balance
HPKO	High Pressure Knock Out
IRPA	Individual Risk Per Annum
KRD	Kapuni Redevelopment
LFL	Lower Flammable Limit
LTS	Low Temperature Separator
MEM	Multi-Energy Method
OGP	International Association of Oil and Gas Producers
P&ID	Piping & Instrumentation Diagram
PLL	Potential Loss of Life
PML	Petroleum Mining Lease
RADD	Risk Assessment Data Directory
SLOD	Significant Likelihood of Death
SLOT	Specified Level of Toxicity
STDC	South Taranaki District Council
QRA	Quantitative Risk Assessment
VCE	Vapour Cloud Explosion

2. INTRODUCTION

2.1 Background

Todd Petroleum Mining Company (Todd) is proposing to conduct development drilling activities at the Kapuni J wellsite located within rural farmland on Palmer Road, approximately 2.5 km South East from Kaponga, South Taranaki within Petroleum Mining Lease (PML) 38839.

For the project to progress, a Land Use Consent from the South Taranaki District Council (STDC) is required. Part of the requirement of the consent application is to conduct a Quantitative Risk Assessment (QRA) of the facility to assess the potential effect it may have on the surrounding land use. Todd has contracted WorleyParsons to undertake the QRA to support the land use consent application.

2.2 Objective

The objective of the QRA is to determine the location specific individual risk (LSIR) associated with the proposed Kapuni J wellsite.

2.3 Scope

The scope for Kapuni J QRA includes the following cases:

- **Drilling phase** which considers only blowout events
- **Normal operations/production for phase 1 wells.** Phase 1 refer to the initial development of Kapuni J wellsite with 4 wells in operation along with the associated process equipment.
- **Normal operations/production for all wells.** This case refers to the eventual development of Kapuni J wellsite which will have 12 producing wells.

Specific assumptions related to the scope is listed in the Assumptions Register attached as Appendix-1.

The following are excluded from this study:

- Third party risk contributors (external risks).
- Loss of containment from pipeline sections outside the plant boundaries.
- Non-hydrocarbon risks (e.g. transportation risk, earthquake risk). The industry generic leak frequency database [Ref. 1] incorporates the frequency of equipment failure and loss of hydrocarbon containment due to seismic activities. Hence to avoid overestimating the leak frequencies, earthquake is not included in the leak frequency calculation as a standalone cause of loss of containment.
- Calculation of individual risk per annum (IRPA) and potential loss of life (PLL) for onsite personnel, and calculation of societal risk for offsite personnel.
- Calculation of injury risk, risk of property damage and accident propagation.
- Recommendations and risk mitigation measures.

2.4 Site Description

The Kapuni J wellsite is a greenfield wellsite, can host up to 12 production wells which are to be drilled in multiphase batches. Phase-1 of the project will consist of 4 wells to be in drilled in early 2021 along with installation of well fluid processing facilities. The Kapuni J wellsite will use the modular construction philosophy developed for the Todd Mangahewa wellsites. The skids will be based on the recently completed Mangahewa G with modifications to align with existing Kapuni Field infrastructure, conditions and philosophies [Ref. 2].

The facilities to be installed on the wellsite for Phase 1 include the following:

- 4 Production Wellheads/Christmas tree upper master and flow wing valves (supplied by drilling/completions contractor).
- 4 6" Production Flow lines (including instrumentation, isolation valves) with provision (spool) for valve pressure testing and isolation, future individual wellstream sand catcher and flow measurement.
- 1 cyclone desander (located away from the wellheads but upstream of the choke valve, to minimize impact of sand production on the downstream facilities).
- 1 start-up heater (located upstream of the choke valve in the startup loop, to ensure temperatures downstream of the choke during start-up remain above hydrate formation temperatures/minimum design temperatures). This will only be used for startup.
- Tie in points for temporary production testing, located in the startup loop.
- 3 production manifolds: Train A Manifold (200NB), Train B Manifold (200NB) and Train C Manifold (250NB). All 3 manifolds will be designed to operate in high-pressure or low-pressure mode.
- 2 Low Temperature Separator (LTS) Skids, each skid will consist of a High Pressure Knock Out (HPKO) Vessel, Gas/Gas Heat Exchanger and Low Temperature Separator.
- 1 Low Pressure Separator Skid, which will take feed from low pressure gas wells and liquid from the Low Temperature Separators.
- Tie-in and layout allowance for future wells and equipment (coolers, permanent production testing train, LTS skid, compressors).
- Overpressure protection equipment to protect low pressure rated equipment, pipework, pipelines and downstream production stations from overpressure.
- Control Systems – Process Control and Safety Instrumented Systems.
- Utilities.

The future development for the Kapuni J wellsite future development is to host 12 producing wells. Additional equipment will be installed on the wellsite include the following:

- 8 Production Wellheads/Christmas tree upper master and flow wing valves (to be supplied by drilling/completions contractor).

- 8 Production Flow lines (including instrumentation, isolation valves) with provision (spool) for valve pressure testing and isolation, future individual wellstream sand catcher and flow measurement.
- 2 cyclone desanders for the eight production flowlines (located away from the wellheads but upstream of the choke valve, to minimize impact of sand production on the downstream facilities).
- 2 air-cooled heat exchangers. 1 to be installed upstream of HPKO A and 1 upstream of the LP Separator.

3. METHODOLOGY

The methodology followed for completing the QRA is aligned with good industry practice and specified in the WorleyParsons' Onshore QRA Method Statement [Ref. 3]. The generic process is illustrated in Figure 3-1 with the slight modification in that this study does not include the calculation of IRPA and PLL and provision of risk mitigation measures.

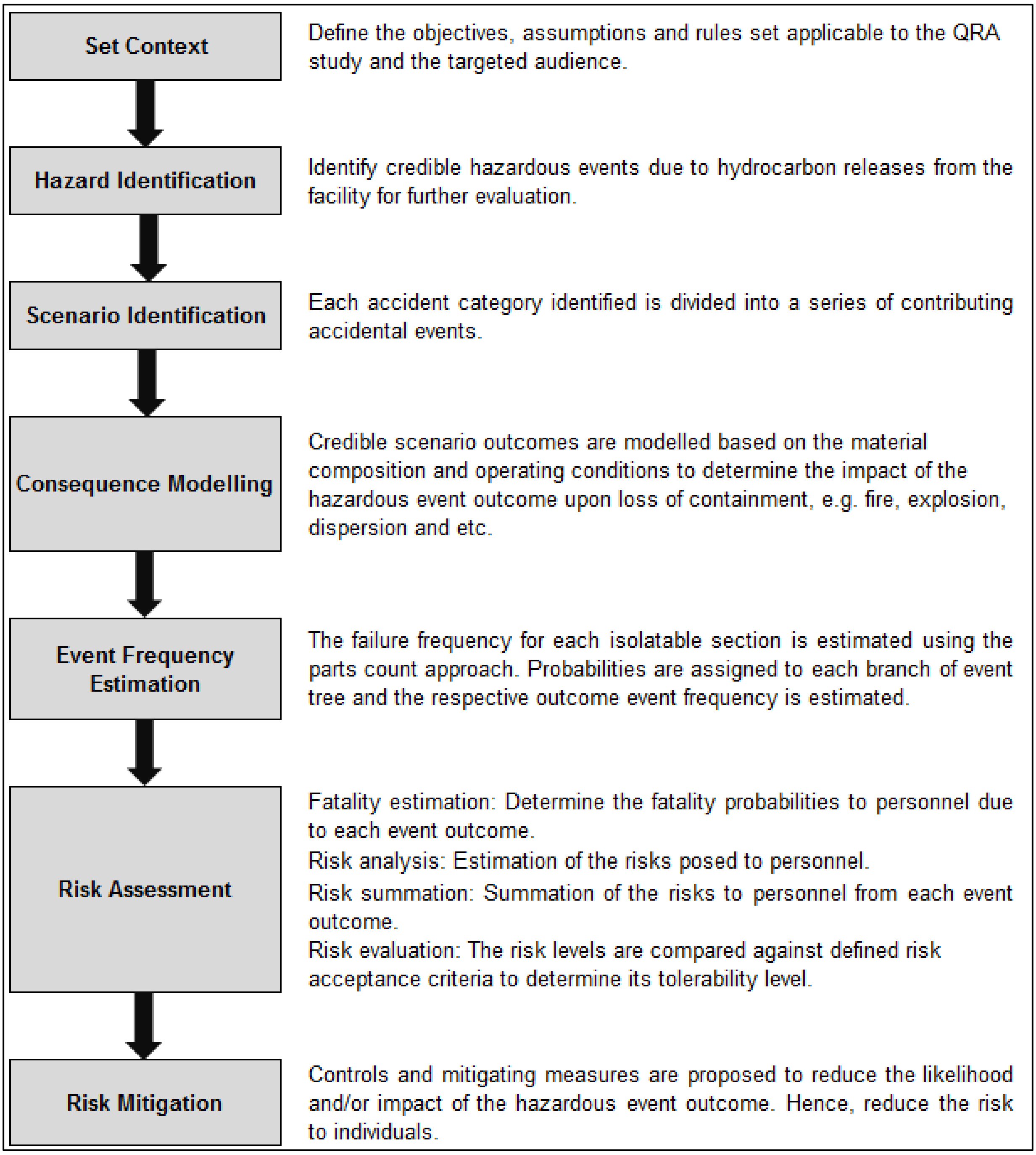

Figure 3-1 QRA Methodology

3.1 Assessment Tools

DNV GL Phast Risk Software version 6.7 is used to build the QRA model. Phast Risk [Ref. 4] is an integrated consequence and risk modelling package developed by DNV GL Software aimed at the onshore petrochemical and chemical process industry for assessing process plant risks via comprehensive QRA. It is designed to perform all the analytical, data processing and results presentation elements of a QRA within a structured framework.

3.2 Peer Review Against International Good Practice

QRA confidence levels are limited by input data including parts counts, level of design detail, generic failure frequencies, ignition probabilities, modelling capability, consequence probits and other criteria, conservatism of assumptions and management factors. QRA outputs are generally conservative and considered to be at best, within an accuracy of two orders of magnitude, with the key purpose being to provide an understanding of potential hazardous events and risk drivers. [Ref. 12]

Todd commissioned Environmental Risk Services (ERS) to conduct a peer review of the draft QRA inputs and assumptions. ERS is an Australian based risk consultancy with extensive experience with QRA in the context of land use planning and major hazard management. The purpose of this peer review was to ensure that the QRA was robust and met with good international practice. A number of the peer review recommendations were adopted, and coupled with detailed design information for the proposed facility, meant that QRA outputs present more representative risk levels for the proposed Kapuni J wellsite. Specific information on the ERS recommendations applied are documented in the relevant sections of this report.

3.3 Assumptions

An assumptions register [Ref. 5] was generated which outlines the basis of all assumptions and the input bases inherent in the QRA study. A previous version of the assumption register was issued together with the revision A of the Kapuni J Wellsite Hazardous Substances Risk Assessment [Ref. 6]. A peer review was conducted by Environmental Risk Solutions (ERS) on behalf of Todd on the methodology of the QRA [Ref. 12]. The register was then updated with the adjustments outlined in the two Kapuni J QRA Methodology memos from Todd to WorleyParsons dated 18 February 2019 [Ref. 7] and 14 March 2019 [Ref. 8].

The full assumption register is included in this report as Appendix 1 and the key assumptions are shown in following subsections for easy reference.

3.3.1 Atmospheric Conditions

Meteorological conditions impact the outcomes of release modelling, including downwind flammable and toxic vapour cloud dispersion distance (influenced by atmospheric stability and wind speed), rate of pool vaporisation (ambient temperature), and atmospheric attenuation of radiant heat (temperature and relative humidity).

The following conditions are used for the QRA modelling.

Wind Speed and Direction

Wind speed and direction data are taken from NIWA's CliFlo database [Ref. 9] for the Hawera Automatic Weather Station (AWS) to represent the atmospheric conditions at the proposed Kapuni J wellsite. Data for 5-year period from January 2008 to December 2012 are taken, with wind speed and direction measurements taken every hour. The windrose is shown Figure 3-2.

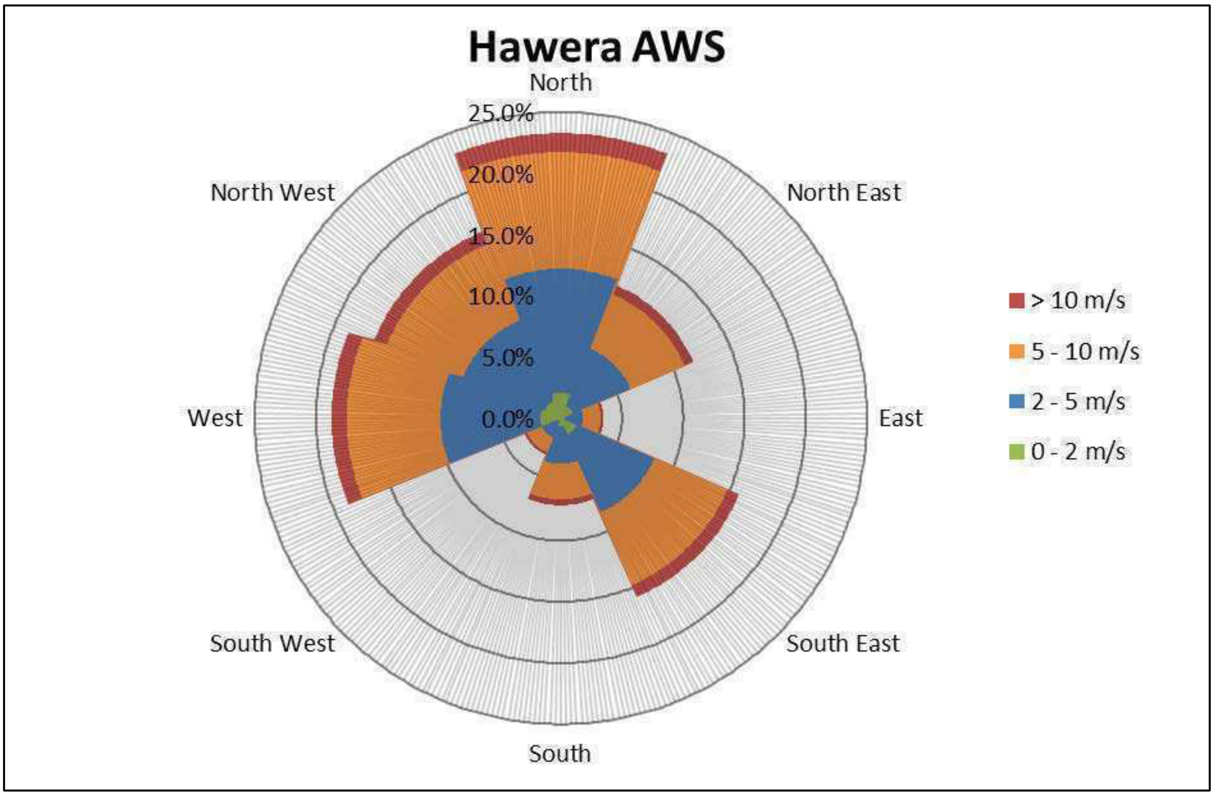

Figure 3-2: Hawera AWS Windrose

The following wind speed and atmospheric stability (Pasquill stability) combinations are used in the QRA. The wind data in tabular format is given in Table 3-1.

Table 3-1: Hawera AWS Wind Data

Wind Speed / Pasquil Stability	North	North East	East	South East	South	South West	West	North West	Total
0 - 2 m/s / F	2.1%	1.1%	0.3%	1.4%	0.6%	0.3%	1.7%	1.5%	9.0%
2 - 5 m/s / D	10.1%	5.1%	1.5%	6.9%	3.1%	1.4%	8.2%	7.2%	43.5%
5 - 10 m/s / D	11.1%	5.6%	1.7%	7.5%	3.4%	1.5%	8.9%	7.9%	47.5%
Total	**23.3%**	**11.8%**	**3.5%**	**15.9%**	**7.1%**	**3.2%**	**18.7%**	**16.5%**	**100.0%**

Note:

1. Pasquill Stability F – stable, night with moderate clouds and light/moderate wind
2. Pasquill Stability D – neutral, little sun and high wind or overcast/windy night

For the modelling, the wind speed reference height (the height at which the wind impacts a release), is set at 1 m (i.e. so as to match the release height). The Power Law wind profile is applied, where the wind speed varies with height according to a power-law profile.

Ambient Temperature and Relative Humidity

The following ambient temperature and relative humidity for Kapuni J wellsite as discussed with the Kapuni Redevelopment (KRD) project are used in the QRA [Ref. 21]:

- Ambient temperature: 14°C
- Relative humidity: 83%

Solar Radiation

Solar radiation is not included in the thermal radiation calculations.

Topography

Phast cannot take into account the effects of the local undulating topography for the gas dispersion. The surface roughness of 30 mm is applied, which represents an area of "open flat terrain; grass, few isolated objects" to represent the area of a typical wellsite.

3.3.2 General Leak Frequency

The leak frequencies for process equipment are taken from the International Association of Oil and Gas Producers (OGP) Risk Assessment Data Directory (RADD) Process Release Frequency [Ref. 1]. The release frequencies of the main process equipment items are based on an analysis of the HSE Hydrocarbon Release Database (HCRD) which has been compiled by the UK HSE over a 20-year period.

Failure frequency data from the HCRD contains detailed historical information on offshore hydrocarbon release incidents occurring in the UK offshore environment and is considered an industry standard for offshore QRA applications. The database categorises failure rates on a detailed basis of equipment type and size and provides a probabilistic hole size distribution associated with the failure.

The HCRD data are also normally used for QRA at onshore facilities, although the use of offshore failure rate may be considered to be conservative for use in most onshore applications, on the basis that:

- Offshore environments tend to be harsher, both external (saliferous environment) and internal (produced sand), increasing the rate of equipment corrosion and erosion;
- Congestion at offshore facilities increases the likelihood of damage through impact; and
- Restricted access to offshore facilities may limit maintenance campaigns, increasing the likelihood of failure.

3.3.3 Blowout Event Frequency

Blowout events are considered in the model for both drilling and production operation. Blowout frequencies are based on OGP RADD 434-2 for Blowout Frequencies [Ref. 10] specifically data related for wells not following North Sea Standards.

The OGP RADD considers 4 possible consequence of a blowout event:

- Blowout (surface flow)
- Blowout (underground flow)

- Diverted well release
- Well release

Surface flow blowout event is considered to be a full blowout event from the full wellbore size. This is modelled based on the expected maximum well fluid flowrate that the reservoir can supply to the wellbore instead of the wellhead pressure. This is because modelling the release based on the wellhead pressure and open hole diameter size would produce a very high flowrate. This would be an unrealistic flowrate as the well can only produce a maximum amount of well fluid. Based on information from Todd [Ref. 22], the flowrate from a new Kapuni well would be as below:

- Absolute open flow : 18 MMscf/d

The release is modelled using the "user defined source" model where the mass flow rates and release velocities are used to estimate the effect distances of ignited events. The composition is based on the well fluid composition from the KRD Project Heat and Material Balance (HMB) Case 2 [Ref. 18].

Underground flow blowout events are considered to have no impact on the surface and are not modelled in this study.

Well release events are assumed to be releases from the wellhead and Christmas trees. It is modelled as a horizontal well fluid release at well pressure of 80 barg. Release sizes are based on the same hole size distribution used for other release cases up to the largest line size which is 10 inch. As the wellhead and Christmas trees will not be present during drilling phase, well releases are only modelled for normal operation case.

Diverted well release event is a well release that can be shut-in or diverted to flare in a short period of time. This event is not modelled in this study as the event frequency during normal operations based on the OGP database is zero [Ref. 10].

The frequency for blowout events during drilling operations is shown in Table 3-2.

Table 3-2 Drilling Blowout Frequencies

Development Drilling, Deep	Blowout (surface flow)	3.50E-04	per drilled well
Completion	Blowout (surface flow)	4.60E-04	per drilled well
Total Blowout Frequency		8.10E-04	per drilled well

For normal operations, a blowout may occur during production, well workover or well wireline activities. Based on information from Todd, well wirelining will be performed once per year per well, and no workover is currently planned for any of the wells during their lifetime [Ref. 11]. The blowout event frequency during normal operations is shown in Table 3-3.

Table 3-3 Normal Operations Blowout Frequencies

Production	Blowout (surface flow)	3.30E-05	per well year
	Well release	9.50E-06	per well year
Wireline	Blowout (surface flow)	1.10E-05	per wireline job
	Well release	1.10E-05	per wireline job
Wireline frequency		1	per well year
Total Blowout Frequency		4.40E-05	per well year

Total Well Release Frequency	2.05E-05	per well year

3.3.4 Release Hole Sizes

For every component failure, there is a range of credible hole sizes from pinhole leak to full bore rupture. The hole size grouping from the OGP RADD Process Release Frequency together with the representative hole sizes used in the QRA is shown in Table 3-4.

Table 3-4: Hole Size Distribution

OGP Hole Size Group (mm)	Representative Hole Size (mm)
1 - 3	2
3 - 10	6
10 - 50	22
50 - 150	85
> 150	Range geometric mean

The representative hole sizes are chosen using the geometric mean of the smallest and largest hole sizes in each group. This approach has the mathematical basis that aligns with numbers that are exponential in nature such as is the case for hole sizes whereby the consequence is dependent on the area of the hole size or square of the diameter. For example, the representative hole size for the range 10 – 50 mm is calculated as $(10 \times 50)^{0.5}$ = 22 mm [Ref. 7].

The same approach is taken to select the representative hole size for rupture cases (release > 150 mm). The selected hole size is calculated as the geometric mean of 150 and the largest line size in the section. This is considered to be a representative approach to this category of hole size with the following justifications [Ref. 8]:

a. Pipework will be designed to be either inherently safe and are considered unlikely to exceed the design pressure or protected with a high integrity pressure protection system (HIPPS) depending on the location within the process.

b. Mechanical joints will be either weld or flanged with no screwed connections direct to pipework.

c. Detailed pipe stressing and design of pipework, including independent verification and certification, will be designed to be ductile. This will ensure that piping can flex and deform in earthquakes and subsidence as well as thermal expansion rather than tear or rupture.

d. Coatings and paint will be specified for exposure to a coastal environment thereby increasing the duration of effectiveness and limiting external corrosion mechanisms.

3.3.5 Leak Frequency Modification Factor

Several leak frequency modification factors are applied to the release frequency database. This is based on the peer review comments of the Kapuni J wellsite Hazardous Substances Risk Assessment report done by ERS [Ref. 12] and the memos from Todd regarding QRA methodology [Ref. 7 & 8]. The factors are listed below:

- Flange Release Frequency
  - Flange release frequency are multiplied with the modifiers for flange type ANSI Raised Face flanges as shown in Table 3-1 of OGP RADD Process Release Frequencies [Ref 1]. The factors are shown in Table 3-5.

Table 3-5 Flange Release Modification Factor

Hole Size Group (mm)	Modification Factor (% of total flange release frequency)
1 - 3	10
3 - 10	10
10 - 50	30
50 - 150	30
> 150	20

  - The maximum hole size for a flange is limited to 22 mm as a release from a flange is normally limited to a segment of a gasket between bolts [Ref. 7].
- Piping Release Frequency
  - Pipework are divided into two categories: process (on skid) piping and interskid piping as described in the definition for equipment type 1 of OGP RADD Process Release Frequencies.
  - For interskid piping, the modification factor for “inter-unit piping” (section 3.5.4 of OGP RADD Process Release Frequencies) of 0.9 is applied. This is understood to be a 90% reduction in frequencies [Ref. 8].
- Rupture Release Frequency

  A review of the UK HSE Hydrocarbon Release Database (HCRD) from 1992 to 2015 has been performed and it was determined that there were 31 incidents in the full bore release category within 24 years. These were reviewed by Todd to determine the applicability of these cases to the Kapuni J wellsite. 65% of the incidents were discounted on the basis that the release scenario cannot occur on Kapuni J. This is due to the factors below:

  a. The source of the release (type of equipment) will not be on site, including flare or vent for EDP, process drains or no alternate equivalent scenarios that would have the same effect.

  b. The scenario cannot occur within the operation, such as no shore to ship transfers or other risks of pipeline surge resulting in catastrophic failure, alternate valve failure that could lead to a similar catastrophic event, overflow to atmosphere or no helicopter refuelling

  c. Contributing factors will not be present – subsea or in the wave zone of the platform

d. Event is on equipment or during an operational phase that is outside of the scope of the QRA – well workover and drilling activity. This equipment will only be present for a small proportion of the overall lifetime of the wellsite.

Therefore, the frequency for rupture releases are reduced by 65% [Ref. 8].

3.3.6 Ignition Probability

Given a release, the probability of ignition is dependent on a range of factors, including:

- Release rate
- Material state (liquid or gas)
- Material physical properties (flash point, density, flammable limits)
- Ignition sources present

There are a range of correlations for applying an ignition probability to a release, and most are based on release rate and state. The UK Offshore Operators Association (UKOOA) has generated a model for predicting ignition probability which takes into account the above, as well as the nature of the surrounding area with respect to potential ignition sources. This model has been used to generate a range of typical correlations [Ref. 13]. For this QRA, the following scenarios are used:

- Scenario 5 - "Small Plant Gas LPG (gas or LPG release from small onshore plant)", which is applicable for releases of flammable gases, vapour or liquids significantly above their normal (NAP) boiling point from small onshore plants (plant area up to 1200 m2, site area up to 35,000 m2).
- Scenario 6 – "Liquid release from small onshore plant", which is applicable for releases of flammable liquids that do not have any significant flash fraction (10% or less) if released from small onshore plants (plant area up to 1200 m2, site area up to 35,000 m2) and which are not bunded or otherwise contained.

The graph of ignition probabilities as a function of mass release rates is shown in Figure 3-3.

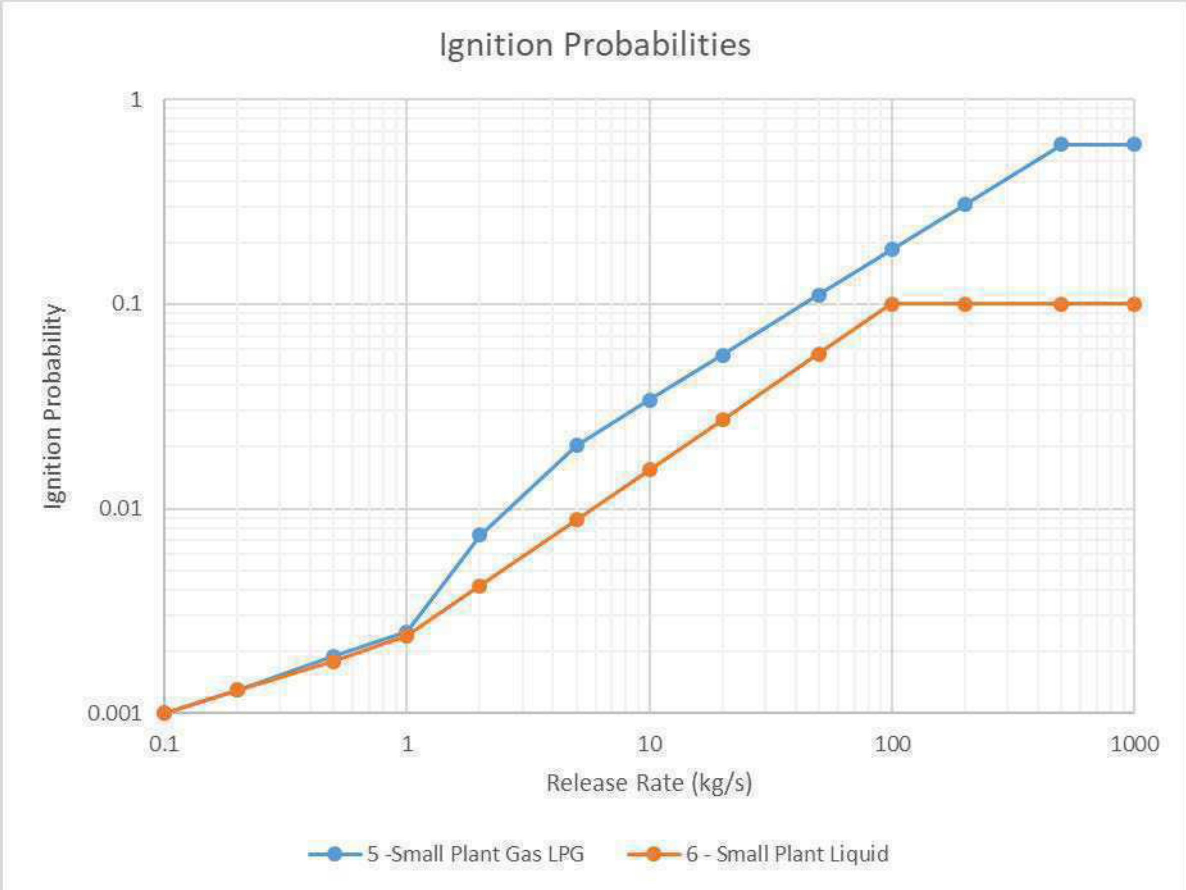

Figure 3-3: Ignition Probabilities

The graph represents the total ignition probability. An overall distribution for early to delayed ignition ratio of 30:70 to 50:50 split is considered reasonable. The timing of ignition is used as a means to predict the nature of the ignited event. Early ignition is taken to indicate a jet fire or pool fire depending on the material released. Delayed ignition is taken to indicate that the ignition would initially result in a flash fire or explosion. For this study, a 30:70 split for immediate: delayed ignition probability is used as per the WorleyParsons QRA standard for onshore QRAs [Ref. 3].

3.3.7 Fatality Criteria

Heat Radiation

The method of calculating the probability of fatality for an individual, given known exposure duration and thermal heat radiation levels, is undertaken in Phast Risk by using a probit function. The probit function is a general formula which takes the same form, but with various constants used. The probit used for lethality calculations is taken from the TNO Green Book [Ref. 14]. The probit function is defined as follows:

Probit = $-36.38 + 2.56 \ln (t \times q^{4/3})$

Where:

t = exposure duration in seconds

q = thermal radiation level in W/m^2

An exposure duration of 20 seconds is used as a base case, although it is noted that personnel are likely to find some form of shielding protection within this time frame.

The NSW Hazardous Industry Planning Advisory Paper No. 4 (HIPAP4) [Ref. 16] provides the following broadly qualitative consequences to thermal radiation for information:

- 2.1 kW/m^2 – Minimum to cause pain after 1 minute
- 4.7 kW/m^2 – Will cause pain in 15 – 20 s and injury (at least 2nd degree burns) after 30s exposure. Considered the criterion for injury risk, at a tolerable frequency of 50 chances in a million per year
- 12.6 kW/m^2 – Significant chance of fatality for extended exposure. High chance of injury
- 23 kW/m^2 – Likely fatality for extended exposure, and chance of fatality for instantaneous exposure
- 35 kW/m^2 – Significant chance of fatality for people exposed instantaneously

Flash Fire

If personnel are within the 100% lower flammable limit (LFL) of the gas plume, 100% fatality is assumed.

Explosion

The "Multi-Energy Explosion" model is used to model the Vapour Cloud Explosion (VCE). The assessment criteria for explosion overpressure are based on the explosion effects taken from the HIPAP4 as given in Table 3-6.

Table 3-6: Effects of Explosion Overpressure

Explosion Overpressure (kPa)	Effects
3.5	• 90% glass breakage • No fatality and very low probability of injury
7	• Damage to internal partitions and joinery but can be repaired • Probability of injury is 10%. No fatality
21	• Reinforced structures distort • Storage tanks fail • 20% chance of fatality to a person in a building
35	• House uninhabitable • Wagons and plants items overturned • Threshold of eardrum damage • 50% chance of fatality for a person in a building and 15% chance of fatality for a person in the open
70	• Threshold of lung damage • 100% chance of fatality for a person in a building or in the open • Complete demolition of houses

BLEVE

Boiling Liquid Expanding Vapour Explosion (BLEVE) is an escalation scenario that occurs as a result of prolonged flame impingement on above ground pressurised vessels containing materials such as liquefied petroleum gas (LPG) or lighter end hydrocarbon. BLEVE would result in an explosion overpressure together with a fireball and missile generation over some distance. As the fireball tends to drift upward and to avoid double counting on the fatality probabilities, only fatalities from the explosion overpressure effects are considered in this risk assessment. The fatality criteria are considered similar to explosion events as shown in Table 3-6 above.

The probability of BLEVE depends on various factors, including the types of flammable material and liquid inventory in the vessel, material of construction of the vessel, types and number of fire protection systems (e.g. relief valves, cooling systems), mechanism of vessel failure (external impact, jet fire impingement or pool fire impingement), etc. There is no clear guideline or criteria to determine the likelihood of a BLEVE on a pressurised vessel. For this risk assessment, BLEVE is considered credible if a pressurised vessel containing at least 4 m^3 of volatile hydrocarbon (liquid butane or lighter) is exposed to direct flame impingement for 5 minutes or longer.

Liquid volume calculation for the vessels on Kapuni J are shown in Table 3-7.

Table 3-7 Kapuni J Vessel Liquid Volume Calculation

Tag No.	Description	Diameter (m)	Length (m)	Liquid Level (m)	Total Volume (m^3)	Liquid Volume (m^3)
V-2742	Low Pressure Separator	1.6	2.4	0.8	4.8	2.4
V-3123 A/B	Low Temperature Separator A/B	1.8	5.6	0.9	14.8	7.4
V-3122 A/B	High Pressure Knockout Drum A/B	1.4	4.5	0.5	6.9	2.2

Based on this calculation, only V-3123 A/B Low Temperature Separators fulfil the criteria of liquid inventory for BLEVE. However, based on the material composition, the component in the LTS liquid section is mostly heavy hydrocarbons with volatile hydrocarbons making up only 25% of the total composition. Therefore, BLEVE is not considered credible for any vessel in the Kapuni J Wellsite.

Toxic Effects by Methanol

Fatality probability when exposed to toxic gas as a function of exposure concentration and duration can be calculated by using a probit function of the form given below:

$$\text{Probit} = a + b \ln (C^n \times t)$$

where:

t = exposure duration in minutes

C = concentration in ppm

a, b and n = material specific probit constants

UK HSE gives the following toxic load values for methanol [Ref. 17]:

- SLOT = 8.02×10^{5} $ppm^{n} \cdot min$ (1% fatality probability)
- SLOD = 2.67×10^{6} $ppm^{n} \cdot min$ (50% fatality probability)

By solving the simultaneous equation, the other constants a and b can be calculated. The probit constants for methanol are:

a = -23.67

b = 1.94

n = 1

The summary of the fatality probabilities for methanol as the function of concentration and exposure duration is shown in Table 3-8.

Table 3-8: Methanol Fatality Probability due to Toxic Effects

Fatality Probability (%)	Concentration (ppm)	Time (Min)
1	80,200	10
50	267,000	10
99	888,700	10

Toxic Effects by Carbon Dioxide

Fatality probability for carbon dioxide is calculated using the same probit equation. UK HSE gives the following toxic load values for carbon dioxide:

- SLOT = 1.5×10^{40} $ppm^{n} \cdot min$ (1% fatality probability)
- SLOD = 1.5×10^{41} $ppm^{n} \cdot min$ (50% fatality probability)

By solving the simultaneous equation, the other constants a and b can be calculated. The probit constants for carbon dioxide are:

a = -90.78

b = 1.01

n = 8

The summary of the fatality probabilities for carbon dioxide as the function of concentration and exposure duration is shown in Table 3-9.

Table 3-9: Carbon Dioxide Fatality Probability due to Toxic Effects

Fatality Probability (%)	Concentration (ppm)	Time (Min)
1	78,886	10
50	105,198	10
99	154,092	10

4. HAZARD IDENTIFICATION

4.1 Hazardous Materials

Based on information from the KRD project documentation [Ref. 2, 18 and 19], this study considers the release of the following substances:

- Well production fluid stream from wellheads and process equipment.
- Chemicals.

The operating conditions and stream composition are obtained from the Heat and Material Balance (HMB) provided by the KRD project. HMB "Case 2" is chosen as the representative conditions during normal production operation. "Case 2" shows the expected wellsite conditions after a few months of production when the wellhead pressure has decreased [Ref. 18]. The HMB is attached as part of the Assumptions Register in Appendix-1.

4.1.1 Well Production Fluid

The well fluid products from Kapuni J contains mainly flammable hydrocarbons and Carbon Dioxide (CO_2). Upstream of the separation equipment, the mixture will be mainly in gas phase (vapour fraction >0.9). Releases from this section are modelled as a gas release with the consequence modelled as jet fire and flash fire for immediate and delayed ignition, respectively. If the flammable gas cloud reaches a congested region onsite, a VCE is possible. A similar approach is followed for releases on the vapour section of the separation system.

Hydrocarbon in the liquid section of the separation system exist as mainly liquid at the operating conditions shown in the HMB. However, as they contain CO_2 and light hydrocarbons, it is expected that they will eventually flash when released to the atmosphere. Liquid hydrocarbon release is considered to lead to a spray fire, flash fire and/or pool fire event.

CO_2 is assessed in terms of the toxic effect with respect to the unignited release scenarios. It is noted that CO_2 may also cause asphyxiation by displacing oxygen in the air. However, as the wellsite is a relatively open area, it is considered that the risk from asphyxiation due to CO_2 is low. Therefore, only toxic effects of the CO_2 as described in UK HSE is assessed in this study [Ref. 17].

4.1.2 Chemicals

Chemicals present in the wellsite include corrosion inhibitor and methanol. However, as corrosion inhibitor is non-flammable, only methanol is included in this risk assessment. Methanol is a flammable and toxic liquid which appears as colourless liquid with a mild, characteristic alcohol odour. Methanol release is modelled similarly to liquid hydrocarbon releases with the additional toxic dispersion effects from an unignited release scenario.

4.2 Release Scenarios

Release rates are calculated mainly based on the release hole sizes and fluid pressure. The height of release from all scenarios are assumed to be at 1 m above ground. It is assumed that 70% of the releases are horizontal releases and 30% of the releases are vertical releases.

The total volume released is driven by either the release rate prior to isolation or the stored volume available for release post isolation (estimated by equipment sizes and locations of isolation valves). For each release case, the worst-case scenario (release at operating pressure until detection/isolation) is determined and used as representative for the release case. As the time for detection and isolation is not known, the initial assessment assumes immediate detection and isolation. For modelling purposes, the following release assumptions are applied:

- Release of the entire inventory is assumed.
- Jet fires are modelled based on initial release conditions, and do not take account of the depressurisation that occurs over time.

The release scenarios and the respective operating conditions that are used in the QRA are given in Table 4-1.

Table 4-1: Release Scenarios and Operating Conditions

No.	Release Case	Description	Stream Comp. (Note-2)	Temp. (°C)	Pres. (barg)	Inventory (m^3)
1	J01A_W001Blow_V	W010 Blowout Event	1	45	80	Note-1
2	J01B_W002Blow_V	W020 Blowout Event	1	45	80	Note-1
3	J01C_W003Blow_V	W030 Blowout Event	1	45	80	Note-1
4	J01D_W004Blow_V	W040 Blowout Event	1	45	80	Note-1
5	J01E_W001WRel_V	W010 Well Release	1	45	80	Note-1
6	J01F_W002WRel_V	W020 Well Release	1	45	80	Note-1
7	J01G_W003WRel_V	W030 Well Release	1	45	80	Note-1
8	J01H_W004WRel_V	W040 Well Release	1	45	80	Note-1
9	J02A_W001Flow_V	Well fluids in production flowline from well W010 isolation valve (XSV-0103) up to choke valve skid boundary including Cyclone Desander V-131	1	45	80	8.3
10	J02B_W001ChIn_V	Well fluids in well W010 production flowline within choke valve skid boundary up to choke valve	1	45	80	8.3
11	J02C_ChMani_V	Well fluids in production manifold from choke valve up to overpressure protection SDV of each train headers	2	44.8	79.5	8.3
12	J02D_W002Flow_V	Well fluids in production flowline from well W020 isolation valve (XSV-0203) up to choke valve skid boundary including desander skid V-141	1	45	80	8.3
13	J02E_W002ChIn_V	Well fluids in well W020 production flowline within choke valve skid boundary up to choke valve	1	45	80	8.3
14	J02F_W003Flow_V	Well fluids in production flowline from well W030 isolation valve (XSV-0303) up to choke valve skid boundary including desander skid V-151	1	45	80	8.3
15	J02G_W003ChIn_V	Well fluids in well W030 production flowline within choke valve skid boundary up to choke valve	1	45	80	8.3

No.	Release Case	Description	Stream Comp. (Note-2)	Temp. (°C)	Pres. (barg)	Inventory (m^3)
16	J02H_W004Flow_V	Well fluids in production flowline from well W040 isolation valve (XSV-0403) up to choke valve skid boundary	1	45	80	8.3
17	J02I_W004ChIn_V	Well fluids in well W040 production flowline within choke valve skid boundary up to choke valve	1	45	80	8.3
18	J03A_TrAHeader_V	Well fluids in train A header from XSV-2001 and XSV-2002 through the LTS coils up to the inlet of the HPKO A (V-220)	2	44.8	79.5	15.6
19	J03B_HPKOAVap_V	HPKO Vessel A (V-220) vapour section through the GG exchanger tube side up to inlet of LTS A (V-230)	3	44.8	79.5	15.6
20	J03C_HPKOALiq_L	HPKO Vessel A (V-220) liquid section up to LCV-2203	9	44.8	79.5	0.3
21	J03D_LTSAVap_V	Low Temperature Separator A (V-220) vapour section through the GG exchanger shell side up to XSV-2405	6	6	48.3	15.6
22	J03E_LTSALiq_L	Low Temperature Separator A (V-220) liquid section up to LCV-2305	11	30.1	48.3	8.5
23	J03F_HPKOALCV_L	HPKO A Liquid from LCV-2203 up to XSV-2204	10	39.2	48.3	0.3
24	J03G_LiqToLTSA_L	Liquid from XSV-2204 to liquid inlet of LTS A (V-230)	10	39.2	48.3	0.1
25	J03H_LTSALCV_L	LTS A Liquid from LCV-2305 up to XSV-2306	12	20.2	24.2	8.5
26	J04A_DryGHeader_V	Dry gas header from XSV-2405 and XSV-3405 up to pig launcher skid boundary	7	38.7	48.1	5.9
27	J04B_DryGPLSkid_V	Dry gas header inside pig launcher skid boundary up to pipeline isolation XSV	7	38.7	48.1	5.9
28	J04C_DryGPLaun_V	Dry Gas Pig Launcher (941-V-xx5)	7	38.7	48.1	5.9
29	J04D_DryGPRSkid_V	Dry gas header from KA-8/12/15/18 inside pig receiver skid	7	38.7	48.1	5.9
30	J04E_DryGPRec_V	Dry Gas from KA-8/12/15/18 Pig Receiver (941-V-xx2)	7	38.7	48.1	5.9
31	J04F_FGHeater_V	Dry Gas from header to fuel gas system	7	38.7	7	5.9
32	J05A_TrBHeader_V	Well fluids in train B header from XSV-3001 and XSV-3002 through the LTS coils up to the inlet of the HPKO B (V-320)	2	44.8	79.5	15.8
33	J05B_HPKOBVap_V	High Pressure Knockout Vessel B (V-320) vapour section through the GG exchanger tube side up to inlet of LTS B (V-330)	3	44.8	79.5	15.8
34	J05C_HPKOBLiq_L	High Pressure Knockout Vessel B (V-320) liquid section up to LCV-3203	9	44.8	79.5	2.3
35	J05D_LTSBVap_V	Low Temperature Separator B (V-330) vapour section through the GG exchanger shell side up to XSV-3405	6	6	48.3	15.8
36	J05E_LTSBLiq_L	Low Temperature Separator B (V-330) liquid section up to LCV-3305	11	30.1	48.3	7.5
37	J05F_HPKOBLCV_L	HPKO B Liquid from LCV-3203 up to XSV-3204	10	39.2	48.3	2.3

No.	Release Case	Description	Stream Comp. (Note-2)	Temp. (°C)	Pres. (barg)	Inventory (m^3)
38	J05G_LiqToLTSB_L	Liquid from XSV-3204 to liquid inlet of LTS B (V-330)	10	39.2	48.3	0.1
39	J05H_LTSBLCV_L	LTS B Liquid from LCV-3305 up to XSV-3306	12	20.2	24.2	7.5
40	J06A_TrCHeader_L	Liquid from LTS A/B XSV-2010 and XSV-3010 up to inlet of Low Pressure Separator (V-420)	12	20.2	24.2	3.7
41	J06B_LPSepVap_V	Low Pressure Separator (V-420) vapour section through the wet gas header up to the wet gas pig launcher skid boundary	13	20.2	24.2	8.1
42	J06C_LPSepLiq_L	Low Pressure Separator (V-420) liquid section up to LCV-4202 and LCV-4212	15	20.2	24.2	3.7
43	J06D_LPSepLCV_L	LP Separator liquid from (V-420) from LCV-4202 and LCV-4212 up to XSV-4203	16	16.1	16.1	3.7
44	J06E_WetGPLSkid_V	Wet gas header inside pig launcher skid boundary up to pipeline isolation XSV	13	20.2	24.2	8.1
45	J06F_WetGPLaun_V	Wet Gas Pig Launcher (941-V-xx3)	13	20.2	24.2	8.1
46	J07A_WetGPipe_V	Wet gas pipeline inside wellsite boundary	13	20.2	24.2	0.7
47	J08A_LiqHeader_L	Liquid header from XSV-2004, XSV-2010, XSV-3004 and XSV-3010 up to liquid pig launcher skid boundary	16	16.1	16.1	2.1
48	J08B_LiqPLSkid_L	Liquid header inside liquid pig launcher skid boundary up to pipeline isolation boundary	16	16.1	16.1	2.1
49	J08C_LiqPLaun_L	Liquid Pig Launcher (941-V-xx7)	16	16.1	16.1	2.1
50	J08D_FBWPLSkid_L	Liquid header inside flowback water pig launcher skid boundary up to pipeline isolation boundary	16	16.1	16.1	2.1
51	J08E_FBWPLaunB_L	Flowback water pig launcher (941-V-xx9)	16	16.1	16.1	2.1
52	J09A_LiqPipe_L	Liquid pipeline inside wellsite boundary	16	16.1	16.1	0.3
53	J10A_FBWPipe_L	Flowback water pipeline inside wellsite boundary	16	16.1	16.1	0.1
54	J11A_DryKAGasPipe_V	Dry gas in incoming pipeline from KA-8/12/15/18 within wellsite	7	38.7	48.1	0.5
55	J12A_DryGasPipe_V	Dry gas export pipeline within wellsite boundary	7	38.7	48.1	1.0
56	J13A_MetTank_L	Methanol Dosing Tank	Methanol	14	0	1.2
57	J13B_MetTankOut_L	Methanol Dosing Tank outlet up to methanol dosing pumps	Methanol	14	0	1.2
58	J13C_MetDisLTS_L	Methanol distribution system to LTS	Methanol	14	120	1.2
59	J14A_CoLTSLiq_L	Liquids from LTS A through the liquid header up to XSV-2004 and XSV-2010	12	20.2	24.2	3.7
60	J15A_CoLTBLiq_L	Liquids from LTS B through the liquid header up to XSV-3004 and XSV-3010	12	20.2	24.2	3.7

Note:
1. Inventory for blowout and well release events are considered to be unlimited because they can be supplied from the downhole reservoir.
2. Stream composition refers to the stream numbers in the KRD project HMB “Case 2” [Ref. 18]. The HMB is attached as part of the Assumptions Register in Appendix-1.

4.3 Assumptions for Normal Operations with All Wells

Currently, there is only engineering information for Phase 1 of the Kapuni J wellsite development. In order to model normal operations with all wells, the Phase 1 model is used with the following modifications [Ref. 23]:

- Release condition and frequency for the additional 8 wells and flowlines are assumed to be identical with the Phase 1 wells, and the information for Phase 1 wells are re-used. This is considered conservative as Todd has informed that Phase 1 wells will be producing at lower pressures by the time all 12 wells are operational. The additional release cases related to the additional wells are shown in Table 4-2.

Some existing release cases are also modified, including the following:

- Release case J02C (releases from the choke valve up to the isolation valves on the overpressure protection skids A/B) is modified:
  - Additional piping sections from the additional wellhead choke valve skids.
  - Additional interconnecting piping between each choke valve skids.
  - Release location move to the middle of the three skids to better represent overall release sources from all three skids.
- Release case J03A (releases from the section from the overpressure protection skid up to the inlet of HPKO A): An air-cooled heat exchanger is added to this section with the following parts:
  - 1 air-cooled heat exchanger
  - 4 of 200mm flange connections – 2 on inlet line and 2 on outlet line
  - 2 small bore fittings – to account for temperature transmitters
  - 20m of 200mm interskid piping –10m upstream and 10m downstream of the heat exchanger.
- Release case J06A (releases from the section from the outlet of the overpressure protection skid up to the inlet of the LP Separator). An air-cooled heat exchanger is added to this section with the following parts:
  - 1 air-cooled heat exchanger
  - 4 of 150mm flange connections – 2 on inlet line and 2 on outlet line
  - 2 small bore fittings – to account for temperature transmitters
  - 1 relief valve with flange
  - 30 m of 150mm interskid piping – 15m upstream and 15m downstream of the heat exchanger.

