APPENDIX C QRA KAPUNI WELLSITES – WORLEY

TODD ENERGY LTD

Kapuni Wellsites
Quantitative Risk Assessment

610114-RPT-R0002
July 2022

Worley New Zealand Ltd
25 Gill Street, New Plymouth 4310
PO Box 705, New Plymouth 4340
New Zealand

Telephone +64-6-759 6300
Facsimile +64-6-759 6301

www.worley.com

Rev	Description	Originator	Reviewer	Worley Approver	Date	Client Approval	Date
A	Issued for Review/Comment	Y Lee	L Ong	Y Lee	10/2020		
0	Approved for Use	Y Lee	L Ong	Y Lee	09/2021		
1	Re-Approved for Use	Y Lee	O Kilian	Y Lee	07/2022		

TABLE OF CONTENTS

APPENDICES

EXECUTIVE SUMMARY

Todd Energy Ltd. (Todd) operates the Kapuni wellsites which are at an onshore gas and condensate field located in South Taranaki approximately 50 km south of New Plymouth. 20 Kapuni wells are located on nine (9) separate wellsites in the area surrounding the Kapuni Production Station (KPS).

Quantitative Risk Assessments (QRAs) have been conducted for these wellsites. The purpose of the QRAs is to develop risk contours to meet the risk assessment requirements of the operative South Taranaki District Plan, Section 11: Hazardous Substances.

Table 1 presents the summary of main findings of the risk assessments.

Table 1: Summary of Main Findings

Wellsite	HIPAP4 Land Use Criteria *(For proposed development of a potentially hazardous nature, or for land use planning in the vicinity of existing hazardous installations)*	
	5E-05 / year *(5E-5 / year risk contour should, as a target, be contained within the boundaries of the industrial site where applicable)*	**1E-6 / year** *(1E-6 / year risk contour for residential development, and places of continuous occupancy such as hotels, tourist resorts)*
	KA-1/7/19/20	
Base Case	Criteria met. The 5E-05 / year risk contour is within the site boundary.	Criteria met. There are no residential developments, hotels, tourist resorts within the contour.
Sensitivity Case	Same as Base Case	Same as Base Case
	KA-2	
Base Case	Criteria met. The 5E-05 / year risk contour is within the site boundary.	Criteria met. There are no residential developments, hotels, tourist resorts within the contour.
	KA-4/14	
Base Case	Criteria met. The 5E-05 / year risk contour is within the site boundary.	Criteria met. There are no residential developments, hotels, tourist resorts within the contour.
Sensitivity Case	Same as Base Case	Same as Base Case
	KA-5/10	
Base Case	Criteria met. The 5E-05 / year risk contour is within the site boundary.	Criteria met. There are no residential developments, hotels, tourist resorts within the contour.
Sensitivity Case	Same as Base Case	Same as Base Case
	KA-6/11/17	
Base Case	Criteria met. The risk level is lower than 5E-05 / year.	Criteria met. There are no residential developments, hotels, tourist resorts within the contour.
Sensitivity Case	Same as Base Case	Same as Base Case

Wellsite	**HIPAP4 Land Use Criteria** *(For proposed development of a potentially hazardous nature, or for land use planning in the vicinity of existing hazardous installations)*	
	5E-05 / year *(5E-5 / year risk contour should, as a target, be contained within the boundaries of the industrial site where applicable)*	**1E-6 / year** *(1E-6 / year risk contour for residential development, and places of continuous occupancy such as hotels, tourist resorts)*
KA-8/12/15/18		
Base Case	**The 5E-05 / year risk contour exceeds the site boundary at the north as the compressor buildings are located at the northern side of the wellsite.**	Criteria met. There are no residential developments, hotels, tourist resorts within the contour.
Sensitivity Case	Same as Base Case	Same as Base Case
KA-13		
Base Case	Criteria met. The 5E-05 / year risk contour is within the site boundary.	Criteria met. There are no residential developments, hotels, tourist resorts within the contour.
Sensitivity Case	Same as Base Case	Same as Base Case

The HIPAP4 Land Use Criteria are met for all wellsites except for KA-8/18 wellsite where the 5E-05/year risk contour exceeds the site boundary at the north as the compressor buildings are located at the northern side of the wellsite.

For all sensitivity cases (where the aboveground sections of the gathering pipelines are included), the risk contours are only slightly larger compared to the base case. This is due to the low release frequencies from the additional pipeline sections which do not contribute significantly to the overall risk. The assessments against the HIPAP4 criteria are all consistent with the base case findings.

Risk contributors to offsite risks are also identified to help to identify the equipment / section of wellsites that are leading to offsite impact. For wellsites that have no offsite impact, risk contributor analyses were not conducted.

1. ABBREVIATIONS

AWS	Automatic Weather Station
BLEVE	Boiling Liquid Expanding Vapour Explosion
CO2	Carbon Dioxide
DNV	Det Norske Veritas Germanischer
EI	Energy Institute
ESDV	Emergency Shutdown Valve
HCRD	Hydrocarbon Release Database
HIPAP4	NSW Hazardous Industry Planning Advisory Paper No. 4
HMB	Heat and Material Balance
HPKO	High Pressure Knock Out
IOGP	International Association of Oil and Gas Producers
IRPA	Individual Risk Per Annum
KGTP	Kapuni Gas Treatment Plant
KPS	Kapuni Production Station
LFL	Lower Flammable Limit
LPG	Liquefied Petroleum Gas
LSIR	Location Specific Individual Risk
LTS	Low Temperature Separator
N2	Nitrogen
NIWA	National Institute of Water and Atmospheric Research Ltd
NNF	Normally No Flow
P&ID	Piping & Instrumentation Diagram
P/L	Pipeline
PECPR	Pressure Equipment, Cranes, and Passenger Ropeways
PLL	Potential Loss of Life
QRA	Quantitative Risk Assessment
STDC	South Taranaki District Council
Todd	Todd Petroleum Mining Company
VCE	Vapour Cloud Explosion
Worley	Worley New Zealand Ltd

2. INTRODUCTION

2.1 Background

Todd Energy Ltd. (Todd) operates the Kapuni wellsites which are at an onshore gas and condensate field located in South Taranaki approximately 50 km south of New Plymouth. Worley New Zealand Ltd. (Worley) has been commissioned by Todd to conduct a Quantitative Risk Assessment (QRA) for the Kapuni wellsites.

2.2 Objective

The objective of the QRA is to develop risk contours to meet the risk assessment requirements of the South Taranaki District Council (STDC) District Plan, Section 11: Hazardous Substances.

2.3 Scope

The scopes include:

1) Conduct risk assessment for seven (7) Kapuni wellsites with 17 wells; and
2) Update the existing KA-4/14 and KA-13 wellsites QRA [Ref. 1] and hence supersedes the results from that QRA.

Currently, seven (7) wellsites are producing, KA-3 is out of service and KA-9 is designed for water disposal only. The wellsite details are summarised in Table 2-1. Only the producing wells are considered in the risk assessment.

Table 2-1: Kapuni Wellsites

Wellsite	Number of wells	Producing	Scheduled for Abandon-ment Note 1	Suspended Note 2	Shut in Note 3	Observation / water Note 4	Notes
KA-1, KA-7, KA-19 and KA-20	4	1			1 (KA-7)	2 (KA-1 Note 1 and KA-20)	
KA-2	1	1					
KA-3	1			1			
KA-4 and KA-14	2	2					KA-14 is only operating once (for 24 hours) every 10 days.
KA-5 and KA-10	2	1				1 (KA-10)	
KA-6, KA-11 and KA-17	3	2		1 (KA-11)			
KA-8, KA-12, KA-15 and KA-18	4	2	1 (KA-12)		1 (KA-15)		
KA-9	2					2	A new well, KW03, is drilled in May 2021 for further water injection purposes.
KA-13	1	1					KA-13 is only operating in 1 out of every 3 months.
Total	20	10	1	2	2	5	

Notes:

1. Wells that are scheduled for abandonment are plugged with abandonment plans underway.
2. Suspended wells are plugged and major intervention is required to bring the well back to service.
3. Shut in wells are isolated but could be brought back into service. Note that KA-7 and KA-15 were considered as producing wells in the Kapuni Safety Case [Ref. 1], however, the wells are currently shut-in and hence are not included in the risk assessment.
4. Water wells are for water injection only and will not be used for hydrocarbon / producing. Observation wells are only for monitoring reservoir conditions and informing development of reserves estimates. They are designed for instrumentation only and cannot inject or produce.

There is no plan to bring the non-producing wells back online in the future. In the unlikely event that this changes, the QRA will be updated to verify any impact on the risk contours. Engagement with STDC will be completed as part of this process and a resource consent process may be required. .

This revision of the report (Rev. 1) also captured the modelling update to consider delayed leak detection as early gas detection systems are not at all wellsites.

2.4 Exclusions

The following are excluded from the QRA:

- Risk from the gathering pipelines to Kapuni Production Station (KPS). The scope for each wellsite includes up to the pipeline isolation valves (if available) or when the pipelines go underground. Pipelines passing through the wellsites (e.g., at KA-4/14 and KA-5) are not considered in the base case. The pipeline sections are assessed in the sensitivity case. Note that the pipeline (P/L) to PECPR on the P&ID are used in some sections to identify the pipeline boundary;
- Risk other than hydrocarbon / process risk (e.g., transportation risk, seismic risk and volcanic risks);
- Decommissioned and/or mothballed and isolated equipment;
- Utilities such as produced water and instrument air as they do not contain any hydrocarbon inventory;
- Individual risk calculations, including Individual Risk Per Annum (IRPA) and Potential Loss of Life (PLL) as the wellsites are normally unmanned;
- Societal risk (F-N curve) as the wellsites are located as remote area with low populations;
- Corrosion inhibitors present at the wellsites as they are not flammable;
- Methanol injecting pumps as they are only used during start-up (except for KA-8/12/15/18 wellsite where methanol dosing is required throughout the year). Note that methanol tanks are always full and connected to the methanol pumps, with the pumps turned off when methanol is not being injected, hence the methanol tanks and tubing to the methanol pumps are included;
- Toxic effect of carbon dioxide; and
- Vapour Cloud Explosion (VCE), as there is limited equipment at the wellsites, and these areas are open with good ventilation expected throughout the year. The possibility of flammable vapour accumulating and developing into subsequent vapour cloud explosions, are considered not credible.

2.5 QRA Study Cases

The QRA study includes the base case and a sensitivity case to study the impact of different modelling input / assumption on the risk results. The QRA base case includes the current operations of the Kapuni wellsites with wellsites' equipment up to the pipeline isolation valves (if available) or when the pipelines go underground. Pipelines passing through the wellsites (e.g., at KA-4/14 and KA-5) are not considered in the base case.

One sensitivity case is considered in the Kapuni Wellsites QRA:

1. Include the aboveground gathering pipeline sections downstream of the pipeline isolation valves. The pipeline sections contain the entire pipeline inventory. The pipelines inventories are referenced from the Kapuni Safety Case [Ref. 1].

The details of the base case and sensitivity case are summarised in Table 2-2.

Table 2-2: Kapuni Wellsites QRA Base Case and Sensitivity Case

QRA Case	Details	Potential Impact
Base case	Current wellsites' operation up to the gathering pipeline isolation valves (if available) or when the pipelines go underground	-
Sensitivity case	Include the aboveground gathering pipeline sections downstream of the pipeline isolation valves. Note that there is no sensitivity case for KA-2 wellsite as there is no pipeline isolation valves and no PECPR identification for the pipeline. The entire aboveground gathering pipeline sections are considered in the base case only.	Addition QRA section(s) for the pipeline sections with the entire pipeline inventory.

2.6 Site Overview

Kapuni is an onshore gas and condensate field located in South Taranaki, approximately 50 km south of New Plymouth. 20 Kapuni wells are located on nine (9) separate wellsites in the area surrounding the Kapuni Production Station (KPS). The production wellsite process is a simple separation of gas and liquids involving the direction of wellstream gas and liquids to a low temperature separator (LTS) unit on the wellsite. The LTS separates the gas and liquids by means of pressure reduction to cause cooling.

An aerial overview of the wellsites location with reference to KPS is shown in Figure 2-1.

The wellsites access points are via vehicle gates which are normally adjacent to the main wellsite control huts for the wellsites. Each wellsite hut is a single storey building which contains the wellsite control logic systems, emergency and communications equipment.

The wellsites have an open layout with areas separated from each other to prevent knock-on effects. The open area reduces the potential for overpressure from an explosion and reduces fire damage / escalation potential.

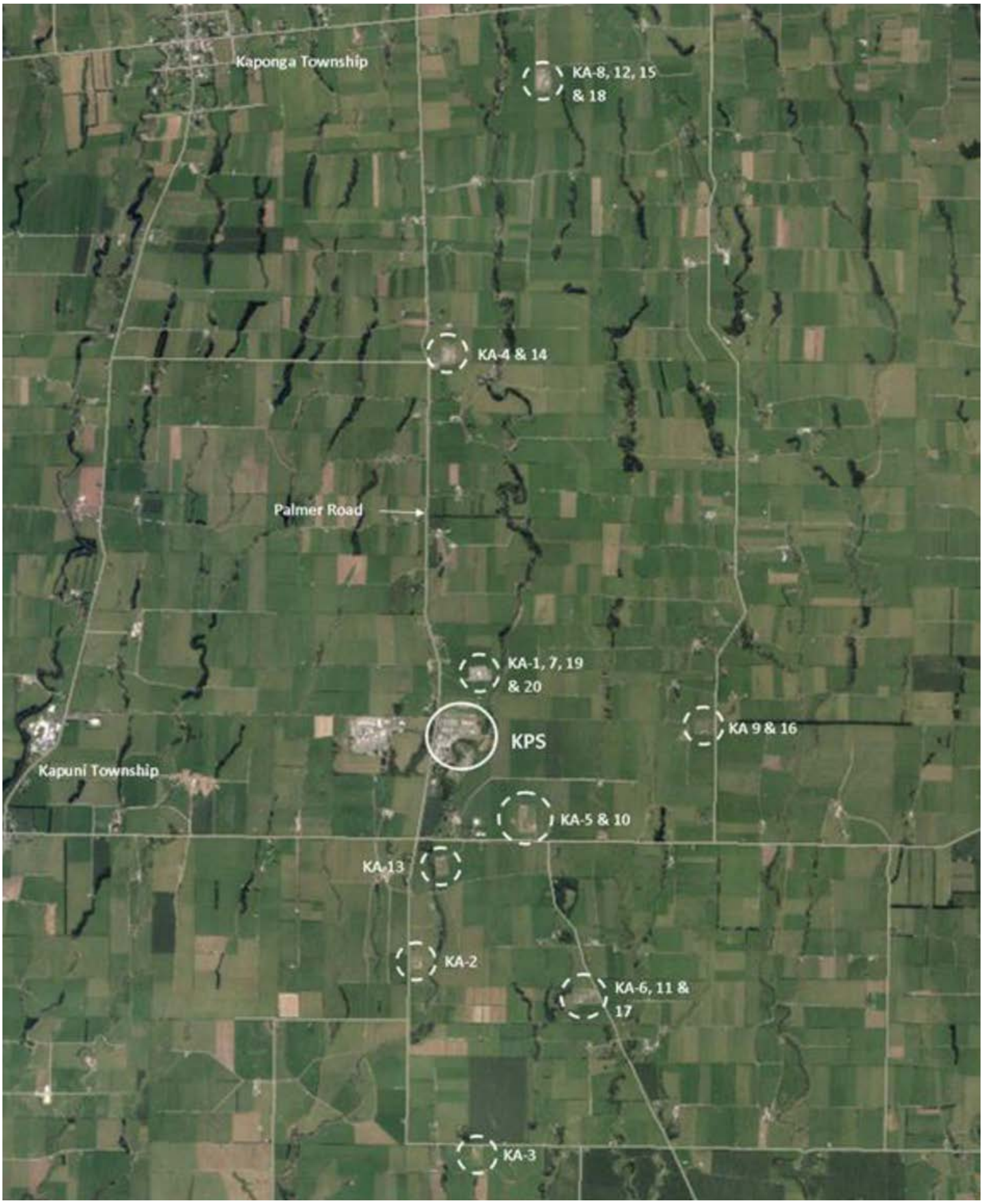


Figure 2-1: Kapuni Wellsites Location with reference to Kapuni Production Station (KPS)

The details of each of the wellsite is as below.

2.6.1 Wellsite KA-1, KA-7, KA-19 and KA-20

Located off Palmer Road, the site contains 4 wells. A wellstream heater is fitted to the KA-19 well. KA-1 well is a contingency for water injection, KA-7 is not operational and KA-20 well is an observation well.

This site also acts as a distribution point for gas from the northern wells. It re-routes gas arriving from the gathering lines from wellsite KA-4/14 and KA-8/12/15/18 to KPS.

2.6.2 Wellsite KA-2

Located on Palmer Road, the site has an LTS unit and the flowline is equipped with two wellstream coolers.

2.6.3 Wellsite KA-3

This wellsite has been suspended and plugged.

2.6.4 Wellsite KA-4 and KA-14

Located just off Palmer Road, the site contains two wells, two LTS units, and a wellstream heater.

2.6.5 Wellsite KA-5 and KA-10

Located just off Skeet Road, this site contains one producing well (KA-5) and one observation well (KA-10), with a Desander unit for solids separation, and a PCV used on start-up.

2.6.6 Wellsite KA-6, KA-11 and KA-17

Located just off Ahipaipa Road, this site contains two producing wells and one suspended well (KA-11). KA-6 and KA-17 wellstream fluids are co-mingled, routed through a wellstream cooler and then to an LTS Unit.

2.6.7 Wellsite KA-8, KA-12, KA-15 and KA-18

Located off Eltham Road, this site contains two producing wells. KA-12 well is scheduled for abandonment and KA-15 well is shut-in and isolated. Two wellstream process skids and two wellhead compression units are fitted to the wells.

2.6.8 Wellsite KA-13

Located just off Skeet Road, this site contains one well, Desander, a flowline choke valve and a High Pressure Knock Out (HPKO) vessel. It connects into the KA-6/5 gathering lines. The HPKO is now bypassed and is not considered.

2.6.9 Wellsite KA-9

Located on Lower Duthie Road, two wells were drilled on the site, KA-9 (referred to as KW-2) and KA-16. Both wells are currently in service as water injection wells. There is very little equipment left on the wellsite, only the water injection line, a filter, and two pig receivers.

The wellsites flow schematic is presented in Figure 2-2.

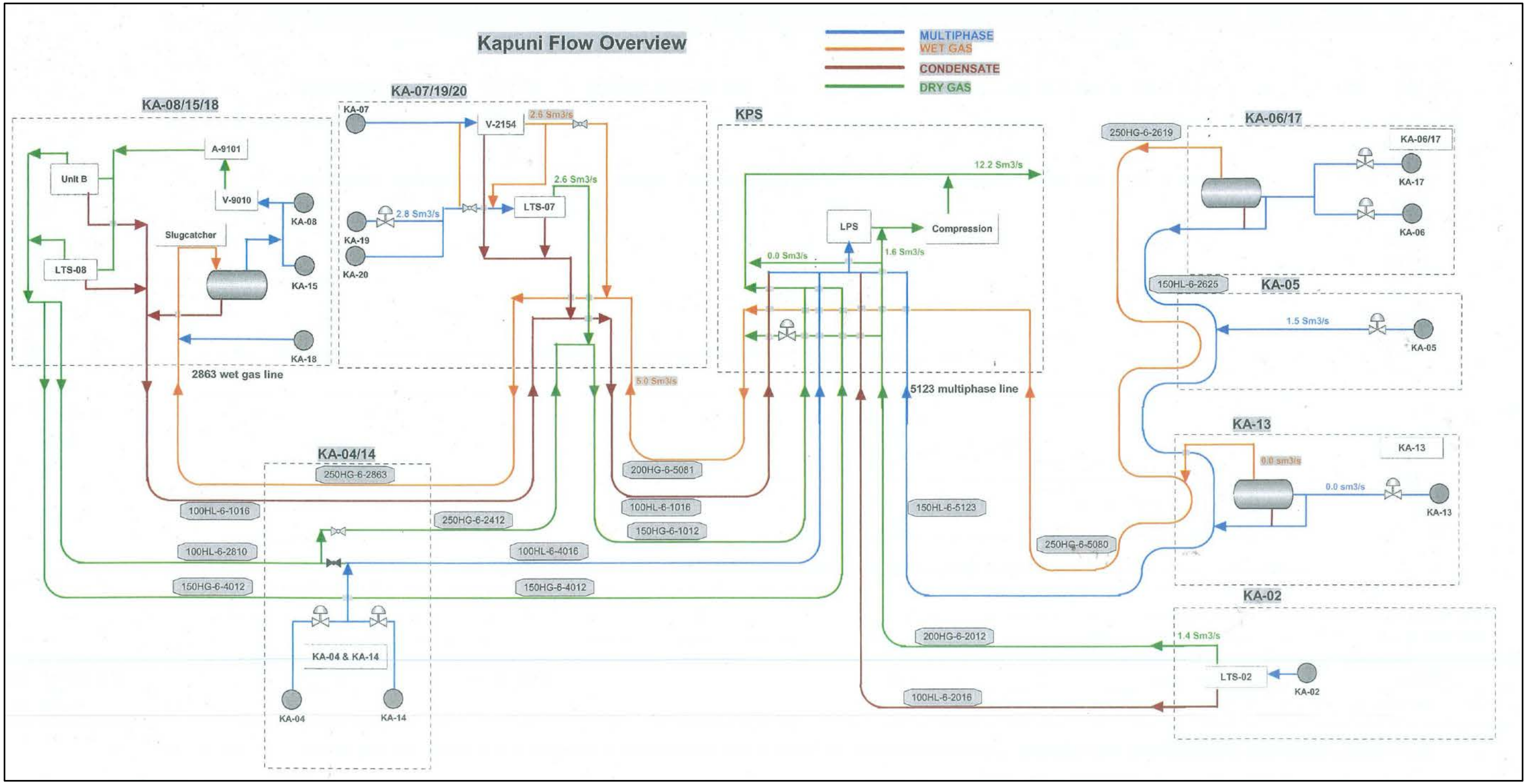


Figure 2-2: Kapuni Wellsites Flow Schematic

3. METHODOLOGY

The methodology followed for completing the QRA is aligned with good industry practice and the Todd Energy Fire and Explosion Analysis and Quantitative Risk Assessment Methodology Guideline [Ref. 2]. The generic process, specified in the Worley's Onshore QRA Method Statement [Ref. 3], is illustrated in Figure 3-1.

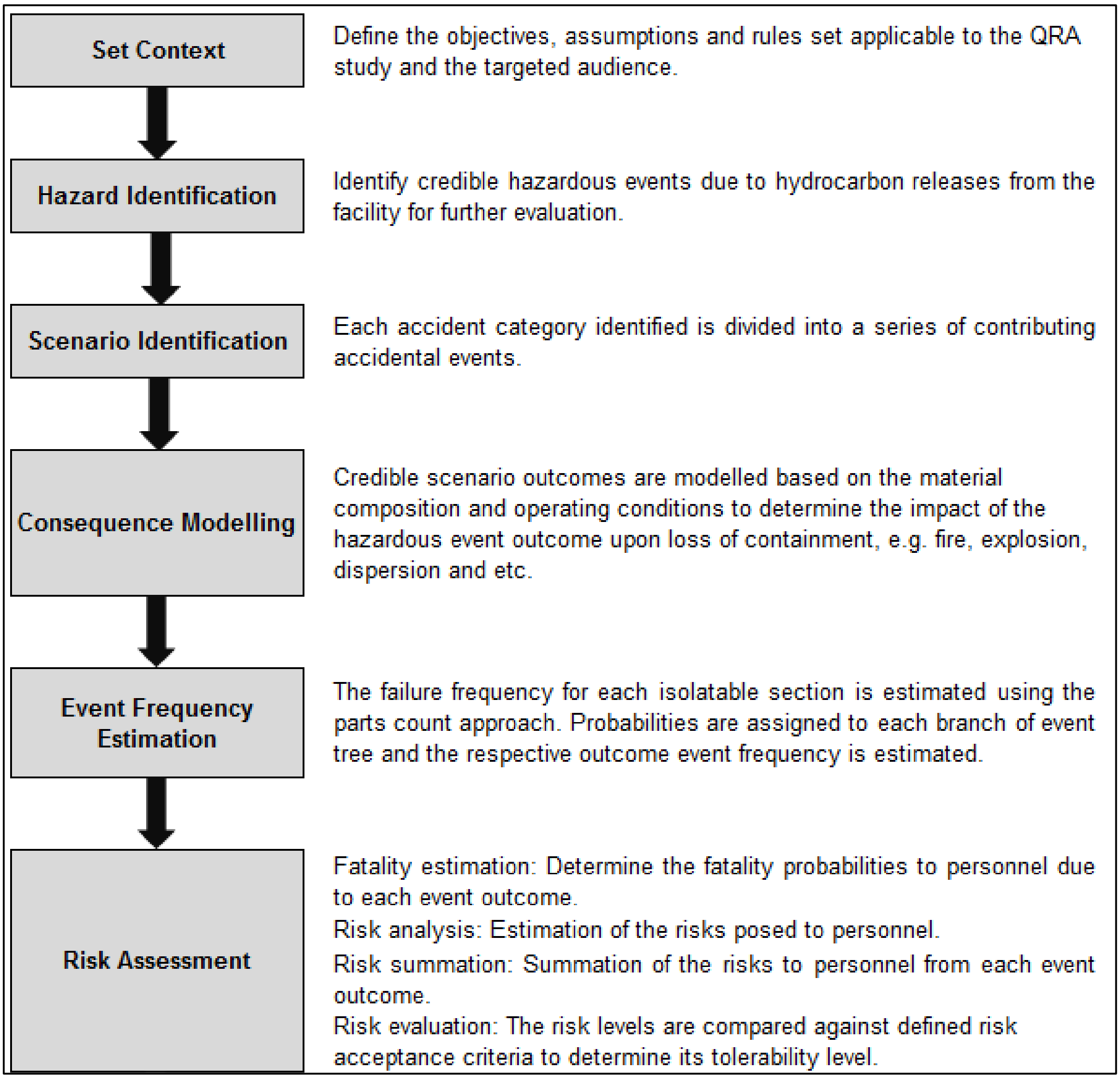


Figure 3-1: QRA Methodology

3.1 Assessment Tools

DNV Safeti Software (formerly known as Phast Risk) [Ref. 4] is used to build the QRA model. Safeti is an integrated consequence and risk modelling package developed by DNV 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. Note that the QRA study started in 2020, where the QRA model was built using Safeti version 8.22, which was the latest version at that time. For the subsequent modelling update, a newer software version at the time of update was used. For this revision of the report (Rev. 1), Safeti version 8.6 was used to perform the required updates. Not all wellsite models were updated to Safeti 8.6.