Table 4-2 Additional Release Cases for Normal Operations with 12 Wells

No.	Release Case	Description	Stream Comp.	Temp. (°C)	Pres. (barg)	Inventory (m^3)
61	J16A_W005Blow_V	W050 Blowout Event	1	45	80	Note-1
62	J16B_W006Blow_V	W060 Blowout Event	1	45	80	Note-1
63	J16C_W007Blow_V	W070 Blowout Event	1	45	80	Note-1
64	J16D_W008Blow_V	W080 Blowout Event	1	45	80	Note-1
65	J16E_W005WRel_V	W050 Well Release	1	45	80	Note-1
66	J16F_W006WRel_V	W060 Well Release	1	45	80	Note-1
67	J16G_W007WRel_V	W070 Well Release	1	45	80	Note-1
68	J16H_W008WRel_V	W080 Well Release	1	45	80	Note-1
69	J17A_W005Flow_V	Well fluids in production flowline from well W050 isolation valve (XSV-0503) up to choke valve skid boundary including cyclone desander V-131	1	45	80	11.3
70	J17B_W005ChIn_V	Well fluids in well W050 production flowline within choke valve skid boundary up to choke valve	1	45	80	11.3
71	J17D_W006Flow_V	Well fluids in production flowline from well W060 isolation valve (XSV-0603) up to choke valve skid boundary including desander skid V-141	1	45	80	11.3
72	J17E_W006ChIn_V	Well fluids in well W060 production flowline within choke valve skid boundary up to choke valve	1	45	80	11.3
73	J17F_W007Flow_V	Well fluids in production flowline from well W070 isolation valve (XSV-0703) up to choke valve skid boundary including desander skid V-151	1	45	80	11.3
74	J17G_W007ChIn_V	Well fluids in well W070 production flowline within choke valve skid boundary up to choke valve	1	45	80	11.3
75	J17H_W008Flow_V	Well fluids in production flowline from well W080 isolation valve (XSV-0803) up to choke valve skid boundary	1	45	80	11.3
76	J17I_W008ChIn_V	Well fluids in well W080 production flowline within choke valve skid boundary up to choke valve	1	45	80	11.3
77	J18A_W009Blow_V	W090 Blowout Event	1	45	80	Note-1
78	J18B_W010Blow_V	W100 Blowout Event	1	45	80	Note-1
79	J18C_W011Blow_V	W110 Blowout Event	1	45	80	Note-1
80	J18D_W012Blow_V	W120 Blowout Event	1	45	80	Note-1
81	J18E_W009WRel_V	W090 Well Release	1	45	80	Note-1
82	J18F_W010WRel_V	W100 Well Release	1	45	80	Note-1
83	J18G_W011WRel_V	W110 Well Release	1	45	80	Note-1
84	J18H_W012WRel_V	W120 Well Release	1	45	80	Note-1
85	J19A_W009Flow_V	Well fluids in production flowline from well W090 isolation valve (XSV-0903) up to choke valve skid boundary including cyclone desander V-131	1	45	80	11.3
86	J19B_W009ChIn_V	Well fluids in well W090 production flowline within choke valve skid boundary up to choke valve	1	45	80	11.3

No.	Release Case	Description	Stream Comp.	Temp. (°C)	Pres. (barg)	Inventory (m^3)
87	J19D_W010Flow_V	Well fluids in production flowline from well W100 isolation valve (XSV-1003) up to choke valve skid boundary including desander skid V-141	1	45	80	11.3
88	J19E_W010ChIn_V	Well fluids in well W100 production flowline within choke valve skid boundary up to choke valve	1	45	80	11.3
89	J19F_W011Flow_V	Well fluids in production flowline from well W110 isolation valve (XSV-1103) up to choke valve skid boundary including desander skid V-151	1	45	80	11.3
90	J19G_W011ChIn_V	Well fluids in well W110 production flowline within choke valve skid boundary up to choke valve	1	45	80	11.3
91	J19H_W012Flow_V	Well fluids in production flowline from well W120 isolation valve (XSV-1203) up to choke valve skid boundary	1	45	80	11.3
92	J19I_W012ChIn_V	Well fluids in well W120 production flowline within choke valve skid boundary up to choke valve	1	45	80	11.3

5. FREQUENCY ANALYSIS

5.1 Drilling Case Frequencies

As discussed above, the drilling case only considers blowout cases. Blowout case frequencies are based on the OGP RADD for blowout events [Ref. 10]. The frequencies of blowout during drilling cases are shown in Table 5-1.

Table 5-1 Drilling Blowout Frequency

No.	QRA Event	Blowout Frequency (per year)	% Contri.
1	J01A_W001Blow_V	8.10E-04	25%
2	J01B_W002Blow_V	8.10E-04	25%
3	J01C_W003Blow_V	8.10E-04	25%
4	J01D_W004Blow_V	8.10E-04	25%
	TOTAL	3.24E-03	100%

The total blowout frequency is 3.24E-03 per year or equivalent to one blowout in 309 years.

5.2 Normal Operations for Phase 1 Frequencies

For normal operations for phase 1 case, parts counts are completed for each QRA event and the leak frequencies are given below. Master copy PIDs issued on 1st of April 2019 are utilized for this study [Ref. 19].

Marked up PIDs and the parts count sheets are attached as Appendix-2 and Appendix-3, respectively. The leak frequencies for normal operations phase 1 for each QRA events are given in Table 5-2 . The highest leak contributors are indicated in **red**. Parts counts are conducted based on the valve configurations as shown on the PIDs, e.g. it is assumed that the pumps are not isolated when not in use, unless assumed otherwise.

Table 5-2: Hydrocarbon Release Frequencies for Normal Operations Phase 1

No.	QRA Events	Leak Frequencies (per annum)						% Contri.
		1 - 3 mm (2 mm)	3 - 10 mm (6 mm)	10 - 50 mm (22 mm)	50 - 150 mm (85 mm)	> 150 mm (Rupture)	TOTAL	
1	J01A_W001Blow_V					4.40E-05	4.40E-05	0.02%
2	J01B_W002Blow_V					4.40E-05	4.40E-05	0.02%
3	J01C_W003Blow_V					4.40E-05	4.40E-05	0.02%
4	J01D_W004Blow_V					4.40E-05	4.40E-05	0.02%
5	J01E_W001WRel_V	1.31E-05	4.57E-06	1.57E-06	2.61E-07	1.05E-06	2.05E-05	0.01%
6	J01F_W002WRel_V	1.31E-05	4.57E-06	1.57E-06	2.61E-07	1.05E-06	2.05E-05	0.01%
7	J01G_W003WRel_V	1.31E-05	4.57E-06	1.57E-06	2.61E-07	1.05E-06	2.05E-05	0.01%
8	J01H_W004WRel_V	1.31E-05	4.57E-06	1.57E-06	2.61E-07	1.05E-06	2.05E-05	0.01%
9	J02A_W001Flow_V	4.02E-03	1.80E-03	1.11E-03	1.81E-04		7.12E-03	3.40%
10	J02B_W001ChIn_V	2.17E-03	8.83E-04	4.71E-04	9.64E-05		3.63E-03	1.73%
11	J02C_ChMani_V	1.12E-02	4.59E-03	2.53E-03	4.05E-04	1.08E-05	1.88E-02	8.98%

No.	QRA Events	Leak Frequencies (per annum)						% Contri.
		1 - 3 mm (2 mm)	3 - 10 mm (6 mm)	10 - 50 mm (22 mm)	50 - 150 mm (85 mm)	> 150 mm (Rupture)	TOTAL	
12	J02D_W002Flow_V	4.02E-03	1.80E-03	1.11E-03	1.81E-04		7.12E-03	3.40%
13	J02E_W002ChIn_V	2.17E-03	8.83E-04	4.71E-04	9.64E-05		3.63E-03	1.73%
14	J02F_W003Flow_V	4.02E-03	1.80E-03	1.11E-03	1.81E-04		7.12E-03	3.40%
15	J02G_W003ChIn_V	2.17E-03	8.83E-04	4.71E-04	9.64E-05		3.63E-03	1.73%
16	J02H_W004Flow_V	2.01E-03	8.28E-04	4.07E-04	2.47E-05		7.12E-03	3.40%
17	J02I_W004ChIn_V	2.17E-03	8.83E-04	4.71E-04	9.64E-05		3.63E-03	1.73%
18	J03A_TrAHeader_V	4.02E-03	1.80E-03	1.11E-03	1.81E-04		7.12E-03	3.40%
19	J03B_HPKOAVap_V	5.55E-03	2.50E-03	1.26E-03	2.05E-04	8.28E-05	9.60E-03	4.59%
20	J03C_HPKOALiq_L	2.22E-03	9.68E-04	5.78E-04	7.23E-05	7.39E-06	3.85E-03	1.84%
21	J03D_LTSAVap_V	8.11E-03	3.54E-03	1.84E-03	3.14E-04	1.18E-04	1.39E-02	6.66%
22	J03E_LTSALiq_L	3.92E-03	1.66E-03	8.85E-04	6.36E-05	1.16E-05	6.53E-03	3.12%
23	J03F_HPKOALCV_L	1.64E-04	6.13E-05	3.84E-05	1.52E-05		2.79E-04	0.13%
24	J03G_LiqToLTSA_L	5.04E-04	1.94E-04	9.97E-05	5.29E-05		8.51E-04	0.41%
25	J03H_LTSALCV_L	8.28E-04	3.29E-04	1.46E-04	4.49E-05		1.35E-03	0.64%
26	J04A_DryGHeader_V	6.63E-04	2.67E-04	1.44E-04	5.67E-06	5.87E-06	1.09E-03	0.52%
27	J04B_DryGPLSkid_V	7.60E-04	2.89E-04	1.42E-04	2.51E-05	1.74E-05	1.23E-03	0.59%
28	J04C_DryGPLaun_V	9.41E-06	3.70E-06	2.20E-06	1.57E-07	1.88E-08	1.55E-05	0.01%
29	J04D_DryGPRSkid_V	1.12E-03	4.42E-04	2.14E-04	4.97E-05	9.44E-06	1.83E-03	0.88%
30	J04E_DryGPRec_V	6.84E-06	2.88E-06	1.65E-06	4.39E-07	2.49E-07	1.21E-05	0.01%
31	J04F_FGHeater_V	2.77E-03	1.27E-03	7.45E-04	2.66E-04		5.05E-03	2.42%
32	J05A_TrBHeader_V	3.26E-03	1.30E-03	6.53E-04	9.02E-05	3.11E-05	5.33E-03	2.55%
33	J05B_HPKOBVap_V	5.55E-03	2.50E-03	1.26E-03	2.05E-04	8.28E-05	9.60E-03	4.59%
34	J05C_HPKOBLiq_L	2.22E-03	9.68E-04	5.78E-04	7.23E-05	7.39E-06	3.85E-03	1.84%
35	J05D_LTSBVap_V	8.11E-03	3.54E-03	1.84E-03	3.14E-04	1.18E-04	1.39E-02	6.66%
36	J05E_LTSBLiq_L	3.22E-03	1.39E-03	7.10E-04	7.88E-05	1.16E-05	5.41E-03	2.58%
37	J05F_HPKOBLCV_L	3.98E-04	1.53E-04	7.23E-05	3.54E-05		6.59E-04	0.31%
38	J05G_LiqToLTSB_L	5.04E-04	1.94E-04	9.97E-05	5.29E-05		8.51E-04	0.41%
39	J05H_LTSBLCV_L	8.28E-04	3.29E-04	1.46E-04	4.49E-05		1.35E-03	0.64%
40	J06A_TrCHeader_L	6.51E-04	2.43E-04	1.15E-04	6.57E-05		1.08E-03	0.51%
41	J06B_LPSepVap_V	4.62E-03	1.97E-03	1.17E-03	9.05E-05	3.98E-05	7.89E-03	3.77%
42	J06C_LPSepLiq_L	2.78E-03	1.21E-03	7.33E-04	1.04E-04	1.16E-05	4.83E-03	2.31%
43	J06D_LPSepLCV_L	7.44E-04	2.98E-04	1.68E-04	6.32E-05		1.27E-03	0.61%
44	J06E_WetGPLSkid_V	1.08E-03	4.24E-04	1.99E-04	2.95E-05	1.54E-05	1.75E-03	0.84%
45	J06F_WetGPLaun_V	2.65E-05	1.13E-05	6.61E-06	1.63E-06	1.02E-06	4.71E-05	0.02%
46	J07A_WetGPipe_V	7.33E-04	3.04E-04	1.34E-04	1.25E-06	1.26E-06	1.17E-03	0.56%
47	J08A_LiqHeader_L	1.16E-03	4.70E-04	2.35E-04	4.80E-05		1.92E-03	0.92%
48	J08B_LiqPLSkid_L	8.43E-04	3.30E-04	1.40E-04	8.91E-05		1.40E-03	0.67%
49	J08C_LiqPLaun_L	1.48E-05	6.22E-06	3.54E-06	8.94E-07	4.93E-07	2.59E-05	0.01%

No.	QRA Events	Leak Frequencies (per annum)						% Contri.
		1 - 3 mm (2 mm)	3 - 10 mm (6 mm)	10 - 50 mm (22 mm)	50 - 150 mm (85 mm)	> 150 mm (Rupture)	TOTAL	
50	J08D_FBWPLSkid_L	1.38E-03	5.61E-04	2.96E-04	9.79E-05		2.33E-03	1.12%
51	J08E_FBWPLaunB_L	1.39E-05	5.89E-06	3.40E-06	2.23E-06		2.54E-05	0.01%
52	J09A_LiqPipe_L	4.08E-04	1.68E-04	8.34E-05	5.32E-06		6.65E-04	0.32%
53	J10A_FBWPipe_L	4.08E-04	1.68E-04	8.34E-05	5.32E-06		6.65E-04	0.32%
54	J11A_DryKAGasPipe_V	1.08E-03	4.38E-04	1.90E-04	3.28E-05	1.26E-06	1.74E-03	0.83%
55	J12A_DryGasPipe_V	7.32E-04	3.03E-04	1.34E-04	1.20E-06	1.26E-06	1.17E-03	0.56%
56	J13A_MetTank_L	1.76E-03	8.26E-04	4.03E-04	6.40E-05	2.31E-05	3.08E-03	1.47%
57	J13B_MetTankOut_L	5.35E-03	2.41E-03	1.33E-03	5.30E-04		9.63E-03	4.60%
58	J13C_MetDisLTS_L	4.75E-03	2.53E-03	1.65E-03	1.03E-03		9.96E-03	4.76%
59	J14A_CoLTSLiq_L	8.44E-04	3.24E-04	1.60E-04	7.46E-05		1.40E-03	0.67%
60	J15A_CoLTBLiq_L	8.44E-04	3.24E-04	1.60E-04	7.46E-05		1.40E-03	0.67%
TOTAL		1.19E-01	5.14E-02	2.81E-02	5.96E-03	7.90E-04	2.09E-01	100%
		56.9%	24.6%	13.4%	2.9%	0.4%		

The total theoretical leak frequency is 0.21 per annum, or equivalent to one leak every 4.8 years. The leak contribution is predominantly from the 1 - 3 mm hole size, which contributes to 57% of the total leak frequency.

The sections with the highest leak frequencies are:

- J02C_ChManiV (8.98%) – the section covers the production manifold from the choke valve up to overpressure protection SDV of each train headers.
- J03D_LTSAVap_V (6.66%) – the section covers the LTS A (V-220) vapour section through the GG exchanger shell side up to XSV-2405.
- J05D_LTSBVap_V (6.66%) – the section covers LTS B (V-330) vapour section through the GG exchanger shell side up to XSV-3405.
- J13C_MetDisLTS_L (4.76%) – the section covers the methanol distribution system to the LTSs.
- J13B_MetTankOut_L (4.60%) – the section covers the methanol dosing tank outlet up to methanol dosing pumps.

The leak frequencies from these scenarios contribute to approximately 32% of the total leak frequency. The common reason for the high leak frequencies for all the above QRA events is mainly contributed by the significant length of aboveground pipework and the numbers of associated equipment (e.g. valves and flanges).

5.3 Normal Operations with All Wells Frequencies

As discussed above, currently there are no PIDs for the additional wellheads and equipment that will eventually be installed at Kapuni J. Therefore, frequency for the additional releases introduced by this case is assumed to be identical to Phase 1 equipment with the modifications as described in section 4.3 above. As such, parts count sheets for the additional release cases introduced by this case are not prepared. The release frequency for each event during normal operations with all wells in production is shown in Table 5-3 below. The highest leak contributors are indicated in **red**.

Table 5-3: Hydrocarbon Release Frequencies for Normal Operation with All Wells in Production

No.	QRA Events	Leak Frequencies (per annum)						% Contri.
		1 - 3 mm (2 mm)	3 - 10 mm (6 mm)	10 - 50 mm (22 mm)	50 - 150 mm (85 mm)	> 150 mm (Rupture)	TOTAL	
1	J01A_W001Blow_V					4.40E-05	4.40E-05	0.01%
2	J01B_W002Blow_V					4.40E-05	4.40E-05	0.01%
3	J01C_W003Blow_V					4.40E-05	4.40E-05	0.01%
4	J01D_W004Blow_V					4.40E-05	4.40E-05	0.01%
5	J01E_W001WRel_V	1.31E-05	4.57E-06	1.57E-06	2.61E-07	1.05E-06	2.05E-05	0.01%
6	J01F_W002WRel_V	1.31E-05	4.57E-06	1.57E-06	2.61E-07	1.05E-06	2.05E-05	0.01%
7	J01G_W003WRel_V	1.31E-05	4.57E-06	1.57E-06	2.61E-07	1.05E-06	2.05E-05	0.01%
8	J01H_W004WRel_V	1.31E-05	4.57E-06	1.57E-06	2.61E-07	1.05E-06	2.05E-05	0.01%
9	J02A_W001Flow_V	4.02E-03	1.80E-03	1.11E-03	1.81E-04		7.12E-03	2.26%
10	J02B_W001ChIn_V	2.17E-03	8.83E-04	4.71E-04	9.64E-05		3.63E-03	1.15%
11	J02C_ChMani_V	2.53E-02	1.04E-02	5.65E-03	1.00E-03	2.16E-05	4.24E-02	13.44%
12	J02D_W002Flow_V	4.02E-03	1.80E-03	1.11E-03	1.81E-04		7.12E-03	2.26%
13	J02E_W002ChIn_V	2.17E-03	8.83E-04	4.71E-04	9.64E-05		3.63E-03	1.15%
14	J02F_W003Flow_V	4.02E-03	1.80E-03	1.11E-03	1.81E-04		7.12E-03	2.26%
15	J02G_W003ChIn_V	2.17E-03	8.83E-04	4.71E-04	9.64E-05		3.63E-03	1.15%
16	J02H_W004Flow_V	2.01E-03	8.28E-04	4.07E-04	2.47E-05		7.12E-03	2.26%
17	J02I_W004ChIn_V	2.17E-03	8.83E-04	4.71E-04	9.64E-05		3.63E-03	1.15%
18	J03A_TrAHeader_V	4.02E-03	1.80E-03	1.11E-03	1.81E-04		7.12E-03	2.26%
19	J03B_HPKOAVap_V	5.55E-03	2.50E-03	1.26E-03	2.05E-04	8.28E-05	9.60E-03	3.04%
20	J03C_HPKOALiq_L	2.22E-03	9.68E-04	5.78E-04	7.23E-05	7.39E-06	3.85E-03	1.22%
21	J03D_LTSAVap_V	8.11E-03	3.54E-03	1.84E-03	3.14E-04	1.18E-04	1.39E-02	4.41%
22	J03E_LTSALiq_L	3.92E-03	1.66E-03	8.85E-04	6.36E-05	1.16E-05	6.53E-03	2.07%
23	J03F_HPKOALCV_L	1.64E-04	6.13E-05	3.84E-05	1.52E-05		2.79E-04	0.09%
24	J03G_LiqToLTSA_L	5.04E-04	1.94E-04	9.97E-05	5.29E-05		8.51E-04	0.27%
25	J03H_LTSALCV_L	8.28E-04	3.29E-04	1.46E-04	4.49E-05		1.35E-03	0.43%
26	J04A_DryGHeader_V	6.63E-04	2.67E-04	1.44E-04	5.67E-06	5.87E-06	1.09E-03	0.34%
27	J04B_DryGPLSkid_V	7.60E-04	2.89E-04	1.42E-04	2.51E-05	1.74E-05	1.23E-03	0.39%
28	J04C_DryGPLaun_V	9.41E-06	3.70E-06	2.20E-06	1.57E-07	1.88E-08	1.55E-05	0.00%
29	J04D_DryGPRSkid_V	1.12E-03	4.42E-04	2.14E-04	4.97E-05	9.44E-06	1.83E-03	0.58%
30	J04E_DryGPRec_V	6.84E-06	2.88E-06	1.65E-06	4.39E-07	2.49E-07	1.21E-05	0.00%
31	J04F_FGHeater_V	2.77E-03	1.27E-03	7.45E-04	2.66E-04		5.05E-03	1.60%
32	J05A_TrBHeader_V	3.26E-03	1.30E-03	6.53E-04	9.02E-05	3.11E-05	5.33E-03	1.69%
33	J05B_HPKOBVap_V	5.55E-03	2.50E-03	1.26E-03	2.05E-04	8.28E-05	9.60E-03	3.04%
34	J05C_HPKOBLiq_L	2.22E-03	9.68E-04	5.78E-04	7.23E-05	7.39E-06	3.85E-03	1.22%

No.	QRA Events	Leak Frequencies (per annum)						% Contri.
		1 - 3 mm (2 mm)	3 - 10 mm (6 mm)	10 - 50 mm (22 mm)	50 - 150 mm (85 mm)	> 150 mm (Rupture)	TOTAL	
35	J05D_LTSBVap_V	8.11E-03	3.54E-03	1.84E-03	3.14E-04	1.18E-04	1.39E-02	4.41%
36	J05E_LTSBLiq_L	3.22E-03	1.39E-03	7.10E-04	7.88E-05	1.16E-05	5.41E-03	1.71%
37	J05F_HPKOBLCV_L	3.98E-04	1.53E-04	7.23E-05	3.54E-05		6.59E-04	0.21%
38	J05G_LiqToLTSB_L	5.04E-04	1.94E-04	9.97E-05	5.29E-05		8.51E-04	0.27%
39	J05H_LTSBLCV_L	8.28E-04	3.29E-04	1.46E-04	4.49E-05		1.35E-03	0.43%
40	J06A_TrCHeader_L	2.88E-03	1.23E-03	6.25E-04	1.87E-04		4.92E-03	1.56%
41	J06B_LPSepVap_V	4.62E-03	1.97E-03	1.17E-03	9.05E-05	3.98E-05	7.89E-03	2.50%
42	J06C_LPSepLiq_L	2.78E-03	1.21E-03	7.33E-04	1.04E-04	1.16E-05	4.83E-03	1.53%
43	J06D_LPSepLCV_L	7.44E-04	2.98E-04	1.68E-04	6.32E-05		1.27E-03	0.40%
44	J06E_WetGPLSkid_V	1.08E-03	4.24E-04	1.99E-04	2.95E-05	1.54E-05	1.75E-03	0.55%
45	J06F_WetGPLaun_V	2.65E-05	1.13E-05	6.61E-06	1.63E-06	1.02E-06	4.71E-05	0.01%
46	J07A_WetGPipe_V	7.33E-04	3.04E-04	1.34E-04	1.25E-06	1.26E-06	1.17E-03	0.37%
47	J08A_LiqHeader_L	1.16E-03	4.70E-04	2.35E-04	4.80E-05		1.92E-03	0.61%
48	J08B_LiqPLSkid_L	8.43E-04	3.30E-04	1.40E-04	8.91E-05		1.40E-03	0.44%
49	J08C_LiqPLaun_L	1.48E-05	6.22E-06	3.54E-06	8.94E-07	4.93E-07	2.59E-05	0.01%
50	J08D_FBWPLSkid_L	1.38E-03	5.61E-04	2.96E-04	9.79E-05		2.33E-03	0.74%
51	J08E_FBWPLaunB_L	1.39E-05	5.89E-06	3.40E-06	2.23E-06		2.54E-05	0.01%
52	J09A_LiqPipe_L	4.08E-04	1.68E-04	8.34E-05	5.32E-06		6.65E-04	0.21%
53	J10A_FBWPipe_L	4.08E-04	1.68E-04	8.34E-05	5.32E-06		6.65E-04	0.21%
54	J11A_DryKAGasPipe_V	1.08E-03	4.38E-04	1.90E-04	3.28E-05	1.26E-06	1.74E-03	0.55%
55	J12A_DryGasPipe_V	7.32E-04	3.03E-04	1.34E-04	1.20E-06	1.26E-06	1.17E-03	0.37%
56	J13A_MetTank_L	1.76E-03	8.26E-04	4.03E-04	6.40E-05	2.31E-05	3.08E-03	0.98%
57	J13B_MetTankOut_L	5.35E-03	2.41E-03	1.33E-03	5.30E-04		9.63E-03	3.05%
58	J13C_MetDisLTS_L	4.75E-03	2.53E-03	1.65E-03	1.03E-03		9.96E-03	3.16%
59	J14A_CoLTSLiq_L	8.44E-04	3.24E-04	1.60E-04	7.46E-05		1.40E-03	0.44%
60	J15A_CoLTBLiq_L	8.44E-04	3.24E-04	1.60E-04	7.46E-05		1.40E-03	0.44%
61	J16A_W005Blow_V					4.40E-05	4.40E-05	0.01%
62	J16B_W006Blow_V					4.40E-05	4.40E-05	0.01%
63	J16C_W007Blow_V					4.40E-05	4.40E-05	0.01%
64	J16D_W008Blow_V					4.40E-05	4.40E-05	0.01%
65	J16E_W005WRel_V	1.31E-05	4.57E-06	1.57E-06	2.61E-07	1.05E-06	2.05E-05	0.01%
66	J16F_W006WRel_V	1.31E-05	4.57E-06	1.57E-06	2.61E-07	1.05E-06	2.05E-05	0.01%
67	J16G_W007WRel_V	1.31E-05	4.57E-06	1.57E-06	2.61E-07	1.05E-06	2.05E-05	0.01%
68	J16H_W008WRel_V	1.31E-05	4.57E-06	1.57E-06	2.61E-07	1.05E-06	2.05E-05	0.01%
69	J17A_W005Flow_V	4.02E-03	1.80E-03	1.11E-03	1.81E-04		7.12E-03	2.26%
70	J17B_W005ChIn_V	2.17E-03	8.83E-04	4.71E-04	9.64E-05		3.63E-03	1.15%
71	J17D_W006Flow_V	4.02E-03	1.80E-03	1.11E-03	1.81E-04		7.12E-03	2.26%
72	J17E_W006ChIn_V	2.17E-03	8.83E-04	4.71E-04	9.64E-05		3.63E-03	1.15%

No.	QRA Events	Leak Frequencies (per annum)						% Contri.
		1 - 3 mm (2 mm)	3 - 10 mm (6 mm)	10 - 50 mm (22 mm)	50 - 150 mm (85 mm)	> 150 mm (Rupture)	TOTAL	
73	J17F_W007Flow_V	4.02E-03	1.80E-03	1.11E-03	1.81E-04		7.12E-03	2.26%
74	J17G_W007ChIn_V	2.17E-03	8.83E-04	4.71E-04	9.64E-05		3.63E-03	1.15%
75	J17H_W008Flow_V	2.01E-03	8.28E-04	4.07E-04	2.47E-05		3.27E-03	1.04%
76	J17I_W008ChIn_V	2.17E-03	8.83E-04	4.71E-04	9.64E-05		3.63E-03	1.15%
77	J18A_W009Blow_V					4.40E-05	4.40E-05	0.01%
78	J18B_W010Blow_V					4.40E-05	4.40E-05	0.01%
79	J18C_W011Blow_V					4.40E-05	4.40E-05	0.01%
80	J18D_W012Blow_V					4.40E-05	4.40E-05	0.01%
81	J18E_W009WRel_V	1.31E-05	4.57E-06	1.57E-06	2.61E-07	1.05E-06	2.05E-05	0.01%
82	J18F_W010WRel_V	1.31E-05	4.57E-06	1.57E-06	2.61E-07	1.05E-06	2.05E-05	0.01%
83	J18G_W011WRel_V	1.31E-05	4.57E-06	1.57E-06	2.61E-07	1.05E-06	2.05E-05	0.01%
84	J18H_W012WRel_V	1.31E-05	4.57E-06	1.57E-06	2.61E-07	1.05E-06	2.05E-05	0.01%
85	J19A_W009Flow_V	4.02E-03	1.80E-03	1.11E-03	1.81E-04		7.12E-03	2.26%
86	J19B_W009ChIn_V	2.17E-03	8.83E-04	4.71E-04	9.64E-05		3.63E-03	1.15%
87	J19D_W010Flow_V	4.02E-03	1.80E-03	1.11E-03	1.81E-04		7.12E-03	2.26%
88	J19E_W010ChIn_V	2.17E-03	8.83E-04	4.71E-04	9.64E-05		3.63E-03	1.15%
89	J19F_W011Flow_V	4.02E-03	1.80E-03	1.11E-03	1.81E-04		7.12E-03	2.26%
90	J19G_W011ChIn_V	2.17E-03	8.83E-04	4.71E-04	9.64E-05		3.63E-03	1.15%
91	J19H_W012Flow_V	2.01E-03	8.28E-04	4.07E-04	2.47E-05		3.27E-03	1.04%
92	J19I_W012ChIn_V	2.17E-03	8.83E-04	4.71E-04	9.64E-05		3.63E-03	1.15%
TOTAL		1.81E-01	7.78E-02	4.30E-02	8.59E-03	1.16E-03	3.15E-01	100%
		57.4%	24.7%	13.6%	2.7%	0.4%		

The total theoretical leak frequency increases from 0.21 (one leak every 4.8 years) to 0.32 per annum (one leak every 3.2 years). The leak contribution is predominantly from the 1 - 3 mm hole size, which contributes to 57% of the total leak frequency.

The list of five highest release frequency remains the same as normal operations for Phase 1. Release case J02C_ChManiV still has the largest release frequency but it now contributes 13.44% of the total release frequency. This is due to the addition of release frequency from the choke valve skids of the additional wells. The five highest release frequency contributors for this case are as follows:

- J02C_ChManiV (13.44%)
- J03D_LTSAVap_V (4.41%)
- J05D_LTSBVap_V (4.41%)
- J13C_MetDisLTS_L (3.16%)
- J13B_MetTankOut_L (3.05%)

6. RISK ANALYSIS

6.1 Risk Criteria

Key deliverable for this study is the location specific individual risk (LSIR) in the form of risk contour. LSIR is the risk of fatality at a point in space to a hypothetical individual at a location for 365 days per year, 24 hours a day, unprotected and unable to escape.

As there are no standard risk criteria which have been developed for the NZ context, this deliverable is assessed against the suggested risk criteria in the NSW Hazardous Industry Planning Advisory Paper No. 4 (HIPAP4) "Risk Criteria for Land Use Planning" as shown in Table 6-1 [Ref. 16].

Table 6-1: HIPAP 4 Individual Fatality Risk criteria

Land Use	Risk Criteria Adopted (per annum)	Interpretation for QRA
Hospitals, schools, childcare facilities, old age housing	0.5×10^{-6} (or 5×10^{-7}) (1 in 2 million)	5×10^{-7} risk contour should not extend to these areas
Residential, hotels, motels, tourist resorts	**1×10^{-6}** **(1 in 1 million)**	**1×10^{-6} risk contour should not extend to these areas**
Commercial developments including retail centres, offices and entertainment centres	5×10^{-6} (1 in 200,000)	5×10^{-6} risk contour should not extend to these areas
Sporting complexes and active open space	10×10^{-6} (or 1×10^{-5}) (1 in 100,000)	1×10^{-5} risk contour should not extend to these areas
Industrial	**50×10^{-6} (or 5×10^{-5})** **(1 in 20,000)**	**5×10^{-5} risk contour should, as a target, be contained within the boundaries of the industrial site where applicable**

The site is situated in an area classified as "rural" under the STDC Operative District Plan [Ref. 20] and surrounded by intensive dairy farmland, and as such a suitable land use category is not easily inferred from the above table. There are no industrial, sporting complexes, hospitals or commercial developments in the area surrounding the wellsite. The closest identified offsite parties are dwellings or houses. Therefore, only the *"Industrial"* (i.e. the 5 x 10^{-5} / year risk) and *"Residential"* (the 1 x 10^{-6} /year risk) are considered.

6.2 Risk Assessment Results

6.2.1 Drilling Operations Risk Results

The risk contour during drilling for Kapuni J wellsite is presented in Figure 6-1**Error! Reference source not found.**. The LSIR results as assessed against the HIPAP4 criteria are given in Table 6-2.

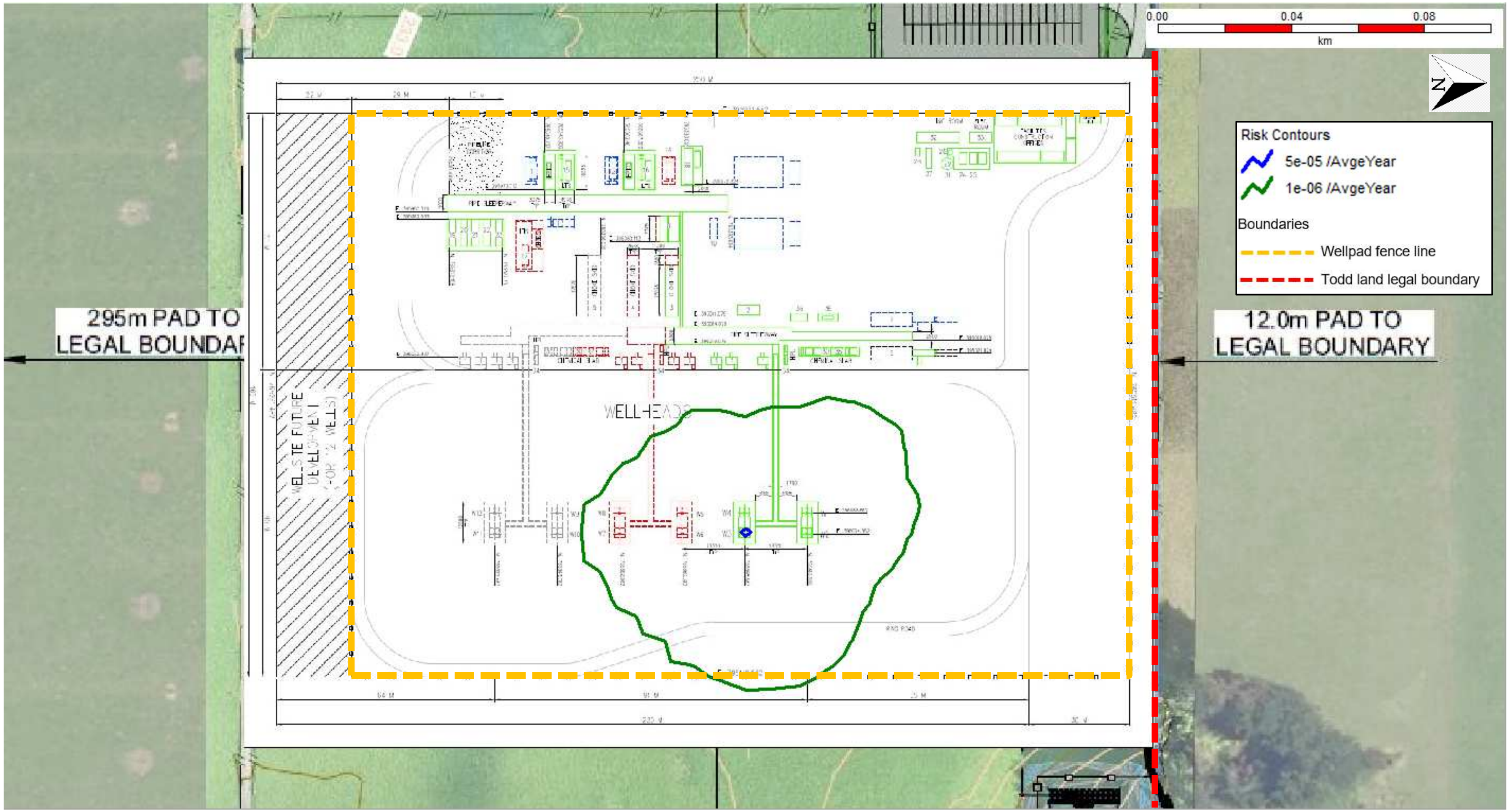

Figure 6-1 Kapuni J Drilling Risk Contour

Table 6-2 Drilling Operation LSIR Results as Assessed against the Risk Criteria

LSIR	Risk Contour	Risk Criteria	Result
5E-05 / year	**Blue**	Industrial 5E-05 / year risk contour should, as a target, be contained within the boundaries of the industrial site where applicable.	No impact. The 5E-05 / year risk contour is within the site boundary.
1E-06 / year	**Green**	Residential 1E-06 / year risk contour should not extend to residential, hotels, motels, tourist resorts	No impact. The risk contour of 1E-06 / year remains within the legal boundary of the land owned by Todd, although it extends slightly beyond the wellpad fence line on the East side.

The result shows that during drilling operations, the risk contours for 5E-05 / year and 1E-06 / year stay within plant boundaries.

6.2.2 Normal Operations for Phase 1 Risk Results

The risk contour during normal operations of Kapuni J wellsite during Phase 1 is presented in Figure 6-2. The LSIR results as assessed against the criteria are given in Table 6-3.

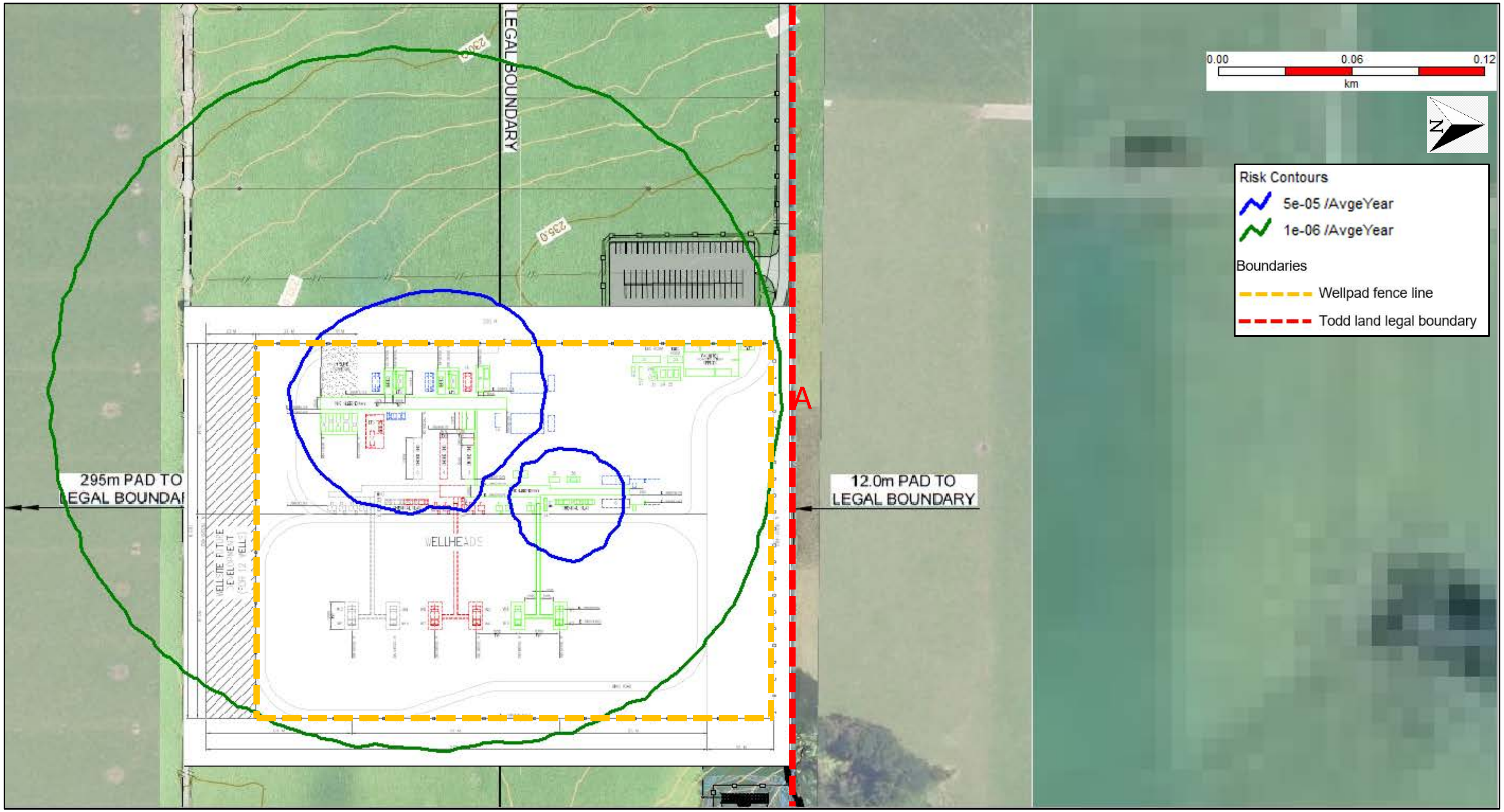

Figure 6-2: Kapuni J Normal Operations for Phase 1 Risk Contour

Table 6-3: Normal Operations for Phase 1 LSIR Results as Assessed against the Risk Criteria

LSIR	Risk Contour	Risk Criteria	Result
5E-05 / year	**Blue**	Industrial 5E-05 / year risk contour should, as a target, be contained within the boundaries of the industrial site where applicable.	No impact. The 5E-05 / year risk contour remains within the legal boundary of the land owned by Todd although it extends beyond the wellpad fence line on the West side.
1E-06 / year	**Green**	Residential 1E-06 / year risk contour should not extend to residential, hotels, motels, tourist resorts	No impact. The risk contour of 1E-06 / year remains within the legal boundary of the land owned by Todd although it extends beyond the wellpad fence line on all sides. The contour does not encroach on any houses or other places of residence.

6.2.3 Normal Operations with All Wells Risk Results

The risk contour during normal operations of Kapuni J wellsite is presented in Figure 6-3. The LSIR results as assessed against the criteria are given in Table 6-4.

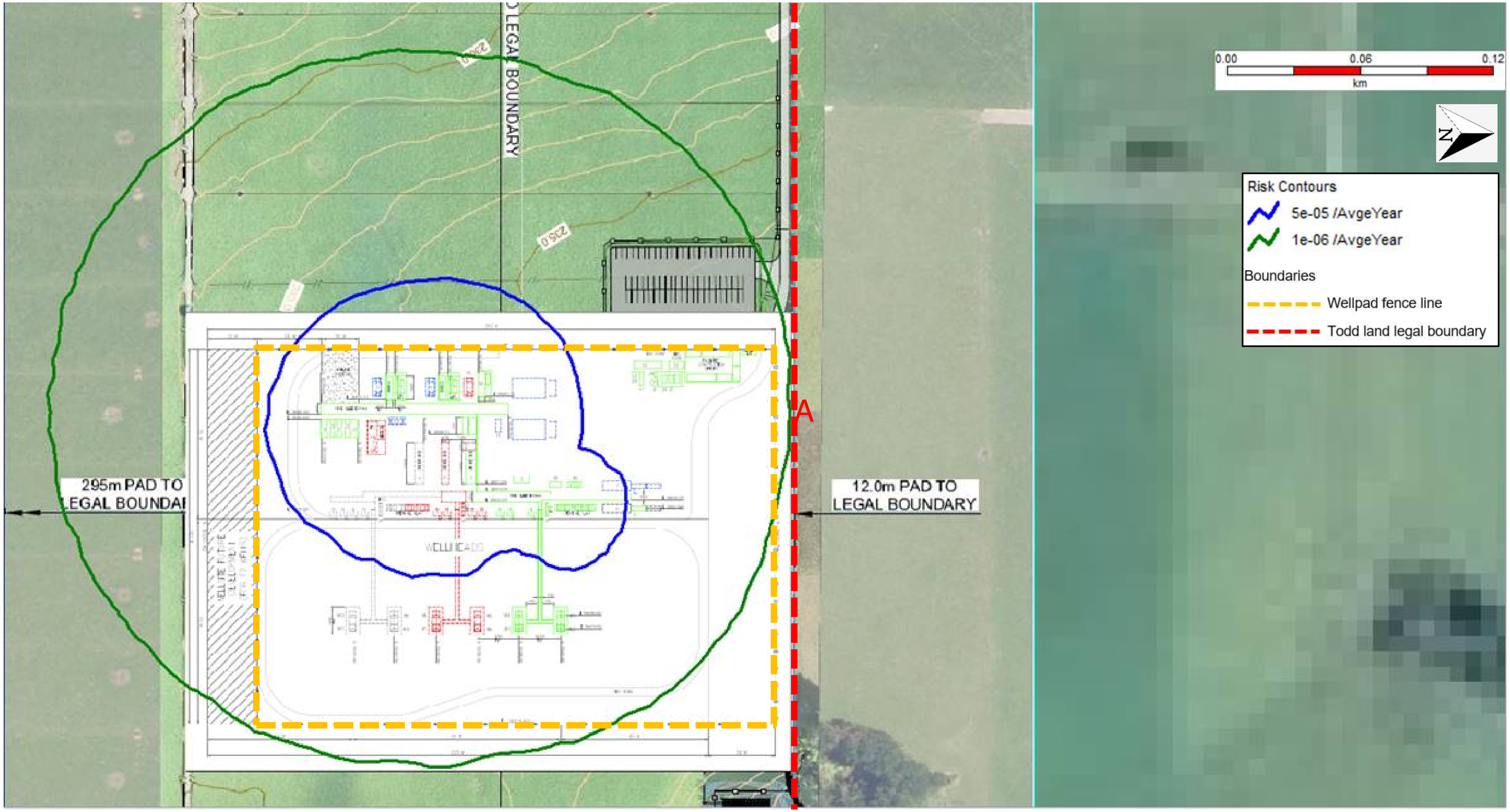

Figure 6-3: Kapuni J Normal Operations with All Wells Contour

Table 6-4: Normal Operations with All Wells LSIR Results as Assessed against the Risk Criteria

LSIR	Risk Contour	Risk Criteria	Result
5E-05 / year	**Blue**	Industrial 5E-05 / year risk contour should, as a target, be contained within the boundaries of the industrial site where applicable.	No impact. The 5E-05 / year risk contour remains within the legal boundary of the land owned by Todd although it extends beyond the wellpad fence line on the West side but still.
1E-06 / year	**Green**	Residential 1E-06 / year risk contour should not extend to residential, hotels, motels, tourist resorts	No impact. The risk contour of 1E-06 / year remains within the legal boundary of the land owned by Todd although it extends beyond the wellpad fence line on all sides. The contour does not encroach on any houses or other places of residence.

Both the 5E-05 per year and 1E-06 per year risk contours are larger in Figure 6-3 with all 12 wells in operation. The 5E-05 per year contour with all 12 wells producing is one large area instead of divided into two during phase 1. This is because there are additional flowlines and choke valve skids around the centre of the Wellpad which will contribute to the risk.

The 1E-06 per year risk contour is larger with all 12 wells producing. The difference is more pronounced to the South and East direction which is due to the possible releases from the 8 additional wellheads and flowlines. The contour also extends slightly farther to the North and West because of the additional equipment that will be installed around the choke skids and LTSs.

6.3 Risk Contributor Analysis

Risk ranking points can be placed in the Phast Risk model to identify the risk contributors at various locations. A risk ranking point is placed on the legal boundary near the Northern-most side of the risk contour to identify the risk contributors (marked as “A” on Figure 6-2 and Figure 6-3). The risk contributors to location A for both normal operations for Phase 1 and normal operations with all wells are described below.

Normal Operations for Phase 1

During normal operations for phase 1, the total LSIR at location A is 7.22E-07 per year. The top five risk contributors to this location is shown in Table 6-5.

Table 6-5 Top Five Risk Contributors to North Legal Boundary during Normal Operations for Phase 1

Release Case	Description	Release Size (mm)	Cons. Event	LSIR Contribution (risk per year)	Percentage Contri.
J05A_TrBHeader_V	Well fluids in train B header from XSV-3001 and XSV-3002 through the LTS coils up to the inlet of the HPKO B (V-320)	174	Jet Fire	3.79E-07	52.54%

Release Case	Description	Release Size (mm)	Cons. Event	LSIR Contribution (risk per year)	Percentage Contri.
J03B_HPKOAVap_V	HPKO Vessel A (V-220) vapour section through the GG exchanger tube side up to inlet of LTS A (V-230)	174	Jet Fire	8.18E-08	11.34%
J02C_ChMani_V	Well fluids in production manifold from choke valve up to overpressure protection SDV of each train headers	174	Jet Fire	7.87E-08	10.89%
J06C_LPSepLiq_L	Low Pressure Separator (V-420) liquid section up to LCV-4202 and LCV-4212	150	Jet Fire	6.15E-08	8.52%
J06A_TrCHeader_L	Liquid from LTS A/B XSV-2010 and XSV-3010 up to inlet of Low Pressure Separator (V-420)	85	Jet Fire	4.36E-08	6.03%

Normal Operations with All Wells

During normal operations with all wells producing, the total LSIR at location A is 8.97E-07 per year. The top five risk contributors to this location is shown in Table 6-6.