3.2 Assumptions

An Assumptions Register [Ref. 5] was generated which outlines the basis of all assumptions and the input bases inherent in the QRA study. Key assumptions are shown in the following subsections for reference.

3.2.1 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. 6] for the Hawera Automatic Weather Station (AWS) to represent the atmospheric conditions at Kapuni. Data for 5-year period from January 2008 to December 2012 are taken, with wind speed and direction measurements taken every hour. The wind rose is shown in Figure 3-2.

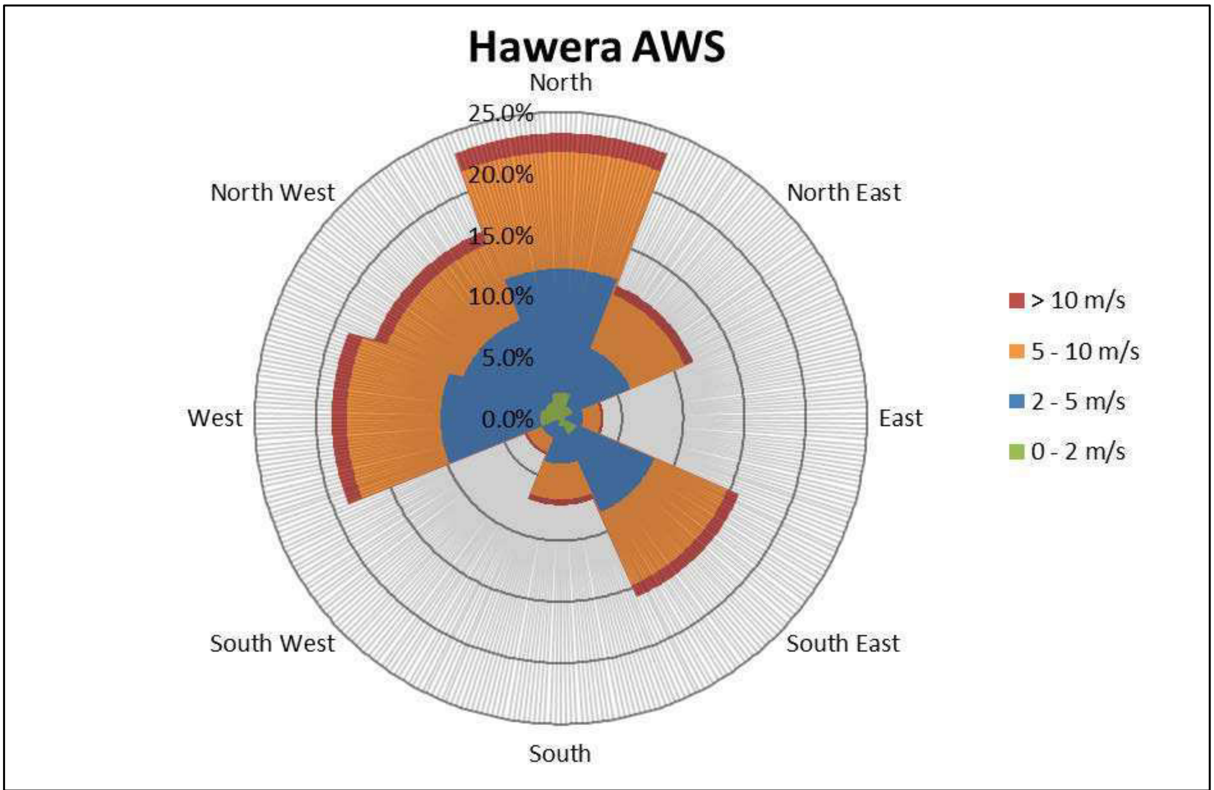


Figure 3-2: Hawera AWS Windrose

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 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:

- Pasquill Stability F – stable, night with moderate clouds and light/moderate wind
- 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 power-law profile.

Ambient Temperature and Relative Humidity

The following ambient temperature and relative humidity are used in the QRA:

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

Solar Radiation

Solar radiation is not included in the thermal radiation calculations.

Topography

Safeti cannot take into account the effects of the local undulating topography for the gas dispersion. A surface roughness of 30 mm was applied, which generally represents an area of "open flat terrain; grass, few isolated objects" to represent the open area of the wellsites.

3.2.2 General Release Frequency

The leak frequencies for process equipment are taken from the International Association of Oil and Gas Producers (IOGP) Process Release Frequency 2019 [Ref. 7]. Release frequencies of the main process equipment items are based on an analysis of the UK HSE hydrocarbon release database (HCRD). Two sets of data are presented in IOGP Process Release Frequency, which include the 1992 – 2015 data and 2006 – 2015 data. The recommended values based on experience in the period 2006 – 2015 (inclusive) are used.

The IOGP Release Frequency Data does not provide the frequencies for atmospheric storage tanks. Therefore, the following leak frequencies from the TNO Purple Book [Ref. 8] are used for the methanol tanks.

The blowout likelihood from the IOGP Blowout Frequencies [Ref. 9] are used, specifically data for offshore operations in areas not operating according to North Sea Standard (Table 2-3 in the IOGP). It is noted that the Kapuni wellsites are located onshore, however, IOGP recommends the use of offshore data presented in Section 2 in the IOGP but noted that there will be a greater degree of uncertainty.

3.2.3 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 Process Release Frequency together with the representative hole sizes used in the QRA is shown in Table 3-2.

Table 3-2: 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. The same approach is taken to select the representative hole size for rupture cases (release > 150 mm).

It is noted for methanol tanks that references to TNO Purple Book failure data, actual hole sizes following the failure data are used as there are no sufficient leak size distribution data in Purple Book to calculate the geometric mean.

22 mm is used as the maximum hole size for small bore fittings. The maximum hole size for a flange is also limited to 22 mm as a release from a flange is normally limited to a segment of a gasket between bolts.

Leak frequency modification factors are also applied to the release frequency database as per Todd Energy's Methodology Guideline [Ref. 2].

3.2.4 Ignition Probabilities

The probability of ignition of a release is a function of the release rate, the nature of the material being released and the conditions of the surrounding plant. The Energy Institute (EI) ignition probability models [Ref. 10] referenced in IOGP Ignition Probabilities [Ref. 11] are used for the estimation of overall ignition probability of loss of containment scenarios.

For wellsites, ignition probabilities are taken from Scenario 5 and 6 and assumed to particularly apply to a 'plant' where processing takes place. This is considered conservative for use at wellsites as not much processing takes place.

The scenarios are described as:

- Scenario 5 – Small Plant Gas LPG (Gas or LPG release from small onshore plant) - Releases of flammable gases, vapour or liquids significantly above their normal boiling point from small onshore plants (plant area up to 1200 m^2, site area up to 35,000 m^2).
- Scenario 6 - Small Plant Liquid (Liquid release from small onshore plant) - 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 m^2, site area up to 35,000 m^2) and which are not bunded or otherwise contained.

The graphs of ignition probabilities as a function of mass release rate are shown in Figure 3-3.

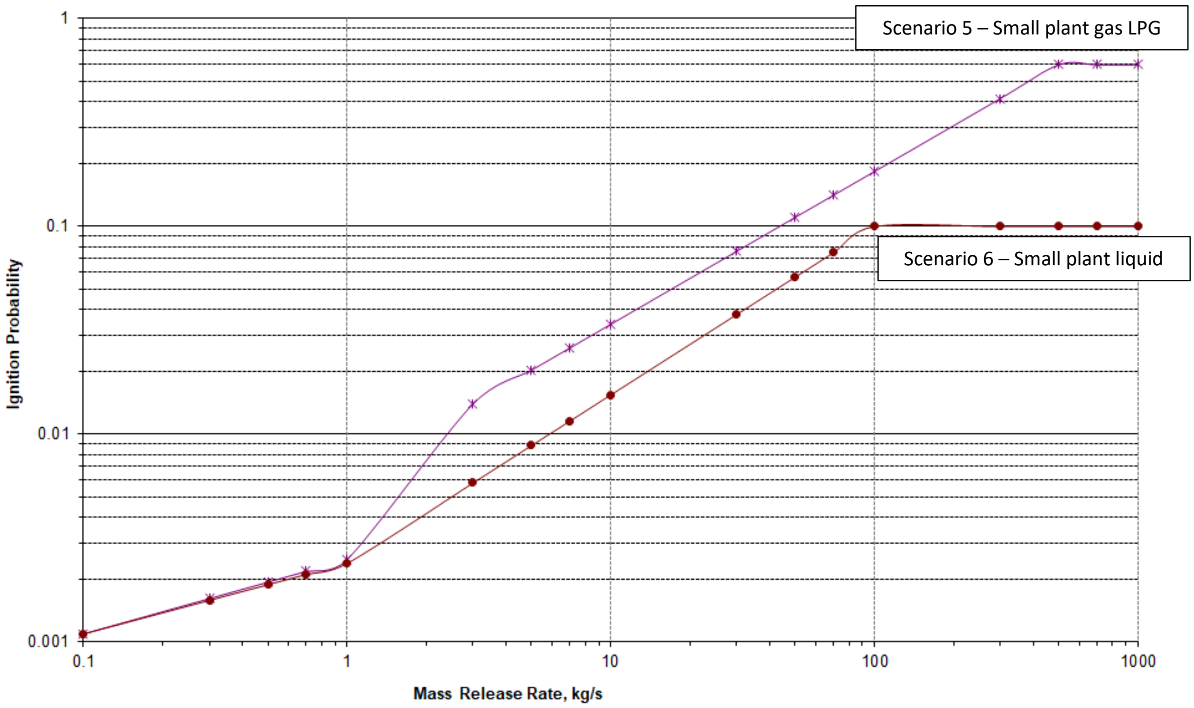


Figure 3-3: Ignition Probabilities

The graph represents the total ignition probability. The Energy Institute suggests that 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 early to delayed ignition probability is used. Given the maturity of the hazardous area, it can be assumed that probability of early ignition would be low.

3.2.5 Fatality Criteria

Thermal Radiation

The method of calculating the probability of fatality for an individual, given known exposure duration and thermal heat radiation levels, is undertaken 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. 12]. 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

Safeti calculates the Probit values during the analysis.

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

Flash Fire

If personnel are within the 100% lower flammable limit (LFL) of the gas plume, 100% fatality is assumed. LFL is the lower end of the concentration range over which the flammable mixture of a gas/ vapour in air can be ignited at a given temperature/ pressure.

A flash fire occurs when a dispersed cloud of flammable gas or vapour and air mixture is ignited within its flammable regions, causing a wall of flame to spread throughout the flammable region and back to the release point. The flame propagates through the cloud in a manner such that negligible or no damaging overpressure is generated. This flash is almost instantaneous as the flame propagates at high speed through the cloud and back to the source.

An assumption of 100% fatality rate within the footprint of the cloud is conservative and does not allow for potential risk reducing considerations such as;

- Uneven mixing of gas and air in the cloud resulting in uneven propagation of the flame,
- Topography,
- Sparsely populated rural land use adjoining the site,
- Availability of shelter,
- Opportunity for escape, and
- Clothing worn by persons exposed to the flash fire.

Thermal radiation outside of the flash fire falls off rapidly and is not sustained due to the instantaneous nature of the event. The potential for fatality outside the flash fire footprint is not considered credible.

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 LPG or lighter end hydrocarbon. 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. Passive Fire Protection can be provided on pressurised vessels to minimise the probability of BLEVE. There is no clear guideline or criteria to determine the likelihood of a BLEVE on a pressurised vessel. For this QRA, 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.

However, based on the liquid inventory and liquid composition in the vessels, BLEVE is considered not possible for any vessel at Kapuni wellsites.

4. HAZARD IDENTIFICATION

4.1 Hazardous Materials

The Heat and Balances (HMBs) for the wellsites are provided by Todd Process Engineer. The wellstream fluid from each well have different flowrates, material compositions and operating conditions. Any stream that has unique consequences will be represented by dedicated sections. For sections with similar operating conditions or fluid composition that have similar consequence results, the worst case scenario will be selected as representative, to rationalise the number of scenarios performed. This is to avoid the averaging out of inputs of different wellstreams, as it may create a stream with 'brand new' operating conditions, material compositions and flowrates which does not represent the actual release conditions.

As far as is reasonable, the compositions in each stream are simplified, i.e. isomers are summed together and the C6+ hypothetical materials (KP01, up to KP30) are represented by different heavy alkanes. The following alkanes are selected to represent different ranges of hypothetical materials found in the streams based on their properties:

- KP01 to KP10 are assumed to be C7;
- KP11 to KP20 are assumed to be C10; and
- KP21 to KP30 are assumed to be C20.

The important characteristic of molecular weight is kept close to the actual value to ensure the release rate is representative. The simplified HMB used in the QRA is presented in Appendix 8.

The effects of water cut of the hydrocarbon on fire hazards are considered identify the streams that are considered not flammable due to high water content. According to Oil and Gas UK Fire and Explosion Guidance [Ref. 13], for water cuts under 50%, no significant reduction in heat fluxes to engulfed objects can be expected (<10%). However, for water cuts over 50%, the flames are significantly less radiative, and the overall heat flux to an obstacle can be reduced by 40% or more. In line with Oil and Gas UK Fire and Explosion Guidance, it is assumed that a mixture remains flammable if it has a water cut of up to 125% (defined as mass of water/ mass of fuel x 100%), although not necessarily capable of supporting a stable flame in the absence of some other supporting mechanisms.

Similarly, increasing concentrations of CO_2 were found to reduce the likelihood of ignition of a methane jet release. At CO_2 concentrations of 22–40% (v/v) it was possible for a self-sustaining flame to exist, but beyond these concentrations a pilot flame was required to aid combustion. Beyond 60% CO_2 the pilot flame had no effect and the mixture was completely inert [Ref. 14].

The average flammability limits of the mixtures are calculated by Safeti software, considering the effects of the inert components (e.g. CO_2, N_2 and water).

4.2 Isolatable Sections and Inventory

An ESD system can limit the outflow once a loss of containment occurs. When activated, emergency shut-down valves (ESDVs) divide the process system into a number of isolatable sections, with each potential leak source associates with a particular isolatable inventory. These sections were split further where necessary and the entire contained inventory was considered as available for release.

Isolatable sections are highlighted in the Piping and Instrumentation Diagrams (P&IDs) and presented in Appendix 1 to Appendix 7. Following the sectionalisation process, parts counts are conducted to perform the frequency analysis for the QRA.

All wellsites have automated ESD on fire detection, and KA-8/18 has automatic ESD on gas detection as well. To assess the impact of additional release inventory due to the delayed detection and isolation, a sensitivity check was conducted on the QRA models for a few selected wellsites. It was found for hydrocarbon gas releases, there is no noticeable impact to the risk results and the study conclusion, as the consequence distances from the gas scenarios have reached steady state and the additional gas inventory will only lead to longer release duration with no impact to the effect distances. However, for condensate releases, the longer release duration can lead to a larger pool accumulation on the ground.

Condensate leaks at the wellsites or along the pipelines (other than minor leaks) will lead to pressure and/or liquid level drop at the process at KPS, which will alert the operators to perform a check at the wellsite(s). Given the proximity to the KPS, operators can generally arrive at the wellsites within 15 minutes to initiate the site ESD. As such, 15 minutes delayed detection will be assumed where 15 minutes of released inventory will be added. Full bore rupture cases are only considered credible when there is major work on site, and the wellsite would be manned to detect the leak immediately. Hence undetected full bore rupture is not considered credible.

The wellsites bunding and drainage systems are designed to contain hazardous materials within the boundaries of the wellsite. Therefore, the condensate pool is assumed to remain confined within the site.

5. RISK ASSESSMENT CRITERIA

This section presents results of the QRA. Risks estimated in this study are presented in the form of Location Specific Individual Risk (LSIR) contours. LSIR is defined as 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. In practice this is not the case and this criterion is therefore conservative.

As there are no standard risk criteria which have been developed for the New Zealand context, this has been assessed against the suggested risk criteria in the NSW HIPAP No. 4 "Risk Criteria for Land Use Planning" [Ref. 16] as shown in Table 5-1.

Table 5-1: Individual Fatality Risk Criteria

Land Use	Risk Criteria Adopted (per annum)	Interpretation for QRA
Industrial	**5E-05 (1 in 20,000)**	**5E-05 risk contour should, as a target, be contained within the boundaries of the industrial site where applicable**
Sporting complexes and active open space	1E-05 (1 in 100,000)	1E-05 risk contour should not extend to these areas
Commercial developments including retail centres, offices and entertainment centres	5E-06 (1 in 200,000)	5E-06 risk contour should not extend to these areas
Residential developments, hotels, tourist resorts	**1E-06 (1 in 1 million)**	**1E-06 risk contour should not extend to these areas**
Hospitals, schools, childcare facilities, old age housing	5E-07 (1 in 2 million)	5E-07 risk contour should not extend to these areas

Kapuni wellsites are situated in the zone classified as "Rural" under the operative South Taranaki District Plan [Ref. 17] and surrounded by 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 wellsites. The closest identified offsite parties are dwellings or houses. Therefore, only the *"Industrial"* (5E-05 / year) and *"Residential"* (1E-06 /year) are considered.

6. WELLSITE KA-1, KA-7, KA-19 AND KA-20

6.1 Release Scenarios

The P&IDs showing the isolatable sections for KA-19, which is the only producing well at this wellsite, are presented in Appendix 1. Table 6-1 details the section description and the respective operating conditions that are used in the QRA.

Table 6-1: Release Scenarios and Operating Conditions for KA-19

No.	Section ID	Description	Material / Stream Note 1	Pressure (barg)	Temp. (°C)	Largest Connection Size (mm)	Section Inventory (m^3)	Isolatable Inventory (m^3)
1	01_KA19_01_WLHEAD_V	Wellstream fluid from KA-19 wellhead to SDV-2140A	15	33.8	40.29	150	*Unlimited Note 2*	
2	02_KA19_02_FLWLNE_V	Wellstream fluid from wellhead SDV-2140A to choke valve HCV-2140X	15	33.8	40.29	150	0.8	6.6
3	03_KA19_02_CHKLNE_V	Wellstream fluid from choke valve HCV-2140X to Wellstream Cooler (E-2153)	16	23.1	33.6	150	1.3	6.6
4	04_KA19_02_WSCOOL_V	Wellstream fluid from Wellstream Cooler (E-2153) to Wellhead Knockout (V-2154)	17	22.8	24	150	1.2	6.6
5	05_KA19_02_WLHKOT_V	Hydrocarbon gas from Wellhead Knockout (V-2154) to SDV-2154A and manual valve 150V385	19	22.8	24	80	3.3	6.6
6	06_KA19_02_WLHKOB_L	Hydrocarbon liquid from Wellhead Knockout (V-2154) to SDV-2154B	18	22.8	24	150	2.1	2.1 Note 4
16	16_KA19_04_CONPIP_L	Hydrocarbon liquid from SDV-2154B and SDV-2853A to Condensate Pipeline	18	22.8	24	100	38.2 Note 3	38.2 Note 5
17	17_KA19_05_GASPP1_V	Hydrocarbon gas from SDV-2154A mix with wet gas from A-5002 to XSV-2165A on the Gas Pipeline to KA-8 via KA-4/14	19	22.8	24	250	15.9	17.9
18	18_KA19_05_GPIG65_V	Scraper Trap (A-2165)	19	22.8	24	250	1.0	17.9
19	19_KA19_05_GPIG63_V	Scraper Trap (A-2163)	19	22.8	24	200	1.0	17.9
20	20_KA19_06_GASPP2_V	Hydrocarbon gas from SDV-2852C mix with dry gas from KA-4/14 wellsite to Gas Pipeline to KPS	8	28.2	23.11	250	7.2 Note 3	8.2

No.	Section ID	Description	Material / Stream Note 1	Pressure (barg)	Temp. (°C)	Largest Connection Size (mm)	Section Inventory (m³)	Isolatable Inventory (m³)
21	21_KA19_06_GPIG67_V	Scraper Trap (A-2167)	8	28.2	23.11	250	1.0	8.2
22	22_KA19_06_GPIG66_V	Scraper Trap (A-2166)	8	28.2	23.11	150	1.0	8.2
23	23_KA19_07_VECGAS_V	KGTP Treated Gas to XSV-2169A for export pipeline (to Kiwi Dairy Co. & Taranaki Byproduct Co.)	Kiwi GC	21.1	38.9	250	7.7 Note 3	15.4
24	24_KA19_07_PG2169_V	Scraper Trap (A-2169)	Kiwi GC	21.1	38.9	250	7.7	15.4
25	25_KA19_07_PG2164_V	Scraper Trap (A-2164)	Kiwi GC	21.1	38.9	150	7.7	15.4
26	26_KA19_08_METTNK_L	Methanol Tank (T-2191) to Methanol Pumps	Methanol	Atm.	Amb.	50	5.0	5.0
Sensitivity Cases								
27	27_KA19_09_KA4GPL_V	Dry gas from KA-4/14 to XSV-2167A	8	28.2	23.11	250	97.3 Note 3	97.3
28	28_KA19_10_KA8GPL_V	Wet gas from XSV-2165A to KA-8/18	19	22.8	24	250	38.7 Note 3	38.7
29	29_KA19_11_KIWICO_V	KGTP Treated Gas from XSV-2169A to export pipeline (to Kiwi Dairy Co. & Taranaki Byproduct Co.)	Kiwi GC	21.1	38.9	250	1100.0 Note 3	1100.0

Notes:

1. Stream composition refers to the stream numbers in the HMB. The full HMB for all wellsites is attached Appendix 8.
2. Inventory from the wellhead section is considered to be unlimited because they can be supplied from the downhole reservoir.
3. Sections connecting to the pipeline inventories due to the lack of isolation valve.
4. Inventories for modelling the 22 mm leak was increased to 12739 kg and 190159 kg for 85 mm leak, assuming the delayed detection and isolation of 15 min (i.e., the releases can sustain up to 15 min). This is conservatively assumed that the leaks can sustain at initial pressure with no depressurisation at the system.
5. Inventory for modelling the 71 mm leak was increased to 131598 kg, assuming the delayed detection and isolation of 15 min (i.e., the releases can sustain up to 15 min). This is conservatively assumed that the leaks can sustain at initial pressure with no depressurisation at the system.

6.2 Release Frequency

The leak frequencies for the process releases are estimated for each representative hole size using parts count results and the historical leak frequencies. The leak frequencies for KA-19 sections for the base case are shown in Table 6-2.