Table 6-6 Top Five Risk Contributors to North Legal Boundary during Normal Operations with All Wells

Release Case	Description	Release Size (mm)	Cons. Event	LSIR Contribution (risk per year)	Percentage Contri.
J05A_TrBHeader_V	Well fluids in train B header from XSV-3001 and XSV-3002 through the LTS coils up to the inlet of the HPKO B (V-320)	174	Jet Fire	3.79E-07	42.30%
J02C_ChMani_V	Well fluids in production manifold from choke valve up to overpressure protection SDV of each train headers	174	Jet Fire	1.52E-07	16.96%
J06A_TrCHeader_L	Liquid from LTS A/B XSV-2010 and XSV-3010 up to inlet of Low Pressure Separator (V-420)	85	Jet Fire	1.45E-07	16.16%
J03B_HPKOAVap_V	HPKO Vessel A (V-220) vapour section through the GG exchanger tube side up to inlet of LTS A (V-230)	174	Jet Fire	8.18E-08	9.12%
J06C_LPSepLiq_L	Low Pressure Separator (V-420) liquid section up to LCV-4202 and LCV-4212	150	Jet Fire	6.15E-08	6.86%

The results show that the total risk at the North legal boundary of the wellsite increased by approximately 24% from 7.22E-07 per year to 8.97E-07 per year. Based on the risk contributors, the increase is mainly due to release cases J02C and J06A. This is because as described in section 4.3 above, when all 12 wells are producing, these sections will include additional piping and equipment. However, the increased risk does not cause the total risk at the boundary to exceed 1E-06 per year.

Table 6-5 and Table 6-6 both show that horizontal jet fire events from large size releases are the main risk contributors to the North boundary of the Kapuni J wellsite. It should be noted that the QRA model cannot take into account the topography of the site. The risk calculation results are based on flat land with no obstructions.

However, the Kapuni J site is not flat and in order to achieve a flat building pad a significant cut and fill redistribution will be implemented as shown in the sideview of the wellsite 3D model in Figure 6-4. Once completed, the pad will be around 2.6 m lower than the ground level at the North boundary [Ref. 8]. This will provide a physical barrier between the Kapuni J wellsite facilities and outside parties beyond the North boundary. As jet fire events are directional, this barrier would help mitigate the effects of a jet fire on the adjoining land.

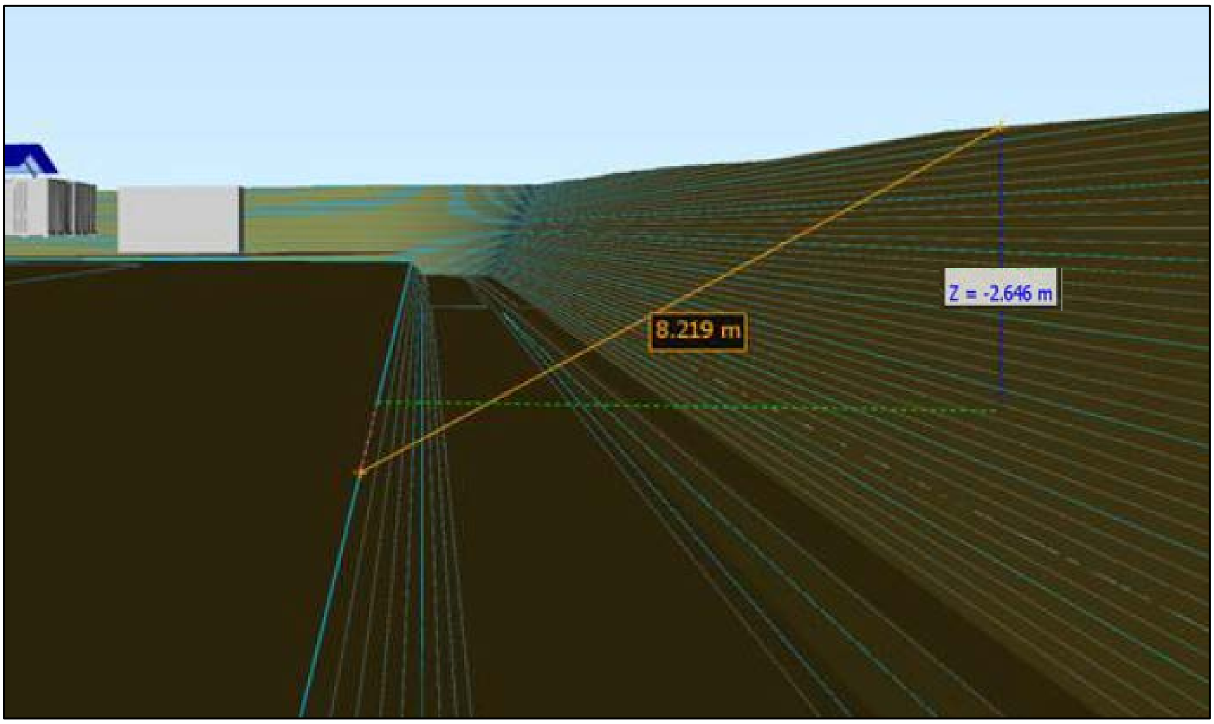

Figure 6-4 Sideview of Planned North Boundary of Kapuni J Wellsite

7. CONCLUSION

A QRA has been conducted for the Kapuni J wellsite, which covers the proposed wellheads and well fluid processing equipment. The assessment considers risks from the Kapuni J wellsite for the following cases:

- Drilling operations which will consider only blowout events
- Normal operations/production for phase 1 wells. Phase 1 refer to the initial development of Kapuni J wellsite with 4 wells in operation along with the associated process equipment.
- Normal operations/production for all wells. This case refers to the eventual development of Kapuni J wellsite which will have 12 producing wells.

The key deliverable of the QRA is the location specific individual risk which are assessed against the HIPAP4 criteria.

During drilling operations, the results show that:

- The risk contours for 5E-05 / year and 1E-06 / year stay within plant boundaries.

During normal operations for phase 1 wells, the results show that:

- The 5E-05 / year risk contour remains within the legal boundary of the land owned by Todd although it extends beyond the wellpad fence line on the West side.
- The 1E-06 / year risk contour remains within the legal boundary of the land owned by Todd although it extends beyond the wellpad fence line on all sides. The contour does not encroach on any houses or other places of residence.

During normal operations with all wells, the results show that:

- The 5E-05 / year risk contour remains within the legal boundary of the land owned by Todd although it extends beyond the wellpad fence line on the West side.
- The 1E-06 / year risk contour remains within the legal boundary of the land owned by Todd although it extends beyond the wellpad fence line on all sides. The risk contour extends further than the one for Phase 1 but still does not encroach on any houses or other places of residence.

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Appendix 1.
QRA Assumption Register

TODD ENERGY LTD

Kapuni J Wellsite
QRA Assumptions Register

620035-TCN-R0001
May 2019

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Rev	Description	Originator	Reviewer	WorleyParsons Approver	Date	Client Approval	Date
A	Issued for Review/Comment	A Setodewo	Y Lee	A Setodewo	05/2019		
0	Approved for Use	A Setodewo	Y Lee	A Setodewo	05/2019		

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APPENDICES

1. INTRODUCTION

This document sets out the assumptions to be used for the Kapuni J Quantitative Risk Assessment (QRA).

1.1 Abbreviations

AWS	Automatic Weather Station
BLEVE	Boiling Liquid Expanding Vapour Explosion
BOP	Blowout Preventer
CO_2	Carbon Dioxide
DNV GL	Det Norske Veritas Germanischer Lloyd
ESDV	Emergency Shutdown Valve
GCPS	Global Congress on Process Safety
HCRD	Hydrocarbon Release Database
HIPAP4	Hazardous Industry Planning Advisory Paper No. 4
HMB	Heat and Material Balance
HPKO	High Pressure Knockout Drum
KRD	Kapuni Redevelopment
LFL	Lower Flammable Limit
LP	Low Pressure
LPG	Liquefied Petroleum Gas
LTS	Low Temperature Separator
LSIR	Location Specific Individual Risk
MEM	Multi-Energy Method
NIWA	National Institute of Water and Atmospheric Research
OGP RADD	Association of Oil and Gas Producers Risk Assessment Data Directory
P&ID	Piping and Instrumentation Diagram
PFD	Process Flow Diagram
QRA	Quantitative Risk Assessment
UKOOA	UK Offshore Operators Association
VCE	Vapour Cloud Explosion

2. ASSUMPTIONS

2.1 Scope of Work

The scope for Kapuni J QRA includes the following cases:

- **Drilling phase** which will only consider blowout events
- **Normal operations/production for phase 1 wells.** Phase 1 refer to the initial development of Kapuni J wellsite with 4 wells in operation along with the associated process equipment. The scope for this case includes the following systems [Ref. 1]:
  - 4 wellheads (W-010/020/030/040)
  - Production flowlines and manifolds
  - 1 Choke valve skid
  - 1 Over pressure protection skid
  - 2 Low Temperature Separators (LTSs) and High-Pressure Knockout Skids (HPKOs) (Trains A/B)
  - 1 Low Pressure (LP) Separator Skid
  - 1 Pig Receiver and Launchers Skid
  - 1 Chemical Slab
  - Any aboveground pipeline sections downstream of the pipeline isolation valves within the plant boundary.
- **Normal operations/production for all wells.** This case refers to the eventual development of Kapuni J wellsite which will have 12 producing wells. The scope for this case includes all of the systems considered for the Phase 1 case above with the following additions:
  - 8 wellheads (W-050/060/070/080/090/100/110/120)
  - Production flowlines for the additional wellheads.
  - 2 Choke valve skids, 1 for each 4 additional wells.
  - 2 Air cooled heat exchangers. 1 each to be added upstream of HPKO A and upstream of LP Separator.

The following assumptions are made for the risk assessment:

- Equipment used only for wellsite start-up operations will be excluded from the risk assessment model. These include the Start-Up Heaters and Start-Up Cyclone Desander Skid. This is because the duration of start-up operations is short compared to the lifetime of the wellsite. Based on this assumption, isolation valves between the choke valves skid and the start-up loop system is considered to be closed [Ref. 2].
- The fuel gas system is provided mostly to supply the start-up heaters. Therefore, during normal operations, most of the fuel gas system is considered not in operation [Ref. 2]. The fuel gas system will be included up to the boundary of the fuel gas package.

- Chemicals present in the wellsite include corrosion inhibitor and methanol. However, as corrosion inhibitor is non-flammable, only methanol will be included in this risk assessment.
- Some streams containing high concentration of Carbon Dioxide (CO_2) will be assessed in terms of toxic dispersion effects with respect to the unignited release scenarios. It is noted that CO_2 may also cause asphyxiation by displacing oxygen in the air. However, as the wellsite is a relatively open area, it is considered that the risk from asphyxiation due to CO_2 is low. Therefore, only toxic effects of the CO_2 as described in UK HSE will be assessed in this study [Ref. 18].
- As per information from Kapuni Redevelopment (KRD) project, most of the methanol injection system will only be required during start-up. During normal operation, methanol will only be supplied to the Low Temperature Separator (LTS) [Ref. 2]. Therefore, only methanol injection to the LTS will be included in this risk assessment.
- As per information from KRD project, normal operation of the wellsite will follow the scheme shown in the Heat and Mass Balance (HMB) drawing provided by the KRD project. HMB Case 2 was selected as the representative conditions for the model [Ref. 3]. This is detailed further in Section 2.6. The HMB shows that the liquid outlet from the LTS will be routed to the LP Separator instead of direct feeding into the liquid collecting header. Based on this assumption, the isolation valve on Train C header and XSV-2004 and XSV-3004 on the Liquids header will be considered as closed.
- Based on information from KRD project, it will be assumed that all 4 wells will be flowing simultaneously during normal operation. Similarly, LTSs and HPKOs on both trains will be operating simultaneously.

2.2 Assessment Tool

The risk assessment model will be set up using DNV GL Phast Risk version 6.7 [Ref. 4].

2.3 Definition of Parts Count Sections

2.3.1 Isolatable Inventory

Each potential leak source will be associated with a particular isolatable inventory. Primarily, the isolatable inventories will be defined by emergency shutdown valve (ESDV) boundaries. As per discussion with KRD process engineer, both XSVs and SDVs will be considered as isolation points. These sections will be further broken down where warranted. However, the entire contained inventory will be considered as available for release. Further breakdown may be warranted due to:

- Significant change in operating parameters (temperature and pressure)
- Significant change in stream composition
- Change in stream phase
- Equipment location

At isolatable boundaries, the valve will be assumed as the last component of the upstream inventory.

- If a cap or blind flange is shown against a valve, it will be assumed to be closed, even if not indicated as such.

The following potential release points will be excluded from the parts count:

- For normally closed valves, both the valve and upstream flange will be counted, but not any equipment items downstream of the valve unless this is exposed to a live inventory (e.g. on a bypass line).
- If a cap or blind flange is shown against a valve, it will be assumed to be closed, even if not indicated as such.

2.3.2 Components

The definition of components within the parts count will be aligned with failure rate data published in the OGP Risk Assessment Data Directory (RADD) Process Release Frequency [Ref. 6]. The parts count will consider the following:

- Equipment items
- Valves
- Flanges
- Instrumentation and small bore fittings
- Pipework

The parts count will be recorded in an MS Excel spreadsheet, with each section broken down based on the piping and instrumentation diagrams (P&IDs). Marked up P&IDs will be attached with the QRA report.

The parts count will use the P&ID set provided by the KRD process engineer, specifically the master copy issued on 1st of April 2019 [Ref. 7]. This copy includes the final LTS arrangement with 2 identical LTS skids.

2.4 Failure Frequency Data and Hole Size Distributions

2.4.1 General Leak Frequency

The leak frequencies for process equipment, pressurized storage vessel and tanks in general will be taken from the OGP RADD Process Release Frequency [Ref. 6]. The release frequencies of the main process equipment items will be based on an analysis of the HSE hydrocarbon release database (HCRD) which has been compiled by the UK HSE over a 20-year period.

Failure frequency data from the HCRD contains detailed historical information on offshore hydrocarbon release incidents occurring in the UK offshore environment and is considered an industry standard for offshore QRA applications. The database categorises failure rates on a detailed basis of equipment type and size and provides a probabilistic hole size distribution associated with the failure.

The HCRD data are also normally used for QRA at onshore facilities, although the use of offshore failure rate may be considered to be conservative for use in most onshore applications, on the basis that:

- Offshore environments tend to be harsher, both external (saliferous environment) and internal (produced sand), increasing the rate of equipment corrosion and erosion;
- Congestion at offshore facilities increases the likelihood of damage through impact; and
- Restricted access to offshore facilities may limit maintenance campaigns, increasing the likelihood of failure.

2.4.2 Hole Size

For every component failure, there is a range of credible hole sizes ranging from pinhole leak to full bore rupture. The hole size grouping from the OGP RADD Process Release Frequency together with the representative hole sizes to be used in the QRA is as shown in Table 2-1.

Table 2-1: Hole Size Distribution

OGP Hole Size Group (mm)	Representative Hole Size (mm)
1 - 3	2
3 - 10	6
10 - 50	22
50 - 150	85
> 150	Range geometric mean

The selected representative hole sizes were chosen using a geometric mean of the smallest and largest hole size in each group. This approach is considered to have a mathematical basis that aligns with numbers that are exponential in nature such as is the case for hole sizes whereby the consequence is dependent on the area of the hole size or square of the diameter. For example, the representative hole size for the range 10 – 50 mm is calculated as $(10 \times 50)^{0.5}$ = 22 mm [Ref. 21].

The same approach will be taken to select the representative hole size for rupture cases (release > 150 mm). The selected hole size will be the geometric mean of 150 and the largest line size in the section. This is considered to be a representative approach to this category of the release with the following justifications [Ref. 22]:

a. Pipework will be designed to be either inherently safe and are considered unlikely to exceed the design pressure or protected with a high integrity pressure protection system (HIPPS) depending on the location within the process

b. Mechanical joints will be either weld or flange with no screwed connections direct to pipework

c. Detailed pipe stressing and design of pipework, including independent verification and certification, to be ductile. This ensures that piping will be able to flex and deform in earthquakes and subsidence as well as thermal expansion rather than tear or rupture.

d. Coatings and paint are specified for exposure to a coastal environment thereby increasing the duration of effectiveness and limiting external corrosion mechanisms.

2.4.3 Leak Frequency Modification Factor

Several leak frequency modification factors will be applied to the release frequency database. This is based on the peer review comments of the Kapuni J wellsite Hazardous Substances Risk Assessment report done by ERS [Ref. 23] and the memos from Todd Energy regarding QRA methodology [Ref. 21 & 22]. The factors are listed below:

- Flange Release Frequency
  - Flange release frequency will be multiplied with the modifiers for flange type ANSI Raised Face flanges as shown in Table 3-1 of OGP RADD Process Release Frequencies [Ref. 23]. The factors are shown in Table 2-2.

Table 2-2 Flange Release Modification Factor

Hole Size Group (mm)	Modification Factor (% of total flange release frequency)
1 - 3	10
3 - 10	10
10 - 50	30
50 - 150	30
> 150	20

  - The maximum hole size for a flange will be limited to 22 mm as a release from a flange is normally limited to a segment of a gasket between bolts [Ref. 21].

- Piping Release Frequency
  - Pipework will be split into categories: process (on skid) piping and interskid piping as described in the definition for equipment type 1 of OGP RADD Process Release Frequencies.
  - For interskid piping, the modification factor for “inter-unit piping” (section 3.5.4 of OGP RADD Process Release Frequencies) which is 0.9 will be applied. This is understood to be a 90% reduction in frequencies [Ref. 21].

- Rupture Release Frequency

  A review of the UK HSE Hydrocarbon Release Database (HCRD) from 1992 to 2015 has been performed to determine how many full-bore rupture cases occur. There were 31 incidents in the full bore release category within 24 years. These were reviewed by Todd Energy for applicability to the Kapuni J facility. 65% of the incidents were discounted on the basis that the release scenario cannot occur on Kapuni J. This is due to the factors below:

  a. The source of the release (type of equipment) will not be on site, including flare or vent for EDP, process drains or no alternate equivalent scenarios that would have the same effect.

  b. The scenario cannot occur within the operation, such as shore to ship transfers or other risks of pipeline surge resulting in catastrophic failure, alternate valve failure that could lead to a similar catastrophic event, overflow to atmosphere or no helicopter refuelling.

c. Contributing factors will not be present – subsea or in the wave zone of the platform.

d. Event is on equipment or during an operational phase that will be outside of the scope of the QRA – well workover and drilling activity. This equipment will only be present for a small proportion of the overall lifetime of the wellsite.

Therefore, the frequency for rupture releases will be reduced by 65% [Ref. 22].

The modified release frequencies used in the QRA is attached as Appendix-1.

2.4.4 Pigging Frequencies

Four pipeline pig launchers and one pig receiver will be located at the Kapuni J wellsite to clean, condition and/or monitor the pipeline. Based on discussion with KRD process engineer, pigging will be assumed to be a half day operation [Ref. 2]. Pigging frequency depends on the pipeline service as shown below:

- Dry Gas service = every 12 months
- Condensate/Water service = every 6 months
- Wet Gas service = every 3 months

This pigging frequency will be used to calculate a modification factor for the leak frequency from the pig launchers and receiver as shown in Table 2-3.

Table 2-3: Pigging Frequencies and Modification Factor

Tag Number	Name	Release Case	Service	Pigging Frequency (per year)	Average pigging duration (hours)	Modification Factor
941-V-xx2	Dry Gas Pipeline Pig Receiver (8")	J04E_DryGPRec_V	Dry Gas	2	12	0.001
941-V-xx3	Wet Gas Pipeline Pig Launcher (10")	J06F_WetGPLaun_V	Wet Gas	12	12	0.005
941-V-xx5	Dry Gas Pipeline Pig Launcher (12")	J04C_DryGPLaun_V	Dry Gas	2	12	0.001
941-V-xx7	Condensate Pipeline Pig Launcher (6")	J08C_LiqPLaun_L	Liquid	4	12	0.003
941-V-xx9	Flowback Water Pipeline Pig Launcher (4")	J08E_FBWPLaunB_L	Liquid	4	12	0.003

2.5 Ignition Probabilities

Given a release, the probability of ignition is dependent on a range of factors, including:

- Release rate
- Material state (liquid or gas)
- Material physical properties (flash point, density, flammable limits)
- Ignition sources present

There are a range of correlations for applying an ignition probability to a release, and most are based on release rate and state. The UK Offshore Operators Association (UKOOA) has generated a model for predicting ignition probability which takes into account the above, as well as the nature of the surrounding area with respect to potential ignition sources. This model has been used to generate a range of typical correlations [Ref. 8]. For this QRA, the following scenarios will be used:

- Scenario 5 - “Small Plant Gas LPG (gas or LPG release from small onshore plant)”, which is applicable for releases of flammable gases, vapour or liquids significantly above their normal (NAP) boiling point from small onshore plants (plant area up to 1200 m2, site area up to 35,000 m2).
- Scenario 6 – “Liquid release from small onshore plant”, which is applicable for releases of flammable liquids that do not have any significant flash fraction (10% or less) if released from small onshore plants (plant area up to 1200 m2, site area up to 35,000 m2) and which are not bunded or otherwise contained.

Note that Scenarios 5 and 6 are assumed to particularly apply to a ‘plant’ whereby processing takes place. This is considered conservative as not much processing takes place at the wellsite.

The graphs of ignition probabilities as a function of mass release rate are shown in Figure 2-1.

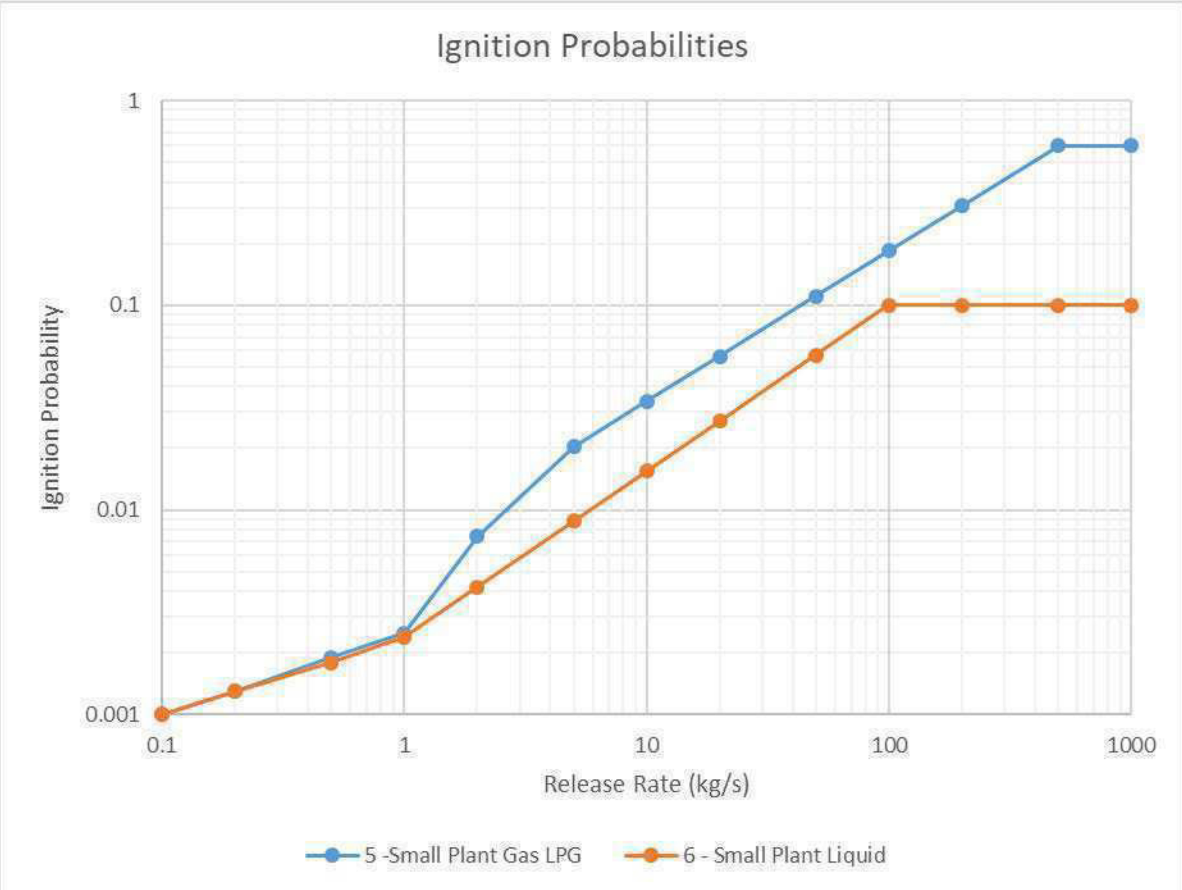

Figure 2-1 Ignition Probability

The graphs represent total ignition probability. An overall distribution for early to delayed ignition ratio of 30:70 to 50:50 split are considered reasonable. The timing of ignition is used as a means to predict the nature of the ignited event. Early ignition is taken to indicate a jet fire or pool fire depending on the material concerned. Delayed ignition is taken to indicate that the ignition would initially result in a flash fire or explosion. For this study, a 30:70 split for immediate: delayed ignition probability will be used as per the WorleyParsons QRA standard for onshore QRAs [Ref. 9].

2.6 Material Composition

An isolatable section may consist of different streams with varying pressures, temperatures and compositions. Any streams that will generate different consequences will be represented by different sections. For sections with similar operating conditions or fluid composition that will generate similar consequences results, the stream which results in worst case result will be selected as representative to rationalise the number of scenarios performed.

The operating conditions will be obtained from the Heat and Mass Balance (HMB) drawing provided by the KRD project. HMB "Case 2" is chosen as the representative conditions during normal production operation. "Case 2" shows the expected wellsite conditions after a few months of production when the wellhead pressure has decreased. It is noted that "Case 1", which shows the expected wellsite conditions during initial production, has higher operating conditions than "Case 2". However, as per information from Todd Energy, the well pressure profile in "Case 1" is only expected to occur for the first few operating months. Therefore, "Case 2" is considered to be more representative of the operating conditions during the lifetime of the wellsite [Ref. 19]. The full HMB for "Case 2" is shown in Appendix 2.

It should be noted that the HMB represents the heavy hydrocarbons as "C6+" components which for most release cases will be modelled by using n-hexane (C_6H_{14}). However, trial consequence modelling shows that this may not be appropriate for liquid streams which contain mostly heavy hydrocarbons. Modelling the material as only n-hexane produces overly large flash fire contours. This is because Phast considers n-hexane will mostly flash into vapour when it is released into the atmosphere while the actual liquid fluid tends to be heavier and more likely to form a pool. Hence the HMB was refined by the KRD project team and a more detailed stream composition was obtained from the HYSYS model with the heavy components divided into n-hexane and n-tridecane ($C_{13}H_{28}$). This will allow Phast to more accurately predict the formation of pools and reduce the flash fire contours to a more representative value. The composition for these cases are shown in Table 2-4 below.

Table 2-4 Liquid Stream Composition

Component Mass Fraction	HMB Stream 9 and 10	HMB Stream 11 and 12	HMB Stream 15 and 16
	HPKO Liquid Out	LTS Liquid Out	LP Liquid Out
Water	0.0519	0.046	0.0517
Carbon Dioxide	0.1526	0.1531	0.0899
Methane	0.0228	0.0265	0.0199
Ethane	0.0387	0.0553	0.0539
Propane	0.0507	0.0788	0.084
n-butane	0.0343	0.0522	0.0578
n-pentane	0.3848	0.3028	0.3411
n-hexane	0.0519	0.046	0.0517
n-tridecane	0.1526	0.1531	0.0899

These streams exist as mainly liquid at the operating conditions shown in the HMB. However, as they contain CO_2 and light hydrocarbons, it will be expected that they will eventually flash when released to the atmosphere. To model the consequence of these releases, the material will be divided into vapour fraction and liquid fraction using the HYSYS Model. The HYSYS model also provides the mass fraction split between the vapour and liquid phase. The vapour and liquid phases will then be modelled separately for the flash fire and pool fire consequences, respectively. Jet fire consequences will be modelled using the initial compositions as they are considered as an immediate event and will occur before the release settles into separate phases.

It should be noted that the compositions for the model are simplified, i.e. isomers are summed together and inert with small amounts such as nitrogen is removed for most streams.

2.7 Release Scenarios

Release Scenarios and Operating Conditions

Release rates will be calculated based on the release hole sizes and fluid pressure. The height of release from all scenarios will be assumed to be at 1 m above ground. It is considered reasonable to assume 70% of the releases are horizontal releases and 30% of the releases are vertical releases.

The total volume released is driven by either the release rate prior to isolation or the stored volume available for release post isolation (estimated by equipment sizes and locations of isolation valves). For each release case, the worst-case scenario (release at operating pressure until detection/isolation) will be determined and used as representative for the release case. As the time for detection and isolation is not known, the initial assessment will assume immediate detection and isolation. For modelling purposes, the following release assumptions will be applied:

- Release of the entire inventory is assumed.
- Jet fires are modelled based on initial release conditions, and do not take account of the depressurisation that occurs over time.

The release scenarios and the respective operating conditions to be used in the Risk Assessment are given in Table 2-5. The sections are highlighted in the Process Flow Diagram (PFD) drawing attached in Appendix 2.

Table 2-5: Release Scenarios and Operating Conditions

No.	Release Case	Description	Stream Comp.	Temp. (°C)	Pres. (barg)	Inventory (m^3)
1	J01A_W001Blow_V	W010 Blowout Event	1	45	80	Note-1
2	J01B_W002Blow_V	W020 Blowout Event	1	45	80	Note-1
3	J01C_W003Blow_V	W030 Blowout Event	1	45	80	Note-1
4	J01D_W004Blow_V	W040 Blowout Event	1	45	80	Note-1
5	J01E_W001WRel_V	W010 Well Release	1	45	80	Note-1
6	J01F_W002WRel_V	W020 Well Release	1	45	80	Note-1
7	J01G_W003WRel_V	W030 Well Release	1	45	80	Note-1
8	J01H_W004WRel_V	W040 Well Release	1	45	80	Note-1

No.	Release Case	Description	Stream Comp.	Temp. (°C)	Pres. (barg)	Inventory (m^3)
9	J02A_W001Flow_V	Well fluids in production flowline from well W010 isolation valve (XSV-0103) up to choke valve skid boundary including Cyclone Desander V-131	1	45	80	8.3
10	J02B_W001ChIn_V	Well fluids in well W010 production flowline within choke valve skid boundary up to choke valve	1	45	80	8.3
11	J02C_ChMani_V	Well fluids in production manifold from choke valve up to overpressure protection SDV of each train headers	2	44.8	79.5	8.3
12	J02D_W002Flow_V	Well fluids in production flowline from well W020 isolation valve (XSV-0203) up to choke valve skid boundary including desander skid V-141	1	45	80	8.3
13	J02E_W002ChIn_V	Well fluids in well W020 production flowline within choke valve skid boundary up to choke valve	1	45	80	8.3
14	J02F_W003Flow_V	Well fluids in production flowline from well W030 isolation valve (XSV-0303) up to choke valve skid boundary including desander skid V-151	1	45	80	8.3
15	J02G_W003ChIn_V	Well fluids in well W030 production flowline within choke valve skid boundary up to choke valve	1	45	80	8.3
16	J02H_W004Flow_V	Well fluids in production flowline from well W040 isolation valve (XSV-0403) up to choke valve skid boundary	1	45	80	8.3
17	J02I_W004ChIn_V	Well fluids in well W040 production flowline within choke valve skid boundary up to choke valve	1	45	80	8.3
18	J03A_TrAHeader_V	Well fluids in train A header from XSV-2001 and XSV-2002 through the LTS coils up to the inlet of the HPKO A (V-220)	2	44.8	79.5	15.6
19	J03B_HPKOAVap_V	HPKO Vessel A (V-220) vapour section through the GG exchanger tube side up to inlet of LTS A (V-230)	3	44.8	79.5	15.6
20	J03C_HPKOALiq_L	HPKO Vessel A (V-220) liquid section up to LCV-2203	9	44.8	79.5	0.3
21	J03D_LTSAVap_V	Low Temperature Separator A (V-220) vapour section through the GG exchanger shell side up to XSV-2405	6	6	48.3	15.6
22	J03E_LTSALiq_L	Low Temperature Separator A (V-220) liquid section up to LCV-2305	11	30.1	48.3	8.5
23	J03F_HPKOALCV_L	HPKO A Liquid from LCV-2203 up to XSV-2204	10	39.2	48.3	0.3
24	J03G_LiqToLTSA_L	Liquid from XSV-2204 to liquid inlet of LTS A (V-230)	10	39.2	48.3	0.1
25	J03H_LTSALCV_L	LTS A Liquid from LCV-2305 up to XSV-2306	12	20.2	24.2	8.5
26	J04A_DryGHeader_V	Dry gas header from XSV-2405 and XSV-3405 up to pig launcher skid boundary	7	38.7	48.1	5.9
27	J04B_DryGPLSkid_V	Dry gas header inside pig launcher skid boundary up to pipeline isolation XSV	7	38.7	48.1	5.9
28	J04C_DryGPLaun_V	Dry Gas Pig Launcher (941-V-xx5)	7	38.7	48.1	5.9
29	J04D_DryGPRSkid_V	Dry gas header from KA-8/12/15/18 inside pig receiver skid	7	38.7	48.1	5.9

No.	Release Case	Description	Stream Comp.	Temp. (°C)	Pres. (barg)	Inventory (m^3)
30	J04E_DryGPRec_V	Dry Gas from KA-8/12/15/18 Pig Receiver (941-V-xx2)	7	38.7	48.1	5.9
31	J04F_FGHeater_V	Dry Gas from header to fuel gas system	7	38.7	7	5.9
32	J05A_TrBHeader_V	Well fluids in train B header from XSV-3001 and XSV-3002 through the LTS coils up to the inlet of the HPKO B (V-320)	2	44.8	79.5	15.8
33	J05B_HPKOBVap_V	High Pressure Knockout Vessel B (V-320) vapour section through the GG exchanger tube side up to inlet of LTS B (V-330)	3	44.8	79.5	15.8
34	J05C_HPKOBLiq_L	High Pressure Knockout Vessel B (V-320) liquid section up to LCV-3203	9	44.8	79.5	2.3
35	J05D_LTSBVap_V	Low Temperature Separator B (V-330) vapour section through the GG exchanger shell side up to XSV-3405	6	6	48.3	15.8
36	J05E_LTSBLiq_L	Low Temperature Separator B (V-330) liquid section up to LCV-3305	11	30.1	48.3	7.5
37	J05F_HPKOBLCV_L	HPKO B Liquid from LCV-3203 up to XSV-3204	10	39.2	48.3	2.3
38	J05G_LiqToLTSB_L	Liquid from XSV-3204 to liquid inlet of LTS B (V-330)	10	39.2	48.3	0.1
39	J05H_LTSBLCV_L	LTS B Liquid from LCV-3305 up to XSV-3306	12	20.2	24.2	7.5
40	J06A_TrCHeader_L	Liquid from LTS A/B XSV-2010 and XSV-3010 up to inlet of Low Pressure Separator (V-420)	12	20.2	24.2	3.7
41	J06B_LPSepVap_V	Low Pressure Separator (V-420) vapour section through the wet gas header up to the wet gas pig launcher skid boundary	13	20.2	24.2	8.1
42	J06C_LPSepLiq_L	Low Pressure Separator (V-420) liquid section up to LCV-4202 and LCV-4212	15	20.2	24.2	3.7
43	J06D_LPSepLCV_L	LP Separator liquid from (V-420) from LCV-4202 and LCV-4212 up to XSV-4203	16	16.1	16.1	3.7
44	J06E_WetGPLSkid_V	Wet gas header inside pig launcher skid boundary up to pipeline isolation XSV	13	20.2	24.2	8.1
45	J06F_WetGPLaun_V	Wet Gas Pig Launcher (941-V-xx3)	13	20.2	24.2	8.1
46	J07A_WetGPipe_V	Wet gas pipeline inside wellsite boundary	13	20.2	24.2	0.7
47	J08A_LiqHeader_L	Liquid header from XSV-2004, XSV-2010, XSV-3004 and XSV-3010 up to liquid pig launcher skid boundary	16	16.1	16.1	2.1
48	J08B_LiqPLSkid_L	Liquid header inside liquid pig launcher skid boundary up to pipeline isolation boundary	16	16.1	16.1	2.1
49	J08C_LiqPLaun_L	Liquid Pig Launcher (941-V-xx7)	16	16.1	16.1	2.1
50	J08D_FBWPLSkid_L	Liquid header inside flowback water pig launcher skid boundary up to pipeline isolation boundary	16	16.1	16.1	2.1
51	J08E_FBWPLaunB_L	Flowback water pig launcher (941-V-xx9)	16	16.1	16.1	2.1
52	J09A_LiqPipe_L	Liquid pipeline inside wellsite boundary	16	16.1	16.1	0.3
53	J10A_FBWPipe_L	Flowback water pipeline inside wellsite boundary	16	16.1	16.1	0.1
54	J11A_DryKAGasPipe_V	Dry gas in incoming pipeline from KA-8/12/15/18 within wellsite	7	38.7	48.1	0.5
55	J12A_DryGasPipe_V	Dry gas export pipeline within wellsite boundary	7	38.7	48.1	1.0
56	J13A_MetTank_L	Methanol Dosing Tank	Methanol	14	0	1.2

No.	Release Case	Description	Stream Comp.	Temp. (°C)	Pres. (barg)	Inventory (m^3)
57	J13B_MetTankOut_L	Methanol Dosing Tank outlet up to methanol dosing pumps	Methanol	14	0	1.2
58	J13C_MetDisLTS_L	Methanol distribution system to LTS	Methanol	14	120	1.2
59	J14A_CoLTSLiq_L	Liquids from LTS A through the liquid header up to XSV-2004 and XSV-2010	12	20.2	24.2	3.7
60	J15A_CoLTBLiq_L	Liquids from LTS B through the liquid header up to XSV-3004 and XSV-3010	12	20.2	24.2	3.7

Note:

1. Inventory for blowout and well release events are considered to be unlimited because they are supplied from the downhole reservoir.

2.7.1 Congested Area

A flammable vapour cloud accumulation at congested area(s) is the prerequisite to have a vapour cloud explosion (VCE). The Kapuni J area is generally open with good ventilation expected throughout the year. However, the areas around some equipment can be quite congested. Identification of congested areas will be based on the layout drawing and the current 3D model. The identified congested areas at the wellsite are marked up on the plot plan provided by the KRD project in Figure 2-2 [Ref. 10].

The “Multi-Energy Explosion” model in DNV GL Phast will be used to model the VCE. The TNO Yellow Book [Ref. 16] recommends the Multi-Energy Method (MEM) as the blast curves are smoothed for practical application and extend to large scaled distances.

The blast strengths are represented by blast curves ranging from 1 for the weakest explosion to 10 for the strongest. Blast curve 1 typically represents an area that is completely unconfined. Strong deflagration is represented by blast curve 6 or higher, and a detonation is represented by blast curve 10.

The rule set to establish congested area is consistent with the recommendations in the Global Congress on Process Safety (GCPS) Facility Siting Rule Set for the TNO Multi-Energy Model for Congested Volumes and Severity Levels [Ref. 17].

The dimensions of each congested area are estimated based on the 3D model and is given in Table 2-6.

Table 2-6: Dimensions of Congested Areas

No.	Description	Width (m)	Length (m)	Height (m)	Volume (m^3)	Blockage Ratio
1	Choke Valve Skid 1	4.5	16.5	2	149	0.1
2	Air Compression Skid	6.8	10.2	4.2	291	0.15
3	Choke Valve Skid 2 (Note)	4.5	16.5	2	149	0.1
4	Choke Valve Skid 3 (Note)	4.5	16.5	2	149	0.1

Note: Choke Valve Skids 2 and 3 are only considered for Normal Operations Case with all 12 wells in production.

DNV GL Phast Risk considers the area blockage ratio as the fraction of the volume of the obstructed region that is occupied by obstructions. This will be approximated for each congested area by using the 3D model.

The selection of blast curve in the MEM is dependent on the degree of obstruction by obstacles inside the vapour cloud, degree of confinement and ignition energy. For each congested area identified, the blast strength selection criteria and corresponding blast strength class is shown in Table 2-7.

Table 2-7: Blast Strength Index of the Congested Areas

No.	Description	Obstruction Note 1	Parallel Plane Confinement Note 2	Ignition Strength Note 3	Blast Strength Class
1	Choke Valve Skid 1	Low	No	Low	2-3
2	Air Compression Skid	Low	No	Low	2-3
3	Choke Valve Skid 2	Low	No	Low	2-3
4	Choke Valve Skid 3	Low	No	Low	2-3

Notes:

1. Obstruction:
   - High – closely packed obstacles within gas cloud giving an overall volume blockage fraction (i.e. the ratio of the volume of the obstructed area occupied by the obstacles and the total volume of the obstructed area itself) in excess of 30% and with spacing between obstacles less than 3 m.
   - Low – obstacles in gas cloud but overall blockage fraction less than 30% and/or spacing between obstacles larger than 3 m.
   - None – no obstacles within gas cloud.
2. Parallel plane confinement:
   - Yes – gas cloud, or parts of it, are confined by walls / barriers on two or three sides.
   - No – gas cloud is not confined, other than by the ground.
3. Ignition strength:
   - High – the ignition source is, for instance, a confined vent explosion. This may be due to the ignition of part of the cloud by a lower energy source, for example, inside a building.
   - Low – the ignition source is a spark, flame, hot surface, etc.

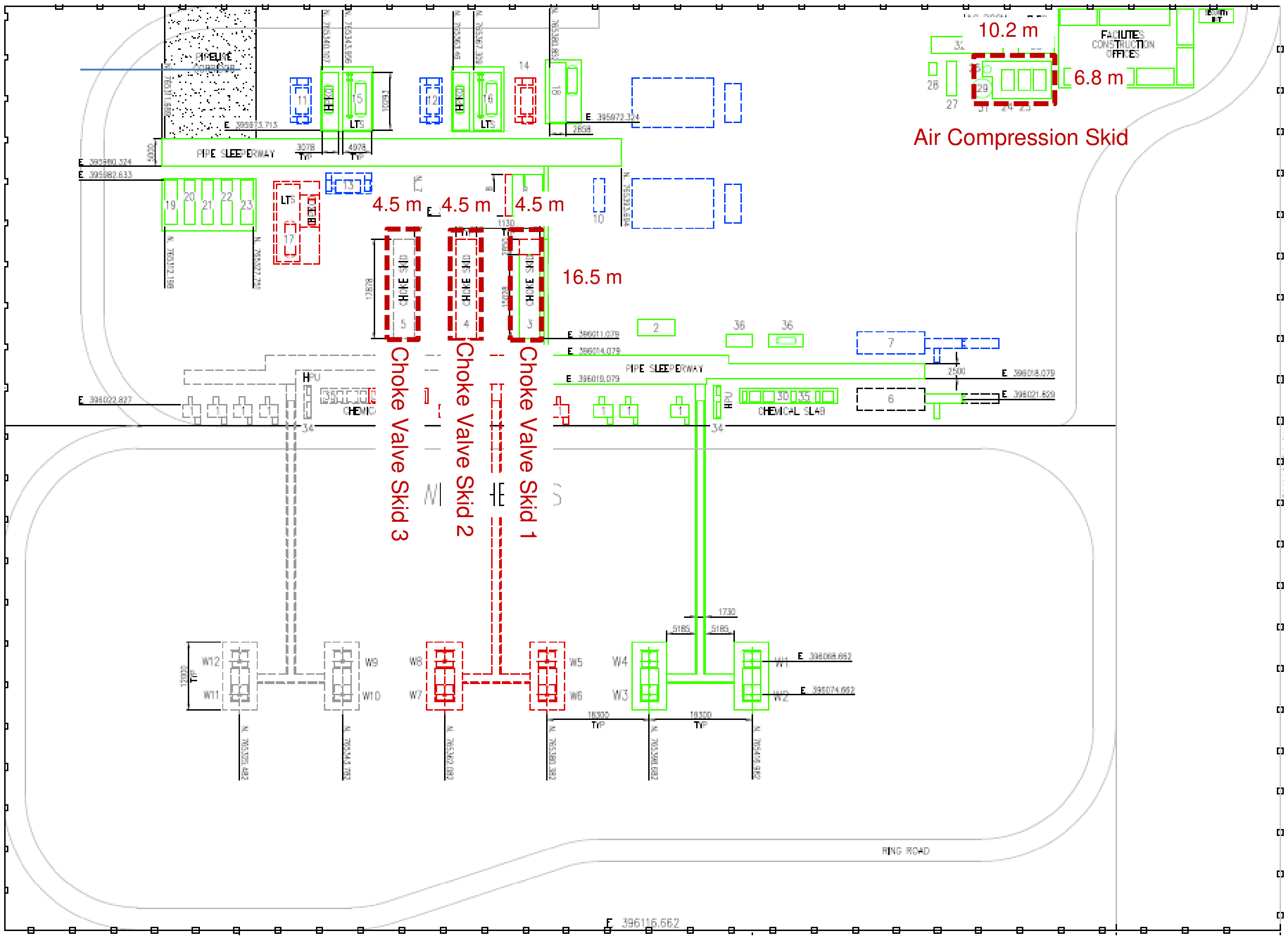

Figure 2-2: Kapuni J Wellsite Layout and Congested Area

2.8 Blowout Events

Blowout events will be considered in the model for both drilling and production operation. Blowout likelihood is based on OGP Risk Assessment Data Directory (RADD) 434-2 for Blowout Frequencies [Ref. 11] specifically data related for wells not following North Sea Standards.

2.8.1 Blowout Consequences

The OGP RADD considers 4 possible consequence of a blowout event:

- Blowout (surface flow)
- Blowout (underground flow)
- Diverted well release
- Well release

Surface flow blowout event is considered to be a full blowout event from the full well bore size. This will be modelled based on the expected maximum well fluid flowrate that the reservoir can supply to the wellbore instead of the wellhead pressure. This is because modelling the release based on the wellhead pressure and open hole diameter size would produce a very high flowrate. This would be an unrealistic flowrate as the well can only produce a maximum amount of well fluid. Based on information from Todd Energy [Ref. 20], the flowrate from a new Kapuni well would be as below:

- Average wellhead pressure : 120 barg
- Average wellhead temperature : 40^{o}C
- Absolute open flow : 18 MMscf/d

The release will be modelled using DNV GL Phast “user defined source” model where the mass flow rates and release velocities are imputed in the models to estimate the effect distances of ignited events. The composition is based on the well fluid composition shown in the Kapuni ReDevelopment (KRD) Project HMB Case 2 [Ref. 1].

Underground flow blowout event was considered to have no consequences on the surface and therefore will not modelled in this study.

Well release event is assumed to be release from the wellhead and Christmas trees. It will be modelled as a horizontal well fluid release at well pressure of 80 barg. Release sizes will be based on the same hole size distribution used for other release cases up to the largest line size which is 10 inch [Ref. 6]. As the wellhead and Christmas trees will not be present during drilling phase, well releases will only be modelled for normal operation case.

Diverted well release event will be assumed to be a well release that can be shut-in or diverted to flare in a short period of time. This event will not be modelled in this study as there is no likelihood of it occurring during normal operations based on the frequencies shown in Table 2-9 below.

2.8.2 Blowout Frequencies

For drilling operations, it will be assumed that a blowout may occur during either development drilling or well completion. The OGP RADD provides the following possible blowout frequencies:

- Development drilling, shallow gas
- Development drilling, deep
- Completion

A shallow gas release is defined as an incident where shallow gas is released from the well after a gas zone has been penetrated before the BOP has been installed (any zone penetrated after the BOP is installed is not a shallow gas incident). The Kapuni reservoir is considered to be a known reservoir which have been drilled for development multiple times before. Therefore, it is assumed unlikely that a drilling operation will penetrate a gas zone before the BOP has been installed. This leads to the assumption that shallow gas releases are unlikely to occur and are excluded from this study.

Drilling Blowout

The frequency for blowout events during drilling operation is shown in Table 2-8.

Table 2-8 Drilling Blowout Frequencies

Development Drilling, Deep	Blowout (surface flow)	3.50E-04	per drilled well
Completion	Blowout (surface flow)	4.60E-04	per drilled well
Total Blowout Frequency		8.10E-04	per drilled well

Normal Operations Blowout

For normal operations, it is assumed that a blowout may occur during either production, well workover or well wireline activities. Based on information from Todd Energy, well wirelining will be performed once per year per well and no workover is currently planned for any of the wells during their lifetime [Ref. 19]. The calculated blowout event frequency is shown in Table 2-9.

Table 2-9 Normal Operations Blowout Frequencies

Production	Blowout (surface flow)	3.30E-05	per well year
	Diverted well release	0	per well year
	Well release	9.50E-06	per well year
Wireline	Blowout (surface flow)	1.10E-05	per wireline job
	Diverted well release	0	per wireline job
	Well release	1.10E-05	per wireline job
Wireline frequency		1	per well year
Total Blowout Frequency		4.40E-05	per well year
Total Well Release Frequency		2.05E-05	per well year

2.9 Assumptions for Normal Operations with All Wells

Currently, there is only engineering information for Phase 1 of the Kapuni J wellsite development. In order to model normal operations with all wells, the Phase 1 model will be used with the following modifications [Ref. 24]:

- Release condition and frequency for the additional 8 wells and flowlines are assumed to be identical with the Phase 1 wells, and the information for Phase 1 wells are re-used. This is considered conservative as Todd has informed that Phase 1 wells will be producing at lower pressures by the time all 12 wells are operational. The additional release cases related to the additional wells are shown in Table 2-10.

Some existing release cases are also modified, including the following:

- Release case J02C (releases from the choke valve up to the isolation valves on the overpressure protection skids A/B) will be modified:
  - Additional piping sections from the additional wellhead choke valve skids.
  - Additional interconnecting piping between each choke valve skids.
  - Release location move to the middle of the three skids to better represent overall release sources from all three skids.
- Release case J03A (releases from the section from the overpressure protection skid up to the inlet of HPKO A): An air cooled HE will be added to this section with the following details:
  - 1 air-cooled heat exchanger
  - 4 of 200mm flange connections – 2 on inlet line and 2 on outlet line
  - 2 small bore fittings – to account for temperature transmitters
  - 20m of 200mm interskid piping –10m upstream and 10m downstream of the heat exchanger.
- Release case J06A (releases from the section from the outlet of the overpressure protection skid up to the inlet of the LP Separator): An air cooled HE will be added to this section with the following details:
  - 1 air-cooled heat exchanger
  - 4 of 150mm flange connections – 2 on inlet line and 2 on outlet line
  - 2 small bore fittings – to account for temperature transmitters
  - 1 relief valve with flange
  - 30 m of 150mm interskid piping – 15m upstream and 15m downstream of the heat exchanger.

Table 2-10 Additional Release Cases for Normal Operations with 12 Wells

No.	Release Case	Description	Stream Comp.	Temp. (°C)	Pres. (barg)	Inventory (m^3)
61	J16A_W005Blow_V	W050 Blowout Event	1	45	80	Note-1
62	J16B_W006Blow_V	W060 Blowout Event	1	45	80	Note-1
63	J16C_W007Blow_V	W070 Blowout Event	1	45	80	Note-1
64	J16D_W008Blow_V	W080 Blowout Event	1	45	80	Note-1
65	J16E_W005WRel_V	W050 Well Release	1	45	80	Note-1
66	J16F_W006WRel_V	W060 Well Release	1	45	80	Note-1
67	J16G_W007WRel_V	W070 Well Release	1	45	80	Note-1
68	J16H_W008WRel_V	W080 Well Release	1	45	80	Note-1
69	J17A_W005Flow_V	Well fluids in production flowline from well W050 isolation valve (XSV-0503) up to choke valve skid boundary including Cyclone Desander V-131	1	45	80	11.3
70	J17B_W005ChIn_V	Well fluids in well W050 production flowline within choke valve skid boundary up to choke valve	1	45	80	11.3
71	J17D_W006Flow_V	Well fluids in production flowline from well W060 isolation valve (XSV-0603) up to choke valve skid boundary including desander skid V-141	1	45	80	11.3
72	J17E_W006ChIn_V	Well fluids in well W060 production flowline within choke valve skid boundary up to choke valve	1	45	80	11.3
73	J17F_W007Flow_V	Well fluids in production flowline from well W070 isolation valve (XSV-0703) up to choke valve skid boundary including desander skid V-151	1	45	80	11.3
74	J17G_W007ChIn_V	Well fluids in well W070 production flowline within choke valve skid boundary up to choke valve	1	45	80	11.3
75	J17H_W008Flow_V	Well fluids in production flowline from well W080 isolation valve (XSV-0803) up to choke valve skid boundary	1	45	80	11.3
76	J17I_W008ChIn_V	Well fluids in well W080 production flowline within choke valve skid boundary up to choke valve	1	45	80	11.3
77	J18A_W009Blow_V	W090 Blowout Event	1	45	80	Note-1
78	J18B_W010Blow_V	W100 Blowout Event	1	45	80	Note-1
79	J18C_W011Blow_V	W110 Blowout Event	1	45	80	Note-1
80	J18D_W012Blow_V	W120 Blowout Event	1	45	80	Note-1
81	J18E_W009WRel_V	W090 Well Release	1	45	80	Note-1
82	J18F_W010WRel_V	W100 Well Release	1	45	80	Note-1
83	J18G_W011WRel_V	W110 Well Release	1	45	80	Note-1
84	J18H_W012WRel_V	W120 Well Release	1	45	80	Note-1
85	J19A_W009Flow_V	Well fluids in production flowline from well W090 isolation valve (XSV-0903) up to choke valve skid boundary including Cyclone Desander V-131	1	45	80	11.3
86	J19B_W009ChIn_V	Well fluids in well W090 production flowline within choke valve skid boundary up to choke valve	1	45	80	11.3

No.	Release Case	Description	Stream Comp.	Temp. (°C)	Pres. (barg)	Inventory (m^3)
87	J19D_W010Flow_V	Well fluids in production flowline from well W100 isolation valve (XSV-1003) up to choke valve skid boundary including desander skid V-141	1	45	80	11.3
88	J19E_W010ChIn_V	Well fluids in well W100 production flowline within choke valve skid boundary up to choke valve	1	45	80	11.3
89	J19F_W011Flow_V	Well fluids in production flowline from well W110 isolation valve (XSV-1103) up to choke valve skid boundary including desander skid V-151	1	45	80	11.3
90	J19G_W011ChIn_V	Well fluids in well W110 production flowline within choke valve skid boundary up to choke valve	1	45	80	11.3
91	J19H_W012Flow_V	Well fluids in production flowline from well W120 isolation valve (XSV-1203) up to choke valve skid boundary	1	45	80	11.3
92	J19I_W012ChIn_V	Well fluids in well W120 production flowline within choke valve skid boundary up to choke valve	1	45	80	11.3

2.10 Atmospheric Conditions for Modelling

Meteorological conditions impact the outcomes of release modelling, including downwind flammable and toxic vapour cloud dispersion distance (influenced by atmospheric stability and wind speed), rate of pool vaporisation (ambient temperature), and atmospheric attenuation of radiant heat (temperature and relative humidity).

The following conditions will be assumed for the QRA modelling:

Wind Speed and Direction

Wind speed and direction data was developed from information provided by NIWA's CliFlo database for a 5 year period from January 2008 to December 2012, with wind speed and direction measurements taken every hour [Ref 13].

CliFlo data from the Hawera Automatic Weather Station (AWS) will be used to represent the atmospheric conditions at the Kapuni J site. The windrose is shown Figure 2-3 below.

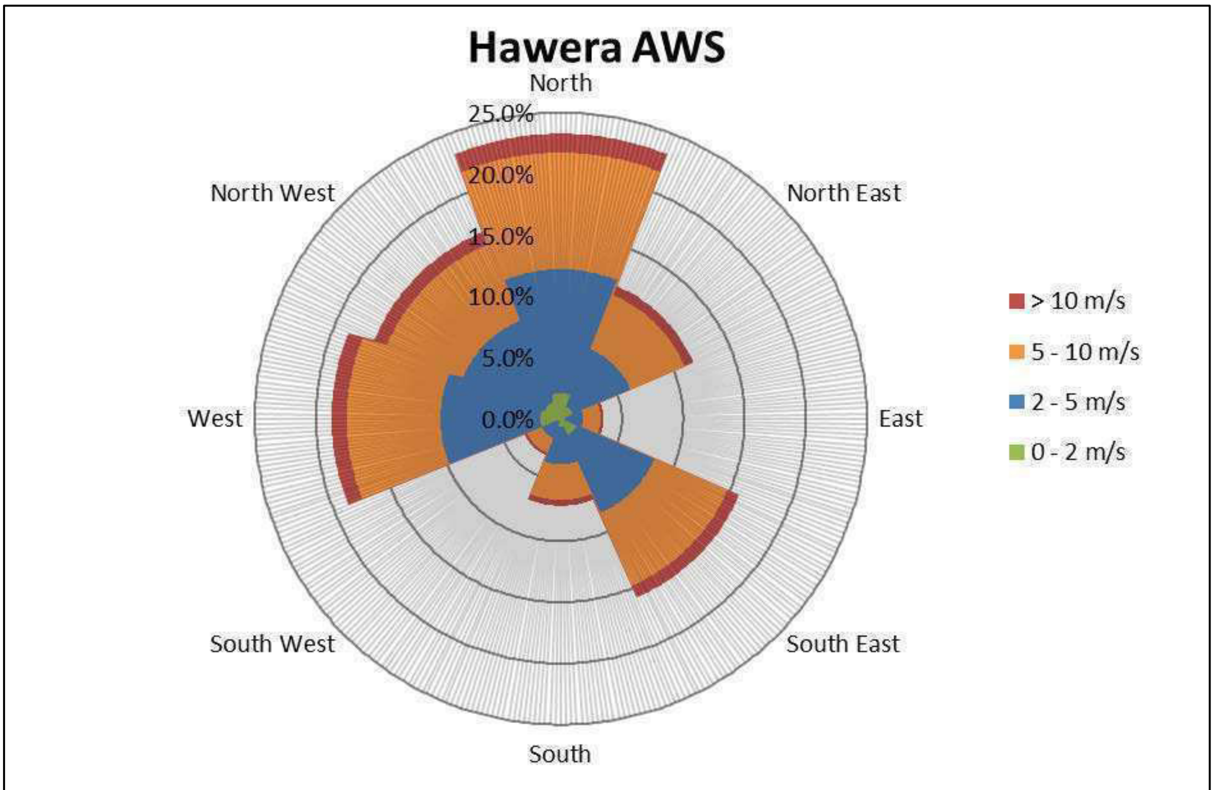

Figure 2-3: Hawera AWS Windrose

The following wind speed and atmospheric stability (Pasquill stability) combinations will be used in the QRA. The wind data in tabular format is given in Table 2-11.

Table 2-11: Hawera AWS Wind Data

Wind Speed / Pasquil Stability	North	North East	East	South East	South	South West	West	North West	Total
0 - 2 m/s / F	2.1%	1.1%	0.3%	1.4%	0.6%	0.3%	1.7%	1.5%	9.0%
2 - 5 m/s / D	10.1%	5.1%	1.5%	6.9%	3.1%	1.4%	8.2%	7.2%	43.5%
5 - 10 m/s / D	11.1%	5.6%	1.7%	7.5%	3.4%	1.5%	8.9%	7.9%	47.5%
Total	**23.3%**	**11.8%**	**3.5%**	**15.9%**	**7.1%**	**3.2%**	**18.7%**	**16.5%**	**100.0%**

Note:

1. Pasquill Stability F – stable, night with moderate clouds and light/moderate wind
2. Pasquill Stability D – neutral, little sun and high wind or overcast/windy night

For the modelling, the wind speed reference height (the height at which the wind impacts a release), will be set at 1 m (i.e. so as to match the release height). The Power Law wind profile will be applied, where the wind speed varies with height according to a power-law profile.

Ambient Temperature and Relative Humidity

The following temperature and relative humidity for Kapuni J as discussed with the KRD project will be used in the consequence modelling [Ref. 12]:

- Ambient temperature: 14°C
- Relative humidity: 83%

Solar Radiation

Solar radiation will be excluded from the calculations.

Topography

Phast cannot take into account the effects of the local undulating topography for the gas dispersion. The surface roughness of 30 mm will be applied, which represents an area of "open flat terrain; grass, few isolated objects" to represent the area of a typical wellsite.

2.11 Fatality Criteria

Heat Radiation

The method of calculating the probability of fatality for an individual, given known exposure duration and thermal heat radiation levels, will be undertaken in Phast Risk by using a probit function. The probit function is a general formula which takes the same form, but with various constants used. The probit used for lethality calculations is taken from the TNO Green Book [Ref. 15]. The probit function is defined as follows:

$$\text{Probit} = -36.38 + 2.56 \ln (t \times q^{4/3})$$

Where:

t = exposure duration in seconds

q = thermal radiation level in W/m^2

An exposure duration of 20 seconds will be used as a base case, although it is noted that personnel are likely to find some form of shielding protection within this time frame.

The NSW Hazardous Industry Planning Advisory Paper No. 4 (HIPAP4) [Ref. 14] provides the following broadly qualitative consequences to thermal radiation for information:

- 2.1 kW/m^2 – Minimum to cause pain after 1 minute
- 4.7 kW/m^2 – Will cause pain in 15 – 20 s and injury (at least 2nd degree burns) after 30s exposure. Considered the criterion for injury risk, at a tolerable frequency of 50 chances in a million per year
- 12.6 kW/m^2 – Significant chance of fatality for extended exposure. High chance of injury
- 23 kW/m^2 – Likely fatality for extended exposure, and chance of fatality for instantaneous exposure
- 35 kW/m^2 – Significant chance of fatality for people exposed instantaneously

Flash Fire

If personnel are within the 100% lower flammable limit (LFL) of the gas plume, 100% fatality will be assumed.

Explosion

As stated above, the “Multi-Energy Explosion” model will be used to model the VCE. The assessment criteria for explosion overpressure effects taken from the HIPAP4 are as given in Table 2-12.

Table 2-12: Effects of Explosion Overpressure

Explosion Overpressure (kPa)	Effects
3.5	• 90% glass breakage • No fatality and very low probability of injury
7	• Damage to internal partitions and joinery but can be repaired • Probability of injury is 10%. No fatality
21	• Reinforced structures distort • Storage tanks fail • 20% chance of fatality to a person in a building
35	• House uninhabitable • Wagons and plants items overturned • Threshold of eardrum damage • 50% chance of fatality for a person in a building and 15% chance of fatality for a person in the open
70	• Threshold of lung damage • 100% chance of fatality for a person in a building or in the open • Complete demolition of houses

BLEVE

Boiling Liquid Expanding Vapour Explosion (BLEVE) is an escalation scenario that occurs as a result of prolonged flame impingement on above ground pressurised vessels containing materials such as liquefied petroleum gas (LPG) or lighter end hydrocarbon. BLEVE would result in an explosion overpressure together with a fireball and missile generation over some distance. As the fireball tends to drift upward and to avoid double counting, only fatalities from the explosion overpressure effects are considered in this risk assessment. The fatality criteria is then considered similar to explosion events as shown in Table 2-12 above.

The probability of BLEVE depends on various factors, including the types of flammable material and liquid inventory in the vessel, material of construction of the vessel, types and number of fire protection systems (e.g. relief valves, cooling systems), mechanism of vessel failure (external impact, jet fire impingement or pool fire impingement), etc. There is no clear guideline or criteria to determine the likelihood of a BLEVE on a pressurised vessel. For this risk assessment, BLEVE will be considered credible if a pressurised vessel containing at least 4 m^3 of volatile hydrocarbon (liquid butane or lighter) is exposed to direct flame impingement for 5 minutes or longer.

Liquid volume calculation for the vessels on Kapuni J are shown in Table 2-13.

Table 2-13 Kapuni J Vessel Liquid Volume Calculation

Tag No.	Description	Diameter (m)	Length (m)	Liquid Level (m)	Total Volume (m^3)	Liquid Volume (m^3)
V-2742	Low Pressure Separator	1.6	2.4	0.8	4.8	2.4
V-3123 A/B	Low Temperature Separator A/B	1.8	5.6	0.9	14.8	7.4
V-3122 A/B	High Pressure Knockout Drum A/B	1.4	4.5	0.5	6.9	2.2

Based on this calculation, there is sufficient liquid volume only in V-3123 A/B Low Temperature Separators. However, based on Table 2-4, the composition of the LTS liquid section is mostly heavy hydrocarbons with volatile hydrocarbons making up only 25% of the total composition. Therefore, it is considered that BLEVE will not be possible for any vessel in the Kapuni J Wellsite.

Toxic Effects by Methanol

Fatality probability when exposed to toxic gas as a function of exposure concentration and duration can be calculated by using a probit function of the form given below:

$$\text{Probit} = a + b \ln (C^n \times t)$$

where:

t = exposure duration in minutes

C = concentration in ppm

a, b and n = material specific probit constants

UK HSE gives the following toxic load values for methanol:

- SLOT = 8.02×10^5 $ppm^n \cdot min$ (1% fatality probability)
- SLOD = 2.67×10^6 $ppm^n \cdot min$ (50% fatality probability)

By solving the simultaneous equation, the other constants a and b can be calculated. The probit constants for methanol are:

a = -23.67

b = 1.94

n = 1

The summary of the fatality probabilities for methanol as the function of concentration and exposure duration is shown in Table 2-14.

Table 2-14: Methanol Fatality Probability due to Toxic Effects

Fatality Probability (%)	Concentration (ppmv)	Time (Min)
1	80,200	10
50	267,000	10
99	888,700	10

Toxic Effects by Carbon Dioxide

Fatality probability for Carbon Dioxide is calculated using the same probit equation as methanol. UK HSE gives the following toxic load values for carbon dioxide:

- SLOT = 1.5×10^{40} $ppm^n \cdot min$ (1% fatality probability)
- SLOD = 1.5×10^{41} $ppm^n \cdot min$ (50% fatality probability)

By solving the simultaneous equation, the other constants a and b can be calculated. The probit constants for carbon dioxide are:

a = -90.78

b = 1.01

n = 8

The summary of the fatality probabilities for Carbon Dioxide as the function of concentration and exposure duration is shown in Table 2-15.

Table 2-15: Carbon Dioxide Fatality Probability due to Toxic Effects

Fatality Probability (%)	Concentration (ppmv)	Time (Min)
1	78,886	10
50	105,198	10
99	154,092	10

2.12 Risk Criteria

Key deliverable for this study is the location specific individual risk (LSIR) in the form of risk contour. LSIR is the risk of fatality at a point in space to a hypothetical individual at a location for 365 days per year, 24 hours a day, unprotected and unable to escape.

As there are no standard risk criteria which have been developed for the NZ context, this deliverable will be assessed against the suggested risk criteria in the NSW Hazardous Industry Planning Advisory Paper No. 4 (HIPAP4) "Risk Criteria for Land Use Planning" as shown in Table 2-16.

Table 2-16: HIPAP 4 Individual Fatality Risk criteria

Land Use	Risk Criteria Adopted (per annum)	Interpretation for QRA
Hospitals, schools, childcare facilities, old age housing	0.5×10^{-6} (or 5×10^{-7}) (1 in 2 million)	5×10^{-7} risk contour should not extend to these areas
Residential, hotels, motels, tourist resorts	1×10^{-6} (1 in 1 million)	1×10^{-6} risk contour should not extend to these areas
Commercial developments including retail centres, offices and entertainment centres	5×10^{-6} (1 in 200,000)	5×10^{-6} risk contour should not extend to these areas
Sporting complexes and active open space	10×10^{-6} (or 1×10^{-5}) (1 in 100,000)	1×10^{-5} risk contour should not extend to these areas
Industrial	50×10^{-6} (or 5×10^{-5}) (1 in 20,000)	5×10^{-5} risk contour should, as a target, be contained within the boundaries of the industrial site where applicable

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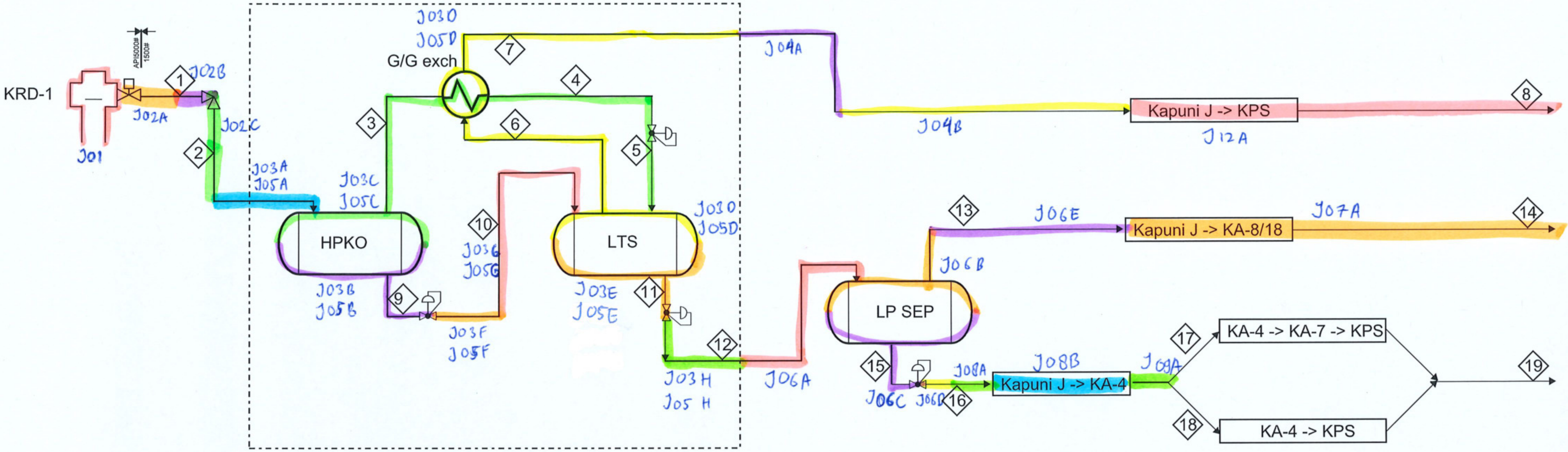
Appendix 1.
Process Release Frequency

Modified OGP RADD Process Release Frequencies

Equipment	Size	Hole Size Distribution				
		1 - 3 mm	3 - 10 mm	10 - 50 mm	50 - 150 mm	> 150 mm
Process Vessel	<= 6 inch	7.40E-04	4.00E-04	2.20E-04	1.30E-04	
	> 6 inch	7.40E-04	4.00E-04	2.20E-04	6.40E-05	2.31E-05
Manual Valves	2 inch	4.40E-05	2.17E-05	1.89E-05		
	6 inch	5.80E-05	2.70E-05	1.42E-05	8.80E-06	
	12 inch	7.50E-05	3.50E-05	1.75E-05	4.70E-06	2.03E-06
	18 inch	9.00E-05	4.20E-05	2.10E-05	5.60E-06	2.35E-06
	24 inch	1.05E-04	4.90E-05	2.44E-05	6.50E-06	2.66E-06
	36 inch	1.32E-04	6.10E-05	3.10E-05	8.20E-06	3.26E-06
Actuated Valves	2 inch	4.10E-04	1.61E-04	1.08E-04		
	6 inch	3.50E-04	1.35E-04	5.70E-05	3.16E-05	
	12 inch	3.20E-04	1.20E-04	5.00E-05	1.14E-05	5.95E-06
	18 inch	2.97E-04	1.11E-04	4.50E-05	1.03E-05	5.50E-06
	24 inch	2.89E-04	1.06E-04	4.30E-05	9.50E-06	5.29E-06
	36 inch	2.67E-04	9.70E-05	3.90E-05	8.60E-06	4.97E-06
Small Bore Fittings	2 inch	3.40E-04	1.42E-04	6.10E-05		
Reciprocating Pump	<= 6 inch	2.99E-03	1.82E-03	1.21E-03	1.03E-03	
	> 6 inch	2.99E-03	1.82E-03	1.21E-03	4.20E-04	2.14E-04
Centrifugal Pump	<= 6 inch	4.70E-03	1.56E-03	5.30E-04	1.37E-04	
	> 6 inch	4.70E-03	1.56E-03	5.30E-04	8.90E-05	1.68E-05
Process Pipe (Interskid)	2 inch	8.60E-06	3.30E-06	2.00E-06		
	6 inch	3.59E-06	1.34E-06	5.20E-07	3.80E-07	
	12 inch	3.11E-06	1.16E-06	4.40E-07	8.90E-08	9.00E-08
	18 inch	3.08E-06	1.13E-06	4.30E-07	8.60E-08	9.00E-08
	24 inch	3.07E-06	1.12E-06	4.30E-07	8.50E-08	8.96E-08
	36 inch	3.06E-06	1.11E-06	4.20E-07	8.50E-08	8.96E-08
Process Pipe (Within Skid)	2 inch	8.60E-05	3.30E-05	2.00E-05		
	6 inch	3.59E-05	1.34E-05	5.20E-06	3.80E-06	
	12 inch	3.11E-05	1.16E-05	4.40E-06	8.90E-07	9.00E-07
	18 inch	3.08E-05	1.13E-05	4.30E-06	8.60E-07	9.00E-07
	24 inch	3.07E-05	1.12E-05	4.30E-06	8.50E-07	8.96E-07
	36 inch	3.06E-05	1.11E-05	4.20E-06	8.50E-07	8.96E-07
Pig Trap	<= 6 inch	3.04E-03	1.28E-03	7.00E-04	7.57E-04	
	> 6 inch	3.04E-03	1.28E-03	7.00E-04	2.43E-04	1.80E-04
Tube Side Heat Exchanger	<= 6 inch	1.61E-03	8.10E-04	4.30E-04	2.66E-04	
	> 6 inch	1.61E-03	8.10E-04	4.30E-04	1.17E-04	5.36E-05
Shell Side Heat Exchanger	<= 6 inch	1.32E-02	1.14E-03	6.30E-04	4.36E-04	
	> 6 inch	2.40E-03	1.14E-03	6.30E-04	1.94E-04	8.47E-05
Plate Heat Exchanger	<= 6 inch	6.60E-03	3.30E-03	1.77E-03	9.50E-04	
	> 6 inch	6.60E-03	1.50E-02	1.77E-03	4.90E-04	1.61E-04
Fin Fan Heat Exchanger	<= 6 inch	1.00E-03	4.90E-04	2.40E-04	1.10E-04	
	> 6 inch	1.00E-03	4.90E-04	2.40E-04	6.00E-05	1.72E-05
Flange	2 inch	4.10E-06	1.55E-06	3.78E-06		
	6 inch	6.00E-06	2.30E-06	5.04E-06		
	12 inch	9.00E-06	3.30E-06	6.12E-06		
	18 inch	1.21E-05	4.40E-06	7.69E-06		
	24 inch	1.54E-05	5.50E-06	9.01E-06		
	36 inch	2.24E-05	7.70E-06	1.21E-05		
Filters	<= 6 inch	1.81E-03	8.40E-04	4.20E-04	2.65E-04	
	> 6 inch	1.81E-03	8.40E-04	4.20E-04	1.19E-04	5.25E-05
Recip Compressors	<= 6 inch	4.30E-02	1.74E-02	7.30E-03	3.08E-03	
	> 6 inch	4.30E-02	1.74E-02	7.30E-03	1.60E-03	5.18E-04
Centrif Compressors	<= 6 inch	6.30E-03	2.08E-03	8.70E-04	3.63E-04	
	> 6 inch	6.30E-03	2.08E-03	8.70E-04	2.00E-04	5.69E-05

Appendix 2.
Section Boundaries for Release Scenarios

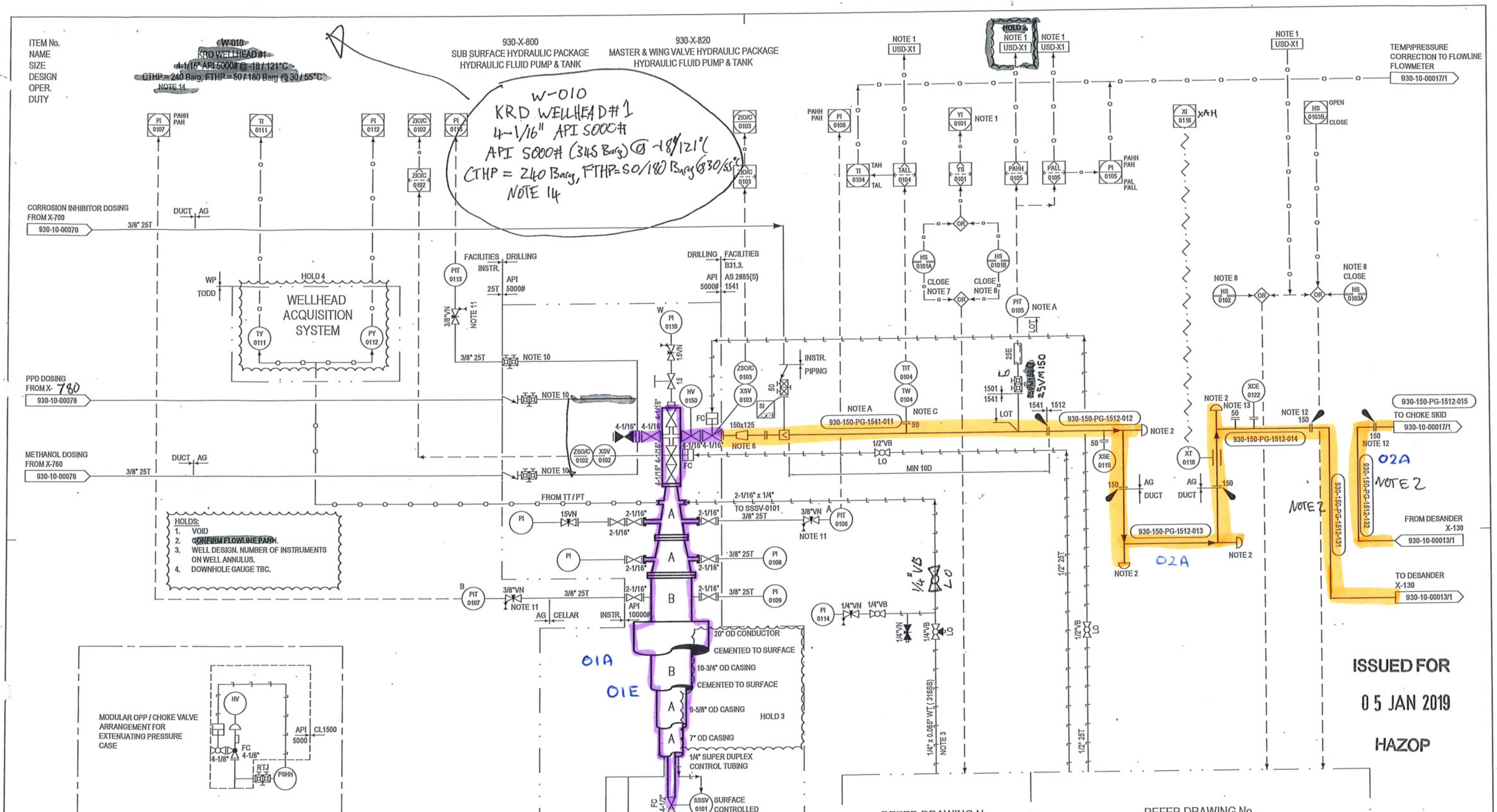


	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
	Heater In	Choke_Out	HPKO_Vap_Out	GG_Tube_Out / Choke_In	Choke_Out	LTS_Vap_Out / GG_Shell_In	LTS_Gas	KRD LTS Gas KPS	HPKO_Liq	LTS_In_2	LTS_Liq_1	LTS_Liq_2/LP _Sep_In	LP_Vap	KA8/18_LP_Out	LP_Liq	Liq_Pipeline_In	KRD_Liq_Via_KA7	KRD_Liq_Direct	KRD_Liq
VapFrac	0.95	0.91	1.00	1.00	0.91	1.00	1.00	1.00	0.00	0.33	0.04	0.25	1.00	1.00	0.00	0.07	0.07	0.07	0.07
T [C]	55	43.2	43.2	32.2	-1.5	2	20.9	18.2	43.2	34.9	27.1	17.2	17.2	14.8	17.2	14.2	13.8	13.8	14
P [bar(g)]	180.0	120.0	120.0	119.7	49.6	49.6	49.4	45.3	120.0	49.6	49.6	24.2	24.2	24.0	24.2	17.7	17.2	17.2	17.3
Mole Flow [Sm3/s]	27.3	27.3	25.0	25.0	25.0	24.0	24.0	24.0	2.4	2.4	3.3	3.3	0.8	0.8	2.5	2.5	1.2	1.3	2.5
Mass Flow [kg/h]	145832	145832	117916	117916	117916	107923	107923	107923	27916	27916	37909	37909	4486	4486	33423	33423	16511	16912	33423
Volume Flow [m3/h]	372.3	514.1	476.7	417.4	1098.4	1173.8	1374.5	1504.8	37.4	77.4	58.7	147.0	102.8	102.3	44.2	70.6	36.3	37.2	73.3
Std Liq Volume Flow [m3/h]	261.8	261.8	223.9	223.9	223.9	208.8	208.8	208.8	37.9	37.9	53.0	53.0	7.6	7.6	45.4	45.4	22.4	23.0	45.4
Mole Fraction [Fraction]																			
WATER	0.0074	0.0074	0.0014	0.0014	0.0014	0.0002	0.0002	0.0002	0.0712	0.0712	0.0599	0.0599	0.0009	0.0009	0.0799	0.0799	0.0799	0.0799	0.0799
NITROGEN	0.0028	0.0028	0.003	0.003	0.003	0.0032	0.0032	0.0032	0.0006	0.0006	0.0001	0.0001	0.0004	0.0004	0	0	0	0	0
CARBON DIOXIDE	0.387	0.387	0.397	0.397	0.397	0.4029	0.4029	0.4029	0.2809	0.2809	0.2713	0.2713	0.5407	0.5407	0.1804	0.1804	0.1804	0.1804	0.1804
METHANE	0.4458	0.4458	0.4699	0.4699	0.4699	0.4942	0.4942	0.4942	0.1903	0.1903	0.0945	0.0945	0.2794	0.2794	0.0322	0.0322	0.0322	0.0322	0.0322
ETHANE	0.0588	0.0588	0.0593	0.0593	0.0593	0.0579	0.0579	0.0579	0.0534	0.0534	0.0652	0.0652	0.0919	0.0919	0.0561	0.0561	0.0561	0.0561	0.0561
PROPANE	0.0339	0.0339	0.0331	0.0331	0.0331	0.0272	0.0272	0.0272	0.0426	0.0426	0.0832	0.0832	0.0566	0.0566	0.0922	0.0922	0.0922	0.0922	0.0922
ISOBUTANE	0.0102	0.0102	0.0095	0.0095	0.0095	0.0061	0.0061	0.0061	0.0175	0.0175	0.0404	0.0404	0.013	0.013	0.0497	0.0497	0.0497	0.0497	0.0497
n-BUTANE	0.0094	0.0094	0.0084	0.0084	0.0084	0.0047	0.0047	0.0047	0.0194	0.0194	0.0435	0.0435	0.0097	0.0097	0.0549	0.0549	0.0549	0.0549	0.0549
ISOPENTANE	0.0036	0.0036	0.0031	0.0031	0.0031	0.0011	0.0011	0.0011	0.0096	0.0096	0.0222	0.0222	0.0022	0.0022	0.029	0.029	0.029	0.029	0.029
n-PENTANE	0.0027	0.0027	0.0021	0.0021	0.0021	0.0006	0.0006	0.0006	0.008	0.008	0.0173	0.0173	0.0013	0.0013	0.0227	0.0227	0.0227	0.0227	0.0227
C6+	0.0381	0.0381	0.0128	0.0128	0.0128	0.0019	0.0019	0.0019	0.3065	0.3065	0.3023	0.3023	0.0036	0.0036	0.403	0.403	0.403	0.403	0.403

KRD WELL SITE FACILITIES
HEAT AND MASS BALANCE CASE 1
TODD ENERGY (INTERNAL)

REV.	DESCRIPTION	DATE

Appendix 2.
Sectionalized PIDs



PROCESS MASTER

NOTES:

1. THIS P&ID DOES NOT SHOW ALL LOGIC, REFER TO CAUSE & EFFECT MATRIX FOR SHUTDOWN LOGIC.
2. CUSHION TEES REQUIRED FROM WELLHEAD TO START-UP LOOP DESANDER INLET.
3. 316 SS 0.065" WT TUBING RATED FOR 10,200 PSI.
4. VOID.
5. PRESSURE TRANSMITTER TAPPING POINT AND VALVES HEAT TRACED.
6. DROP OUT SPOOL FOR MODULAR OPP / CHOKE VALVE.
7. SSSV-0101 PUSH BUTTON HS-0101A LOCATED AT SITE ENTRANCE.
8. HS-0101B FOR SSSV-0101, HS-0102 FOR XSV-0102, HS-0103A FOR XSV-0103 PUSH BUTTONS LOCATED ON RESPECTIVE WELLHEAD HYDRAULIC CONTROL PACKAGE.
9. VOID.
10. 10,000 PSI DOUBLE BLOCK AND BLEED VALVES FITTED DIRECTLY TO INSTRUMENT FLANGE BETWEEN KILL WING VALVES.
11. INSTRUMENT BLOCK AND BLEED VALVES RATED FOR 5,000 PSIG.
12. FLANGE SET TO ALLOW FOR DROP OUT SPOOL WHEN PERMANENT DESANDER IS NOT REQUIRED.
13. FOR FUTURE EROSION PROBE.
14. POTENTIAL FOR CITHP TO BE 265 Barg INITIALING REQUIRING THE INSTALLATION OF MODULAR OPP.

PROJECT NOTES:

A. DUPLEX PIPE FROM FLOW WING VALVE TO DN 150 FLANGE DOWNSTREAM OF CI INJECTION QUILL (MINIMUM MIXING LENGTH OF 10D FROM INJECTION QUILL).
B. VOID.
C. INSTRUMENTATION TO VISIBLE FROM WELLHEAD MANUAL VALVE.

WorleyParsons resources & energy
620051
04.02.19 - 11:55
941-10-27001(X)-1

This drawing is confidential and is the property of TODD ENERGY. It must not be disclosed to any third party or lent without written consent from TODD ENERGY.

NO	DATE	BY	DESCRIPTION	CHKD	APPR.	CHKD	APPR.
A0	01.19	VK	620051 ISSUED FOR HAZOP	DS	GD		
			CONSTRUCTION ISSUE	CONSULTANT		TODD	

NO	DATE	BY	ECP	DESCRIPTION	CHKD	APPR.	CHKD	APPR.
0	12/18	VK		FIRST ISSUE				
				REVISIONS	CONSULTANT		TODD	

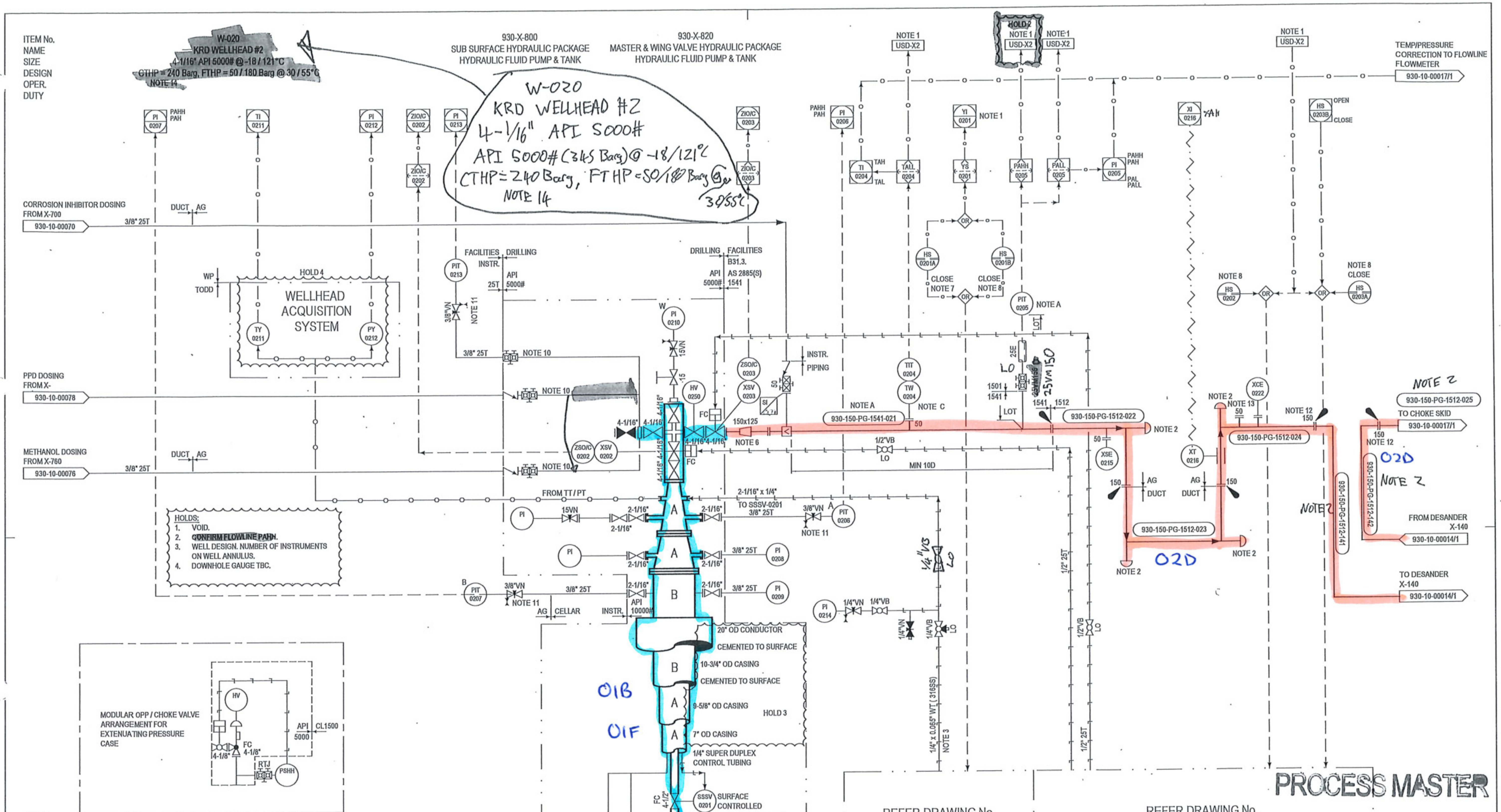
NUMBER	TITLE
REFERENCE DRAWINGS	

		DATE
DESIGNED	G. DAVIDSON	12/18
DRAWN	V. KAING	12/18
CHECKED	D. STEWART	12/18
APPROVED	G. DAVIDSON	12/18
APPROVED		
SCALE		
STICKFILE		

KAPUNI WELLSITES
PIPING & INSTRUMENT DIAGRAM
WELLHEAD X1
WELLSITE J

Todd Energy

SHEET No 1 of 2
REVISION A0 0
DRAWING No 930-10-00001(X)



PROCESS MASTER

ISSUED FOR

05 JAN 2019

HAZOP

NOTES:
1. THIS P&ID DOES NOT SHOW ALL LOGIC, REFER TO CAUSE & EFFECT MATRIX FOR SHUTDOWN LOGIC.
2. CUSHION TEES REQUIRED FROM WELLHEAD TO START-UP LOOP DESANDER INLET.
3. 316 SS 0.065" WT TUBING RATED FOR 10,200 PSI.
4. VOID.
5. PRESSURE TRANSMITTER TAPPING POINT AND VALVES HEAT TRACED.
6. DROP OUT SPOOL FOR MODULAR OPP / CHOKE VALVE.
7. SSSV-0201 PUSH BUTTON HS-0201A LOCATED AT SITE ENTRANCE.
8. HS-0201B FOR SSSV-0201, HS-0202 FOR XSV-0202, HS-0301A FOR XSV-0103 PUSH BUTTONS LOCATED ON RESPECTIVE WELLHEAD HYDRAULIC CONTROL PACKAGE.
9. VOID.
10. 10,000 PSI DOUBLE BLOCK AND BLEED VALVES FITTED DIRECTLY TO INSTRUMENT FLANGE BETWEEN KILL WING VALVES.
11. INSTRUMENT BLOCK AND BLEED VALVES RATED FOR 5,000 PSIG.
12. FLANGE SET TO ALLOW FOR FUTURE DROP OUT WHEN PERMANENT DESANDER IS NOT REQUIRED.
13. FOR FUTURE EROSION PROBE.
14. POTENTIAL FOR CITHP TO BE 265 Barg INITIALLY REQUIRING THE INSTALLATION OF MODULAR OPP.

PROJECT NOTES:
A. DUPLEX PIPE FROM FLOW WING VALVE TO DN 150 FLANGE DOWNSTREAM OF CI INJECTION QUILL (MINIMUM MIXING LENGTH OF 10D FROM INJECTION QUILL).
B. VOID.
C. INSTRUMENTATION TO VISIBLE FROM WELLHEAD MANUAL VALVE.

WorleyParsons resources & energy
620051
04.02.19 - 12:24
941-10-27002(X)-1

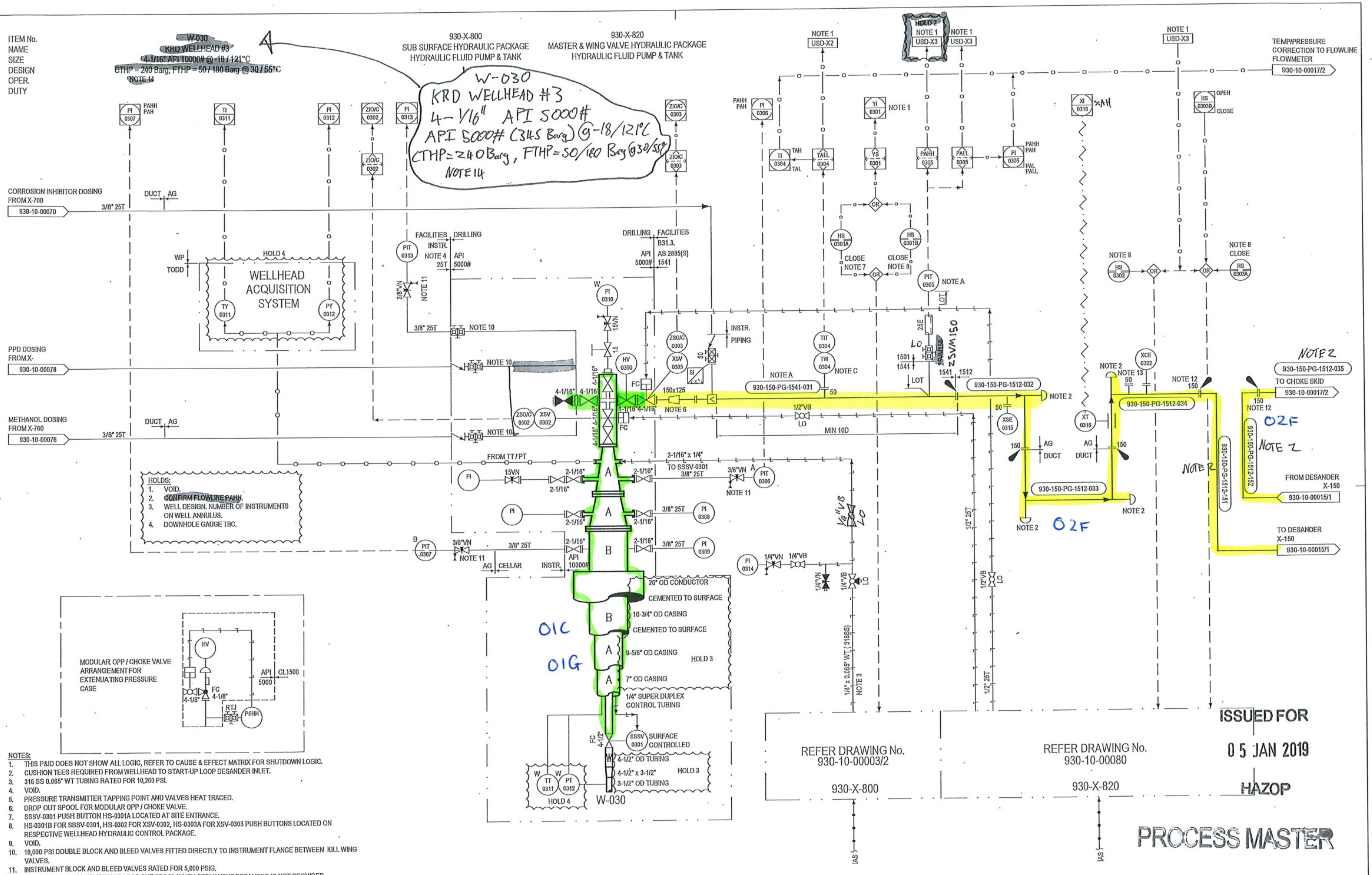
NO	DATE	BY	DESCRIPTION	CHKD	APPR.	CHKD	APPR.	NO	DATE	BY	ECP	DESCRIPTION
A0	02/19	VK	620051 ISSUED FOR HAZOP	DS	GD			0	12/18	VK		FIRST ISSUE
			CONSTRUCTION ISSUE	CONSULTANT		TODD						REVISIONS

		DATE
DESIGNED	G. DAVIDSON	12/18
DRAWN	V. KAING	12/18
CHECKED	D. STEWART	12/18
APPROVED	G. DAVIDSON	12/18
APPROVED		
SCALE		
STICKFILE		

KAPUNI WELLSITES
PIPING & INSTRUMENT DIAGRAM
WELLHEAD X2
WELLSITE J

Todd Energy

SHEET No 1 OF 2 REVISION A0 0
DRAWING No 930-10-00002(X)



NOTES:

1. THIS P&ID DOES NOT SHOW ALL LOGIC, REFER TO CAUSE & EFFECT MATRIX FOR SHUTDOWN LOGIC.
2. CUSHION TEES REQUIRED FROM WELLHEAD TO START-UP LOOP DESANDER INLET.
3. 316 SS 0.065" WT TUBING RATED FOR 10,200 PSI.
4. VOID.
5. PRESSURE TRANSMITTER TAPPING POINT AND VALVES HEAT TRACED.
6. DROP OUT SPOOL FOR MODULAR OPP / CHOKE VALVE.
7. SSSV-0301 PUSH BUTTON HS-0301A LOCATED AT SITE ENTRANCE.
8. HS-0301B FOR SSSV-0301, HS-0302 FOR XSV-0302, HS-0303A FOR XSV-0303 PUSH BUTTONS LOCATED ON RESPECTIVE WELLHEAD HYDRAULIC CONTROL PACKAGE.
9. VOID.
10. 10,000 PSI DOUBLE BLOCK AND BLEED VALVES FITTED DIRECTLY TO INSTRUMENT FLANGE BETWEEN KILL WING VALVES.
11. INSTRUMENT BLOCK AND BLEED VALVES RATED FOR 5,000 PSIG.
12. FLANGE SET TO ALLOW FUTURE DROP OUT SPOOL WHEN PERMANENT DESANDER IS NOT REQUIRED.
13. FOR FUTURE EROSION PROBE.
14. POTENTIAL FOR CITHP TO BE 265 Barg INITIALLY REQUIRING THE INSTALLATION OF MODULAR OPP.