Table 6-2: Hydrocarbon Release Frequencies for KA-19 (Base Case)

No	QRA Event	1 - 3 mm	3 - 10 mm	10 - 50 mm	50 - 150 mm	> 150 mm	TOTAL	% Contrib.
1	01_KA19_01_WLHEAD_V	3.37E-05	1.38E-05	5.67E-06	1.13E-06	7.09E-07	5.50E-05	0.3%
	KA-19 Blowout					4.20E-05	4.20E-05	0.2%
2	02_KA19_02_FLWLNE_V	9.10E-04	3.85E-04	2.06E-04	7.36E-06	1.58E-06	1.51E-03	7.9%
3	03_KA19_02_CHKLNE_V	1.88E-03	8.15E-04	4.43E-04	3.27E-05	3.77E-06	3.18E-03	16.6%
4	04_KA19_02_WSCOOL_V	1.25E-03	4.67E-04	1.93E-04	4.23E-05	7.70E-07	1.95E-03	10.2%
5	05_KA19_02_WLHKOT_V	1.21E-03	5.38E-04	2.88E-04	4.71E-05		2.08E-03	10.8%
6	06_KA19_02_WLHKOB_L	7.25E-04	3.42E-04	1.88E-04	5.65E-05	1.41E-06	1.31E-03	6.8%
16	16_KA19_04_CONPIP_L	1.28E-03	5.68E-04	2.99E-04	5.02E-05		2.20E-03	11.5%
17	17_KA19_05_GASPP1_V	7.89E-04	3.47E-04	1.85E-04	2.45E-05	5.30E-06	1.35E-03	7.0%
18	18_KA19_05_GPIG65_V	7.94E-07	4.05E-07	2.24E-07	5.42E-08	1.77E-08	1.49E-06	0.01%
19	19_KA19_05_GPIG63_V	3.75E-07	1.94E-07	1.08E-07	2.83E-08	8.83E-09	7.15E-07	0.004%
20	20_KA19_06_GASPP2_V	1.11E-03	4.89E-04	2.60E-04	3.01E-05	5.67E-06	1.90E-03	9.9%
21	21_KA19_06_GPIG67_V	1.84E-07	9.52E-08	5.28E-08	1.35E-08	4.42E-09	3.50E-07	0.002%
22	22_KA19_06_GPIG66_V	9.29E-08	4.81E-08	2.67E-08	1.32E-08	4.39E-12	1.81E-07	0.001%
23	23_KA19_07_VECGAS_V	1.60E-03	6.89E-04	3.71E-04	3.38E-05	3.59E-06	2.70E-03	14.1%
24	24_KA19_07_PG2169_V	1.17E-06	5.96E-07	3.30E-07	7.64E-08	2.67E-08	2.20E-06	0.011%
25	25_KA19_07_PG2164_V	1.01E-07	5.17E-08	2.86E-08	1.35E-08	4.39E-12	1.95E-07	0.001%
26	26_KA19_08_METTNK_L	4.64E-04	3.03E-04	1.12E-04	1.35E-05	5.00E-06	9.03E-04	4.7%
TOTAL		1.13E-02	4.96E-03	2.55E-03	3.44E-04	6.99E-05	1.92E-02	
% Contribution		59%	26%	13%	2%	0.4%		

The total leak frequencies for KA-19 wellsite (for the base case) is 1.92E-02 per year, which is equivalent to one leak every 52.1 years. Most of the leaks are predicted to be from small leaks, where 85% of the leaks are from hole sizes less than 10 mm diameter.

The leak frequencies for KA-19 sections for the sensitivity case are shown in Table 6-3.

Table 6-3: Hydrocarbon Release Frequencies for KA-19 (Sensitivity Case)

No	QRA Event	1 - 3 mm	3 - 10 mm	10 - 50 mm	50 - 150 mm	> 150 mm	TOTAL	% Contrib.
27	27_KA19_09_KA4GPL_V	3.19E-05	1.42E-05	7.35E-06	1.14E-06	3.54E-07	5.50E-05	0.3%
28	28_KA19_10_KA8GPL_V	3.19E-05	1.42E-05	7.35E-06	1.14E-06	3.54E-07	5.50E-05	0.3%
29	29_KA19_11_KIWICO_V	3.19E-05	1.42E-05	7.35E-06	1.14E-06	3.54E-07	5.50E-05	0.3%
TOTAL (Base Case and Sensitivity)		1.14E-02	5.00E-03	2.57E-03	3.48E-04	7.09E-05	1.93E-02	
% Contribution		59%	26%	13%	2%	0.4%		

The total leak frequency for KA-19 wellsite (including the sensitivity cases) is 1.93E-02 per year, which is equivalent to one leak every 51.7 years.

6.3 Risk Results

The risk results are presented in this section. The risk contours are contributed from both flammable and toxic risks from all release scenarios based on all the hazardous materials onsite.

The only toxic risk onsite is from the methanol tank due to methanol toxicity. As the methanol tank is stored at atmospheric condition with limited inventory (5 m^3 at maximum capacity) and bunded, the methanol toxic risk is very minor and localised. Hence no separate toxic risk contour was provided. Methanol toxic effect was modelled by using the probit method as detailed in the Assumptions Register [Ref. 5].

6.3.1 Base Case

The base case LSIR for KA-19 wellsite is presented in Figure 6-1.

Figure 6-1: LSIR Contours for KA-19 Wellsite (Base Case)

The risk assessed against the HIPAP4 criteria are summarised in Table 6-4.

Table 6-4: LSIR Results Assessed Against the HIPAP4 Land Use Criteria for KA-19 (Base Case)

LSIR	Risk Contour	HIPAP4 Land Use Criteria	Result
5E-05 / year	**Blue**	5E-5 / year risk contour should, as a target, be contained within the boundaries of the industrial site where applicable.	Criteria met. The 5E-05 / year risk contour is within the site boundary.
1E-6 / year	**Red**	1E-6 / year risk contour should not extend to residential developments, hotels, tourist resorts.	Criteria met. There are no residential developments, hotels, tourist resorts within the contour.

6.3.2 Sensitivity Case

The LSIR for KA-19 wellsite sensitivity case, which include the gathering pipeline sections is presented in Figure 6-2.

Figure 6-2: LSIR Contours for KA-19 Wellsite (Sensitivity Case)

The risk contours for the sensitivity case are larger compared to the base case. Nonetheless, and the assessment against the HIPAP4 criteria is the same. Hence is it not repeated.

6.4 Risk Contributors

The risk contributors to offsite risks at selected locations (points A to D) as shown in Figure 6-3 can be identified from the QRA model.

Figure 6-3: Location Selected to Identify Risk Contributors at KA-19 wellsite

6.4.1 Base Case

The risk contributors for the base case with the risk contributors and percentage of contribution are shown in Table 6-5.

Table 6-5: Risk Contributors to Selected Locations for KA-19 (Base Case)

Point	LSIR (per year)	Contributor	% Contribution	Consequence
A	5.87E-07	06_KA19_02_WLHKOB_L_85 mm (Hydrocarbon liquid from Wellhead Knockout (V-2154) to SDV-2154B)	56.8%	Jet fire with pool fire from early ignition (78%) Delayed pool fire with flash fire (22%)
		16_KA19_04_CONPIP_L_71 mm (Hydrocarbon liquid from SDV-2154B (from Wellhead Knockout (V-2154)) to Condensate Pipeline)	42.2%	Jet fire with pool fire from early ignition (76%) Delayed pool fire with flash fire (24%)
B	5.44E-07	06_KA19_02_WLHKOB_L_85 mm (Hydrocarbon liquid from Wellhead Knockout (V-2154) to SDV-2154B)	61.3%	Jet fire with pool fire from early ignition (78%) Delayed pool fire with flash fire (22%)

Point	LSIR (per year)	Contributor	% Contribution	Consequence
		16_KA19_04_CONPIP_L_71 mm (Hydrocarbon liquid from SDV-2154B (from Wellhead Knockout (V-2154)) to Condensate Pipeline)	38.7%	Jet fire with pool fire from early ignition (69%) Delayed pool fire with flash fire (31%)
C	2.04E-06	06_KA19_02_WLHKOB_L_85 mm (Hydrocarbon liquid from Wellhead Knockout (V-2154) to SDV-2154B)	44.8%	Jet fire with pool fire from early ignition (69%) Delayed pool fire with flash fire (31%)
		16_KA19_04_CONPIP_L_71 mm (Hydrocarbon liquid from SDV-2154B (from Wellhead Knockout (V-2154)) to Condensate Pipeline)	37.8%	Delayed pool fire with flash fire (68%) Jet fire with pool fire from early ignition (32%)
D	3.46E-07	06_KA19_02_WLHKOB_L_85 mm (Hydrocarbon liquid from Wellhead Knockout (V-2154) to SDV-2154B)	63.5%	Jet fire with pool fire from early ignition (91%) Delayed pool fire with flash fire (9%)
		16_KA19_04_CONPIP_L_71 mm (Hydrocarbon liquid from SDV-2154B (from Wellhead Knockout (V-2154)) to Condensate Pipeline)	34.6%	Jet fire with pool fire from early ignition (87%) Delayed pool fire with flash fire (13%)

The risk contributor analysis shows that the offsite risk contributors at different locations are contributed by two (2) same scenarios, which are the liquid sections from the Wellhead Knockout (V-2154) to the SDV-2154B (06_KA19_02_WLHKOB_L) and from the same SDV to the condensate export pipeline (16_KA19_04_CONPIP_L).

These sections have relatively high release frequencies (contributed 18.5% to the total wellsite leak frequency), and with the potential to have a large leak for 15 minutes (conservatively assumed that the leaks were remained at initial release rate with no depressurisation due to the leaks), hence can lead to a large liquid release.

6.4.2 Sensitivity Case

The risk contributors for the sensitivity case with the risk contributors and percentage of contribution are shown in Table 6-6.

Table 6-6: Risk Contributors to Selected Locations for KA-19 (Sensitivity Case)

Point	LSIR (per year)	Contributor	% Contribution	Consequence
A	7.32E-07	06_KA19_02_WLHKOB_L_85 mm (Hydrocarbon liquid from Wellhead Knockout (V-2154) to SDV-2154B)	45.5%	Jet fire with pool fire from early ignition (78%) Delayed pool fire with flash fire (22%)
		16_KA19_04_CONPIP_L_71 mm (Hydrocarbon liquid from SDV-2154B (from Wellhead Knockout (V-2154)) to Condensate Pipeline)	33.8%	Jet fire with pool fire from early ignition (76%) Delayed pool fire with flash fire (24%)

Point	LSIR (per year)	Contributor	% Contribution	Consequence
B	5.44E-07	06_KA19_02_WLHKOB_L_85 mm (Hydrocarbon liquid from Wellhead Knockout (V-2154) to SDV-2154B)	61.3%	Jet fire with pool fire from early ignition (78%) Delayed pool fire with flash fire (22%)
		16_KA19_04_CONPIP_L_71 mm (Hydrocarbon liquid from SDV-2154B (from Wellhead Knockout (V-2154)) to Condensate Pipeline)	38.7%	Jet fire with pool fire from early ignition (69%) Delayed pool fire with flash fire (31%)
C	2.78E-06	06_KA19_02_WLHKOB_L_85 mm (Hydrocarbon liquid from Wellhead Knockout (V-2154) to SDV-2154B)	32.9%	Jet fire with pool fire from early ignition (68%) Delayed pool fire with flash fire (32%)
		16_KA19_04_CONPIP_L_71 mm (Hydrocarbon liquid from SDV-2154B (from Wellhead Knockout (V-2154)) to Condensate Pipeline)	27.8%	Delayed pool fire with flash fire (68%) Jet fire with pool fire from early ignition (32%)
D	9.95E-07	27_KA19_09_KA4GPL_V_194 mm (Dry gas pipeline)	38.8%	Immediate jet fire (100%)
		29_KA19_11_KIWICO_V_194 mm (KGTP Treated Gas to export pipeline (to Kiwi Dairy Co. & Taranaki Byproduct Co.))	27.6%	Immediate jet fire (97%) Delayed flash fire (3%)
		06_KA19_02_WLHKOB_L_85 mm (Hydrocarbon liquid from Wellhead Knockout (V-2154) to SDV-2154B)	21.4%	Jet fire with pool fire from early ignition (91%) Delayed pool fire with flash fire (9%)
		16_KA19_04_CONPIP_L_71 mm (Hydrocarbon liquid from SDV-2154B (from Wellhead Knockout (V-2154)) to Condensate Pipeline)	11.6%	Delayed pool fire with flash fire (87%) Jet fire with pool fire from early ignition (13%)

The risk contributors for the sensitivity case are largely consistent with the base case, except at point D (at the west side of the wellsite) where the risks are also contributed by jet fires from the export pipelines.

It should be noted that Safeti cannot consider the effect of the obstacles / objects located along the way where the heat is radiated from the release source. In reality heat may be shielded by some process equipment / piping before extending offsite. Safeti also cannot consider the ground topography for pool spread, instead, flat area is assumed and the pool can spread until it reaches a bund wall or the pool formed minimum thickness (normally 5 mm).

7. WELLSITE KA-2

7.1 Release Scenarios

The P&IDs showing the isolatable sections for KA-2 are presented in Appendix 2. Table 7-1 details the section description and the respective operating conditions that are used in the QRA. There are no sensitivity cases for this wellsite.