PROJECT NOTES:

A. DUPLEX PIPE FROM FLOW WING VALVE TO DN 150 FLANGE DOWNSTREAM OF CI INJECTION QUILL (MINIMUM MIXING LENGTH OF 10D FROM INJECTION QUILL).
B. VOID.
C. INSTRUMENTATION TO VISIBLE FROM WELLHEAD MANUAL VALVE.

WorleyParsons resources & energy
620051
941-10-27003(X)-1

This drawing is confidential and is the property of TODD ENERGY. It must not be disclosed to any third party or lent without written consent from TODD ENERGY.

NO	DATE	BY	DESCRIPTION	CHKD	APPR.	CHKD	APPR.
A0	02/19	VK	620051 ISSUED FOR HAZOP	DS			
0	12/18	VK	FIRST ISSUE				

CONSTRUCTION ISSUE — CONSULTANT — TODD — REVISIONS — REFERENCE DRAWINGS (NUMBER, TITLE)

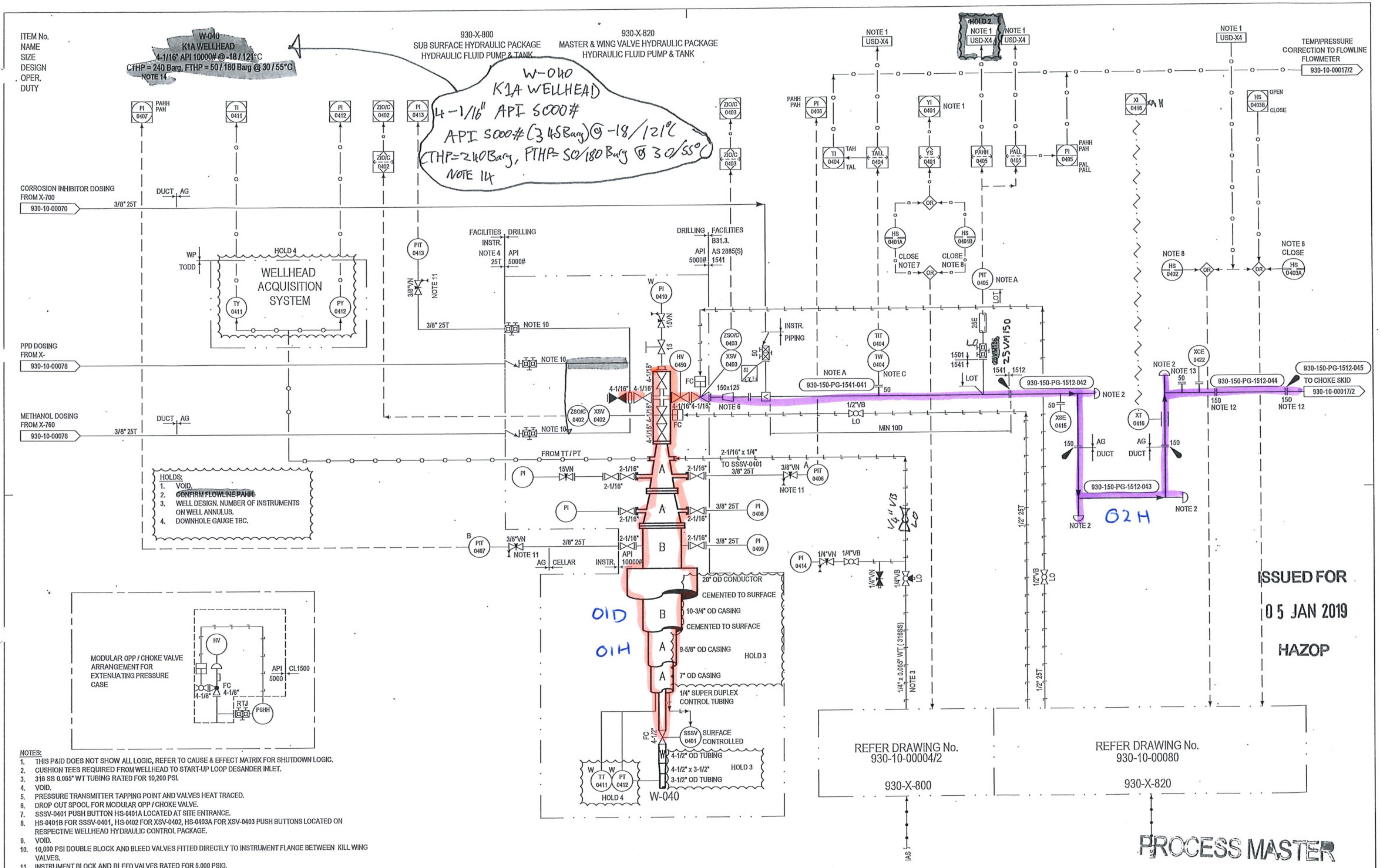
DESIGNED	G. DAVIDSON	
DRAWN	V. KAING	12/18
CHECKED	D. STEWART	12/18
APPROVED	G. DAVIDSON	12/18
APPROVED		
SCALE		
STICKFILE		

KAPUNI WELLSITES
PIPING & INSTRUMENT DIAGRAM
WELLHEAD X3
WELLSITE J

Todd Energy

SHEET No 1 OF 2 — REVISION A0 0

DRAWING No 930-10-00003(X)



NOTES:

1. THIS P&ID DOES NOT SHOW ALL LOGIC, REFER TO CAUSE & EFFECT MATRIX FOR SHUTDOWN LOGIC.
2. CUSHION TEES REQUIRED FROM WELLHEAD TO START-UP LOOP DESANDER INLET.
3. 316 SS 0.065" WT TUBING RATED FOR 10,200 PSI.
4. VOID.
5. PRESSURE TRANSMITTER TAPPING POINT AND VALVES HEAT TRACED.
6. DROP OUT SPOOL FOR MODULAR OPP / CHOKE VALVE.
7. SSSV-0401 PUSH BUTTON HS-0401A LOCATED AT SITE ENTRANCE.
8. HS-0401B FOR SSSV-0401, HS-0402 FOR XSV-0402, HS-0403A FOR XSV-0403 PUSH BUTTONS LOCATED ON RESPECTIVE WELLHEAD HYDRAULIC CONTROL PACKAGE.
9. VOID.
10. 10,000 PSI DOUBLE BLOCK AND BLEED VALVES FITTED DIRECTLY TO INSTRUMENT FLANGE BETWEEN KILL WING VALVES.
11. INSTRUMENT BLOCK AND BLEED VALVES RATED FOR 5,000 PSIG.
12. FLANGE SET TO ALLOW FOR FUTURE DROP OUT SPOOL WHEN PERMANENT DESANDER IS NOT REQUIRED.
13. FOR FUTURE EROSION PROBE.
14. POTENTIAL FOR CITHP TO BE 285 Barg INITIALLY REQUIRING THE INSTALLATION OF MODULAR OPP.

PROJECT NOTES:

A. DUPLEX PIPE FROM FLOW WING VALVE TO DN 150 FLANGE DOWNSTREAM OF CI INJECTION QUILL (MINIMUM MIXING LENGTH OF 10D FROM INJECTION QUILL).
B. VOID.
C. INSTRUMENTATION TO VISIBLE FROM WELLHEAD MANUAL VALVE.

WorleyParsons resources & energy
620051
04.02.19 - 12:35
941-10-27004(X)-1

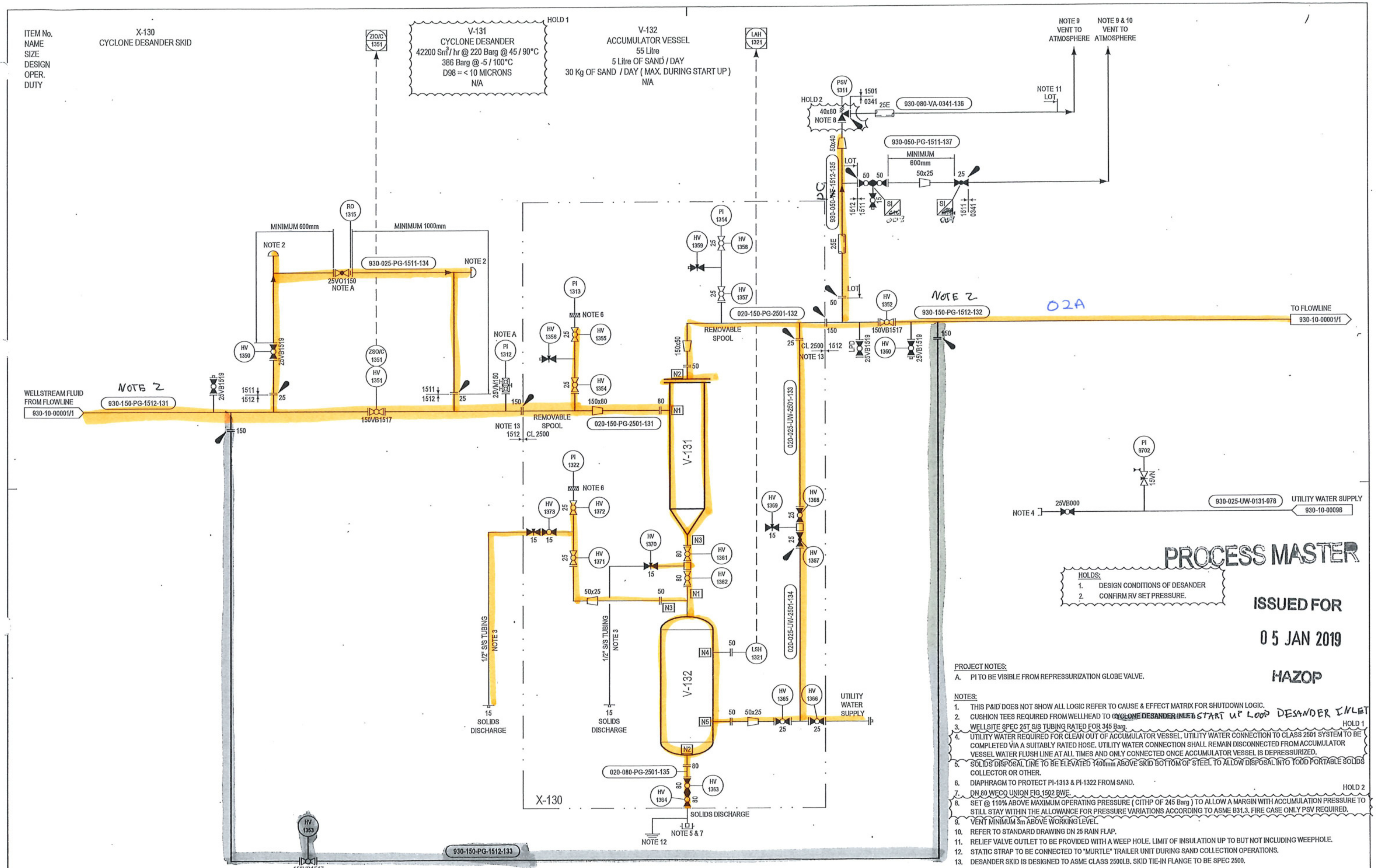
NO	DATE	BY	CONSTRUCTION ISSUE	CHKD	APPR.	CHKD	APPR.	NO	DATE	BY	ECP	DESCRIPTION	CHKD	APPR.	CHKD	APPR.	NUMBER	TITLE
A0	02/19	VK	620051 ISSUED FOR HAZOP	DS		.	.	0	12/18	VK	.	FIRST ISSUE	.	.	.	.	.	.
				CONSULTANT		TODD						REVISIONS	CONSULTANT		TODD		REFERENCE DRAWINGS	

DESIGNED G. DAVIDSON	DATE	KAPUNI WELLSITES
DRAWN V. KAING	12/18	PIPING & INSTRUMENT DIAGRAM
CHECKED D. STEWART	12/18	WELLHEAD X4
APPROVED G. DAVIDSON	12/18	WELLSITE J
APPROVED .	.	
SCALE		
STICKFILE		

Todd Energy

SHEET No 1 OF 2 — REVISION A0 0

DRAWING No 930-10-00004(X)



HOLDS:
1. DESIGN CONDITIONS OF DESANDER
2. CONFIRM RV SET PRESSURE.

PROCESS MASTER

ISSUED FOR

05 JAN 2019

HAZOP

PROJECT NOTES:

A. PI TO BE VISIBLE FROM REPRESSURIZATION GLOBE VALVE.

NOTES:

1. THIS P&ID DOES NOT SHOW ALL LOGIC REFER TO CAUSE & EFFECT MATRIX FOR SHUTDOWN LOGIC.
2. CUSHION TEES REQUIRED FROM WELLHEAD TO ~~CYCLONE DESANDER INLET~~ START UP LOOP DESANDER INLET
3. ~~WELLSITE SPEC 25T S/S TUBING RATED FOR 345 Barg.~~
4. UTILITY WATER REQUIRED FOR CLEAN OUT OF ACCUMULATOR VESSEL. UTILITY WATER CONNECTION TO CLASS 2501 SYSTEM TO BE COMPLETED VIA A SUITABLY RATED HOSE. UTILITY WATER CONNECTION SHALL REMAIN DISCONNECTED FROM ACCUMULATOR VESSEL. WATER FLUSH LINE AT ALL TIMES AND ONLY CONNECTED ONCE ACCUMULATOR VESSEL IS DEPRESSURIZED. HOLD 1
5. ~~SOLIDS DISPOSAL LINE TO BE ELEVATED 1400mm ABOVE SKID BOTTOM OF STEEL TO ALLOW DISPOSAL INTO TODD PORTABLE SOLIDS~~ COLLECTOR OR OTHER.
6. DIAPHRAGM TO PROTECT PI-1313 & PI-1322 FROM SAND.
7. ~~DN 80 WECO UNION FIG 1502 BWE.~~ HOLD 2
8. SET @ 110% ABOVE MAXIMUM OPERATING PRESSURE (CITHP OF 245 Barg) TO ALLOW A MARGIN WITH ACCUMULATION PRESSURE TO STILL STAY WITHIN THE ALLOWANCE FOR PRESSURE VARIATIONS ACCORDING TO ASME B31.3. FIRE CASE ONLY PSV REQUIRED.
9. ~~VENT MINIMUM 3m ABOVE WORKING LEVEL.~~
10. REFER TO STANDARD DRAWING DN 25 RAIN FLAP.
11. RELIEF VALVE OUTLET TO BE PROVIDED WITH A WEEP HOLE. LIMIT OF INSULATION UP TO BUT NOT INCLUDING WEEPHOLE.
12. STATIC STRAP TO BE CONNECTED TO "MURTLE" TRAILER UNIT DURING SAND COLLECTION OPERATIONS.
13. DESANDER SKID IS DESIGNED TO ASME CLASS 2500LB. SKID TIE-IN FLANGE TO BE SPEC 2500.

WorleyParsons resources & energy
620051
941-10-27007(X)-1

NO	DATE	BY	CONSTRUCTION ISSUE	DS	APPR.	CHKD	APPR.	NO	DATE	BY	ECP	DESCRIPTION	CHKD	APPR.	CHKD	APPR.	NUMBER	TITLE
A0	03/19	VK	620051 ISSUED FOR HAZOP					0	12/18	VK		FIRST ISSUE						

CONSULTANT · TODD · REVISIONS · CONSULTANT · TODD · REFERENCE DRAWINGS

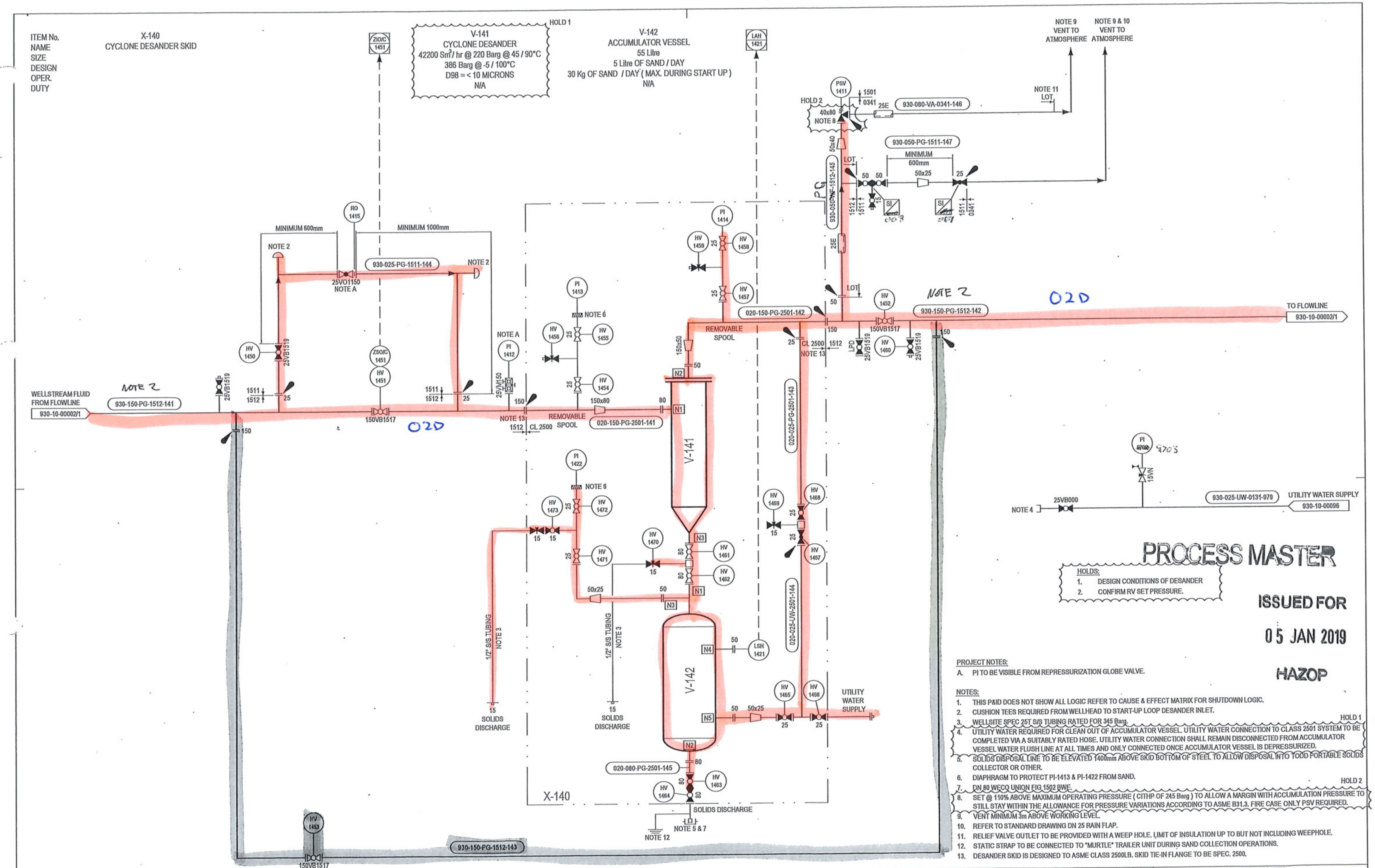
DESIGNED	G. DAVIDSON	12/18
DRAWN	V. KAING	12/18
CHECKED	D. STEWART	12/18
APPROVED	G. DAVIDSON	12/18
APPROVED		
SCALE		
STICKFILE		

KAPUNI WELLSITES
PIPING & INSTRUMENT DIAGRAM
CYCLONE DESANDER SKID 01
WELLSITE J

Todd Energy

SHEET No 1 of 1 · REVISION A0 0

DRAWING No 930-10-00013(X)



PROCESS MASTER

HOLDS:
1. DESIGN CONDITIONS OF DESANDER
2. CONFIRM RV SET PRESSURE.

ISSUED FOR

05 JAN 2019

HAZOP

PROJECT NOTES:

A. PI TO BE VISIBLE FROM REPRESSURIZATION GLOBE VALVE.

NOTES:

1. THIS P&ID DOES NOT SHOW ALL LOGIC REFER TO CAUSE & EFFECT MATRIX FOR SHUTDOWN LOGIC.
2. CUSHION TEES REQUIRED FROM WELLHEAD TO START-UP LOOP DESANDER INLET.
3. WELLSITE SPEC 25T S/S TUBING RATED FOR 345 Barg.
4. UTILITY WATER REQUIRED FOR CLEAN OUT OF ACCUMULATOR VESSEL. UTILITY WATER CONNECTION TO CLASS 2501 SYSTEM TO BE COMPLETED VIA A SUITABLY RATED HOSE. UTILITY WATER CONNECTION SHALL REMAIN DISCONNECTED FROM ACCUMULATOR VESSEL WATER FLUSH LINE AT ALL TIMES AND ONLY CONNECTED ONCE ACCUMULATOR VESSEL IS DEPRESSURIZED. (HOLD 1)
5. SOLIDS DISPOSAL LINE TO BE ELEVATED 1400mm ABOVE SKID BOTTOM OF STEEL TO ALLOW DISPOSAL INTO TODD PORTABLE SOLIDS COLLECTOR OR OTHER.
6. DIAPHRAGM TO PROTECT PI-1413 & PI-1422 FROM SAND.
7. DN 80 WECO UNION FIG 1502 BWE.
8. SET @ 110% ABOVE MAXIMUM OPERATING PRESSURE (CITHP OF 245 Barg) TO ALLOW A MARGIN WITH ACCUMULATION PRESSURE TO STILL STAY WITHIN THE ALLOWANCE FOR PRESSURE VARIATIONS ACCORDING TO ASME B31.3. FIRE CASE ONLY PSV REQUIRED. (HOLD 2)
9. VENT MINIMUM 3m ABOVE WORKING LEVEL.
10. REFER TO STANDARD DRAWING DN 25 RAIN FLAP.
11. RELIEF VALVE OUTLET TO BE PROVIDED WITH A WEEP HOLE. LIMIT OF INSULATION UP TO BUT NOT INCLUDING WEEPHOLE.
12. STATIC STRAP TO BE CONNECTED TO "MURTLE" TRAILER UNIT DURING SAND COLLECTION OPERATIONS.
13. DESANDER SKID IS DESIGNED TO ASME CLASS 2500LB. SKID TIE-IN FLANGE TO BE SPEC. 2500.

WorleyParsons resources & energy
620051
04.02.19 - 14:39
930-10-00014(X)-1

NO	DATE	BY	CONSTRUCTION ISSUE	CHKD	APPR.	CHKD	APPR.
A0	02/19	VK	620051 ISSUED FOR HAZOP	DS			

NO	DATE	BY	ECP	DESCRIPTION (REVISIONS)	CHKD	APPR.	CHKD	APPR.
0	12/18	VK		FIRST ISSUE				

NUMBER	TITLE (REFERENCE DRAWINGS)

		DATE
DESIGNED	G. DAVIDSON	
DRAWN	V. KAING	12/18
CHECKED	D. STEWART	12/18
APPROVED	G. DAVIDSON	12/18
APPROVED		
SCALE		
STICKFILE		

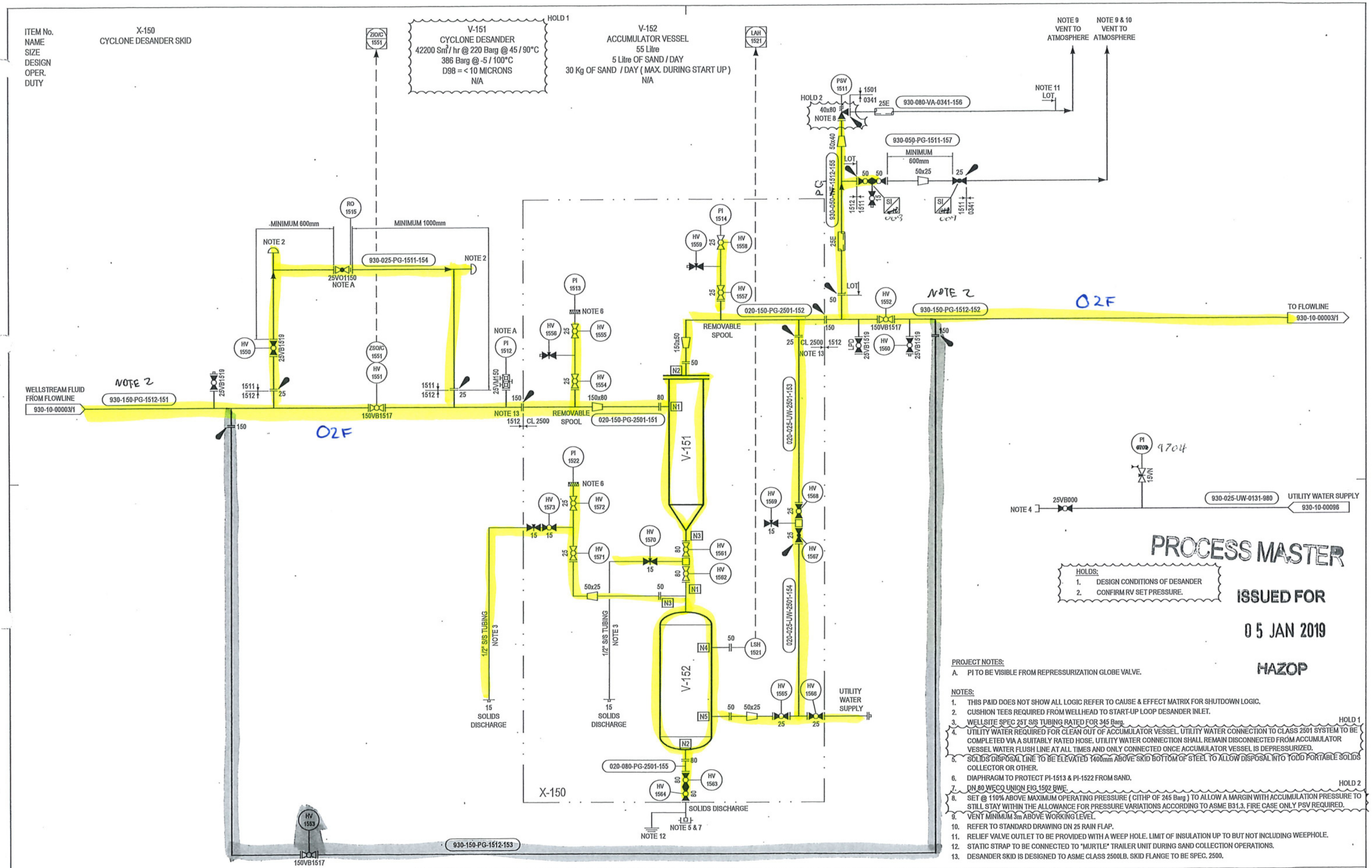
KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM
CYCLONE DESANDER SKID 02
WELLSITE J

Todd Energy

SHEET No 1 OF 1 — REVISION A0 0

DRAWING No 930-10-00014(X)



PROJECT NOTES:

A. PI TO BE VISIBLE FROM REPRESSURIZATION GLOBE VALVE.

NOTES:

1. THIS P&ID DOES NOT SHOW ALL LOGIC REFER TO CAUSE & EFFECT MATRIX FOR SHUTDOWN LOGIC.
2. CUSHION TEES REQUIRED FROM WELLHEAD TO START-UP LOOP DESANDER INLET.
3. WELLSITE SPEC 25T S/S TUBING RATED FOR 345 Barg.
4. UTILITY WATER REQUIRED FOR CLEAN OUT OF ACCUMULATOR VESSEL. UTILITY WATER CONNECTION TO CLASS 2501 SYSTEM TO BE COMPLETED VIA A SUITABLY RATED HOSE. UTILITY WATER CONNECTION SHALL REMAIN DISCONNECTED FROM ACCUMULATOR VESSEL WATER FLUSH LINE AT ALL TIMES AND ONLY CONNECTED ONCE ACCUMULATOR VESSEL IS DEPRESSURIZED. (HOLD 1)
5. SOLIDS DISPOSAL LINE TO BE ELEVATED 1400mm ABOVE SKID BOTTOM OF STEEL TO ALLOW DISPOSAL INTO TODD PORTABLE SOLIDS COLLECTOR OR OTHER.
6. DIAPHRAGM TO PROTECT PI-1513 & PI-1522 FROM SAND.
7. DN 80 WECO UNION FIG 1502 BWE.
8. SET @ 110% ABOVE MAXIMUM OPERATING PRESSURE (CITHP OF 245 Barg) TO ALLOW A MARGIN WITH ACCUMULATION PRESSURE TO STILL STAY WITHIN THE ALLOWANCE FOR PRESSURE VARIATIONS ACCORDING TO ASME B31.3. FIRE CASE ONLY PSV REQUIRED. (HOLD 2)
9. VENT MINIMUM 3m ABOVE WORKING LEVEL.
10. REFER TO STANDARD DRAWING DN 25 RAIN FLAP.
11. RELIEF VALVE OUTLET TO BE PROVIDED WITH A WEEP HOLE. LIMIT OF INSULATION UP TO BUT NOT INCLUDING WEEPHOLE.
12. STATIC STRAP TO BE CONNECTED TO "MURTLE" TRAILER UNIT DURING SAND COLLECTION OPERATIONS.
13. DESANDER SKID IS DESIGNED TO ASME CLASS 2500LB. SKID FLANGE TO BE SPEC. 2500.

WorleyParsons resources & energy
620051
04.02.19 - 15:46
930-10-00015(X)-1

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NO	DATE	BY	DESCRIPTION	CHKD	APPR.	CHKD	APPR.
A0	03/19	VK	620051 ISSUED FOR HAZOP	DS			
0	12/18	VK	FIRST ISSUE				

CONSTRUCTION ISSUE — CONSULTANT — TODD — REVISIONS — NUMBER — TITLE — REFERENCE DRAWINGS

DESIGNED	G. DAVIDSON	DATE
DRAWN	V. KAING	12/18
CHECKED	D. STEWART	12/18
APPROVED	G. DAVIDSON	12/18
APPROVED	.	.
SCALE	.	
STICKFILE		

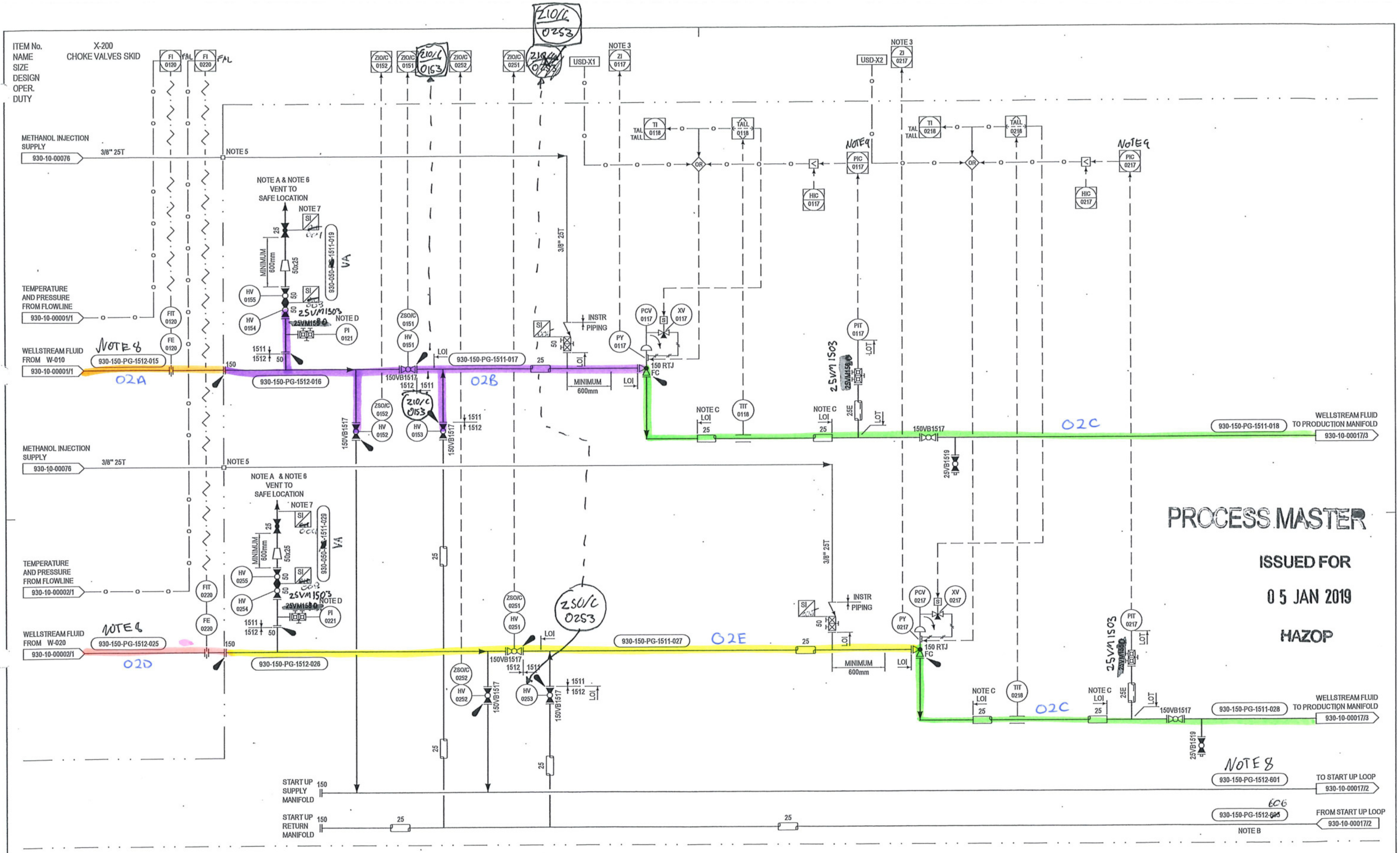
KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM
CYCLONE DESANDER SKID 03
WELLSITE J

Todd Energy

SHEET No 1 OF 1 — REVISION A0 0

DRAWING No 930-10-00015(X)



NOTES:
1. THIS P&ID DOES NOT SHOW ALL LOGIC REFER TO CAUSE & EFFECT MATRIX FOR SHUTDOWN LOGIC.
2. VOID.
3. DEVIATION ALARM RAISED IF DEVIATION EXISTS BETWEEN REQUESTED POSITION AND POSITION FEEDBACK. REFER TO FUNCTIONAL CONTROL DESCRIPTION FOR DETAILS.
4. VOID.
5. METHANOL TUBING TO BE SUPPLIED WITH UNIONS AT SKID LIMITS TO ALLOW FOR FUTURE REMOVAL / RELOCATION.
6. REFER TO STANDARD DRAWING 000-50032-01 FOR DN 25 RAIN FLAP DETAILS.
7. SI- GLOBE VALVE TO BE EASILY ACCESSIBLE TO ENSURE THROTTLING DURING DEPRESSURIZATION ONLY UTILIZES GLOBE VALVE.
8. ~~[illegible]~~ TEES AND TARGET CROSSES REQUIRED TO START UP LOOP DESANDER INLET
9. PIC OVERRIDE SET POINT BASED ON MANIFOLD LINE OUT

PROJECT NOTES:
A. VENT OUTLET TO EXTEND 3m ABOVE MAXIMUM WORKING HEIGHT ADEQUATE SUPPORT TO BE PROVIDED.
B. MINIMIZE LENGTH OF PIPEWORK BETWEEN H-610 HEATER OUTLET AND CHOKE VALVES.
C. PIPING TO BE INSULATED 200mm UPSTREAM & DOWNSTREAM OF TITs WITH 25mm THICK INSULATION.
D. PI-0121 & PI-0221 TO BE READABLE FROM DN 50 DEPRESSURIZATION VALVES.

WorleyParsons resources & energy
620051
04.02.19 - 15:45
941-10-27005(X)-1

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NO	DATE	BY	DESCRIPTION	CHKD	APPR.	CHKD	APPR.
A0	02/19	VK	620051 ISSUED FOR HAZOP	DS	GD		
			CONSTRUCTION ISSUE	CONSULTANT		TODD	

NO	DATE	BY	ECP	DESCRIPTION
0	12/18	VK		FIRST ISSUE
				REVISIONS

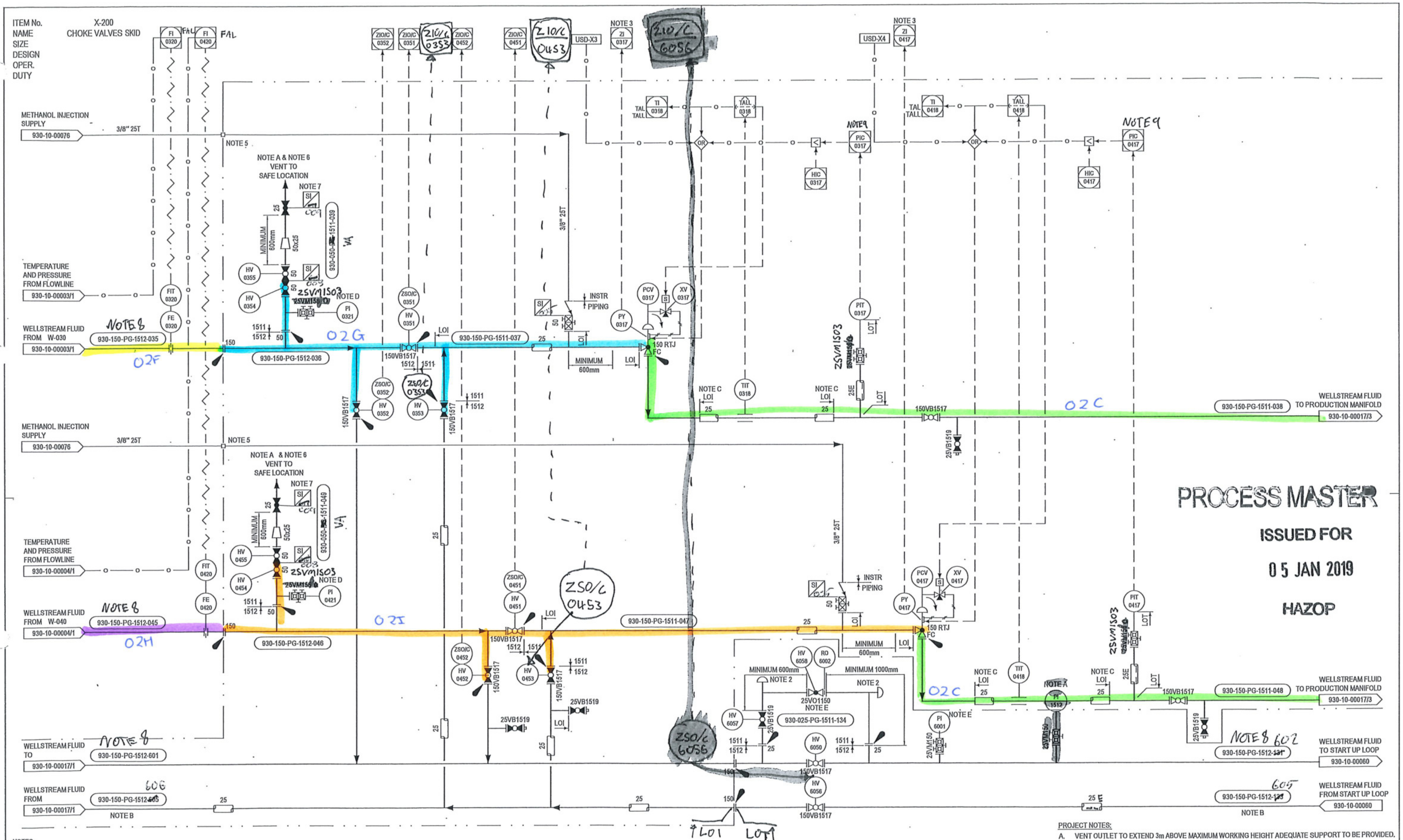
NUMBER	TITLE
	REFERENCE DRAWINGS

		DATE
DESIGNED	G. DAVIDSON	
DRAWN	V. KAING	12/18
CHECKED	D. STEWART	12/18
APPROVED	G. DAVIDSON	12/18
APPROVED		
SCALE		

KAPUNI WELLSITES
PIPING & INSTRUMENT DIAGRAM
CHOKE VALVES SKID
WELLSITE J

Todd Energy

SHEET No 1 of 3 REVISION A0 0
DRAWING No 930-10-00017(X)



NOTES:

1. THIS P&ID DOES NOT SHOW ALL LOGIC REFER TO CAUSE & EFFECT MATRIX FOR SHUTDOWN LOGIC.
2. CUSHION TEES REQUIRED FROM WELLHEAD TO START-UP LOOP DESANDER INLET.
3. DEVIATION ALARM RAISED IF DEVIATION EXISTS BETWEEN REQUESTED POSITION AND POSITION FEEDBACK.
   REFER TO FUNCTIONAL CONTROL DESCRIPTION FOR DETAILS.
4. VOID.
5. METHANOL TUBING TO BE SUPPLIED WITH UNIONS AT SKID LIMITS TO ALLOW FOR FUTURE REMOVAL / RELOCATION.
6. REFER TO STANDARD DRAWING 000-50032-01 FOR DN 25 RAIN FLAP DETAILS.
7. SI- GLOBE VALVE TO BE EASILY ACCESSIBLE TO ENSURE THROTTLING DURING DEPRESSURIZATION ONLY UTILIZES GLOBE VALVE.
8. CUSHION TEES AND TARGET CROSSES REQUIRED TO START UP LOOP DESANDER INLET
9. PIC OVERRIDE SET POINT BASED ON MANIFOLD

PROJECT NOTES:

A. VENT OUTLET TO EXTEND 3m ABOVE MAXIMUM WORKING HEIGHT ADEQUATE SUPPORT TO BE PROVIDED.
B. MINIMIZE LENGTH OF PIPEWORK BETWEEN H-610 HEATER OUTLET AND CHOKE VALVES.
C. PIPING TO BE INSULATED 200mm UPSTREAM & DOWNSTREAM OF TITs WITH 25mm THICK INSULATION.
D. PI-0321 & PI-0421 TO BE READABLE FROM DN 50 DEPRESSURIZATION VALVES.
E. PI TO BE VISIBLE FROM DEPRESSURIZATION GLOBE VALVE.

WorleyParsons resources & energy
620051
941-10-27006(X)-1

NO	DATE	BY	CONSTRUCTION ISSUE	CHKD	APPR.	CHKD	APPR.
A0	02/19	VK	620051 ISSUED FOR HAZOP	DS	GD		

NO	DATE	BY	ECP	DESCRIPTION	CHKD	APPR.	CHKD	APPR.
0	12/18	VK		FIRST ISSUE				

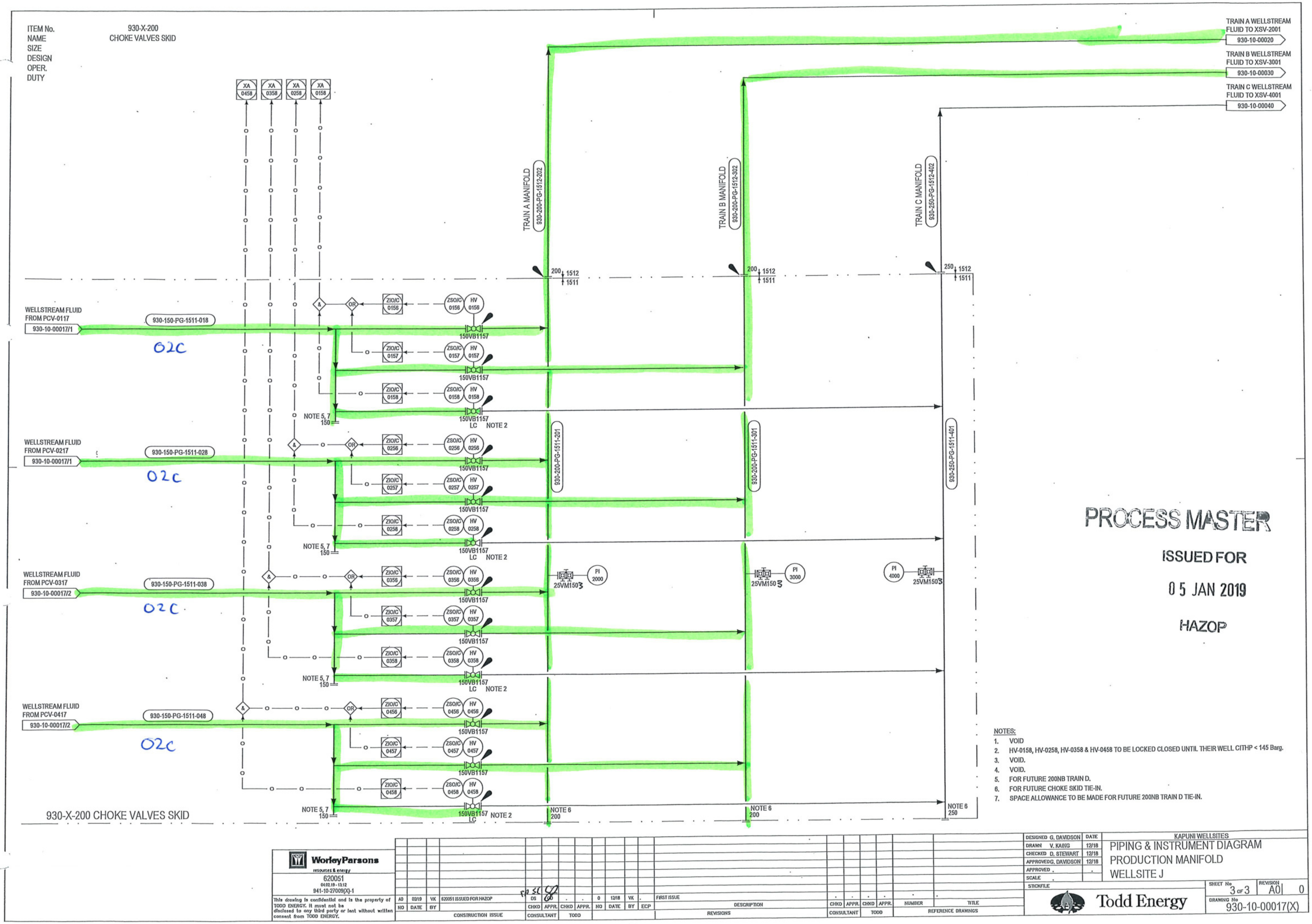
REVISIONS — CONSULTANT — TODD — NUMBER — TITLE — REFERENCE DRAWINGS

		DATE
DESIGNED	G. DAVIDSON	
DRAWN	V. KAING	12/18
CHECKED	D. STEWART	12/18
APPROVED	G. DAVIDSON	12/18
APPROVED		
SCALE		
STICKFILE		

KAPUNI WELLSITES
PIPING & INSTRUMENT DIAGRAM
CHOKE VALVES SKID
WELLSITE J

Todd Energy

SHEET No 2 OF 3 — REVISION A0 0
DRAWING No 930-10-00017(X)



ITEM No. 930-X-200
NAME CHOKE VALVES SKID
SIZE
DESIGN
OPER.
DUTY
XA 0458
XA 0358
XA 0258
XA 0158
TRAIN A WELLSTREAM FLUID TO XSV-2001
930-10-00020
TRAIN B WELLSTREAM FLUID TO XSV-3001
930-10-00030
TRAIN C WELLSTREAM FLUID TO XSV-4001
930-10-00040
TRAIN A MANIFOLD 930-200-PG-1512-202
TRAIN B MANIFOLD 930-200-PG-1512-302
TRAIN C MANIFOLD 930-250-PG-1512-402
200 1512 1511
250 1512 1511
WELLSTREAM FLUID FROM PCV-0117
930-10-00017/1
930-150-PG-1511-018
02C
WELLSTREAM FLUID FROM PCV-0217
930-10-00017/1
930-150-PG-1511-028
02C
WELLSTREAM FLUID FROM PCV-0317
930-10-00017/2
930-150-PG-1511-038
02C
WELLSTREAM FLUID FROM PCV-0417
930-10-00017/2
930-150-PG-1511-048
02C
ZIO/C 0156
ZSO/C 0156
HV 0156
ZIO/C 0157
ZSO/C 0157
HV 0157
ZIO/C 0158
ZSO/C 0158
HV 0158
ZIO/C 0256
ZSO/C 0256
HV 0256
ZIO/C 0257
ZSO/C 0257
HV 0257
ZIO/C 0258
ZSO/C 0258
HV 0258
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ZSO/C 0356
HV 0356
ZIO/C 0357
ZSO/C 0357
HV 0357
ZIO/C 0358
ZSO/C 0358
HV 0358
ZIO/C 0456
ZSO/C 0456
HV 0456
ZIO/C 0457
ZSO/C 0457
HV 0457
ZIO/C 0458
ZSO/C 0458
HV 0458
150VB1157
LC NOTE 2
NOTE 5, 7 150
930-200-PG-1511-201
930-200-PG-1511-301
930-250-PG-1511-401
25VM1503
PI 2000
PI 3000
PI 4000
NOTE 6 200
NOTE 6 250
930-X-200 CHOKE VALVES SKID
PROCESS MASTER
ISSUED FOR
05 JAN 2019
HAZOP
NOTES:
1. VOID
2. HV-0158, HV-0258, HV-0358 & HV-0458 TO BE LOCKED CLOSED UNTIL THEIR WELL CITHP < 145 Barg.
3. VOID.
4. VOID.
5. FOR FUTURE 200NB TRAIN D.
6. FOR FUTURE CHOKE SKID TIE-IN.
7. SPACE ALLOWANCE TO BE MADE FOR FUTURE 200NB TRAIN D TIE-IN.
WorleyParsons resources & energy
620051
941-10-27009(X)-1
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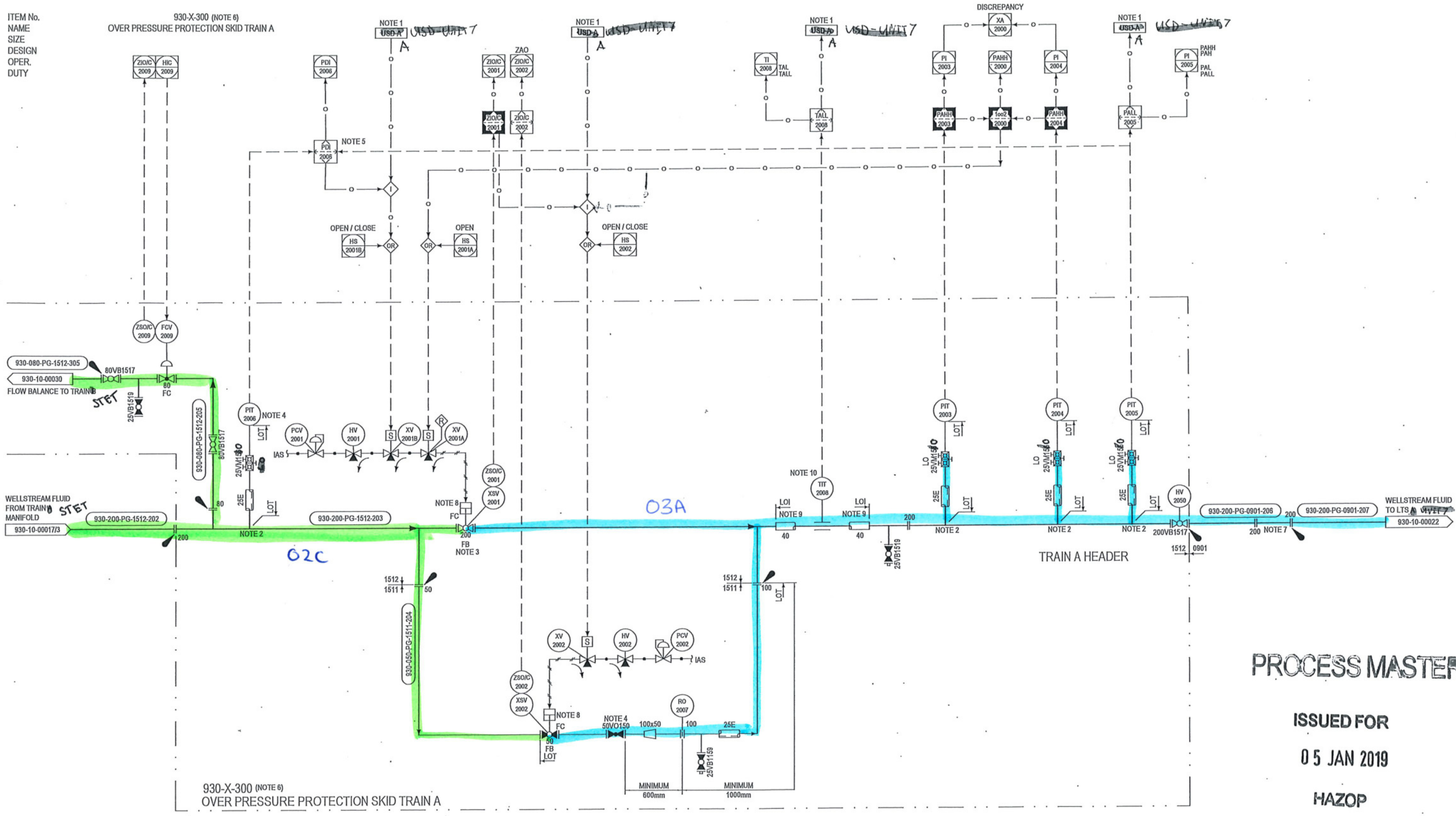
A0 03/19 VK 620051 ISSUED FOR HAZOP DS
0 12/18 VK FIRST ISSUE
NO DATE BY CONSTRUCTION ISSUE CHKD APPR. CHKD APPR. CONSULTANT TODD
NO DATE BY ECP DESCRIPTION REVISIONS
CHKD APPR. CHKD APPR. CONSULTANT TODD NUMBER TITLE REFERENCE DRAWINGS
DESIGNED G. DAVIDSON 12/18
DRAWN V. KAING 12/18
CHECKED D. STEWART 12/18
APPROVED G. DAVIDSON 12/18
APPROVED
SCALE
STICKFILE
KAPUNI WELLSITES
PIPING & INSTRUMENT DIAGRAM
PRODUCTION MANIFOLD
WELLSITE J
SHEET No 3 of 3
REVISION A0 0
Todd Energy
DRAWING No 930-10-00017(X)



PROCESS MASTER

ISSUED FOR

05 JAN 2019

HAZOP

NOTES:

1. THIS P&ID DOES NOT SHOW ALL LOGIC, REFER TO CAUSE & EFFECT MATRIX FOR SHUTDOWN LOGIC.
2. PRESSURE TRANSMITTER TAPPING POINTS & VALVES TO BE HEAT TRACED & INSULATED.
3. TRAIN A SHUTDOWN VALVE XSV-2001 TO BE LOCATED AS CLOSE AS POSSIBLE TO THE CHOKE SKID MANIFOLD, TO MINIMIZE VENTED INVENTORIES.
4. PIT-2006 TO BE READABLE FROM XSV-2002 BYPASS LINE GLOBE VALVE.
5. DIFFERENTIAL PRESSURE MUST BE LESS THAN 10 BAR FOR TRAIN A SHUTDOWN VALVE TO OPEN.
6. OPP TRAIN A & B ARE LOCATED ON SKID X-300.
7. DROP OUT SPOOL FOR FUTURE COMPRESSOR TIE-IN (HIGH PRESSURE GAS FROM COMPRESSOR TO LTS).
8. BYPASS VALVE XSV-2002 IS INTERLOCKED WITH XSV-2001 AND WILL CLOSE WHEN XSV-2001 IS OPENED.
9. PIPING TO BE INSULATED WITH NO HEAT TRACT 200mm UPSTREAM & DOWNSTREAM OF TIT WITH 40mm THICK INSULATION.
10. TIT-2001 TO BE READABLE FROM BYPASS VALVE XSV-2002.

WorleyParsons resources & energy
620051
04.02.19 - 13:13
941-10-27010(X)-1

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NO	DATE	BY	DESCRIPTION	CHKD	APPR.	CHKD	APPR.
A0	02/19	VK	620051 ISSUED FOR HAZOP	DS			
0	12/18	VK	FIRST ISSUE				

CONSTRUCTION ISSUE | CONSULTANT | TODD | REVISIONS | CONSULTANT | TODD | NUMBER | TITLE | REFERENCE DRAWINGS

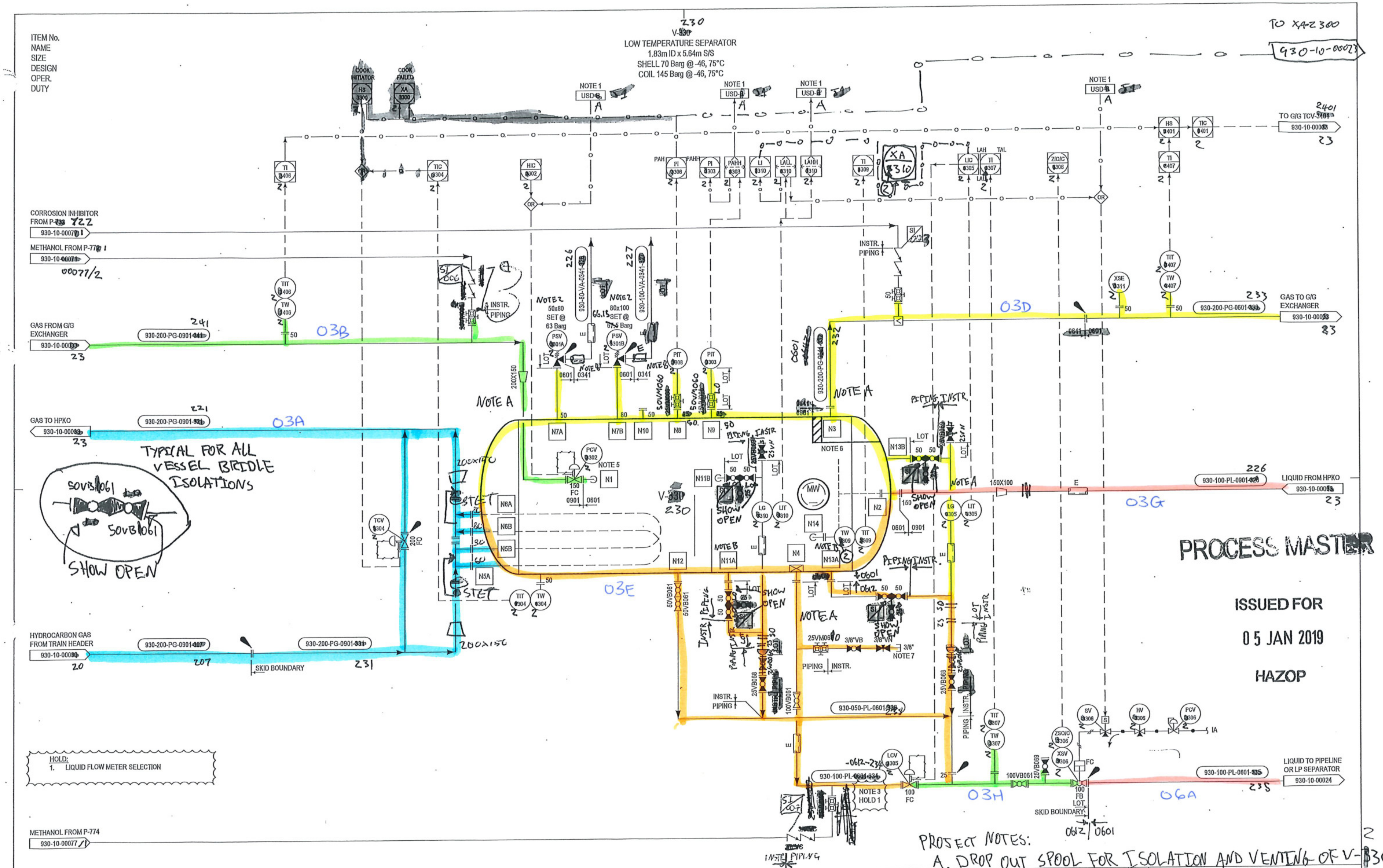
		DATE
DESIGNED	G. DAVIDSON	
DRAWN	V. KAING	12/18
CHECKED	D. STEWART	12/18
APPROVED	G. DAVIDSON	12/18
APPROVED		
SCALE		
STICKFILE		

KAPUNI WELLSITES
PIPING & INSTRUMENT DIAGRAM
OVER PRESSURE SKID TRAIN A
WELLSITE J

Todd Energy

SHEET No 1 OF 1 | REVISION A0 | 0

DRAWING No 930-10-00020(X)



NOTES:

1. THIS P&ID DOES NOT SHOW ALL LOGIC, REFER TO CAUSE & EFFECT MATRIX FOR SHUTDOWN LOGIC.
2. VOID. PSV PRESSURE SET LESS THAN LTS DESIGN PRESSURE
3. DROP OUT SPOOL FOR FUTURE FLOW METER INSTALLATION
4. VENT TO TERMINATE ADJACENT TO PSV VENT.
5. PCV-0302 TO BE LOCATED ON VESSEL INLET NOZZLE (NOZZLE TO BE CLASS 900LB)
6. VANE PACK DEMISTER.
7. SAMPLE POINT.
8. RELIEF VALVE OUTLET TO BE PROVIDED WITH A WEEP HOLE. LIMIT OF TRACING TO BE UP TO BUT NOT INCLUDING WEEPHOLE.

TO ACCOMODATE DOWNSTREAM PIPELINE DESIGN PRESSURE

WorleyParsons
620051

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REV	DATE	BY	DESCRIPTION
A0	01/19	VK	620051 ISSUED FOR HAZOP
0	12/18	VK	FIRST ISSUE

CONSTRUCTION ISSUE / REVISIONS / REFERENCE DRAWINGS

DESIGNED	G. DAVIDSON	12/18
DRAWN	V. KAING	12/18
CHECKED	D. STEWART	12/18
APPROVED	G. DAVIDSON	12/18

KAPUNI WELLSITES
PIPING & INSTRUMENT DIAGRAM
LTS UNIT B 51
WELLSITE J

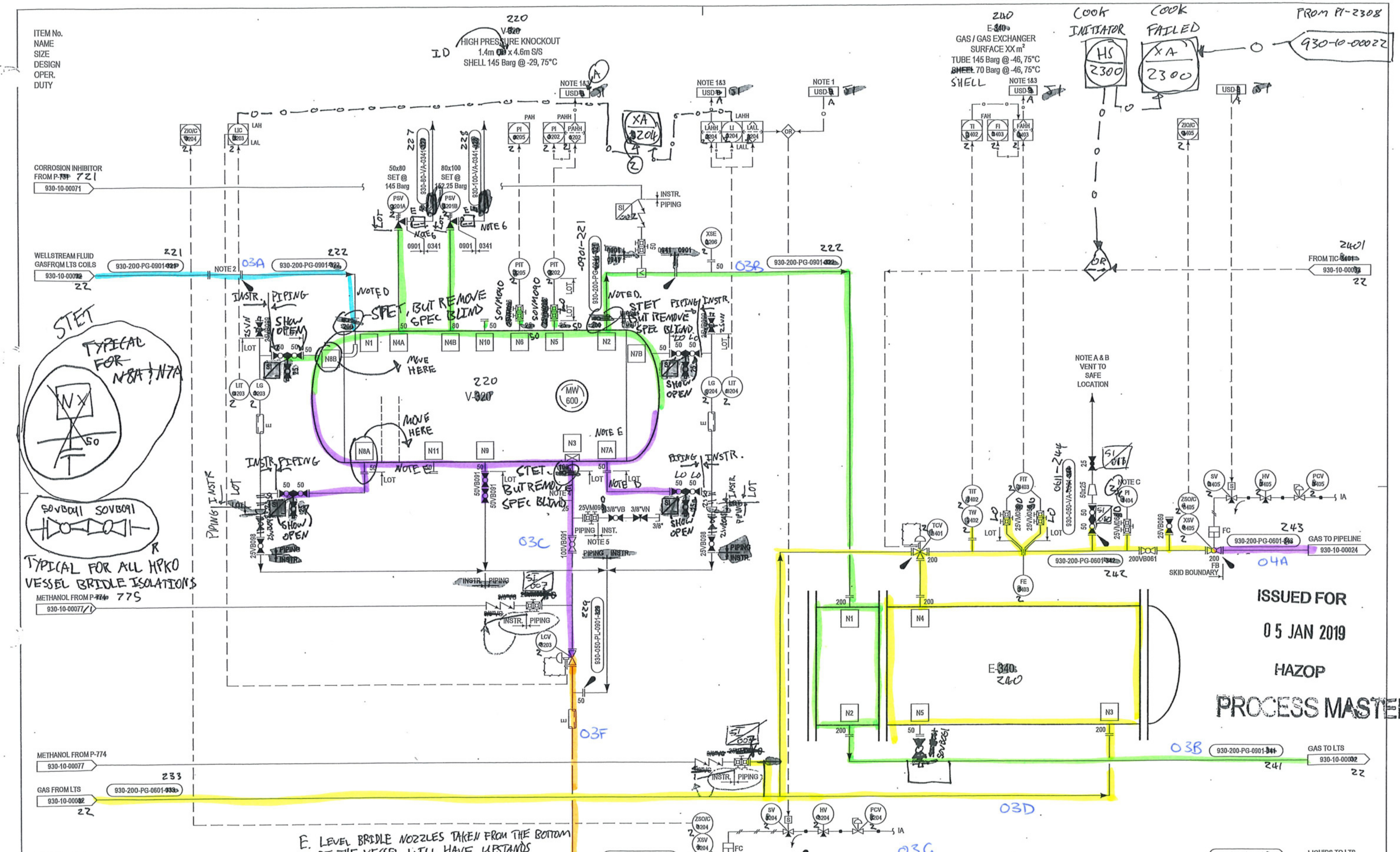
Todd Energy

SHEET No 1 OF 1 — REVISION A0
DRAWING No 930-10-00082(X)

PROJECT NOTES:

A. DROP OUT SPOOL FOR ISOLATION AND VENTING OF V-230

B. LEVEL BRIDLE NOZZLES TAKEN FROM THE BOTTOM OF THE VESSEL WILL BE PROVIDED WITH UPSTANDS



PROJECT NOTES:

A. VENT PIPING TO EXTEND 3m ABOVE MAXIMUM PERSONAL WORKING HEIGHT.
B. VENT VALVE TO BE ACCESSIBLE FROM GRADE.
C. PI TO BE VISIBLE FROM VENT VALVES.
D. DROP OUT SPOOL FOR ISOLATION AND VENTING OF V-~~320~~ 220

NOTES:

1. THIS P&ID DOES NOT SHOW ALL LOGIC, REFER TO CAUSE & EFFECT MATRIX FOR SHUTDOWN LOGIC.
2. DROP OUT SPOOL FOR FUTURE COOLER TIE-IN
3. HPKO PAHH / LAHH / FAHH ACTIVATES OPP TO PRESERVE SAFETY TIME.
4. FOR FUTURE METHANOL INJECTION POINT.
5. SAMPLE POINT.
6. RELIEF VALVE OUTLET TO BE PROVIDED WITH A WEEPHOLE. LIMIT OF INSULATION UP TO BUT NOT INCLUDING WEEPHOLE

WorleyParsons resources & energy
620051
930-10-00033(X)-1

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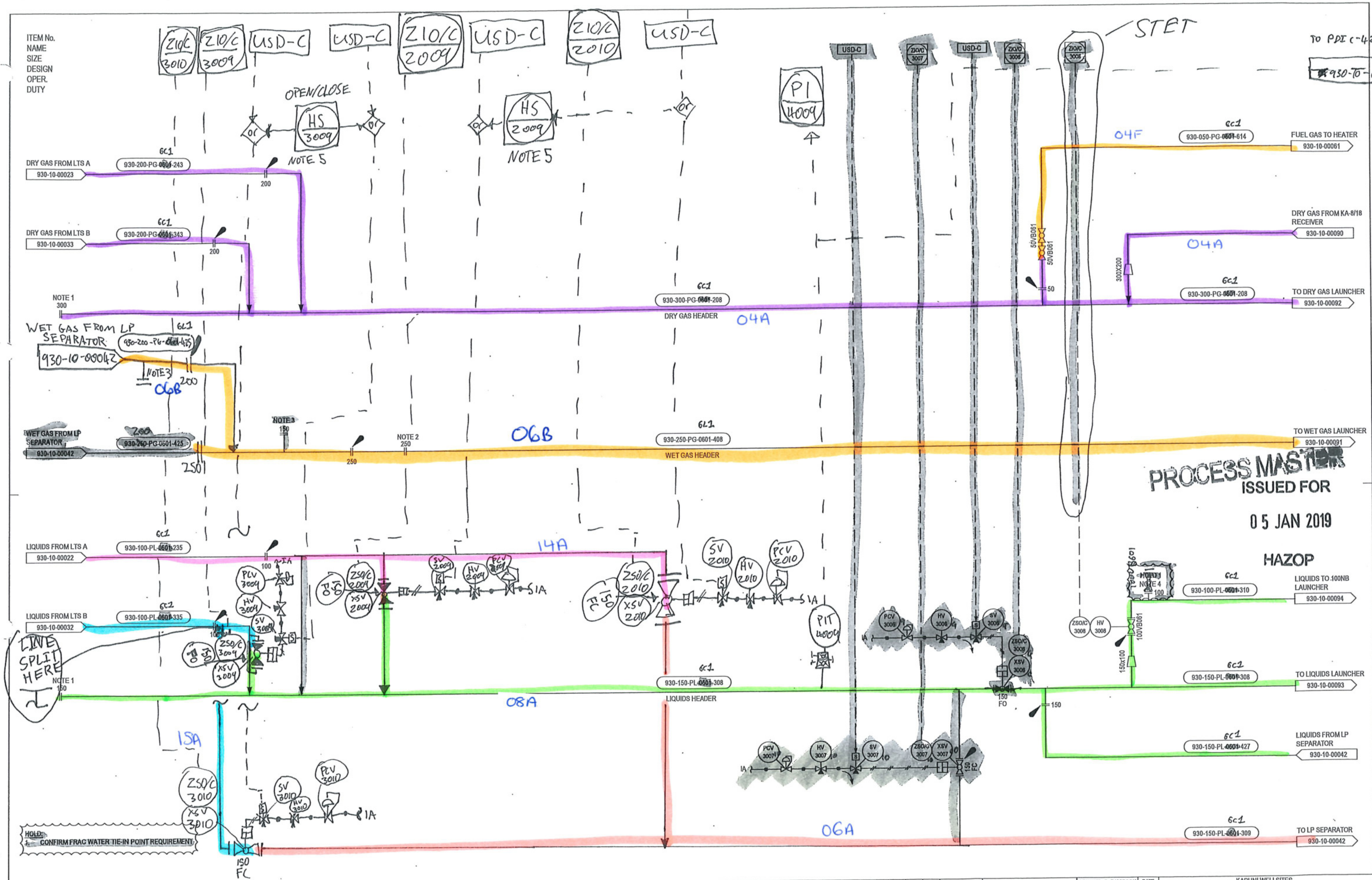
NO	DATE	BY	DESCRIPTION
A0	01/19	VK	620051 ISSUED FOR HAZOP
0	12/18	VK	FIRST ISSUE

DESIGNED	G. DAVIDSON	12/18
DRAWN	V. KAING	12/18
CHECKED	D. STEWART	12/18
APPROVED	G. DAVIDSON	12/18

KAPUNI WELLSITES
PIPING & INSTRUMENT DIAGRAM
LTS ~~UNIT B~~ J1
WELLSITE J

Todd Energy

SHEET No 1 OF 1 — REVISION A0 0
DRAWING No 930-10-00033(X)



NOTES:

1. BLIND FLANGE FOR FUTURE LTS TRAIN C TIE-IN.
2. DROP OUT SPOOL FOR FUTURE COMPRESSOR TIE-IN.
3. FOR FUTURE LP SEPARATOR BYPASS.
4. TIE-IN POINT FOR WATER FLOW BACK.
5. VALVES 2009 AND 3009 XSV-2009 AND XSV-3009 INTERLOCKED WITH XSV-2010 AND XSV 3010 RESPECTIVELY, AS TO HAVE ONLY ONE OPEN AT A TIME FOR WELL TESTING IN K-1?A

WorleyParsons resources & energy
620051
04.02.18 - 12.18
941-10-27013(X)-1

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NO	DATE	BY	CONSTRUCTION ISSUE	CHKD	APPR.	CHKD	APPR.	NO	DATE	BY	ECP	DESCRIPTION	CHKD	APPR.	CHKD	APPR.	NUMBER	TITLE
A0	02/19	VK	620051 ISSUED FOR HAZOP	DS				0	12/18	VK		FIRST ISSUE						

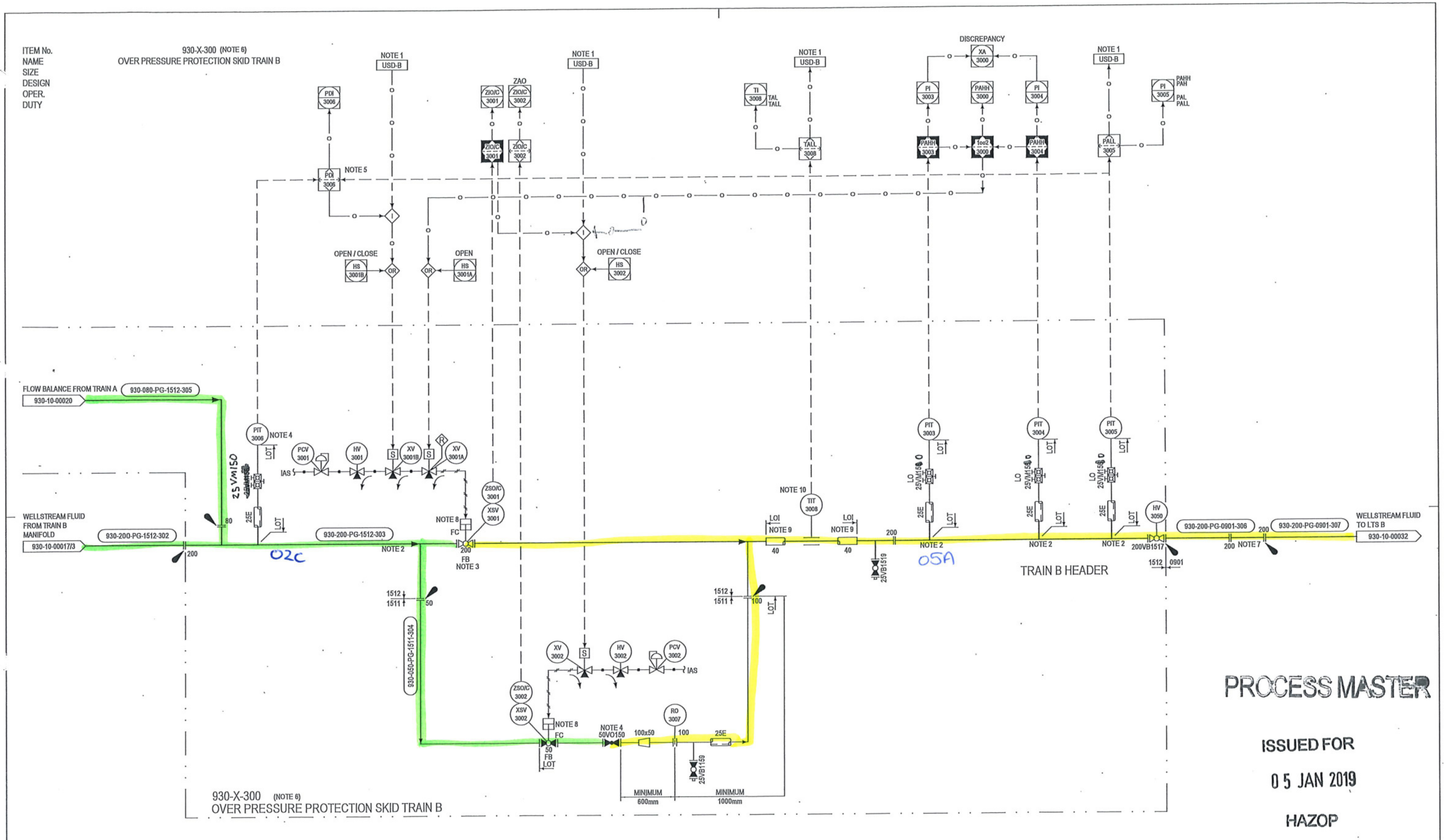
CONSULTANT | TODD | REVISIONS | CONSULTANT | TODD | REFERENCE DRAWINGS

DESIGNED	G. DAVIDSON	
DRAWN	V. KAING	12/18
CHECKED	D. STEWART	12/18
APPROVED	G. DAVIDSON	12/18
APPROVED		
SCALE		
STICKFILE		

KAPUNI WELLSITES
PIPING & INSTRUMENT DIAGRAM
GATHERING HEADERS
WELLSITE J

Todd Energy

SHEET No 1 of 1 | REVISION A0 0
DRAWING No 930-10-00024(X)



NOTES:

1. THIS P&ID DOES NOT SHOW ALL LOGIC, REFER TO CAUSE & EFFECT MATRIX FOR SHUTDOWN LOGIC.
2. PRESSURE TRANSMITTER TAPPING POINTS & VALVES TO BE HEAT TRACED & INSULATED.
3. TRAIN A SHUTDOWN VALVE XSV-3001 TO BE LOCATED AS CLOSE AS POSSIBLE TO THE CHOKE SKID MANIFOLD, TO MINIMIZE VENTED INVENTORIES.
4. PIT-3006 TO BE READABLE FROM XSV-3002 BYPASS LINE GLOBE VALVE.
5. DIFFERENTIAL PRESSURE MUST BE LESS THAN 10 BAR FOR TRAIN A SHUTDOWN VALVE TO OPEN.
6. OPP TRAIN A & B ARE LOCATED ON SKID X-300.
7. DROP OUT SPOOL FOR FUTURE COMPRESSOR TIE-IN (HIGH PRESSURE GAS FROM COMPRESSOR TO LTS).
8. BYPASS VALVE XSV-3002 IS INTERLOCKED WITH XSV-3001 AND WILL CLOSE WHEN XSV-3001 IS OPENED.
9. PIPING TO BE INSULATED WITH NO HEAT TRACT 200mm UPSTREAM & DOWNSTREAM OF TIT WITH 40mm THICK INSULATION
10. TIT-3001 TO BE READABLE FROM BYPASS VALVE XSV-3002.

WorleyParsons resources & energy
620051
941-10-27011(X)-1

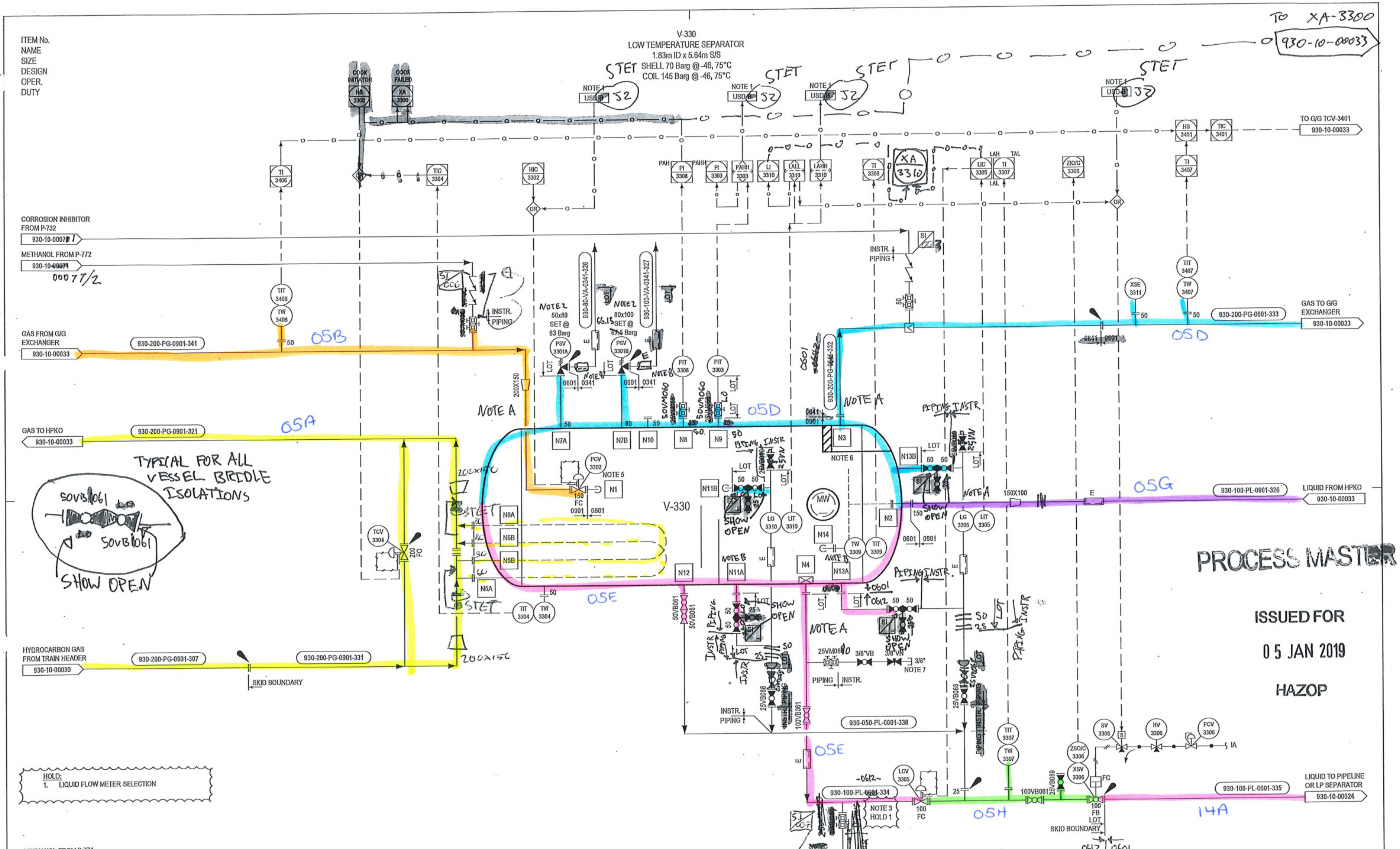
NO	DATE	BY		CHKD	APPR.	CHKD	APPR.	NO	DATE	BY	ECP	DESCRIPTION	CHKD	APPR.	CHKD	APPR.	NUMBER	TITLE
A0	02/19	VK	620051 ISSUED FOR HAZOP	DS				0	12/18	VK		FIRST ISSUE						
			CONSTRUCTION ISSUE	CONSULTANT		TODD						REVISIONS	CONSULTANT		TODD		REFERENCE DRAWINGS	

DESIGNED	G. DAVIDSON	DATE
DRAWN	V. KAING	12/18
CHECKED	D. STEWART	12/18
APPROVED	G. DAVIDSON	12/18
APPROVED		
SCALE		
STICKFILE		

KAPUNI WELLSITES
PIPING & INSTRUMENT DIAGRAM
OVER PRESSURE SKID TRAIN B
WELLSITE J

Todd Energy

SHEET No 1 OF 1 | REVISION A0 0
DRAWING No 930-10-00030(X)



PROJECT NOTES:
A. DROP OUT SPOOL FOR ISOLATION AND VENTING OF V-330
B. LEVEL BRIDLE NOZZLES TAKEN FROM THE BOTTOM OF THE VESSEL WILL BE PROVIDED WITH UPSTANDS

NOTES:
1. THIS P&ID DOES NOT SHOW ALL LOGIC, REFER TO CAUSE & EFFECT MATRIX FOR SHUTDOWN LOGIC.
2. VOID. PSV PRESSURE SET LESS THAN LTS DESIGN PRESSURE
3. DROP OUT SPOOL FOR FUTURE FLOW METER INSTALLATION
4. VENT TO TERMINATE ADJACENT TO PSV VENT.
5. PCV-3302 TO BE LOCATED ON VESSEL INLET NOZZLE (NOZZLE TO BE CLASS 900LB)
6. VANE PACK DEMISTER.
7. SAMPLE POINT.
8. RELIEF VALVE OUTLET TO BE PROVIDED WITH TO ACCOMODATE DOWNSTREAM PIPELINE DESIGN PRESSURE

A WEEP HOLE LIMIT OF TRACING TO BE UP TO BUT NOT INCLUDING WEEPHOLE

WorleyParsons resources & energy
620051
04.02.19 - 08.30
930-10-00032(X)-1

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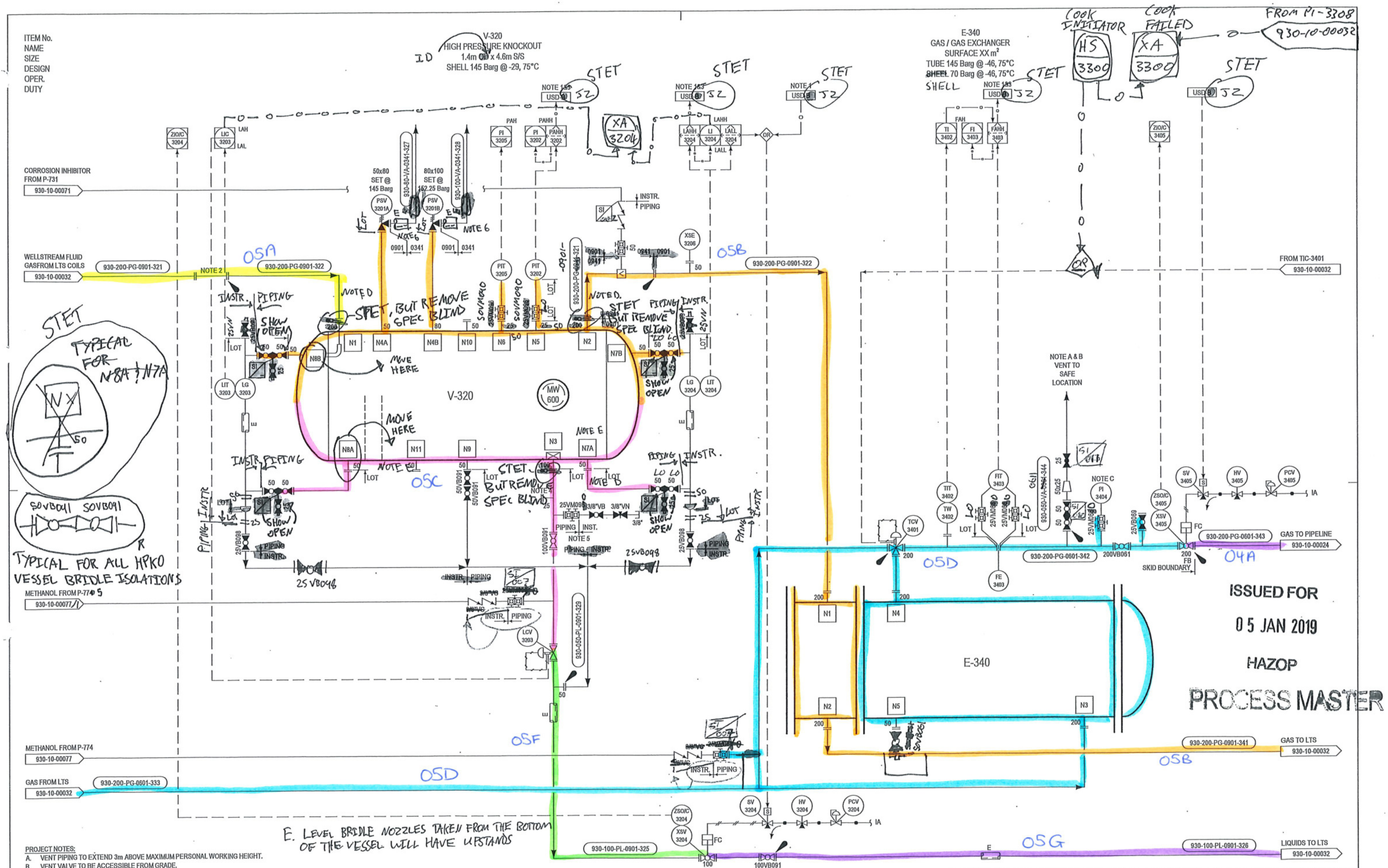
NO	DATE	BY	DESCRIPTION
A0	01/19	VK	620051 ISSUED FOR HAZOP
0	12/18	VK	FIRST ISSUE

DESIGNED G. DAVIDSON 12/18
DRAWN V. KAING 12/18
CHECKED D. STEWART 12/18
APPROVED G. DAVIDSON 12/18

KAPUNI WELLSITES
PIPING & INSTRUMENT DIAGRAM
LTS UNIT B J2
WELLSITE J

Todd Energy

SHEET No 1 OF 1
REVISION A0 0
DRAWING No 930-10-00032(X)



PROJECT NOTES:

A. VENT PIPING TO EXTEND 3m ABOVE MAXIMUM PERSONAL WORKING HEIGHT.
B. VENT VALVE TO BE ACCESSIBLE FROM GRADE.
C. PI TO BE VISIBLE FROM VENT VALVES.
D. DROP OUT SPOOL FOR ISOLATION AND VENTING OF V-320

NOTES:

1. THIS P&ID DOES NOT SHOW ALL LOGIC, REFER TO CAUSE & EFFECT MATRIX FOR SHUTDOWN LOGIC.
2. DROP OUT SPOOL FOR FUTURE COOLER TIE-IN
3. HPKO PAHH / LAHH / FAHH ACTIVATES OPP TO PRESERVE SAFETY TIME.
4. FOR FUTURE METHANOL INJECTION POINT.
5. SAMPLE POINT.
6. RELIF VALVE OUTLET TO BE PROVIDED WITH A WEEPHOLE. LIMIT OF ~~INSULATION~~ UPTO BUT NOT INCLUDING WEEPHOLE

WorleyParsons resources & energy
620051
930-10-00033(X)-1

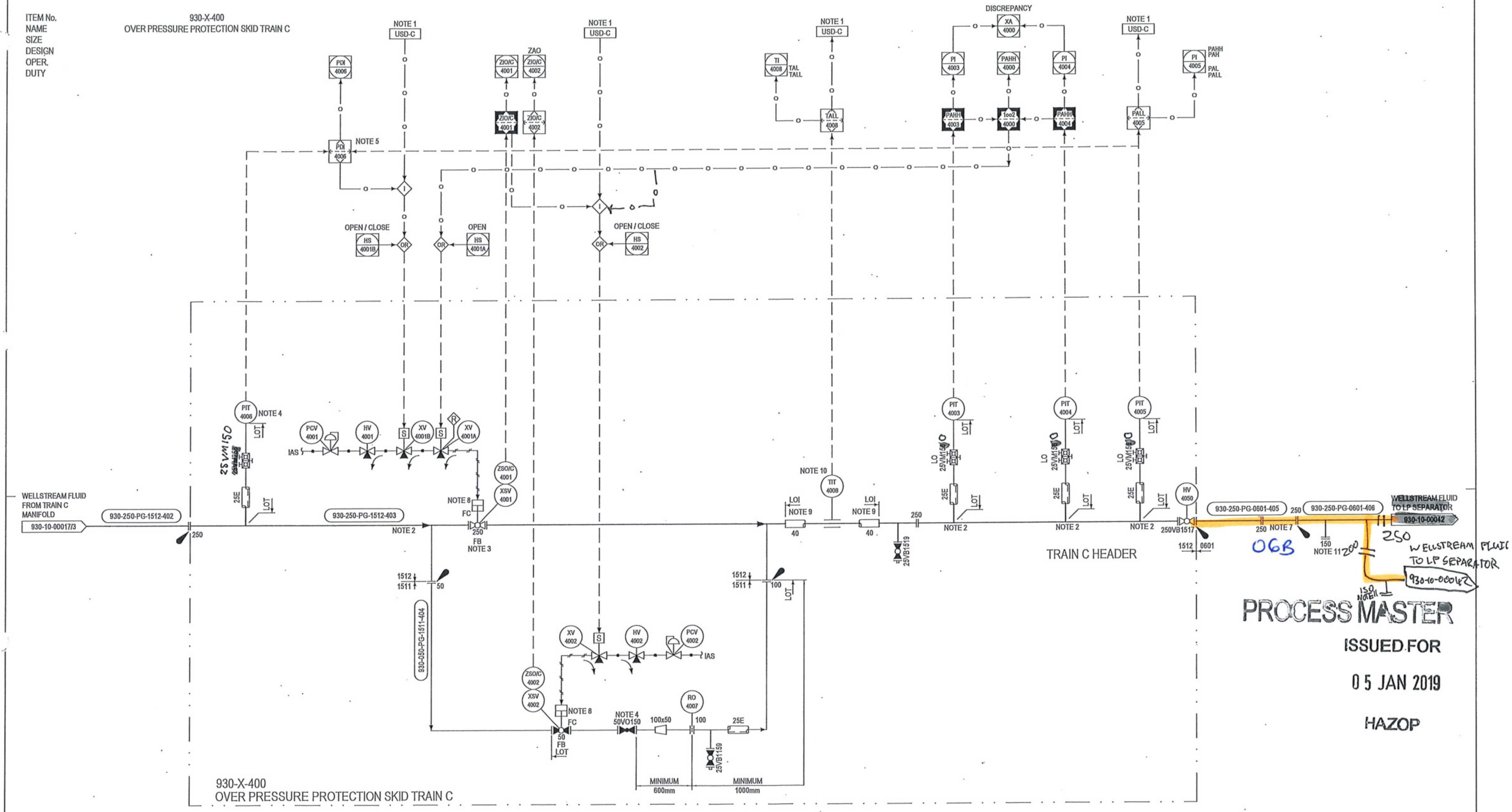
NO	DATE	BY	DESCRIPTION	CHKD	APPR.	CHKD	APPR.	NO	DATE	BY	ECP	DESCRIPTION
A0	01/19	VK	620051 ISSUED FOR HAZOP	DS				0	12/18	VK		FIRST ISSUE
CONSTRUCTION ISSUE				CONSULTANT		TODD		REVISIONS				

DESIGNED G. DAVIDSON 12/18
DRAWN V. KAING 12/18
CHECKED D. STEWART 12/18
APPROVED G. DAVIDSON 12/18

KAPUNI WELLSITES
PIPING & INSTRUMENT DIAGRAM
LTS UNIT B J2
WELLSITE J

Todd Energy

SHEET No 1 of 1 — REVISION A0 0
DRAWING No 930-10-00033(X)



NOTES:

1. THIS P&ID DOES NOT SHOW ALL LOGIC, REFER TO CAUSE & EFFECT MATRIX FOR SHUTDOWN LOGIC.
2. PRESSURE TRANSMITTER TAPPING POINTS & VALVES TO BE HEAT TRACED & INSULATED.
3. TRAIN A SHUTDOWN VALVE XSV-4001 TO BE LOCATED AS CLOSE AS POSSIBLE TO THE CHOKE SKID MANIFOLD, TO MINIMIZE VENTED INVENTORIES.
4. PIT-4006 TO BE READABLE FROM XSV-4002 BYPASS LINE GLOBE VALVE.
5. DIFFERENTIAL PRESSURE MUST BE LESS THAN 10 BAR FOR TRAIN A SHUTDOWN VALVE TO OPEN.
6. VOID.
7. DROP OUT SPOOL FOR FUTURE COOLER TIE-IN.
8. BYPASS VALVE XSV-4002 IS INTERLOCKED WITH XSV-4001 AND WILL CLOSE WHEN XSV-4001 IS OPENED.
9. PIPING TO BE INSULATED WITH NO HEAT TRACT 200mm UPSTREAM & DOWNSTREAM OF TIT WITH 40mm THICK INSULATION
10. TIT-4001 TO BE READABLE FROM BYPASS VALVE XSV-4002.
11. FOR FUTURE LP SEPARATOR BYPASS.

WorleyParsons resources & energy
620051
04.02.19 - 13:20
941-10-27012(X)-1

This drawing is confidential and is the property of TODD ENERGY. It must not be disclosed to any third party or lent without written consent from TODD ENERGY.