Table 7-1: Release Scenarios and Operating Conditions for KA-2

No.	Section ID	Description	Material / Stream Note 1	Pressure (barg)	Temp. (°C)	Largest Connection Size (mm)	Section Inventory (m^3)	Isolatable Inventory (m^3)
1	01_KA02_01_WLHEAD_V	Wellstream fluid from KA-02 wellhead to XSV-0200C	1	31.74	43.72		*Unlimited* Note 2	
2	02_KA02_02_FLWLNE_V	Wellstream fluid from XSV-0200C to XSV-0200A	1	31.74	43.72	100	0.1	0.1
3	03_KA02_03_FLWLNE_V	Wellstream fluid from XSV-0200A to Wellstream Coolers (E-2210 & E-2260)	1	31.74	43.72	150	1.1	75.8
4	04_KA02_03_WSCOL1_V	Wellstream fluid from Wellstream Cooler (E-2210) to Gas/Condensate Exchanger (E-0201A)	2	31.64	24	150	1.4	75.8
5	05_KA02_03_WSCOL2_V	Wellstream fluid from Wellstream Cooler (E-2260) to Gas/Condensate Exchanger (E-0201A)	2	31.64	24	150	1.7	75.8
6	06_KA02_03_GCEXCT_V	Hydrocarbon gas from Gas/Condensate Exchanger (E-0201A) (tube side) to LT Separator (V-0202A)	2	31.64	24	150	1.1	75.8
7	07_KA02_03_LTSEPR_V	Wellstream fluid from LT Separator (V-0202A) to HP Knockout (V-201A)	2	31.64	24	150	0.1	75.8
8	08_KA02_03_HPKNOT_V	Hydrocarbon gas from HP Knockout (V-0201A) to Gas/Gas Exchanger (E-0202A)	2	31.64	24	150	0.9	75.8
9	*09_KA02_03_HPKNOB_L*	*Hydrocarbon liquid from HP Knockout (V-0201A) to Secondary Knockout (V-0204A)*	*3 Note 4*	*18.96*	*30*	-	-	-
10	10_KA02_03_SCDKOT_V	Hydrocarbon gas from Secondary Knockout (V-0204A) to LT Separator (V-0202A)	2	31.64	24	50	1.0	75.8

No.	Section ID	Description	Material / Stream Note 1	Pressure (barg)	Temp. (°C)	Largest Connection Size (mm)	Section Inventory (m³)	Isolatable Inventory (m³)
11	*11_KA02_03_SCDKOB_L*	*Hydrocarbon liquid from Secondary Knockout (V-0204A) to Gas/Condensate Exchanger (E-0201A)*	*3 Note 4*	*18.96*	*30*	-	-	-
12	12_KA02_03_GGEX1T_V	Hydrocarbon gas from Gas/Gas Exchanger (E-0202A) (tube side) to Gas/Gas Exchanger (E-0203A)	2	31.64	24	150	1.1	75.8
13	13_KA02_03_GGEX2T_V	Hydrocarbon gas from Gas/Gas Exchanger (E-0203A) (tube side) to LT Separator (V-0202A)	2	31.64	24	150	1.1	75.8
14	14_KA02_03_LTSEPT_V	Hydrocarbon gas from LT Separator (V-0202A) to Gas/Gas Exchanger (E-0203A)	4	22.8	14.21	150	2.3	75.8
15	15_KA02_03_GGEX1S_V	Hydrocarbon gas from Gas/Gas Exchanger (E-0203A) (shell side) to Gas/Gas Exchanger (E-0202A)	4	22.8	14.21	150	1.1	75.8
16	16_KA02_03_GGEX2S_V	Hydrocarbon gas from Gas/Gas Exchanger (E-0202A) (shell side) to gas export pipeline	5	22.56	22.4	200	61.7 Note 3	75.8
17	*17_KA02_03_LTSEPB_L*	*Hydrocarbon liquid from LT Separator (V-0202A) to Gas/Condensate Exchanger (E-0201A)*	*3 Note 4*	*18.96*	*30*	-	-	-
18	*18_KA02_03_GCEXCS_L*	*Hydrocarbon liquid from Gas/Condensate Exchanger (E-0201A) (shell side) to condensate export pipeline*	*3 Note 4*	*18.96*	*30*	-	-	-
19	19_KA02_03_FGKPOT_V	Hydrocarbon gas from PCV-0216A through Fuel Gas KO Pot (V-0203A) and Instrument Gas Receiver (V-0205A) to XSV-0203A	5	7	22.4	40	0.1	75.8
20	20_KA02_04_FUELGS_V	Fuel gas from XSV-0203A to Inhibitor Pumps (P-0202A/B/C) and Methanol Pump (P-0203)	5	7	22.4	25	0.03	0.03
21	21_KA02_03_GASPIG_V	Gas Scraper Trap (A-0103) to A-0503	5	22.56	22.4	200	1.0	75.8
22	*22_KA02_03_CONPIG_L*	*Condensate Scraper Trap (A-0101B) to A-0501A*	*3 Note 4*	*18.96*	*30*	-	-	-
23	23_KA02_05_METTNK_L	Methanol Tank (T-0203) to Methanol Pump (P-0203)	Methanol	Atm.	Amb.	25	2.2	2.2

Notes:

1. Stream composition refers to the stream numbers in the HMB. The full HMB for all wellsites is attached Appendix 8.
2. Inventory from the wellhead section is considered to be unlimited because they can be supplied from the downhole reservoir.
3. Sections connecting to the pipeline inventories due to the lack of isolation valve.
4. Stream 3 is constituting of high water content (% water cut is >125%) and is not considered as flammable. Hence these sections are not considered in the QRA.

7.2 Release Frequency

The leak frequencies for the process releases are estimated for each representative hole size using parts count results and the historical leak frequencies. The leak frequencies for KA-2 sections are shown in Table 7-2.

Table 7-2: Hydrocarbon Release Frequencies for KA-2

No	QRA Event	1 - 3 mm	3 - 10 mm	10 - 50 mm	50 - 150 mm	> 150 mm	TOTAL	% Contrib.
1	01_KA02_01_WLHEAD_V	3.37E-05	1.38E-05	5.67E-06	1.84E-06		5.50E-05	0.2%
	KA02 Blowout				4.20E-05		4.20E-05	0.2%
2	02_KA02_02_FLWLNE_V	4.33E-04	1.88E-04	9.75E-05	1.16E-05		7.30E-04	2.8%
3	03_KA02_03_FLWLNE_V	6.85E-04	2.92E-04	1.55E-04	8.31E-06	1.44E-06	1.14E-03	4.4%
4	04_KA02_03_WSCOL1_V	1.10E-03	3.99E-04	1.59E-04	2.95E-05	3.91E-07	1.69E-03	6.5%
5	05_KA02_03_WSCOL2_V	1.37E-03	5.11E-04	2.18E-04	3.01E-05	5.22E-07	2.13E-03	8.2%
6	06_KA02_03_GCEXCT_V	6.05E-04	3.22E-04	1.98E-04	1.14E-04	3.85E-07	1.24E-03	4.8%
7	07_KA02_03_LTSEPR_V	2.93E-04	1.27E-04	6.53E-05	6.06E-06	1.65E-06	4.93E-04	1.9%
8	08_KA02_03_HPKNOT_V	6.34E-04	2.86E-04	1.53E-04	3.44E-05	3.85E-07	1.11E-03	4.3%
9	*09_KA02_03_HPKNOB_L*	*Not flammable*						
10	10_KA02_03_SCDKOT_V	6.75E-04	3.04E-04	1.63E-04	3.81E-05		1.18E-03	4.6%
11	*11_KA02_03_SCDKOB_L*	*Not flammable*						
12	12_KA02_03_GGEX1T_V	6.96E-04	3.58E-04	2.17E-04	1.12E-04	3.85E-07	1.38E-03	5.3%
13	13_KA02_03_GGEX2T_V	8.90E-04	4.39E-04	2.45E-04	1.26E-04	3.85E-07	1.70E-03	6.6%
14	14_KA02_03_LTSEPT_V	1.10E-03	4.93E-04	2.64E-04	4.57E-05	2.91E-06	1.91E-03	7.4%
15	15_KA02_03_GGEX1S_V	1.01E-03	4.80E-04	2.36E-04	1.04E-04	3.85E-07	1.83E-03	7.1%
16	16_KA02_03_GGEX2S_V	2.62E-03	1.19E-03	6.14E-04	1.52E-04	4.96E-06	4.58E-03	17.7%
17	*17_KA02_03_LTSEPB_L*	*Not flammable*						
18	*18_KA02_03_GCEXCS_L*	*Not flammable*						
19	19_KA02_03_FGKPOT_V	1.39E-03	6.61E-04	4.84E-04			2.54E-03	9.8%
20	20_KA02_04_FUELGS_V	9.12E-04	3.91E-04	2.28E-04			1.53E-03	5.9%
21	21_KA02_03_GASPIG_V	1.12E-06	5.81E-07	3.21E-07	8.28E-08	2.65E-08	2.14E-06	0.01%
22	*22_KA02_03_CONPIG_L*	*Not flammable*						
23	23_KA02_05_METTNK_L	2.97E-04	1.26E-04	7.22E-05	5.00E-06	5.00E-06	6.05E-04	2.3%
TOTAL		1.47E-02	6.68E-03	3.57E-03	8.62E-04	1.88E-05	2.59E-02	
% Contribution		57%	26%	14%	3%	0.07%		

The total estimated release frequency from KA-2 is 2.59E-2 per year, or equivalent to one leak every 38.6 years. Most of the leaks are predicted to be from small leaks, where 83% of the leaks are from hole sizes less than 10 mm in diameter.

7.3 Risk Results

The risk results are presented in this section. The risk contours are contributed from both flammable and toxic risks from all release scenarios based on all the hazardous materials onsite.

The only toxic risk onsite is from the methanol tank due to methanol toxicity. As the methanol tank is stored at atmospheric condition with limited inventory (2.2 m^3 at maximum capacity) and bunded, the methanol toxic risk is very minor and localised. Hence no separate toxic risk contour was provided. Methanol toxic effect was modelled by using the probit method as detailed in the Assumptions Register [Ref. 5].

The risk contour for KA-2 wellsite is presented in Figure 7-1.

Figure 7-1: Risk Contour for KA-2 Wellsite

The risk assessed against the HIPAP4 criteria are summarised in Table 7-3.

Table 7-3: LSIR Results Assessed Against the HIPAP4 Land Use Criteria for KA-2

LSIR	Risk Contour	HIPAP4 Land Use Criteria	Result
5E-05 / year	**Blue**	5E-5 / year risk contour should, as a target, be contained within the boundaries of the industrial site where applicable.	Criteria met. The 5E-05 / year risk contour is within the site boundary.
1E-6 / year	**Red**	1E-6 / year risk contour should not extend to residential developments, hotels, tourist resorts.	Criteria met. There are no residential developments, hotels, tourist resorts within the contour.

7.4 Risk Contributors

The risk contributors to offsite risks at selected locations (points A and B) as shown in Figure 6-2 can be identified from the QRA model.

Figure 7-2: Location Selected to Identify Risk Contributors at KA-2

The risk contributors with the risk contributors and percentage of contribution are shown in Table 7-4.

Table 7-4: Risk Contributors to Selected Locations for KA-2

Point	LSIR (per year)	Contributor	% Contribution	Consequence
A	2.06E-06	13_KA02_03_GGEX2T_V_85mm (Hydrocarbon gas from Gas/Gas Exchanger (E-0203A) (tube side) to LT Separator (V-0202A))	17.6%	Jet fire due to early ignition
		06_KA02_03_GCEXCT_V_85mm (Hydrocarbon gas from Gas/Condensate Exchanger (E-0201A) (tube side) to LT Separator (V-0202A))	15.8%	Jet fire due to early ignition
		16_KA02_03_GGEX2S_V_85mm (Hydrocarbon gas from Gas/Gas Exchanger (E-0203A) (shell side) to Gas/Gas Exchanger (E-0202A))	15.8%	Jet fire due to early ignition
		12_KA02_03_GGEX1T_V_85mm (Hydrocarbon gas from Gas/Gas Exchanger (E-0202A) (tube side) to Gas/Gas Exchanger (E-0203A))	15.5%	Jet fire due to early ignition
B	1.29E-06	13_KA02_03_GGEX2T_V_85mm	18.7%	Jet fire due to early ignition
		06_KA02_03_GCEXCT_V_85mm	17.2%	Jet fire due to early ignition
		12_KA02_03_GGEX1T_V_85mm	16.6%	Jet fire due to early ignition
		16_KA02_03_GGEX2S_V_85mm	10.0%	Jet fire due to early ignition

The risk contributor analysis shows that the offsite risk contributors are jet fires from early ignition from large releases (85 mm) from multiple heat exchangers that are connected with the gas export pipeline, and hence sharing a large inventory. The main risk contributors at both offsite locations are the same (with slight differences in the percentage of contributions due to the equipment locations).