NO	DATE	BY	CONSTRUCTION ISSUE	CHKD	APPR.	CHKD	APPR.	NO	DATE	BY	ECP	DESCRIPTION	CHKD	APPR.	CHKD	APPR.	NUMBER	TITLE
A0	02/19	VK	620051 ISSUED FOR HAZOP	DS	GD	.	.	0	12/18	VK	.	FIRST ISSUE	.	.	.	.	.	.
				CONSULTANT		TODD						REVISIONS	CONSULTANT		TODD		REFERENCE DRAWINGS	

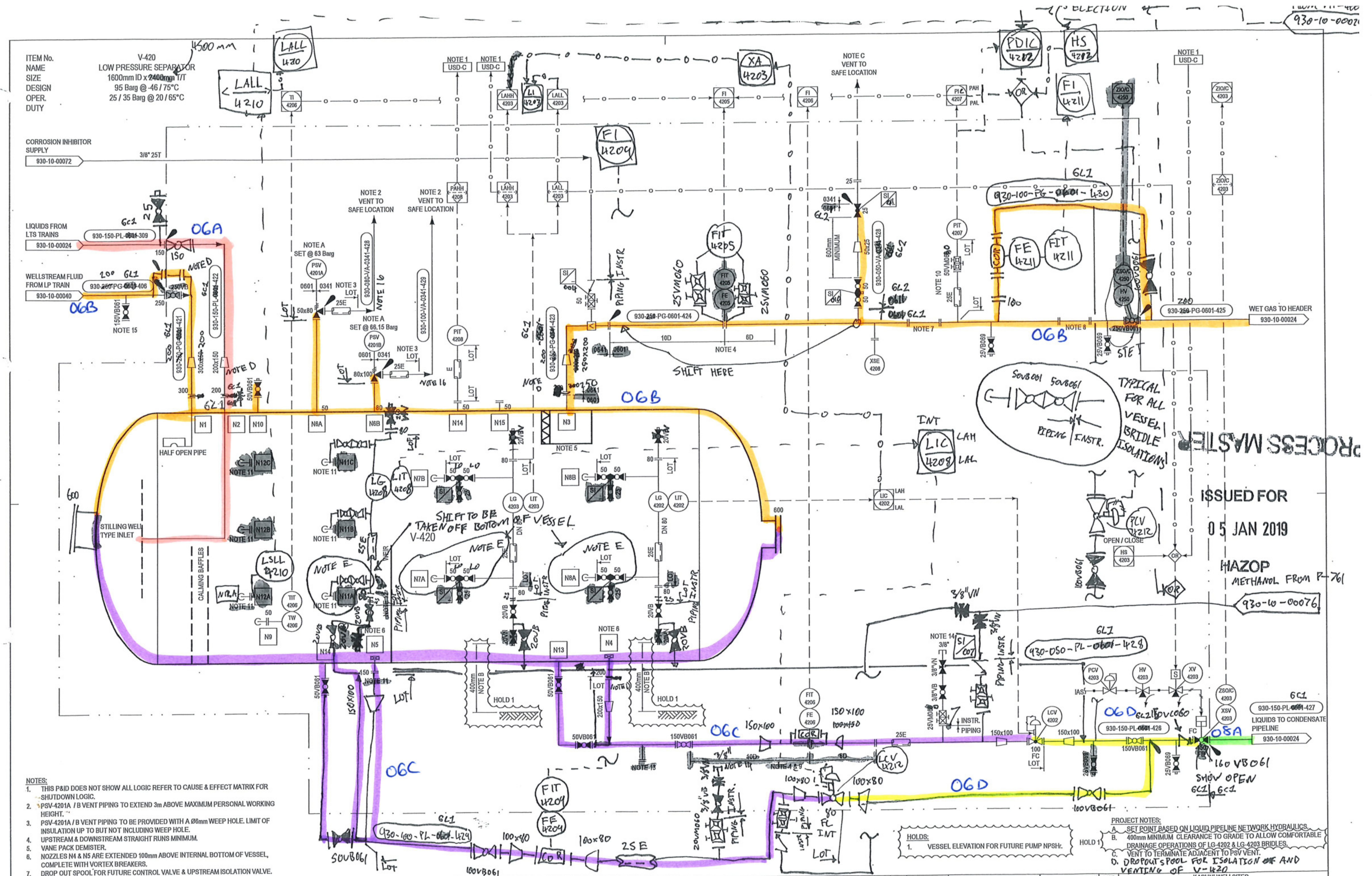
DESIGNED	G. DAVIDSON	DATE
DRAWN	V. KAING	12/18
CHECKED	D. STEWART	12/18
APPROVED	G. DAVIDSON	12/18
APPROVED	.	.
SCALE	.	
STICKFILE		

KAPUNI WELLSITES
PIPING & INSTRUMENT DIAGRAM
OVER PRESSURE SKID TRAIN C
WELLSITE J

Todd Energy

SHEET No 1 OF 1 — REVISION A0 0

DRAWING No 930-10-00040(X)



NOTES:
1. THIS P&ID DOES NOT SHOW ALL LOGIC REFER TO CAUSE & EFFECT MATRIX FOR SHUTDOWN LOGIC.
2. PSV-4201A / B VENT PIPING TO EXTEND 3m ABOVE MAXIMUM PERSONAL WORKING HEIGHT.
3. PSV-4201A / B VENT PIPING TO BE PROVIDED WITH A Ø6mm WEEP HOLE. LIMIT OF INSULATION UP TO BUT NOT INCLUDING WEEP HOLE.
4. UPSTREAM & DOWNSTREAM STRAIGHT RUNS MINIMUM.
5. VANE PACK DEMISTER.
6. NOZZLES N4 & N5 ARE EXTENDED 100mm ABOVE INTERNAL BOTTOM OF VESSEL, COMPLETE WITH VORTEX BREAKERS.
7. DROP OUT SPOOL FOR FUTURE CONTROL VALVE & UPSTREAM ISOLATION VALVE.
8. DROP OUT SPOOL FOR FUTURE CHECK VALVE.
9. DROP OUT SPOOL FOR FUTURE CORIOLIS FLOW METER.
10. PRESSURE TRANSMITTER TAPPING POINTS & VALVES TO BE HEAT TRACED & INSULATED: PIT-4207.
11. CONNECTIONS PROVIDED FOR FUTURE THREE PHASE OPERATION. VOID
12. INTERNAL WEIR TO BE ADJUSTABLE TYPE TO ACCOMMODATE THREE PHASE OPERATION. INITIALLY WEIR NOT INSTALLED, TWO PHASE SEPARATION ONLY. VOID
13. FOR FUTURE METHANOL INJECTION POINT.
14. SAMPLE POINT.
15. TIE-IN FOR WELL SERVICES.
16. RELIEF VALVE OUTLET TO BE PROVIDED WITH A WEEPHOLE. LIMIT OF TRACING TO BE UP TO BUT NOT INCLUDING WEEPHOLE

PROJECT NOTES:
A. SET POINT BASED ON LIQUID PIPELINE NETWORK HYDRAULICS.
B. 400mm MINIMUM CLEARANCE TO GRADE TO ALLOW COMFORTABLE DRAINAGE OPERATIONS OF LG-4202 & LG-4203 BRIDLES.
C. VENT TO TERMINATE ADJACENT TO PSV VENT.
D. DROPOUT SPOOL FOR ISOLATION AND VENTING OF V-420
E. LEVEL BRIDLE NOZZLES TAKEN FROM THE BOTTOM OF THE VESSEL WILL HAVE

WorleyParsons
resources & energy
620051
941-10-27015(X)-1

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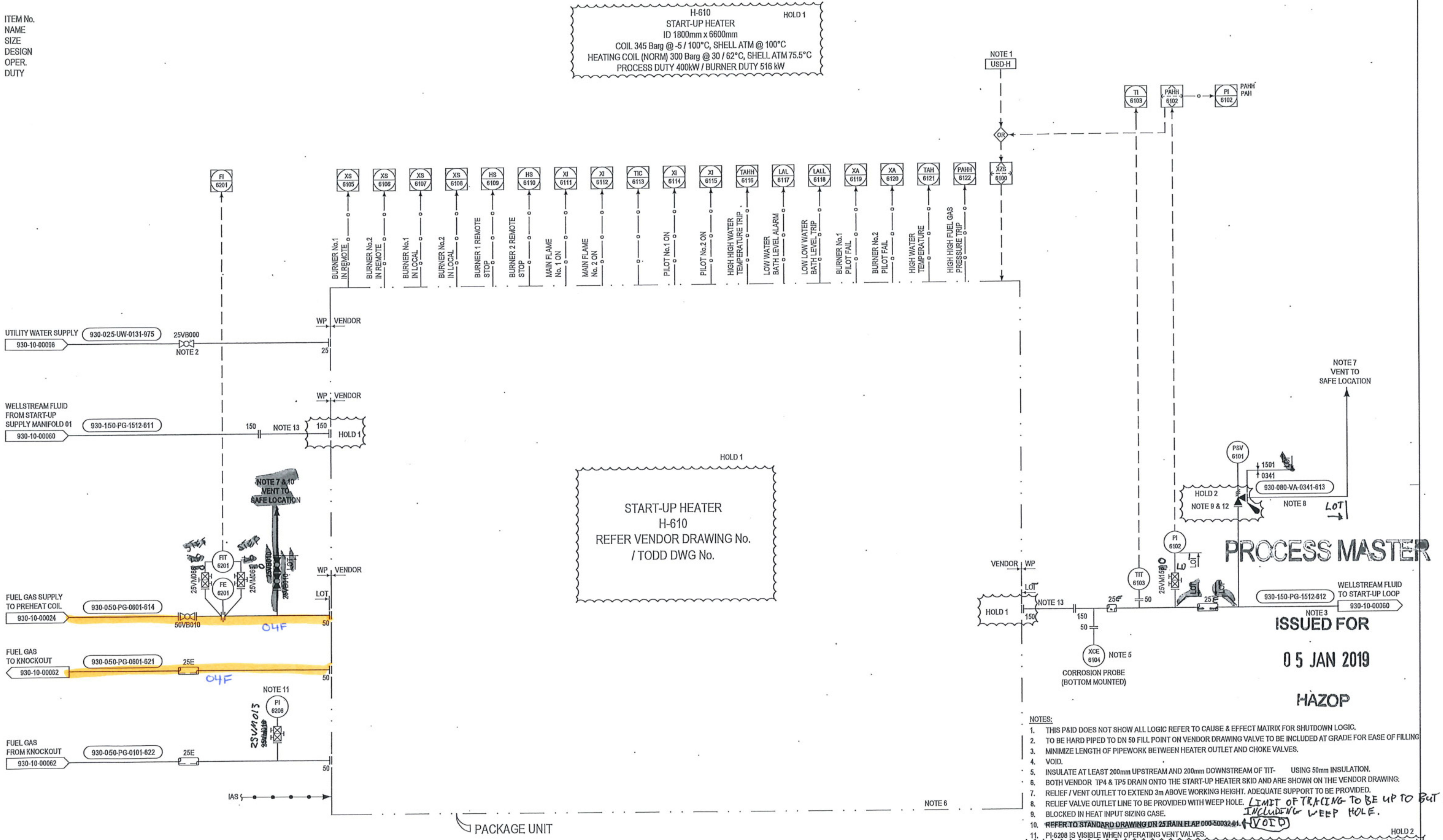
A0	03/19	VK	620051 ISSUED FOR HAZOP					0	12/18	VK		FIRST ISSUE
NO	DATE	BY	CONSTRUCTION ISSUE	CHKD	APPR.	CHKD	APPR.	NO	DATE	BY	ECP	DESCRIPTION
				CONSULTANT		TODD						REVISIONS

DESIGNED G. DAVIDSON	DATE	KAPUNI WELLSITES
DRAWN V. KAING	12/18	PIPING & INSTRUMENT DIAGRAM
CHECKED D. STEWART	12/18	SEPARATOR 930-V-420
APPROVED G. DAVIDSON	12/18	WELLSITE J
APPROVED .	.	
SCALE .		
STICKFILE		

Todd Energy

SHEET No 1 OF 1 | REVISION A0 0

DRAWING No 930-10-00042(X)



NOTES:

1. THIS P&ID DOES NOT SHOW ALL LOGIC REFER TO CAUSE & EFFECT MATRIX FOR SHUTDOWN LOGIC.
2. TO BE HARD PIPED TO DN 50 FILL POINT ON VENDOR DRAWING VALVE TO BE INCLUDED AT GRADE FOR EASE OF FILLING
3. MINIMIZE LENGTH OF PIPEWORK BETWEEN HEATER OUTLET AND CHOKE VALVES.
4. VOID.
5. INSULATE AT LEAST 200mm UPSTREAM AND 200mm DOWNSTREAM OF TIT- USING 50mm INSULATION.
6. BOTH VENDOR TP4 & TP5 DRAIN ONTO THE START-UP HEATER SKID AND ARE SHOWN ON THE VENDOR DRAWING.
7. RELIEF / VENT OUTLET TO EXTEND 3m ABOVE WORKING HEIGHT. ADEQUATE SUPPORT TO BE PROVIDED.
8. RELIEF VALVE OUTLET LINE TO BE PROVIDED WITH WEEP HOLE. LIMIT OF TRACING TO BE UP TO BUT NOT INCLUDING WEEP HOLE.
9. BLOCKED IN HEAT INPUT SIZING CASE.
10. ~~REFER TO STANDARD DRAWING ON 25 RAIN FLAP 000-50032-01.~~ VOID
11. PI-6208 IS VISIBLE WHEN OPERATING VENT VALVES.
12. THE PSV IS SET AT 270 Barg WHICH IS HIGHER THAN DESIGN PRESSURE (AND CITHP) OF THE HEATER COILS (245 Barg). IN ORDER TO AVOID SPURIOUS LIFTING. HOWEVER, ASME B31.3 ALLOWS UP TO A 20% ALLOWANCE FOR PRESSURE VARIATION FOR NO MORE THAN 50 HOURS AT ANY ONE TIME AND NOT MORE THAN 500 HOURS PER YEAR. HOLD 2
13. REMOVABLE SPOOLS FOR HEATER BUNDLE REMOVAL.

HOLDS:

1. DESIGN CONDITIONS OF HEATER
2. CONFIRM PSV SET PRESSURE.

WorleyParsons resources & energy
620051
04.02.19 - 04.11
941-10-27008(X)-1

NO	DATE	BY	CONSTRUCTION ISSUE	CHKD	APPR.	CHKD	APPR.
A0	01/19	VK	620051 ISSUED FOR HAZOP	DS			

NO	DATE	BY	ECP	DESCRIPTION	CHKD	APPR.	CHKD	APPR.
0	12/18	VK		FIRST ISSUE				

REVISIONS — CONSULTANT / TODD — REFERENCE DRAWINGS (NUMBER / TITLE)

DESIGNED	G. DAVIDSON	
DRAWN	V. KAING	12/18
CHECKED	D. STEWART	12/18
APPROVED	G. DAVIDSON	12/18
APPROVED		
SCALE		
STICKFILE		

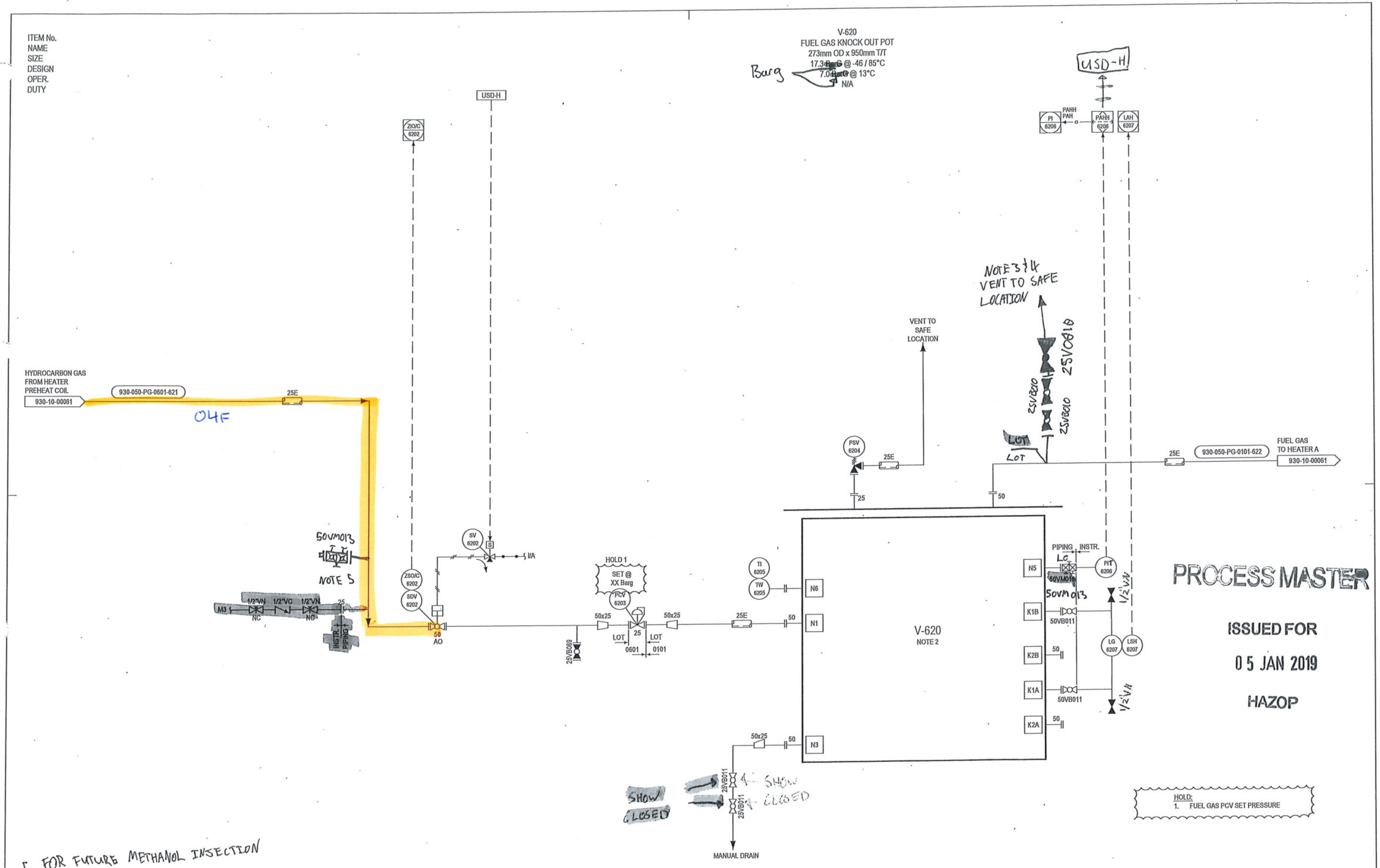
KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM
START UP HEATER SKID
WELLSITE J

Todd Energy

SHEET No 1 OF 1 — REVISION A0 0

DRAWING No 930-10-00061(X)



5. FOR FUTURE METHANOL INJECTION

NOTES:
1. FAL-6204 IS AN EVENT LOG ONLY.
2. RE-USED FUEL GAS KNOCK OUT POT V-2664.
3. RELIEF/VENT OUTLET TO EXTEND 3m ABOVE WORKING HEIGHT. ADEQUATE SUPPORT TO BE PROVIDED
4. REFER TO STANDARD DRAWING DN 25 RAIN FLAP 000-S0032-01

WorleyParsons
resources & energy
620051
04.02.19 - 08.18
941-10-27019(X)-1

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NO	DATE	BY	CONSTRUCTION ISSUE	CHKD	APPR.	CHKD	APPR.	NO	DATE	BY	ECP	DESCRIPTION	CHKD	APPR.	CHKD	APPR.	NUMBER	TITLE
A0	01/19	VK	620051 ISSUED FOR HAZOP	DS				0	12/18	VK		FIRST ISSUE						

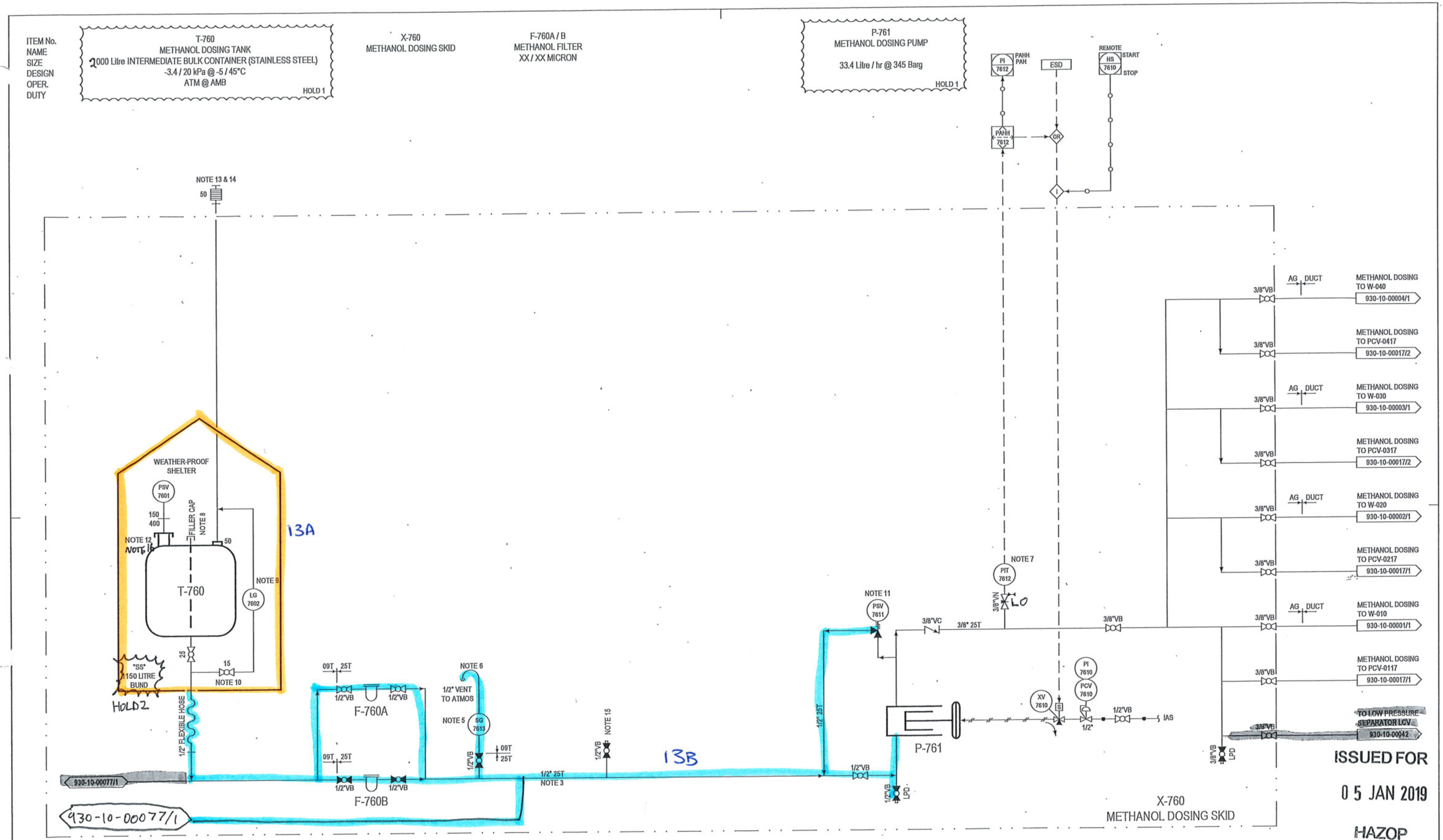
CONSULTANT | TODD | REVISIONS | CONSULTANT | TODD | REFERENCE DRAWINGS

DESIGNED	G. DAVIDSON	
DRAWN	V. KAING	12/18
CHECKED	D. STEWART	12/18
APPROVED	G. DAVIDSON	12/18
APPROVED		
SCALE		
STICKFILE		

KAPUNI WELLSITES
PIPING & INSTRUMENT DIAGRAM
FUEL GAS CONDITIONING
WELLSITE J

Todd Energy

SHEET No 1 OF 1
REVISION A0 0
DRAWING No 930-10-00062(X)



ISSUED FOR

05 JAN 2019

HAZOP

PROCESS MASTER

NOTES:

1. THIS P&ID DOES NOT SHOW ALL LOGIC, REFER TO CAUSE & EFFECT MATRIX FOR SHUTDOWN LOGIC.
2. VOID.
3. PUMP SUCTION LINE TO BE FLOODED AT ALL TIMES.
4. VOID.
5. BOTTOM OF SIGHT GLASS TO BE LOCATED TBC mm BELOW MIN. LEVEL IN T-760
6. TOP OF VENT TO BE LOCATED ABOVE TOP OF TANK T-760
7. ENSURE PIT- 7612 READABLE FROM PUMP P-761.
8. FILLING CONNECTION WITH DIP LEG TO IBC BOTTOM TO ALLOW BOTTOM FILLING.
9. SIGHT GLASS WITH 0-1000L SCALE.
10. SS DRIP TRAY REQUIRED WITHIN BIND.
11. ~~PSV SPECIFIED FOR 380 Barg TO COVER WORST CASE CITHP OF 345 Barg. PSV HAS AN ADJUSTABLE SPRING RANGE DOWN TO 345 Barg SO IT CAN BE REQUIRED IF ACTUAL CITHPS ARE LOWER.~~
PSV SPECIFIED FOR 264 Barg TO COVER WORST CASE CITHP OF 240 Barg.
12. EMERGENCY MANHOLE COVER 6" VENT INSTALLED WITH MECHANICAL RESTRAINT TO PREVENT TOTAL BLOW OFF. SET AT 3.4 kPa.
13. FLAME ARRESTOR WITH WEATHER PROOF HOOD.
14. OPERATIONAL VENT TO DISCHARGE TO SAFE LOCATION AT LEAST 3m ABOVE WORKING HEIGHT.
15. TIE-IN POINT FOR FUTURE METHANOL SUPPLY.
16. TANKER MUST BE EARTHED DURING TANK FILLING

HOLDS:
1. DESIGN CONDITIONS FOR CHEMICAL INJECTION UNITS
2. BUNDING REQUIREMENTS TBC

WorleyParsons
resources & energy
620051
930-10-00076(X)-1

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NO	DATE	BY	CONSTRUCTION ISSUE	CHKD	APPR.	CHKD	APPR.	NO	DATE	BY	ECP	DESCRIPTION	CHKD	APPR.	CHKD	APPR.
A0	01/19	VK	620051 ISSUED FOR HAZOP	DS	GD	.	.	0	12/18	VK	.	FIRST ISSUE	.	.	.	.

CONSULTANT | TODD | REVISIONS | CONSULTANT | TODD

NUMBER | TITLE — REFERENCE DRAWINGS

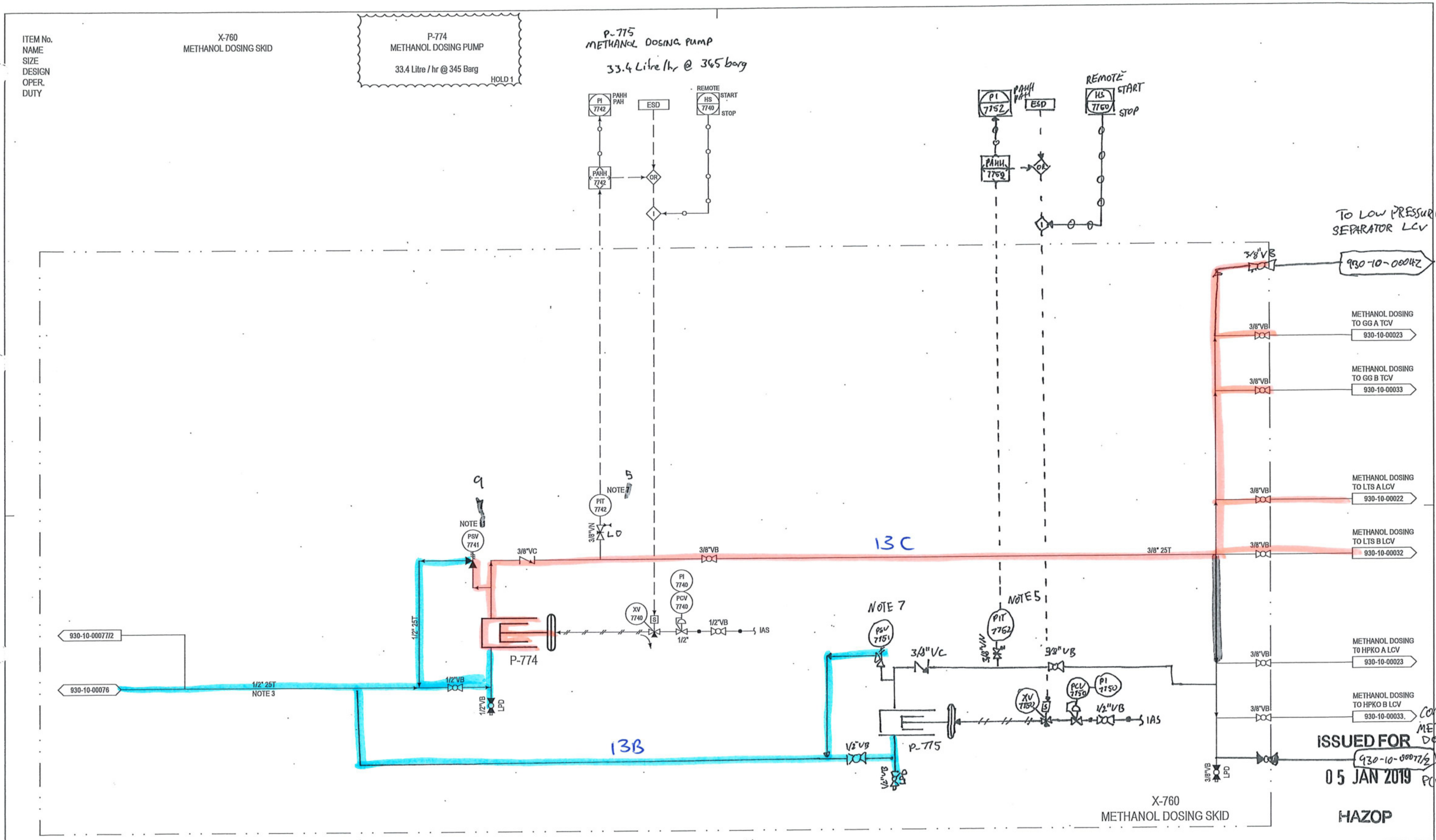
DESIGNED	G. DAVIDSON	12/18
DRAWN	V. KAING	12/18
CHECKED	D. STEWART	12/18
APPROVED	G. DAVIDSON	12/18
APPROVED		
SCALE		
STICKFILE		

KAPUNI WELLSITES
PIPING & INSTRUMENT DIAGRAM
DOSING SUPPLY METHANOL
WELLSITE J

Todd Energy

SHEET No 1 OF 1 | REVISION A0 0

DRAWING No 930-10-00076(X)



7. PSV SPECIFIED FOR 145 Barg

9. PSV SPECIFIED FOR 70 Barg

NOTES:

1. THIS P&ID DOES NOT SHOW ALL LOGIC, REFER TO CAUSE & EFFECT MATRIX FOR SHUTDOWN LOGIC.
2. VOID.
3. PUMP SUCTION LINE TO BE FLOODED AT ALL TIMES.
4. VOID.
5. ENSURE PIT-7742 AND PIT-7752 READABLE FROM PUMP P-774 AND P-775
6. SS DRIP TRAY REQUIRED WITHIN BIND.
7. ~~PSV SPECIFIED FOR 380 Barg TO COVER WORST CASE CITHP OF 345 Barg. PSV HAS AN ADJUSTABLE SPRING RANGE DOWN TO 345 Barg SO IT CAN BE REQUIRED IF ACTUAL CITHPS ARE LOWER.~~
8. TIE-IN POINT FOR FUTURE METHANOL SUPPLY.

HOLDS:
1. DESIGN CONDITIONS FOR CHEMICAL INJECTION UNITS

WorleyParsons resources & energy
620051
930-10-00077(X)-1

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NO	DATE	BY	CONSTRUCTION ISSUE	CHKD	APPR.	CHKD	APPR.	NO	DATE	BY	ECP	DESCRIPTION
A0	01/19	VK	620051 ISSUED FOR HAZOP	DS	GD			0	12/18	VK		FIRST ISSUE

CONSULTANT / TODD — REVISIONS — NUMBER / TITLE — REFERENCE DRAWINGS

DESIGNED	G. DAVIDSON	12/18
DRAWN	V. KAING	12/18
CHECKED	D. STEWART	12/18
APPROVED	G. DAVIDSON	12/18
APPROVED		
SCALE		
STICKFILE		

KAPUNI WELLSITES
PIPING & INSTRUMENT DIAGRAM
DOSING SUPPLY METHANOL
WELLSITE J

Todd Energy

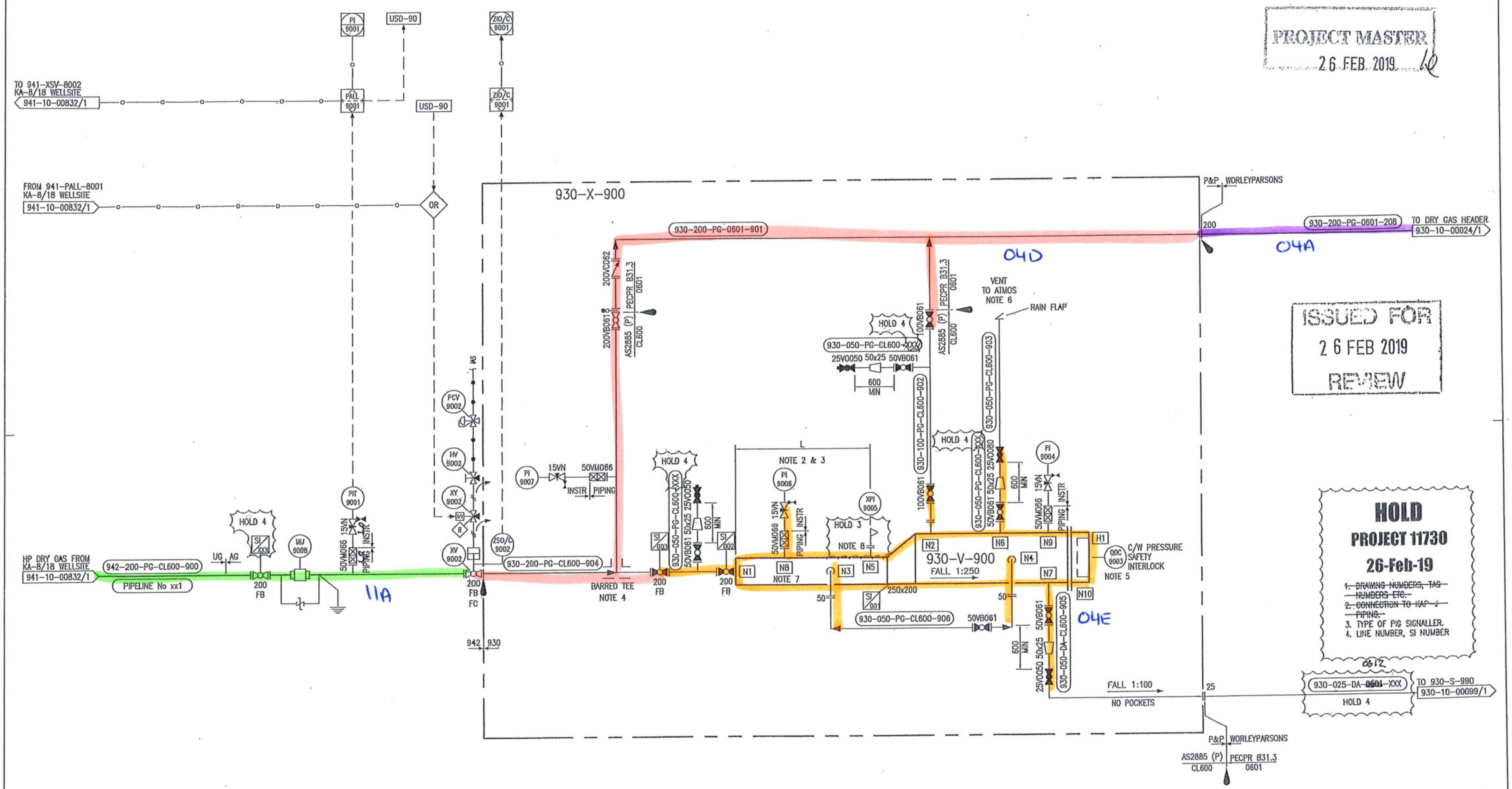
SHEET No 1 OF 2 — REVISION A0 0

DRAWING No 930-10-00077(X)

ITEM No		930-X-900	930-V-900
NAME	KA-8/12/15/18 HP DRY GAS PIPELINE	PIG RECEIVER SKID	KAP-J HP DRY GAS PIPELINE PIG RECEIVER
SIZE	DN200	DN200	DN200
DESIGN	70 barg @ -10/60 °C	-	70 barg @ -10/60 °C
OPER	45/55 barg @ 10/35 °C	-	45/55 barg @ 10/35 °C
DUTY			

PROJECT MASTER 26 FEB 2019

ISSUED FOR 26 FEB 2019 REVIEW



HOLD
PROJECT 11730
26-Feb-19

1. ~~DRAWING NUMBERS, TAG NUMBERS ETC.~~
2. ~~CONNECTION TO KAP-J PIPING.~~
3. TYPE OF PIG SIGNALLER.
4. LINE NUMBER, SI NUMBER

GENERAL NOTES

1. REFER TO CAUSE & EFFECT MATRIX FOR SHUTDOWN LOGIC.
2. PROVISIONS TO BE MADE FOR PIG RECEIVER FOR INTELLIGENT PIGGING.
3. L=MIN LENGTH EQUAL TO MAX LENGTH OF INTELLIGENT PIG.
4. BARRED TEES NOT TO HAVE INTERNAL DIAMETER REDUCED.
5. QUICK OPENING CLOSURE TO BE FLANGED. QUICK OPENING CLOSURE TO BE VERTICAL.
6. VENT TO BE MINIMUM OF 3 m ABOVE WORKING LEVEL.
7. PIPELINE & PIPELINE ASSEMBLIES UNDER AS2885(P) SPEC.
8. CLAMP ON TYPE PIG SIGNALLER HOLD 3

ALL NEW WORK
PROJECT K1706 (11730)

A1 TO A3

NO	DATE	BY	CONSTRUCTION ISSUE	CHKD	APPR.	CHKD	APPR.
A3	02/19	RC	ISSUED FOR DETAIL DESIGN - K1706 (11730)	GPP		FC	FB
A2	03/19	GRP	ISSUED FOR HAZOP - K1706 (11730)	TVH	FK	RC	KB
A1	05/18	GRP	ISSUED FOR REVIEW - K1706 (11730)	SAR	KK	AF	FB

NUMBER	TITLE
930-XX-00090/1	930-V-900 PIG RECEIVER
930-XX-XXXX/XX	CAUSE AND EFFECT MATRIX

REFERENCE DRAWINGS

JOB NO. 11730

P+P ENGINEERING CONSULTANTS

		DATE
DESIGNED	J THOMAS	05/18
DRAWN	G PARKER	05/18
CHECKED	S ROWE	05/18
APPROVED	K KRUTZ	05/18
APPROVED	A FAKE	05/18
SCALE	NONE	

KAPUNI WELLSITES

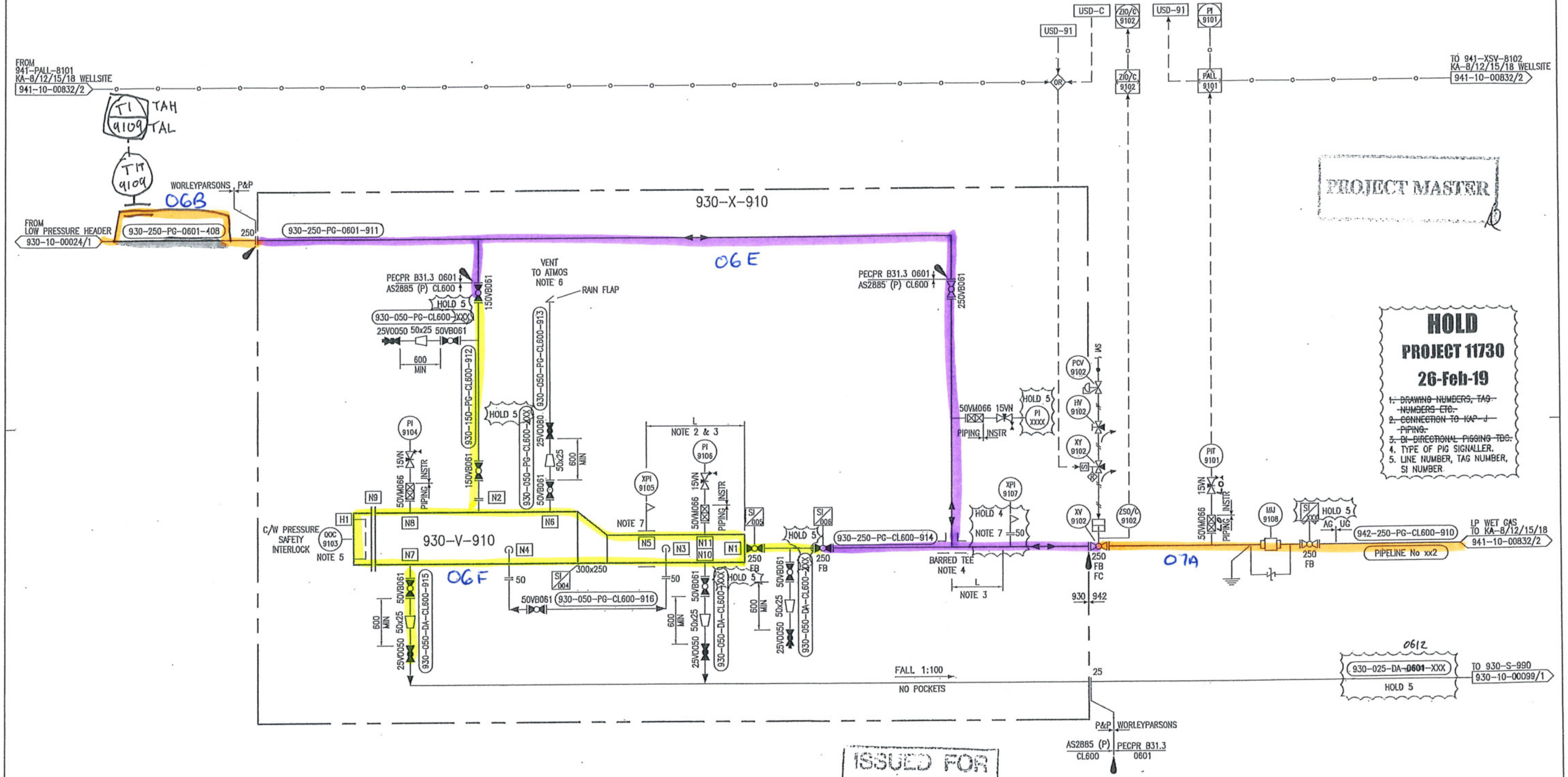
PIPING & INSTRUMENT DIAGRAM
KA-8/12/15/18 TO KAP-J - xx1 LINE
DN200 930-V-900 PIG RECEIVER

Todd Energy

SHEET No 1 of 1 REVISION A3

DRAWING No 930-10-00090-01(X)

	930-V-910	930-X-910	
ITEM No	930-V-910	930-X-910	
NAME	KAP-J LP WET GAS PIPELINE PIG LAUNCHER/RECEIVER	PIG LAUNCHER/RECEIVER SKID	KAP-J LP WET GAS PIPELINE
SIZE	DN250	DN250	DN250
DESIGN	70 barg @ -10/60 °C	-	70 barg @ -10/60 °C
OPER	20/30 barg @ 10/30 °C	-	20/30 barg @ 10/30 °C
DUTY			



ISSUED FOR
26 FEB 2019
REVIEW

GENERAL NOTES
1. REFER TO CAUSE & EFFECT MATRIX FOR SHUTDOWN LOGIC.
2. PROVISIONS TO BE MADE FOR PIG LAUNCHER/RECEIVER FOR INTELLIGENT PIGGING.
3. L=MIN LENGTH EQUAL TO MAX LENGTH OF INTELLIGENT PIG.
4. BARRED TEES NOT TO HAVE INTERNAL DIAMETER REDUCED.
5. QUICK OPENING CLOSURE TO BE FLANGED. QUICK OPENING CLOSURE TO BE VERTICAL.
6. VENT TO BE MINIMUM OF 3 m ABOVE WORKING LEVEL.
7. CLAMP ON TYPE PIG SIGNALLER HOLD 4

ALL NEW WORK
PROJECT K1706 (11730)

A1 TO A3

JOB NO. 11730

P+P ENGINEERING CONSULTANTS

NO	DATE	BY	CONSTRUCTION ISSUE	CHKD	APPR.	CHKD	APPR.
A3	02/19	KC	ISSUED FOR DETAIL DESIGN - K1706 (11730)	GRP	JAT	RG	FB
A2	01/19	GRP	ISSUED FOR HAZOP - K1706 (11730)	TVH	KK	RG	FB
A1	05/18	GRP	ISSUED FOR REVIEW - K1706 (11730)	SAR	KK	AF	KB

NUMBER	TITLE
930-XX-0000001	930-V-910 PIG RECEIVER
930-XX-0000XXX	CAUSE AND EFFECT MATRIX

REFERENCE DRAWINGS

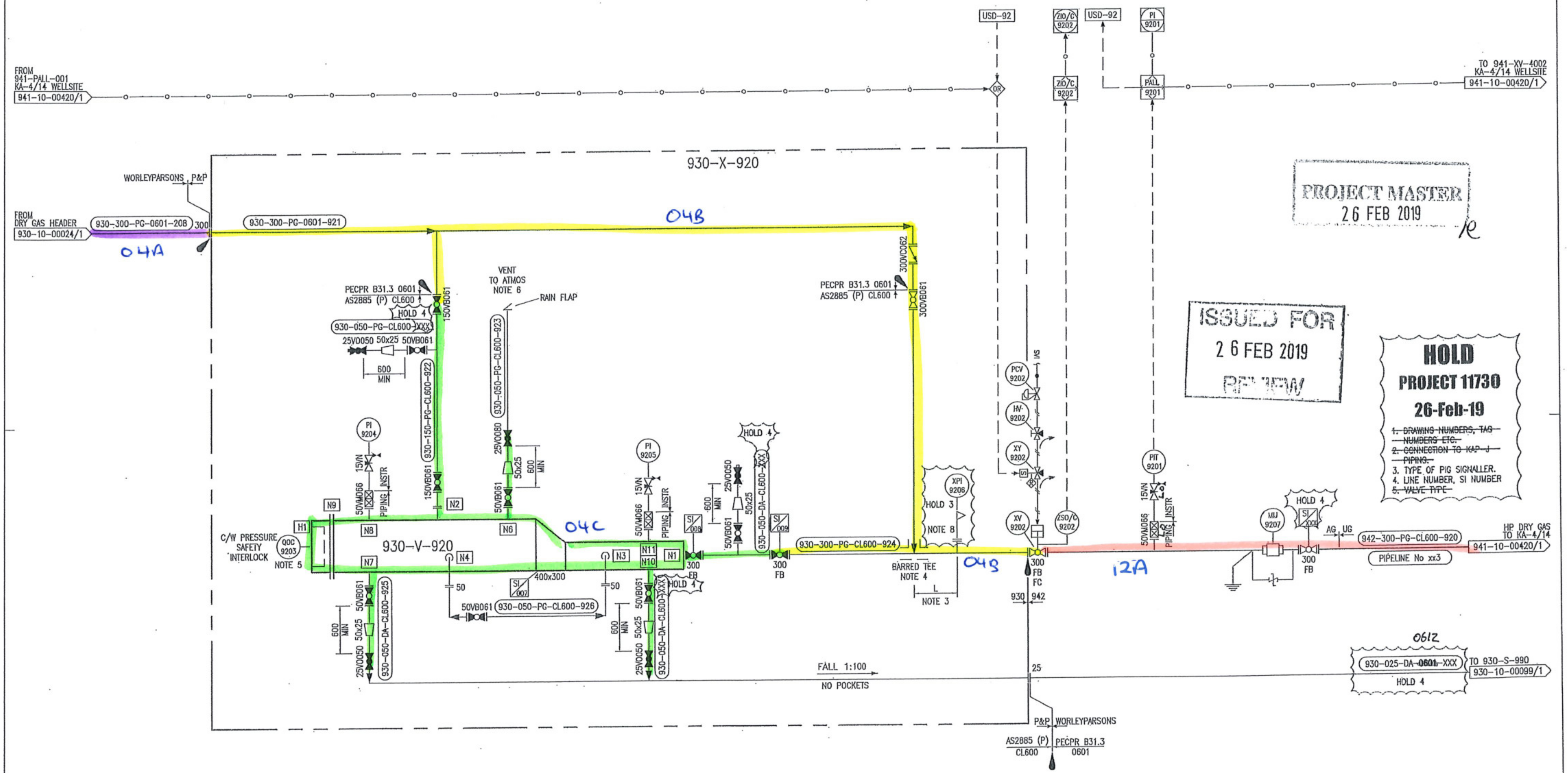
		DATE
DESIGNED	J THOMAS	05/18
DRAWN	G PARKER	05/18
CHECKED	S ROWE	05/18
APPROVED	K KRUTZ	05/18
APPROVED	A FAKE	05/18
SCALE	NONE	

KAPUNI WELLSITES
PIPING & INSTRUMENT DIAGRAM
KAP-J TO KA-8/12/15/18 - xx2 LINE
DN250 930-V-910 PIG LAUNCHER/RECEIVER

Todd Energy

SHEET No 1 of 1 — REVISION A3
DRAWING No 930-10-00091-01(X)

ITEM No	930-V-920	930-X-920	KA-4/14 HP DRY GAS PIPELINE
NAME	KAP-J HP DRY GAS PIPELINE PIG LAUNCHER	PIG LAUNCHER SKID	
SIZE	DN300	DN300	DN300
DESIGN	70 barg @ -10/60 °C	-	70 barg @ -10/60 °C
OPER	40/55 barg @ 10/35 °C	-	40/55 barg @ 10/35 °C
DUTY			



GENERAL NOTES
1. REFER TO CAUSE & EFFECT MATRIX FOR SHUTDOWN LOGIC.
2. PROVISIONS TO BE MADE FOR PIG LAUNCHER FOR INTELLIGENT PIGGING.
3. L=MIN LENGTH EQUAL TO MAX LENGTH OF INTELLIGENT PIG.
4. BARRED TEES NOT TO HAVE INTERNAL DIAMETER REDUCED.
5. QUICK OPENING CLOSURE TO BE FLANGED. QUICK OPENING CLOSURE TO BE VERTICAL.
6. VENT TO BE MINIMUM OF 3 m ABOVE WORKING LEVEL.
7. PIPELINE & PIPELINE ASSEMBLIES UNDER AS2885(P) SPEC.
8. CLAMP ON TYPE PIG SIGNALLER HOLD 3

ALL NEW WORK
PROJECT K1706 (11730)

A1 TO A3

JOB NO. 11730

P+P ENGINEERING CONSULTANTS

NO	DATE	BY	CONSTRUCTION ISSUE	CHKD	APPR.	CHKD	APPR.
A3	03/19	PD	ISSUED FOR DETAIL DESIGN - K1706 (11730)	GRP	JMT	RG	KB
A2	03/19	GRP	ISSUED FOR HAZOP - K1706 (11730)	TVH	KK	RG	KB
A1	05/18	GRP	ISSUED FOR REVIEW - K1706 (11730)	SAR	KK	AF	KB

NUMBER	TITLE
930-XX-00001	930-V-920 PIG LAUNCHER
930-XX-00XXXX	CAUSE AND EFFECT MATRIX

		DATE
DESIGNED	J THOMAS	05/18
DRAWN	G PARKER	05/18
CHECKED	S ROWE	05/18
APPROVED	K KRUTZ	05/18
APPROVED	A FAKE	05/18
SCALE	NONE	

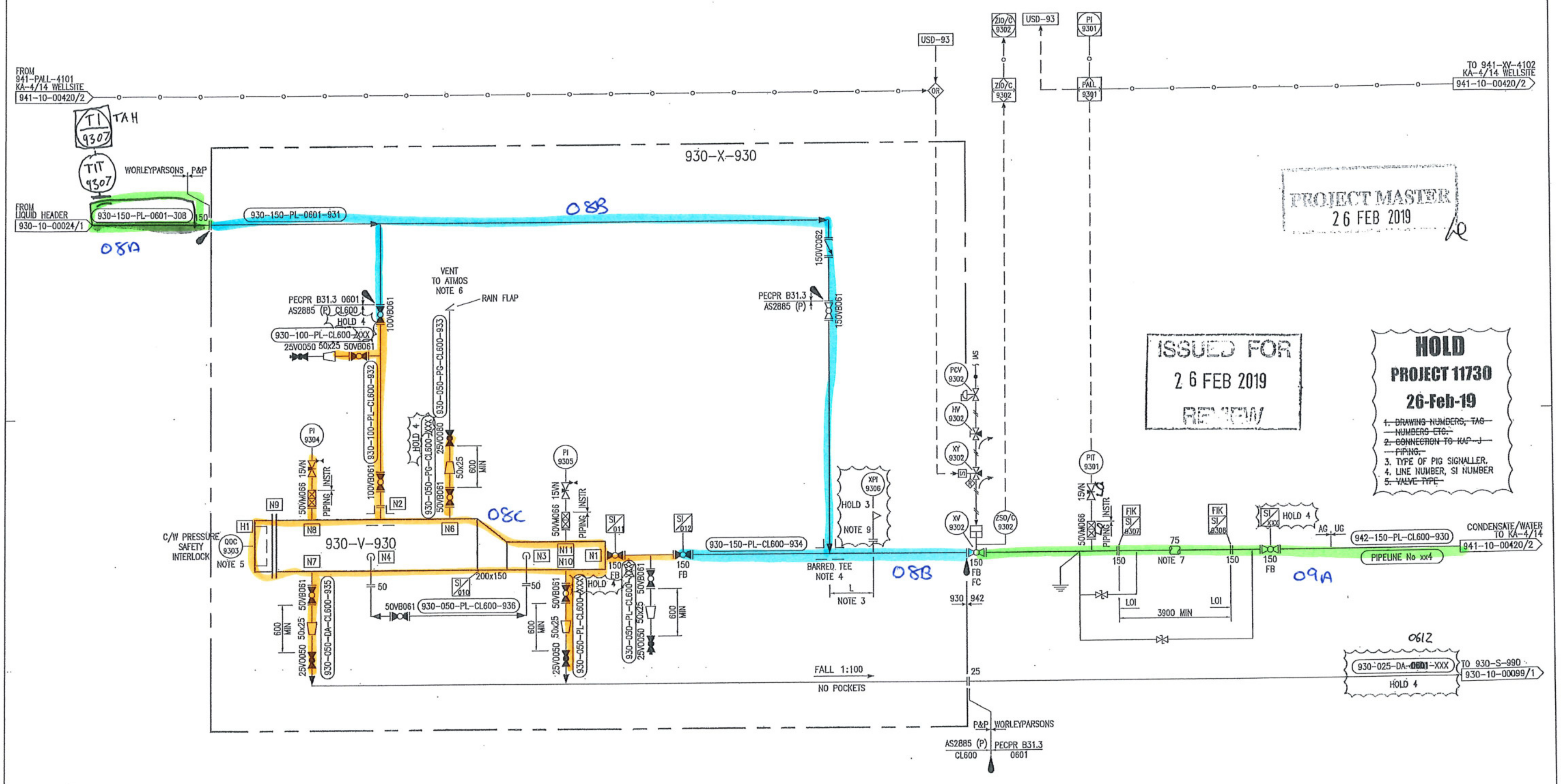
KAPUNI WELLSITES
PIPING & INSTRUMENT DIAGRAM
KAP-J TO KA-4/14 - xx3 LINE
DN300 930-V-920 PIG LAUNCHER

Todd Energy

SHEET No 1 of 1 — REVISION A3

DRAWING No 930-10-00092-01(X)

ITEM No	930-V-930	930-X-930	KA-4/14 CONDENSATE/WATER PIPELINE
NAME	KAP-J CONDENSATE/WATER PIPELINE PIG LAUNCHER	PIG LAUNCHER SKID	
SIZE	DN150	DN150	DN150
DESIGN	70 barg @ -10/60 °C	70 barg @ -10/60 °C	70 barg @ -10/60 °C
OPER	20/25 barg @ 15/30 °C	20/25 barg @ 15/30 °C	20/25 barg @ 15/30 °C
DUTY			



GENERAL NOTES
1. REFER TO CAUSE & EFFECT MATRIX FOR SHUTDOWN LOGIC.
2. PROVISIONS TO BE MADE FOR PIG LAUNCHER FOR INTELLIGENT PIGGING.
3. L=MIN LENGTH EQUAL TO MAX LENGTH OF INTELLIGENT PIG.
4. BARRED TEES NOT TO HAVE INTERNAL DIAMETER REDUCED.
5. QUICK OPENING CLOSURE TO BE FLANGED. QUICK OPENING CLOSURE TO BE VERTICAL.
6. VENT TO BE MINIMUM OF 3m ABOVE WORKING LEVEL.
7. CATHODIC PROTECTION ISOLATION SPOOL. SPOOL ONLY TO BE INSULATED TO MINIMISE RADIAL TEMP GRADIENT PREVENTING MOISTURE MIGRATION ACROSS INTERNAL COATING, WHICH CAN CAUSE INTERNAL COATING TO DETACH FROM PIPE INTERNAL SURFACE.
8. PIPELINE & PIPELINE ASSEMBLIES UNDER AS2885(P) SPEC.
9. CLAMP ON TYPE PIG SIGNALLER HOLD 3

ALL NEW WORK
PROJECT K1706 (11730)

A1 TO A3

JOB NO. 11730

P+P ENGINEERING CONSULTANTS

NO	DATE	BY	DESCRIPTION	CHKD	APPR.	CHKD	APPR.
A3	03/19		ISSUED FOR DETAIL DESIGN - K1706 (11730)	GFP		RC	KB
A2	03/19	GFP	ISSUED FOR HAZOP - K1706 (11730)	TVH	YK	RG	KB
A1	05/18	GFP	ISSUED FOR REVIEW - K1706 (11730)	SAR	KK	AF	KB
			CONSTRUCTION ISSUE	CONSULTANT		TODD	

NUMBER	TITLE
930-XX-000001	930-V-930 PIG LAUNCHER
930-XX-000XXX	CAUSE AND EFFECT MATRIX

REFERENCE DRAWINGS

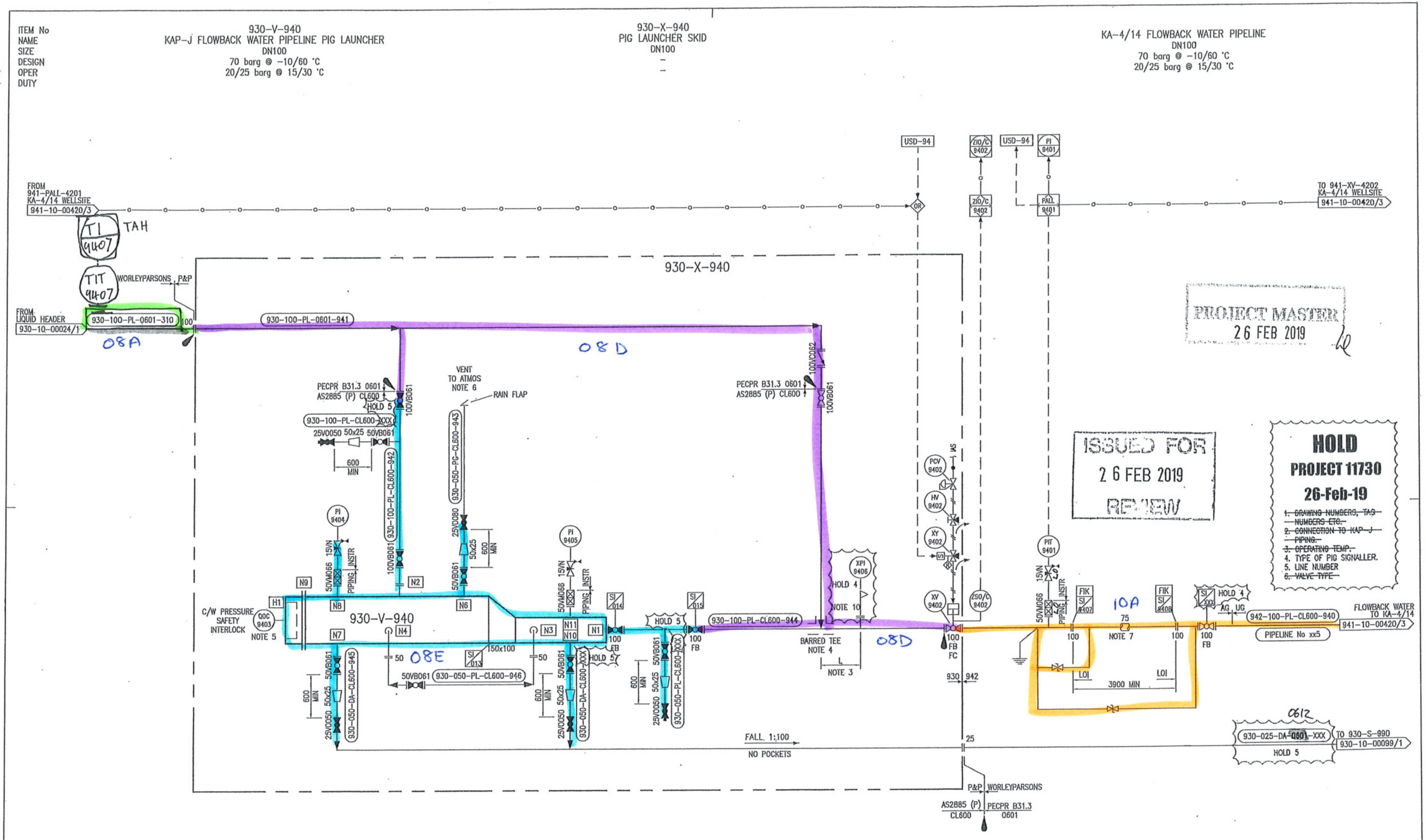
		DATE
DESIGNED	J THOMAS	05/18
DRAWN	G PARKER	05/18
CHECKED	S ROWE	05/18
APPROVED	K KRUTZ	05/18
APPROVED	A FAKE	05/18
SCALE	NONE	

KAPUNI WELLSITES
PIPING & INSTRUMENT DIAGRAM
KAP-J TO KA-4/14 - xx4 LINE
DN150 930-V-930 PIG LAUNCHER

Todd Energy

SHEET No 1 of 1 — REVISION A3

DRAWING No 930-10-00093-01(X)



GENERAL NOTES
1. REFER TO CAUSE & EFFECT MATRIX FOR SHUTDOWN LOGIC.
2. VOID.
3. L=MIN LENGTH EQUAL TO MAX LENGTH OF INTELLIGENT PIG.
4. BARRED TEES NOT TO HAVE INTERNAL DIAMETER REDUCED.
5. VOID.
6. VOID.
7. CATHODIC PROTECTION ISOLATION SPOOL. SPOOL ONLY TO BE INSULATED TO MINIMISE RADIAL TEMP GRADIENT PREVENTING MOISTURE MIGRATION ACROSS INTERNAL COATING, WHICH CAN CAUSE INTERNAL COATING TO DETACH FROM PIPE INTERNAL SURFACE.
8. TEMPORARY LAUNCHER TO BE USED.
9. PIPELINE & PIPELINE ASSEMBLIES UNDER AS2885(P) SPEC.
10. CLAMP ON TYPE PIG SIGNALLER HOLD 4

ALL NEW WORK
PROJECT K1706 (11730)

A1 TO A3

JOB NO. 11730

P+P ENGINEERING CONSULTANTS

NO	DATE	BY	CONSTRUCTION ISSUE	CONSULTANT		TODD	
A3	03/19	KC	ISSUED FOR DETAIL DESIGN - K1706 (11730)	GFP	JST	RC	FB
A2	04/19	GFP	ISSUED FOR HAZOP - K1706 (11730)	TVH	KK	RC	FB
A1	05/18	GFP	ISSUED FOR REVIEW - K1706 (11730)	SAR	KK	AF	FB

NUMBER	TITLE
930-XX-000XX/1	930-V-940 PIG LAUNCHER
930-XX-000XX/X	CAUSE AND EFFECT MATRIX

REFERENCE DRAWINGS

		DATE
DESIGNED	J THOMAS	
DRAWN	G PARKER	05/18
CHECKED	S ROWE	05/18
APPROVED	K KRUTZ	05/18
APPROVED	A FAKE	05/18
SCALE	NONE	

KAPUNI WELLSITES
PIPING & INSTRUMENT DIAGRAM
KAP-J TO KA-4/14 - xx5 LINE
DN100 930-V-940 PIG LAUNCHER

Todd Energy

SHEET No 1 of 1
REVISION A3
DRAWING No 930-10-00094-01(X)

Appendix 3.
Parts Count Sheets

Drilling Operations
Release Frequency Summary

No	QRA Event		1 - 3 mm (2 mm)	3 - 10 mm (7 mm)	10 - 50 mm (30 mm)	50 - 150 mm (100 mm)	> 150 mm (Full bore rupture)	TOTAL
1	J01A_W001Blow_V	J01A					8.10E-04	8.10E-04
2	J01B_W002Blow_V	J01B					8.10E-04	8.10E-04
3	J01C_W003Blow_V	J01C					8.10E-04	8.10E-04
4	J01D_W004Blow_V	J01D					8.10E-04	8.10E-04
		TOTAL					3.24E-03	3.24E-03

Normal Operations
Release Frequency Summary

No	QRA Event		1 - 3 mm (2 mm)	3 - 10 mm (6 mm)	10 - 50 mm (22 mm)	50 - 150 mm (85 mm)	> 150 mm (Rupture)	TOTAL	% Contribution
1	J01A_W001Blow_V	J01A					4.40E-05	4.40E-05	0.02%
2	J01B_W002Blow_V	J01B					4.40E-05	4.40E-05	0.02%
3	J01C_W003Blow_V	J01C					4.40E-05	4.40E-05	0.02%
4	J01D_W004Blow_V	J01D					4.40E-05	4.40E-05	0.02%
5	J01E_W001WRel_V	J01E	1.31E-05	4.57E-06	1.57E-06	2.61E-07	1.05E-06	2.05E-05	0.01%
6	J01F_W002WRel_V	J01F	1.31E-05	4.57E-06	1.57E-06	2.61E-07	1.05E-06	2.05E-05	0.01%
7	J01G_W003WRel_V	J01G	1.31E-05	4.57E-06	1.57E-06	2.61E-07	1.05E-06	2.05E-05	0.01%
8	J01H_W004WRel_V	J01H	1.31E-05	4.57E-06	1.57E-06	2.61E-07	1.05E-06	2.05E-05	0.01%
9	J02A_W001Flow_V	J02A	4.02E-03	1.80E-03	1.11E-03	1.81E-04		7.12E-03	3.40%
10	J02B_W001ChIn_V	J02B	2.17E-03	8.83E-04	4.71E-04	9.64E-05		3.63E-03	1.73%
11	J02C_ChMani_V	J02C	1.12E-02	4.59E-03	2.53E-03	4.05E-04	1.08E-05	1.88E-02	8.98%
12	J02D_W002Flow_V	J02D	4.02E-03	1.80E-03	1.11E-03	1.81E-04		7.12E-03	3.40%
13	J02E_W002ChIn_V	J02E	2.17E-03	8.83E-04	4.71E-04	9.64E-05		3.63E-03	1.73%
14	J02F_W003Flow_V	J02F	4.02E-03	1.80E-03	1.11E-03	1.81E-04		7.12E-03	3.40%
15	J02G_W003ChIn_V	J02G	2.17E-03	8.83E-04	4.71E-04	9.64E-05		3.63E-03	1.73%
16	J02H_W004Flow_V	J02H	2.01E-03	8.28E-04	4.07E-04	2.47E-05		7.12E-03	3.40%
17	J02I_W004ChIn_V	J02I	2.17E-03	8.83E-04	4.71E-04	9.64E-05		3.63E-03	1.73%
18	J03A_TrAHeader_V	J03A	4.02E-03	1.80E-03	1.11E-03	1.81E-04		7.12E-03	3.40%
19	J03B_HPKOAVap_V	J03B	5.55E-03	2.50E-03	1.26E-03	2.05E-04	8.28E-05	9.60E-03	4.59%
20	J03C_HPKOALiq_L	J03C	2.22E-03	9.68E-04	5.78E-04	7.23E-05	7.39E-06	3.85E-03	1.84%
21	J03D_LTSAVap_V	J03D	8.11E-03	3.54E-03	1.84E-03	3.14E-04	1.18E-04	1.39E-02	6.66%
22	J03E_LTSALiq_L	J03E	3.92E-03	1.66E-03	8.85E-04	6.36E-05	1.16E-05	6.53E-03	3.12%
23	J03F_HPKOALCV_L	J03F	1.64E-04	6.13E-05	3.84E-05	1.52E-05		2.79E-04	0.13%
25	J03G_LiqToLTSA_L	J03G	5.04E-04	1.94E-04	9.97E-05	5.29E-05		8.51E-04	0.41%
26	J03H_LTSALCV_L	J03H	8.28E-04	3.29E-04	1.46E-04	4.49E-05		1.35E-03	0.64%
27	J04A_DryGHeader_V	J04A	6.63E-04	2.67E-04	1.44E-04	5.67E-06	5.87E-06	1.09E-03	0.52%
28	J04B_DryGPLSkid_V	J04B	7.60E-04	2.89E-04	1.42E-04	2.51E-05	1.74E-05	1.23E-03	0.59%
29	J04C_DryGPLaun_V	J04C	9.41E-06	3.70E-06	2.20E-06	1.57E-07	1.88E-08	1.55E-05	0.01%
30	J04D_DryGPRSkid_V	J04D	1.12E-03	4.42E-04	2.14E-04	4.97E-05	9.44E-06	1.83E-03	0.88%
31	J04E_DryGPRec_V	J04E	6.84E-06	2.88E-06	1.65E-06	4.39E-07	2.49E-07	1.21E-05	0.01%
32	J04F_FGHeater_V	J04F	2.77E-03	1.27E-03	7.45E-04	2.66E-04		5.05E-03	2.42%
33	J05A_TrBHeader_V	J05A	3.26E-03	1.30E-03	6.53E-04	9.02E-05	3.11E-05	5.33E-03	2.55%
34	J05B_HPKOBVap_V	J05B	5.55E-03	2.50E-03	1.26E-03	2.05E-04	8.28E-05	9.60E-03	4.59%
35	J05C_HPKOBLiq_L	J05C	2.22E-03	9.68E-04	5.78E-04	7.23E-05	7.39E-06	3.85E-03	1.84%
36	J05D_LTSBVap_V	J05D	8.11E-03	3.54E-03	1.84E-03	3.14E-04	1.18E-04	1.39E-02	6.66%
37	J05E_LTSBLiq_L	J05E	3.22E-03	1.39E-03	7.10E-04	7.88E-05	1.16E-05	5.41E-03	2.58%
38	J05F_HPKOBLCV_L	J05F	3.98E-04	1.53E-04	7.23E-05	3.54E-05		6.59E-04	0.31%
39	J05G_LiqToLTSB_L	J05G	5.04E-04	1.94E-04	9.97E-05	5.29E-05		8.51E-04	0.41%
40	J05H_LTSBLCV_L	J05H	8.28E-04	3.29E-04	1.46E-04	4.49E-05		1.35E-03	0.64%
41	J06A_TrCHeader_L	J06A	6.51E-04	2.43E-04	1.15E-04	6.57E-05		1.08E-03	0.51%
42	J06B_LPSepVap_V	J06B	4.62E-03	1.97E-03	1.17E-03	9.05E-05	3.98E-05	7.89E-03	3.77%
43	J06C_LPSepLiq_L	J06C	2.78E-03	1.21E-03	7.33E-04	1.04E-04	1.16E-05	4.83E-03	2.31%
44	J06D_LPSepLCV_L	J06D	7.44E-04	2.98E-04	1.68E-04	6.32E-05		1.27E-03	0.61%
45	J06E_WetGPLSkid_V	J06E	1.08E-03	4.24E-04	1.99E-04	2.95E-05	1.54E-05	1.75E-03	0.84%
46	J06F_WetGPLaun_V	J06F	2.65E-05	1.13E-05	6.61E-06	1.63E-06	1.02E-06	4.71E-05	0.02%
47	J07A_WetGPipe_V	J07A	7.33E-04	3.04E-04	1.34E-04	1.25E-06	1.26E-06	1.17E-03	0.56%
48	J08A_LiqHeader_L	J08A	1.16E-03	4.70E-04	2.35E-04	4.80E-05		1.92E-03	0.92%
49	J08B_LiqPLSkid_L	J08B	8.43E-04	3.30E-04	1.40E-04	8.91E-05		1.40E-03	0.67%
50	J08C_LiqPLaun_L	J08C	1.48E-05	6.22E-06	3.54E-06	8.94E-07	4.93E-07	2.59E-05	0.01%
51	J08D_FBWPLSkid_L	J08D	1.38E-03	5.61E-04	2.96E-04	9.79E-05		2.33E-03	1.12%
52	J08E_FBWPLaunB_L	J08E	1.39E-05	5.89E-06	3.40E-06	2.23E-06		2.54E-05	0.01%
53	J09A_LiqPipe_L	J09A	4.08E-04	1.68E-04	8.34E-05	5.32E-06		6.65E-04	0.32%
54	J10A_FBWPipe_L	J10A	4.08E-04	1.68E-04	8.34E-05	5.32E-06		6.65E-04	0.32%
55	J11A_DryKAGasPipe_V	J11A	1.08E-03	4.38E-04	1.90E-04	3.28E-05	1.26E-06	1.74E-03	0.83%
56	J12A_DryGasPipe_V	J12A	7.32E-04	3.03E-04	1.34E-04	1.20E-06	1.26E-06	1.17E-03	0.56%
57	J13A_MetTank_L	J13A	1.76E-03	8.26E-04	4.03E-04	6.40E-05	2.31E-05	3.08E-03	1.47%
58	J13B_MetTankOut_L	J13B	5.35E-03	2.41E-03	1.33E-03	5.30E-04		9.63E-03	4.60%
59	J13C_MetDisLTS_L	J13C	4.75E-03	2.53E-03	1.65E-03	1.03E-03		9.96E-03	4.76%
60	J14A_CoLTSLiq_L	J14A	8.44E-04	3.24E-04	1.60E-04	7.46E-05		1.40E-03	0.67%
61	J15A_CoLTBLiq_L	J15A	8.44E-04	3.24E-04	1.60E-04	7.46E-05		1.40E-03	0.67%
		TOTAL	1.19E-01	5.14E-02	2.81E-02	5.96E-03	7.90E-04	2.09E-01	100.00%

Section ID	J02A
Full Name	J02A_W001Flow_V
Pressure	80 barg
Temperature	45 C
Material Composition	1
Description	Well fluids in production flowline from well W010 isolation valve (XSV-0103) up to choke valve skid boundary including Cyclone Desander V-131

Equipment	Size	P& ID				
		TOTAL	XXX1	XXX5	00013	
Process Vessel	<= 6 inch	1			1	
	> 6 inch					
Manual Valves	2 inch	13			13	
	6 inch	3			3	
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	6	4		2	
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch	5			5	
	6 inch	66	6	40	20	
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch	18	2		16	
	6 inch	24	11	2	11	
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J02B
Full Name	J02B_W001ChIn_V
Pressure	80 barg
Temperature	45 C
Material Composition	1
Description	Well fluids in well W010 production flowline within choke valve skid boundary up to choke valve

Equipment	Size	P& ID				
		TOTAL	XXX5			
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch	3	3			
	6 inch	3	3			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch	1	1			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	2	2			
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch	5	5			
	6 inch	10.1	10.1			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch	4	4			
	6 inch	5	5			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J02C
Full Name	J02C_ChMani_V
Pressure	79.5 barg
Temperature	44.8 C
Material Composition	2
Description	Well fluids in production manifold from choke valve up to overpressure protection SDV of each train headers

Equipment	Size	P& ID				
		TOTAL	XXX5/XXX6	XXX9	XX10	XX11
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch	13	4	6	3	
	6 inch	16	4	12		
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch	3			2	1
	6 inch	2			1	1
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	13	8	3	1	1
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch	40		20	10	10
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch	10			5	5
	6 inch	50	20	20	5	5
	12 inch	8		4	2	2
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch	25	4	6	12	3
	6 inch	44	12	28	2	2
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J02D
Full Name	J02D_W002Flow_V
Pressure	80 barg
Temperature	45 C
Material Composition	1
Description	Well fluids in production flowline from well W020 isolation valve (XSV-0203) up to choke valve skid boundary including desander skid V-141

Equipment	Size	P& ID				
		TOTAL	XXX1	XXX5	00013	
Process Vessel	<= 6 inch	1			1	
	> 6 inch					
Manual Valves	2 inch	13			13	
	6 inch	3			3	
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	7	5		2	
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch	5			5	
	6 inch	75	65		10	
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch	18	2		16	
	6 inch	23	10	2	11	
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J02E
Full Name	J02E_W002Chln_V
Pressure	80 barg
Temperature	45 C
Material Composition	1
Description	Well fluids in well W020 production flowline within choke valve skid boundary up to choke valve

Equipment	Size	P& ID				
		TOTAL	XXX5			
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch	3	3			
	6 inch	3	3			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch	1	1			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	2	2			
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch	5	5			
	6 inch	10.1	10.1			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch	4	4			
	6 inch	5	5			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J02F
Full Name	J02F_W003Flow_V
Pressure	80 barg
Temperature	45 C
Material Composition	1
Description	Well fluids in production flowline from well W030 isolation valve (XSV-0303) up to choke valve skid boundary including desander skid V-151

Equipment	Size	P& ID				
		TOTAL	XXX2	XXX6	00013	
Process Vessel	<= 6 inch	1			1	
	> 6 inch					
Manual Valves	2 inch	13			13	
	6 inch	3			3	
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	7	5		2	
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch	5			5	
	6 inch	75		65	10	
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch	18	2		16	
	6 inch	23	10	2	11	
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J02G
Full Name	J02G_W003ChIn_V
Pressure	80 barg
Temperature	45 C
Material Composition	1
Description	Well fluids in well W030 production flowline within choke valve skid boundary up to choke valve

Equipment	**Size**	**P& ID**				
		TOTAL	**XXX6**			
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch	3	3			
	6 inch	3	3			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch	1	1			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	2	2			
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch	5	5			
	6 inch	10.1	10.1			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch	4	4			
	6 inch	5	5			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J02H
Full Name	J02H_W004Flow_V
Pressure	80 barg
Temperature	45 C
Material Composition	1
Description	Well fluids in production flowline from well W040 isolation valve (XSV-0403) up to choke valve skid boundary

Equipment	**Size**	**P& ID**				
		TOTAL	**XXX2**	**XXX6**		
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	5	5			
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch	65		65		
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch	2	2			
	6 inch	12	10	2		
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J02I
Full Name	J02I_W004ChIn_V
Pressure	80 barg
Temperature	45 C
Material Composition	1
Description	Well fluids in well W040 production flowline within choke valve skid boundary up to choke valve

Equipment	Size	P& ID				
		TOTAL	XXX6			
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch	3	3			
	6 inch	3	3			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch	1	1			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	2	2			
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch	5	5			
	6 inch	10.1	10.1			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch	4	4			
	6 inch	5	5			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J03A
Full Name	J03A_TrAHeader_V
Pressure	79.5 barg
Temperature	44.8 C
Material Composition	2
Description	Well fluids in train A header from XSV-2001 and XSV-2002 through the LTS coils up to the inlet of the HPKO A (V-220)

Equipment	Size	P& ID				
		TOTAL	20	00022/1	00022/2	
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch	2	2			
	6 inch	1	1			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch	1		1		
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	4	4			
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch	30.9	8.9	22		
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch	5	5			
	12 inch	30	6	14.5	9.5	
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch	3	3			
	6 inch	22	9	9	4	
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J03B
Full Name	J03B_HPKOAVap_V
Pressure	79.5 barg
Temperature	44.8 C
Material Composition	3
Description	HPKO Vessel A (V-220) vapour section through the GG exchanger tube side up to inlet of LTS A (V-230)

Equipment	Size	P& ID				
		TOTAL	00022/1	00022/2	00023/1	
Process Vessel	<= 6 inch					
	> 6 inch	0.68		0.68		
Manual Valves	2 inch	4		4		
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch	1	1			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	7	2	5		
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch					
	12 inch	15	10.2	4.8		
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch	1		1		
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch	4		4		
	6 inch	8	2	6		
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J03C	
Full Name	J03C_HPKOALiq_L	
Pressure	79.5	barg
Temperature	44.8	C
Material Composition	9	
Description	HPKO Vessel A (V-220) liquid section up to LCV-2203	

Equipment	Size	P& ID				
		TOTAL	00022/2			
Process Vessel	<= 6 inch					
	> 6 inch	0.32	0.32			
Manual Valves	2 inch	8	8			
	6 inch	1	1			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch	1	1			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	3	3			
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch	3	3			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch	11	11			
	6 inch	9	9			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J03D
Full Name	J03D_LTSAVap_V
Pressure	48.3 barg
Temperature	6 C
Material Composition	6
Description	Low Temperature Separator A (V-220) vapour section through the GG exchanger shell side up to XSV-2405

Equipment	Size	P& ID				
		TOTAL	00022/1	00023/1	00023/2	
Process Vessel	<= 6 inch					
	> 6 inch	0.5	0.5			
Manual Valves	2 inch	8	4	4		
	6 inch					
	12 inch	1		1		
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch	2		2		
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	10	7	3		
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch					
	12 inch	22.3	6	16.3		
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch	1		1		
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch	13	7	6		
	6 inch	11	1	10		
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID J03E
Full Name J03E_LTSALiq_L
Pressure 48.3 barg
Temperature 30.1 C
Material Composition 11
Description Low Temperature Separator A (V-220) liquid section up to LCV-2305

Equipment	Size	P& ID				
		TOTAL	00022/1			
Process Vessel	<= 6 inch					
	> 6 inch	0.5	0.5			
Manual Valves	2 inch	6	6			
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch	1	1			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	6	6			
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch	9.8	9.8			
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch	6	6			
	6 inch	4	4			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J03F
Full Name	J03F_HPKOALCV_L
Pressure	48.3 barg
Temperature	39.2 C
Material Composition	10
Description	HPKO A Liquid from LCV-2203 up to XSV-2204

Equipment	**Size**	**P& ID**				
		TOTAL	**00022/2**			
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch					
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch	4	4			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch	2	2			
	6 inch	2	2			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J03G
Full Name	J03G_LiqToLTSA_L
Pressure	48.3 barg
Temperature	39.2 C
Material Composition	10
Description	Liquid from XSV-2204 to liquid inlet of LTS A (V-230)

Equipment	Size	P& ID				
		TOTAL	00022/1	00022/2		
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch					
	6 inch	1		1		
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch					
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch	11.6	3.9	7.7		
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch					
	6 inch	5	2	3		
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J03H
Full Name	J03H_LTSALCV_L
Pressure	24.2 barg
Temperature	20.2 C
Material Composition	12
Description	LTS A Liquid from LCV-2305 up to XSV-2306

Equipment	**Size**	**P& ID**				
		TOTAL	**00022/1**	**00022/2**		
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch	1	1			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	1	1			
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch	3.5	3.5			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch					
	6 inch	2	2			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J03I
Full Name	J03I_ClassVap_V
Pressure	48.3 barg
Temperature	39.2 C
Material Composition	6
Description	Classifier (V-240) vapour section up to gas line to LTS A (V-230)

Equipment	Size	P& ID				
		TOTAL				
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch					
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J04A
Full Name	J04A_DryGHeader_V
Pressure	48.1 barg
Temperature	38.7 C
Material Composition	7
Description	Dry gas header from XSV-2405 and XSV-3405 up to pig launcher skid boundary

Equipment	Size	P& ID				
		TOTAL	XX13	XX17	XX36	XX34
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch	1	1			
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	1			1	
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch	5	5			
	6 inch					
	12 inch	16.4		16.4		4.4
	18 inch	48.9	44.5		4.4	
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch	1	1			
	6 inch	2	1	1		
	12 inch	2	1		1	
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J04B
Full Name	J04B_DryGPLSkid_V
Pressure	48.1 barg
Temperature	38.7 C
Material Composition	7
Description	Dry gas header inside pig launcher skid boundary up to pipeline isolation XSV

Equipment	Size	P& ID				
		TOTAL	XX36			
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch					
	6 inch					
	12 inch	1	1			
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch					
	12 inch	1	1			
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch					
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch					
	12 inch					
	18 inch	10.5	10.5			
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch					
	6 inch	1	1			
	12 inch	4	4			
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J04C
Full Name	J04C_DryGPLaun_V
Pressure	48.1 barg
Temperature	38.7 C
Material Composition	7
Description	Dry Gas Pig Launcher (941-V-xx5)

Equipment	Size	P& ID				
		TOTAL	XX36			
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch	10	10			
	6 inch	2	2			
	12 inch	2	2			
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	3	3			
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch	7	7			
	12 inch					
	18 inch	2	2			
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch	13	13			
	6 inch	3	3			
	12 inch	3	3			
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J04D
Full Name	J04D_DryGPRSkid_V
Pressure	48.1 barg
Temperature	38.7 C
Material Composition	7
Description	Dry gas header from KA-8/12/15/18 inside pig receiver skid

Equipment	Size	P& ID				
		TOTAL	XX34			
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch					
	6 inch	1	1			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch	1	1			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	1	1			
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch					
	12 inch	10.5	10.5			
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch					
	6 inch	7	7			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J04E
Full Name	J04E_DryGPRec_V
Pressure	48.1 barg
Temperature	38.7 C
Material Composition	7
Description	Dry Gas from KA-8/12/15/18 Pig Receiver (941-V-xx2)

Equipment	**Size**	**P& ID**				
		TOTAL	**XX34**			
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch	9	9			
	6 inch	2	2			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch	1	1			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	2	2			
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch	7	7			
	12 inch	2	2			
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch	1	1			
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch	13	13			
	6 inch	7	7			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J04F
Full Name	J04F_FGHeater_V
Pressure	7 barg
Temperature	38.7 C
Material Composition	7
Description	Dry Gas from header to fuel gas system

Equipment	Size	P& ID				
		TOTAL	00024		00061	00062
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch	2	1		1	
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch	1				1
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch					
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch	25	25			
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch	5			5	5
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch	1			1	
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch	5			4	1
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J05A
Full Name	J05A_TrBHeader_V
Pressure	79.5 barg
Temperature	44.8 C
Material Composition	2
Description	Well fluids in train B header from XSV-3001 and XSV-3002 through the LTS coils up to the inlet of the HPKO B (V-320)

Equipment	Size	P& ID				
		TOTAL	XX10	XX16	XX17	
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch	2	2			
	6 inch	1	1			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch	1		1		
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	4	4			
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch	45.9	8.9	37		
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch	5	5			
	12 inch	30	6	14.5	9.5	
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch	3	3			
	6 inch	22	9	9	4	
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J05B
Full Name	J05B_HPKOBVap_V
Pressure	79.5 barg
Temperature	44.8 C
Material Composition	3
Description	High Pressure Knockout Vessel B (V-320) vapour section through the GG exchanger tube side up to inlet of LTS B (V-330)

Equipment	**Size**	**P& ID**				
		TOTAL	**XX16**	**XX17**		
Process Vessel	<= 6 inch					
	> 6 inch	0.68		0.68		
Manual Valves	2 inch	4		4		
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch	1	1			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	7	2	5		
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch					
	12 inch	15	10.2	4.8		
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch	1		1		
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch	4		4		
	6 inch	8	2	6		
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J05C	
Full Name	J05C_HPKOBLiq_L	
Pressure	79.5	barg
Temperature	44.8	C
Material Composition	9	
Description	High Pressure Knockout Vessel B (V-320) liquid section up to LCV-3203	

Equipment	Size	P& ID				
		TOTAL	XX17			
Process Vessel	<= 6 inch					
	> 6 inch	0.32	0.32			
Manual Valves	2 inch	8	8			
	6 inch	1	1			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch	1	1			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	3	3			
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch	3	3			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch	11	11			
	6 inch	9	9			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J05D
Full Name	J05D_LTSBVap_V
Pressure	48.3 barg
Temperature	6 C
Material Composition	6
Description	Low Temperature Separator B (V-330) vapour section through the GG exchanger shell side up to XSV-3405

Equipment	Size	P& ID				
		TOTAL	XX16	XX17		
Process Vessel	<= 6 inch					
	> 6 inch	0.5	0.5			
Manual Valves	2 inch	8	4	4		
	6 inch					
	12 inch	1		1		
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch	2		2		
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	10	7	3		
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch					
	12 inch	22.3	6	16.3		
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch	1		1		
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch	13	7	6		
	6 inch	11	1	10		
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J05E
Full Name	J05E_LTSBLiq_L
Pressure	48.3 barg
Temperature	30.1 C
Material Composition	11
Description	Low Temperature Separator B (V-330) liquid section up to LCV-3305

Equipment	Size	P& ID				
		TOTAL	XX16			
Process Vessel	<= 6 inch					
	> 6 inch	0.5	0.5			
Manual Valves	2 inch	6	6			
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch	1	1			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	6	6			
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch	4	4			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch	6	6			
	6 inch	4	4			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J05F
Full Name	J05F_HPKOBLCV_L
Pressure	48.3 barg
Temperature	39.2 C
Material Composition	10
Description	HPKO B Liquid from LCV-3203 up to XSV-3204

Equipment	Size	P& ID				
		TOTAL	XX17			
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch	1	1			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch					
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch	1	1			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch					
	6 inch	2	2			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J05G
Full Name	J05G_LiqToLTSB_L
Pressure	48.3 barg
Temperature	39.2 C
Material Composition	10
Description	Liquid from XSV-3204 to liquid inlet of LTS B (V-330)

Equipment	Size	P& ID TOTAL	XX16	XX17		
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch					
	6 inch	1		1		
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch					
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch	11.6	3.9	7.7		
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch					
	6 inch	5	2	3		
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J05H
Full Name	J05H_LTSBLCV_L
Pressure	24.2 barg
Temperature	20.2 C
Material Composition	12
Description	LTS B Liquid from LCV-3305 up to XSV-3306

Equipment	Size	P& ID				
		TOTAL	XX16			
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch	1	1			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	1	1			
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch	3.5	3.5			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch					
	6 inch	2	2			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J06A
Full Name	J06A_TrCHeader_L
Pressure	24.2 barg
Temperature	20.2 C
Material Composition	12
Description	Liquid from LTS A/B XSV-2010 and XSV-3010 up to inlet of Low Pressure Separator (V-420)

Equipment	Size	P& ID				
		TOTAL	24	XX15		
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch					
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch	47	42	5		
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch	12.6		12.6		
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch					
	6 inch	5	2	3		
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J06B
Full Name	J06B_LPSepVap_V
Pressure	24.2 barg
Temperature	20.2 C
Material Composition	13
Description	Low Pressure Separator (V-420) vapour section through the wet gas header up to the wet gas pig launcher skid boundary

Equipment	Size	P& ID				
		TOTAL	23	24	00042	91
Process Vessel	<= 6 inch					
	> 6 inch	0.5			0.5	
Manual Valves	2 inch	13			13	
	6 inch	2			2	
	12 inch	2			2	
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	6			6	
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch	77.1	20	42.7	10	4.4
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch	2			2	
	6 inch	2			2	
	12 inch	19.2			19.2	
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch	11			11	
	6 inch	3		1	2	
	12 inch	24	3	2	18	1
	18 inch					
	24 inch	1			1	
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J06C
Full Name	J06C_LPSepLiq_L
Pressure	24.2 barg
Temperature	20.2 C
Material Composition	15
Description	Low Pressure Separator (V-420) liquid section up to LCV-4202 and LCV-4212

Equipment	Size	P& ID				
		TOTAL	42			
Process Vessel	<= 6 inch					
	> 6 inch	0.5	0.5			
Manual Valves	2 inch	9	9			
	6 inch	2	2			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch	1	1			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	3	3			
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch	2	2			
	6 inch	6	6			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch	9	9			
	6 inch	12	12			
	12 inch	3	3			
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J06D
Full Name	J06D_LPSepLCV_L
Pressure	16.1 barg
Temperature	16.1 C
Material Composition	16
Description	LP Separator liquid from (V-420) from LCV-4202 and LCV-4212 up to XSV-4203

Equipment	Size	P& ID				
		TOTAL	42			
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch	2	2			
	6 inch	1	1			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch	1	1			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch					
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch	6	6			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch	2	2			
	6 inch	4	4			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J06E
Full Name	J06E_WetGPLSkid_V
Pressure	24.2 barg
Temperature	20.2 C
Material Composition	13
Description	Wet gas header inside pig launcher skid boundary up to pipeline isolation XSV

		P& ID				
Equipment	**Size**	**TOTAL**	**XX35**			
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch					
	6 inch	1	1			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch					
	12 inch	1	1			
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	1	1			
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch					
	12 inch	10.5	10.5			
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch					
	6 inch	3	3			
	12 inch	2	2			
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J06F
Full Name	J06F_WetGPLaun_V
Pressure	24.2 barg
Temperature	20.2 C
Material Composition	13
Description	Wet Gas Pig Launcher (941-V-xx3)

Equipment	Size	P& ID				
		TOTAL	XX35			
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch	10	10			
	6 inch	2	2			
	12 inch	2	2			
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	2	2			
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch	7	7			
	12 inch	2	2			
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch	1	1			
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch	14	14			
	6 inch	3	3			
	12 inch	3	3			
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J07A
Full Name	J07A_WetGPipe_V
Pressure	24.2 barg
Temperature	20.2 C
Material Composition	13
Description	Wet gas pipeline inside wellsite boundary

Equipment	Size	P& ID				
		TOTAL	XX35			
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	2	2			
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch	14	14			
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch					
	6 inch					
	12 inch	1	1			
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J08A
Full Name	J08A_LiqHeader_L
Pressure	16.1 barg
Temperature	16.1 C
Material Composition	16
Description	Liquid header from XSV-2004, XSV-2010, XSV-3004 and XSV-3010 up to liquid pig launcher skid boundary

Equipment	Size	P& ID				
		TOTAL	XX13	XX15	XX37	XX38
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch					
	6 inch	1	1			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	2			1	1
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch	103.2	89.3	5.1	4.4	4.4
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch					
	6 inch	9	6	1	1	1
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J08B
Full Name	J08B_LiqPLSkid_L
Pressure	16.1 barg
Temperature	16.1 C
Material Composition	16
Description	Liquid header inside liquid pig launcher skid boundary up to pipeline isolation boundary

Equipment	Size	P& ID				
		TOTAL	XX37			
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch					
	6 inch	2	2			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch	1	1			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch					
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch	10.5	10.5			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J08C
Full Name	J08C_LiqPLaun_L
Pressure	16.1 barg
Temperature	16.1 C
Material Composition	16
Description	Liquid Pig Launcher (941-V-xx7)

Equipment	Size	P& ID				
		TOTAL	XX37			
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch	10	10			
	6 inch	2	2			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch	1	1			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	3	3			
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch	9	9			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch	1	1			
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch	15	15			
	6 inch	6	6			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J08D
Full Name	J08D_FBWPLSkid_L
Pressure	16.1 barg
Temperature	16.1 C
Material Composition	16
Description	Liquid header inside flowback water pig launcher skid boundary up to pipeline isolation boundary

Equipment	Size	P& ID				
		TOTAL	XX38			
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch	2	2			
	6 inch	3	3			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch	1	1			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	1	1			
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch	10.5	10.5			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch	2	2			
	6 inch	7	7			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J08E
Full Name	J08E_FBWPLaunB_L
Pressure	16.1 barg
Temperature	16.1 C
Material Composition	16
Description	Flowback water pig launcher (941-V-xx9)

Equipment	Size	P& ID				
		TOTAL	XX37			
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch	10	10			
	6 inch	2	2			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	3	3			
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch	10	10			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch	1	1			
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch	15	15			
	6 inch	6	6			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J09A
Full Name	J09A_LiqPipe_L
Pressure	16.1 barg
Temperature	16.1 C
Material Composition	16
Description	Liquid pipeline inside wellsite boundary

Equipment	Size	P& ID				
		TOTAL	XX37			
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	1	1			
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch	14	14			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch					
	6 inch	3	3			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J10A
Full Name	J10A_FBWPipe_L
Pressure	16.1 barg
Temperature	16.1 C
Material Composition	16
Description	Flowback water pipeline inside wellsite boundary

Equipment	Size	P& ID				
		TOTAL	XX38			
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	1	1			
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch	14	14			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch					
	6 inch	3	3			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J11A
Full Name	J11A_DryKAGasPipe_V
Pressure	48.1 barg
Temperature	38.7 C
Material Composition	7
Description	Dry gas in incoming pipeline from KA-8/12/15/18 within wellsite

Equipment	Size	P& ID				
		TOTAL	XX34			
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch	1	1			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	2	2			
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch	14	14			
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch					
	6 inch	1	1			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J12A
Full Name	J12A_DryGasPipe_V
Pressure	48.1 barg
Temperature	38.7 C
Material Composition	7
Description	Dry gas export pipeline within wellsite boundary

Equipment	**Size**	**P& ID**				
		TOTAL	**XX36**			
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	2	2			
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch					
	18 inch	14	14			
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch					
	6 inch					
	12 inch	1	1			
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J13A
Full Name	J13A_MetTank_L
Pressure	barg
Temperature	14 C
Material Composition	Methanol
Description	Methanol Dosing Tank

Equipment	Size	P& ID				
		TOTAL	XX32			
Process Vessel	<= 6 inch					
	> 6 inch	1	1			
Manual Valves	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	3	3			
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J13B
Full Name	J13B_MetTankOut_L
Pressure	barg
Temperature	14 C
Material Composition	Methanol
Description	Methanol Dosing Tank outlet up to methanol dosing pumps

Equipment	Size	P& ID				
		TOTAL	XX32	XX44		
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch	12	7	5		
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	1	1			
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch	10	5	5		
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch	1	1			
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch	2	2			
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J13C
Full Name	J13C_MetDisLTS_L
Pressure	120 barg
Temperature	14 C
Material Composition	Methanol
Description	Methanol distribution system to LTS

Equipment	Size	P& ID				
		TOTAL	XX32	XXX1	XXX5	XXX6
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch	6	6			
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch	1	1			
Reciprocating Pump	<= 6 inch	1	1			
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch	134	134			
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J14A
Full Name	J14A_CoLTSLiq_L
Pressure	24.2 barg
Temperature	20.2 C
Material Composition	12
Description	Liquids from LTS A through the liquid header up to XSV-2004 and XSV-2010

Equipment	Size	P& ID				
		TOTAL	22	24	00032	
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch	2		2		
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch					
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch	10	5	5		
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch	2	2			
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch					
	6 inch	6	1	5		
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					

Section ID	J15A
Full Name	J15A_CoLTBLiq_L
Pressure	24.2 barg
Temperature	20.2 C
Material Composition	12
Description	Liquids from LTS B through the liquid header up to XSV-3004 and XSV-3010

Equipment	Size	P& ID				
		TOTAL	22	24	00032	
Process Vessel	<= 6 inch					
	> 6 inch					
Manual Valves	2 inch					
	6 inch					
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Actuated Valves	2 inch					
	6 inch	2		2		
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Small Bore Fittings	2 inch					
Reciprocating Pump	<= 6 inch					
	> 6 inch					
Centrifugal Pump	<= 6 inch					
	> 6 inch					
Process Pipe (Interskid)	2 inch					
	6 inch	10		5	5	
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Process Pipe (Within Skid)	2 inch					
	6 inch	2			2	
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Pig Trap	<= 6 inch					
	> 6 inch					
Tube Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Shell Side Heat Exchanger	<= 6 inch					
	> 6 inch					
Plate Heat Exchanger	<= 6 inch					
	> 6 inch					
Fin Fan Heat Exchanger	<= 6 inch					
	> 6 inch					
Flange	2 inch					
	6 inch	6		5	1	
	12 inch					
	18 inch					
	24 inch					
	36 inch					
Filters	<= 6 inch					
	> 6 inch					
Recip Compressors	<= 6 inch					
	> 6 inch					
Centrif Compressors	<= 6 inch					
	> 6 inch					