It should be noted that Safeti cannot consider the effect of the obstacles / objects located along the way where the heat is radiated from the release source. In reality heat may be shielded by some process equipment / piping before extending offsite. Safeti also cannot consider the ground topography for pool spread, instead, flat area is assumed and the pool can spread until it reaches a bund wall or the pool formed minimum thickness (normally 5 mm).

8. WELLSITE KA-4 AND KA-14

8.1 Release Scenarios

The P&IDs showing the isolatable sections for KA-4 and KA-14 are presented in Appendix 3. Table 8-1 details the section description and the respective operating conditions that are used in the QRA.

Table 8-1: Release Scenarios and Operating Conditions for KA-4 and KA-14

No.	Section ID	Description	Material / Stream Note 1	Pressure (barg)	Temp. (°C)	Largest Connection Size (mm)	Section Inventory (m^3)	Isolatable Inventory (m^3)
1	01_KA04_01_KA4WHD_V	KA-04 wellhead	37	18	17.6	100	*Unlimited* Note 2	
3	03_KA04_03_KA14WH_V	KA-14 wellhead	40	19.2	18.6	100	*Unlimited* Note 2	
5	05_KA04_05_KA14FW_V	Wellfluid from KA-14 wellhead to SDV-2430B	40	19.2	18.6	100	0.6	0.6
6	06_KA04_06_KA14CK_V	Wellfluid from SDV-2430B to the commingled line	41	18.5	18.1	150	0.0	1.4
7	07_KA04_06_KA4FLW_V	Wellfluid from KA-4 wellhead to the commingled line	38	16.2	16.1	150	1.0	1.4
8	08_KA04_06_MIXFLW_V	Mixed flow to SDV-2404A	39	18.3	13.5	100	0.4	1.4
9	09_KA04_07_METTNK_L	Methanol Tank (T-2429) to Methanol Pumps	Methanol	Atm.	Amb.	50	4.7	4.7
10	10_KA04_08_GASPPL_V	Dry gas pipeline from KA-8 Launcher A-2814 to XSV-2440A	33	17.21	30	250	18.1 Note 3	19.1
11	11_KA04_08_GASPIG_V	Scraper Launcher (A-2440)	33	17.21	30	250	1.0	19.1
Sensitivity Cases								
12	12_KA04_09_MTPPLN_V	From SDV-2404A to multiphase pipeline	39	18	27	100	20.8 Note 3	20.8
13	13_KA04_10_GASPLN_V	Gas pipeline from KA-8 A-2813 to KPS Receiver A-502D	33	17.21	30	150	85.8 Note 3	85.8
14	14_KA04_11_GASKA7_V	From XSV-2440A to Dry Gas Pipeline to KA-7	33	17.21	30	250	97.2 Note 3	97.2
15	15_KA04_08_GASPPL_V	Dry gas pipeline from KA-8 Launcher A-2814 to KA-4/14	33	17.21	30	250	18.1 Note 3	19.1

Notes:

1. Stream composition refers to the stream numbers in the HMB. The full HMB for all wellsites is attached Appendix 8.
2. Inventory from the wellhead section is considered to be unlimited because they can be supplied from the downhole reservoir.
3. Sections connecting to the pipeline inventories due to the lack of isolation valve.

8.2 Release Frequency

The leak frequencies for the process releases are estimated for each representative hole size using parts count results and the historical leak frequencies. The leak frequencies for KA-4 and KA-14 sections for the base case are shown in Table 6-2. The KA-14 well is only in operation for 24 hours every 10 days.

Table 8-2: Hydrocarbon Release Frequencies for KA-4 and KA-14 (Base Case)

No	QRA Event	1 - 3 mm	3 - 10 mm	10 - 50 mm	50 - 150 mm	> 150 mm	TOTAL	% Contrib.
1	01_KA04_01_KA4WHD_V	3.37E-05	1.38E-05	5.67E-06	1.84E-06		5.50E-05	0.9%
	KA-04 Blowout				4.20E-05		4.20E-05	0.7%
3	03_KA04_03_KA14WH_V	3.37E-06	1.38E-06	5.67E-07	1.84E-07		5.50E-06	0.1%
	KA-14 Blowout				4.20E-06		4.20E-06	0.1%
5	05_KA04_05_KA14FW_V	3.06E-05	1.33E-05	6.71E-06	1.13E-06		5.17E-05	0.9%
6	06_KA04_06_KA14CK_V	1.40E-04	5.92E-05	3.22E-05	4.30E-07	1.26E-07	2.32E-04	3.9%
7	07_KA04_06_KA4FLW_V	1.33E-03	5.66E-04	2.98E-04	1.78E-05	2.14E-06	2.21E-03	37.1%
8	08_KA04_06_MIXFLW_V	1.01E-03	4.36E-04	2.12E-04	3.79E-05		1.70E-03	28.4%
9	09_KA04_07_METTNK_L	2.49E-04	2.18E-04	6.64E-05	2.66E-05	5.00E-06	5.65E-04	9.5%
10	10_KA04_08_GASPPL_V	6.45E-04	2.86E-04	1.51E-04	2.05E-05	3.69E-06	1.11E-03	18.5%
11	11_KA04_08_GASPIG_V	1.83E-07	9.46E-08	5.25E-08	1.35E-08	4.39E-09	3.48E-07	0.01%
TOTAL		3.44E-03	1.59E-03	7.73E-04	1.53E-04	1.10E-05	5.97E-03	100.0%
% Contribution		58%	20%	10%	2%	0.1%		

The total leak frequency for KA-4 and KA-14 wellsite (for the base case) is 5.97E-03 per year, which is equivalent to one leak every 167 years. Most of the leaks are predicted to be from small leaks, where 78% of the leaks are from hole sizes less than 10 mm diameter.

The leak frequencies for KA-4 and KA-14 sections for the sensitivity case are shown in Table 8-3.

Table 8-3: Hydrocarbon Release Frequencies for KA-4 and KA-14 (Sensitivity Case)

No	QRA Event	1 - 3 mm	3 - 10 mm	10 - 50 mm	50 - 150 mm	> 150 mm	TOTAL	% Contrib.
12	12_KA04_09_MTPPLN_V	2.30E-04	9.88E-05	5.12E-05	6.01E-06		3.86E-04	4.8%
13	13_KA04_10_GASPLN_V	5.18E-04	2.22E-04	1.19E-04	6.49E-06	9.87E-07	8.66E-04	10.7%
14	14_KA04_11_GASKA7_V	6.03E-05	2.81E-05	1.43E-05	2.86E-06	8.86E-07	1.06E-04	1.3%
15	15_KA04_08_GASPPL_V	4.64E-04	2.03E-04	1.10E-04	1.01E-05	1.24E-06	7.88E-04	9.7%
TOTAL (Base Case and Sensitivity)		4.71E-03	2.14E-03	1.07E-03	1.78E-04	1.41E-05	8.12E-03	
% Contribution		58%	26%	13%	2%	0.2%		

The total leak frequencies for KA-19 wellsite (including the sensitivity cases) is 8.12E-03 per year, which is equivalent to one leak every 123 years.

8.3 Risk Results

The risk results are presented in this section. The risk contours are contributed from both flammable and toxic risks from all release scenarios based on all the hazardous materials onsite.

The only toxic risk onsite is due to methanol toxicity from the methanol tank. As the methanol tank is stored at atmospheric condition with limited inventory (4.7 m^3 at maximum capacity) and bunded, the methanol toxic risk is very minor and localised. Hence no separate toxic risk contour was provided. Methanol toxic effect was modelled by using the probit method as detailed in the Assumptions Register [Ref. 5].

8.3.1 Base Case

The base case risk contour for KA-4 and KA-14 wellsite is presented in Figure 8-1.

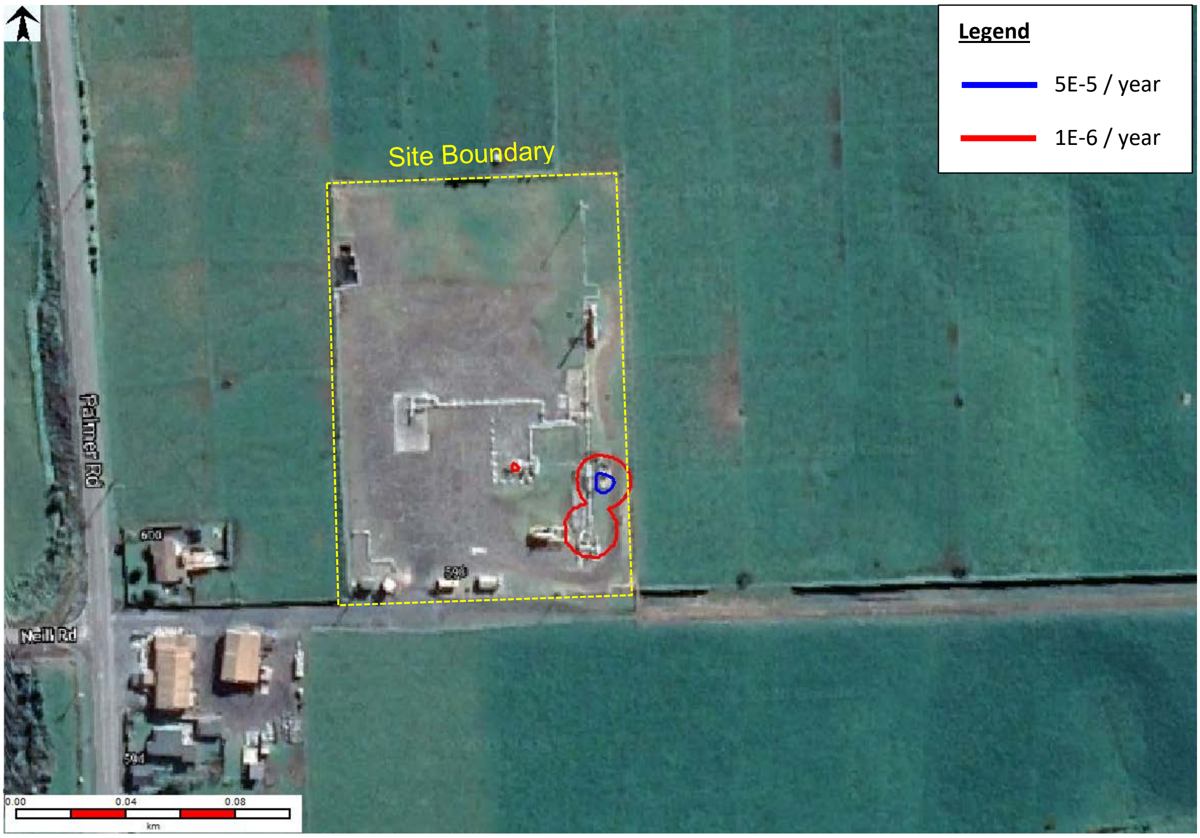


Figure 8-1: Risk Contour for KA-4 and KA-14 Wellsite (Base Case)

The risk assessed against the HIPAP4 criteria for the base case are summarised in Table 8-4.

Table 8-4: LSIR Results Assessed Against the HIPAP4 Land Use Criteria for KA-4 and KA-14 (Base Case)

LSIR	Risk Contour	HIPAP4 Land Use Criteria	Result
5E-05 / year	Blue	5E-5 / year risk contour should, as a target, be contained within the boundaries of the industrial site where applicable.	Criteria met. The 5E-05 / year risk contour is within the site boundary.
1E-6 / year	Red	1E-6 / year risk contour should not extend to residential developments, hotels, tourist resorts.	Criteria met. There are no residential developments, hotels, tourist resorts within the contour.

8.3.2 Sensitivity Case

The risk contour for KA-4/14 wellsite sensitivity case, which include the gathering pipeline sections is presented in Figure 8-2.

Figure 8-2: Risk Contour for KA-4 and KA-14 Wellsite (Sensitivity Case)

The risk contours for the sensitivity case similar to the base case and the assessment against the HIPAP4 criteria is the same, hence is it not repeated.

8.4 Risk Contributors

For both the base case and sensitivity cases, the 5E-05 / year risk contour and the 1E-06 /year risk contour remain within the site boundary. This is due to the low operating frequencies for the KA-4 well. As the risk contours did not extend offsite, no locations were selected for risk contributor identification.

9. WELLSITE KA-5 AND KA-10

9.1 Release Scenarios

The P&IDs indication the isolatable sections presented in Appendix 4 for KA-5, which is the only producing well at this wellsite. Table 9-1 details the section description and the respective operating conditions that are used in the QRA.

Table 9-1: Release Scenarios and Operating Conditions for KA-5

No.	Section ID	Description	Material / Stream Note 1	Pressure (barg)	Temp. (°C)	Largest Connection Size (mm)	Section Inventory (m^3)	Isolatable Inventory (m^3)
Base Cases								
1	01_KA05_01_WLHEAD_L	Wellstream fluid from KA-05 wellhead to XSV-0500B	6	23.3	28.13		*Unlimited* Note 2	
2	02_KA05_02_FLWLNE_L	Wellstream fluid from XSV-0500B to Desander (V-0516)	6	23.3	28.13	150	0.1	3.2 Note 4
3	03_KA05_02_DESAND_L	Wellstream fluid from Desander (V-0516) to choke valve PCV-0514A	6	23.3	28.13	150	2.4	3.2 Note 4
4	04_KA05_02_CHKLNE_L	Wellstream fluid choke valve PCV-0514A to XSV-0514A	7	18	22.33	150	0.7	3.2 Note 5
5	05_KA05_03_METHTK_L	Methanol Tank (T-0509) to Methanol Pump (P-0509)	Methanol	Atm	Amb	25	0.5	0.5
Sensitivity Cases								
7	07_KA05_04_LIQPIP_L	Wellstream fluid from XSV-0514A mix with condensate from A-2614 to liquid pipeline to KA-13 and KPS	8	18	21	150	1.9	57.4 Note 3, 6
8	08_KA05_05_KA6PPL_V	Gas from KA-6 & KA-11 passing through KA-5 to KA-13 and KPS	13	20.71	22.93	250	5.2	158.1 Note 3

Notes:

1. Stream composition refers to the stream numbers in the HMB. The full HMB for all wellsites is attached Appendix 8.
2. Inventory from the wellhead section is considered to be unlimited because they can be supplied from the downhole reservoir.
3. Sections connecting to the pipeline inventories due to the lack of isolation valve.

4. Inventories for modelling the 6 mm leak was increased to 133 kg, 1,791 kg for 22 mm and 26,728 kg for 85 mm leak, assuming the delayed detection and isolation of 15 min (i.e., the releases can sustain up to 15 min). This is conservatively assumed that the leaks can sustain at initial pressure with no depressurisation at the system.
5. Inventories for modelling the 6 mm leak was increased to 103 kg, 1,388 kg for 22 mm and 20,714 Inventory for modelling the 85 mm leak was increased to 24,839 kg, assuming the delayed detection and isolation of 15 min (i.e., the releases can sustain up to 15 min). This is conservatively assumed that the leak can sustain at initial pressure with no depressurisation at the system.
6. Inventory for modelling the 85 mm leak was increased to 21,428 kg, assuming the delayed detection and isolation of 15 min (i.e., the releases can sustain up to 15 min). This is conservatively assumed that the leaks can sustain at initial pressure with no depressurisation at the system.

9.2 Release Frequency

The leak frequencies for the process releases are estimated for each representative hole size using parts count results and the historical leak frequencies. The leak frequencies for KA-5 sections for the base case are shown in Table 9-2.

Table 9-2: Hydrocarbon Release Frequencies for KA-5 (Base Case)

No	QRA Event	1 - 3 mm	3 - 10 mm	10 - 50 mm	50 - 150 mm	> 150 mm	TOTAL	% Contrib.
1	01_KA05_01_WLHEAD_L	3.37E-05	1.38E-05	5.67E-06	1.13E-06	7.09E-07	3.37E-05	1.1%
	KA-05 Blowout					4.20E-05	4.20E-05	0.9%
2	02_KA05_02_FLWLNE_L	5.97E-04	2.50E-04	1.34E-04	2.04E-06	4.47E-07	5.97E-04	20.4%
3	03_KA05_02_DESAND_L	8.91E-04	4.14E-04	2.21E-04	6.15E-05	2.63E-06	8.91E-04	33.0%
4	04_KA05_02_CHKLNE_L	8.30E-04	3.56E-04	1.88E-04	1.24E-05	2.75E-06	8.30E-04	28.9%
5	05_KA05_03_METHTK_L	4.45E-04	2.93E-04	1.17E-04	5.00E-06	5.00E-06	8.69E-04	15.7%
TOTAL		2.80E-03	1.33E-03	6.65E-04	8.21E-05	5.35E-05	4.92E-03	100.0%
% Contribution		57%	27%	14%	2%	1%		

The total leak frequency for KA-5 wellsite (for the base case) is 4.92E-03 per year, which is equivalent to one leak every 208 years. Most of the leaks are predicted to be from small leaks, where 86% of the leaks are from hole sizes less than 10 mm diameter.

The leak frequencies for KA-5 sections for the sensitivity case are shown in Table 9-3.

Table 9-3: Hydrocarbon Release Frequencies for KA-5 (Sensitivity Case)

No	QRA Event	1 - 3 mm	3 - 10 mm	10 - 50 mm	50 - 150 mm	> 150 mm	TOTAL	% Contrib.
7	07_KA05_04_LIQPIP_L	7.27E-04	3.09E-04	1.65E-04	8.32E-06	1.39E-06	1.21E-03	17.3%
8	08_KA05_05_KA6PPL_V	5.12E-04	2.27E-04	1.22E-04	1.72E-05	2.99E-06	8.80E-04	12.6%
TOTAL (Base Case and Sensitivity)		4.03E-03	1.86E-03	9.51E-04	1.08E-04	5.79E-05	7.01E-03	
% Contribution		58%	27%	14%	2%	0.8%		

The total leak frequency for KA-5 wellsite (including the sensitivity cases) is 7.01E-03 per year, which is equivalent to one leak every 143 years.

9.3 Risk Results

The risk results are presented in this section. The risk contours are contributed from both flammable and toxic risks from all release scenarios based on all the hazardous materials onsite.

The only toxic risk onsite is due to methanol toxicity from the methanol tank. As the methanol tank is stored at atmospheric condition with limited inventory (0.5 m^3 at maximum capacity) and bunded, the methanol toxic risk is very minor and localised. Hence no separate toxic risk contour was provided. Methanol toxic effect was modelled by using the probit method as detailed in the Assumptions Register [Ref. 5].

9.3.1 Base Case

The base case risk contour for KA-5 and KA-10 wellsite is presented in Figure 9-1.

Figure 9-1: Risk Contour for KA-5 and KA-10 Wellsite (Base Case)

The risk assessed against the HIPAP4 criteria for the base case are summarised in Table 9-4.

Table 9-4: LSIR Results Assessed Against the HIPAP4 Land Use Criteria for KA-5 and KA-10 (Base Case)

LSIR	Risk Contour	HIPAP4 Land Use Criteria	Result
5E-05 / year	Blue	5E-5 / year risk contour should, as a target, be contained within the boundaries of the industrial site where applicable.	Criteria met. The 5E-05 / year risk contour is within the site boundary.
1E-6 / year	Red	1E-6 / year risk contour should not extend to residential developments, hotels, tourist resorts.	Criteria met. There are no residential developments, hotels, tourist resorts within the contour.

9.3.2 Sensitivity Case

The risk contour for KA-5 and KA-10 wellsite sensitivity case, which include the gathering pipeline sections is presented in Figure 9-2.

Figure 9-2: Risk Contour for KA-5 and KA-10 Wellsite (Sensitivity Case)

The risk contours for the sensitivity case are slightly larger compared to the base case due to the additional sections, however the assessment against the HIPAP4 criteria is the same. Hence is it not repeated.

9.4 Risk Contributors

For both the base case and sensitivity cases, the 5E-05 / year risk contour and the 1E-06 /year risk contour remain within the site boundary. This is because there is only very limited equipment onsite. As the risk contours did not extend offsite, no locations were selected for risk contributor identification.

10. WELLSITE KA-6, KA-11 AND KA-17

10.1 Release Scenarios

The P&IDs indication the isolatable sections presented in Appendix 5 for KA-6 and KA-17, which are the producing wells at this wellsite. The wellsite modification from CUSP Phase 3 has been considered in this revision of the report, which include the bypass of the High Pressure Knockout vessel (V-2654) and the installation of new header. V-2654 is currently isolated and will be permanently disconnected from process as part of the execution of the project, which the vessel may remain on site post CUSP until permanently demolished and removed. If the vessel were to be brought back into operation, it will require a consent and the QRA will be updated.

Table 10-1 details the section description and the respective operating conditions that are used in the QRA.

Table 10-1: Release Scenarios and Operating Conditions for KA-6 and KA-17

No.	Section ID	Description	Material / Stream Note 1	Pressure (barg)	Temp. (°C)	Largest Connection Size (mm)	Section Inventory (m^3)	Isolatable Inventory (m^3)
1	01_KA06_01_WLHEAD_V	Wellstream fluid from KA-06 wellhead to XSV-2600	9	36.5	28.18	150	*Unlimited* Note 2	
2	02_KA17_02_WLHEAD_V	Wellstream fluid from KA-17 wellhead to XSV-2680A	14	22	29.82	150	*Unlimited* Note 2	
3	03_KA06_03_DESAND_V	Wellstream fluid from XSV-2600 through KA-6 Desander (V-2601) to Wellstream Cooler (E-2651)	9	36.5	28.2	150	2.5	11.0
4	04_KA17_03_DESAND_V	Wellstream fluid from XSV-2680A through KA-17 Desander (V-2682) to condensate pipeline	14	22	29.8	150	3.0	11.0
6	06_KA06_03_WSCOOL_V	Wellstream fluid from Wellstream Cooler (E-2651) to gas pipeline	9	36.5	28.2	150	1.4	11.0
7	07_KA06_03_GASPLN_V	Wellstream fluid from Wellstream Cooler (E-2651) to XSV-2671A to gas pipeline	9	36.5	28.2	250	1.5	11.0
8	08_KA06_03_CONPLN_L	Wellstream fluid from KA-17 well to XSV-2672A	14	22	29.8	150	0.5	11.0 Note 4
9	09_KA06_03_GASPIG_V	Scraper Trap (A-2613) on gas gathering pipeline	9	36.5	28.2	250	1.1	11.0
10	10_KA06_03_CONPIG_L	Scraper Trap (A-2614) on condensate gathering pipeline	14	22	29.8	150	1.0	11.0 Note 4
12	12_KA06_04_METNK2_L	Methanol Tank (T-2609) to Methanol Pumps (P-2609A & C)	Methanol	Atm.	Amb.	50	2.2	2.2

No.	Section ID	Description	Material / Stream Note 1	Pressure (barg)	Temp. (°C)	Largest Connection Size (mm)	Section Inventory (m^3)	Isolatable Inventory (m^3)
Sensitivity Cases								
14	14_KA06_05_GASPLN_V	Gas pipeline to KA-05	9	36.5	28.2	250	152.9 Note 3	152.9
15	15_KA06_06_CONPLN_L	Condensate pipeline to KA-05	14	22	29.8	150	55.5 Note 3	55.5 Note 5

Notes:

1. Stream composition refers to the stream numbers in the HMB. The full HMB for all wellsites is attached Appendix 8.
2. Inventory from the wellhead section is considered to be unlimited because they can be supplied from the downhole reservoir.
3. Sections connecting to the pipeline inventories due to the lack of isolation valve.
4. Inventories for modelling the 22 mm leak was increased to 1,664 kg, and 24,839 kg for 85 mm leak, assuming the delayed detection and isolation of 15 min (i.e., the releases can sustain up to 15 min). This is conservatively assumed that the leaks can sustain at initial pressure with no depressurisation at the system.
5. Inventory for modelling the 85 mm leak was increased to 24,839 kg, assuming the delayed detection and isolation of 15 min (i.e., the releases can sustain up to 15 min). This is conservatively assumed that the leak can sustain at initial pressure with no depressurisation at the system.

10.2 Release Frequency

The leak frequencies for the process releases are estimated for each representative hole size using parts count results and the historical leak frequencies. The leak frequencies for KA-6 and KA-17 sections for the base case are shown in Table 10-2.

Table 10-2: Hydrocarbon Release Frequencies for KA-6 and KA-17 (Base Case)

No.	QRA Event	1 - 3 mm	3 - 10 mm	10 - 50 mm	50 - 150 mm	> 150 mm	TOTAL	% Contrib.
1	01_KA06_01_WLHEAD_V	3.37E-05	1.38E-05	5.67E-06	1.13E-06	7.09E-07	5.50E-05	0.3%
	KA-06 Blowout					4.20E-05	4.20E-05	0.3%
2	02_KA17_02_WLHEAD_V	3.37E-05	1.38E-05	5.67E-06	1.13E-06	7.09E-07	5.50E-05	0.4%
	KA-17 Blowout					4.20E-05	4.20E-05	0.4%
3	03_KA06_03_DESAND_V	2.09E-03	9.26E-04	4.97E-04	7.38E-05	4.39E-06	3.59E-03	26.6%
4	04_KA17_03_DESAND_V	1.90E-03	8.51E-04	4.58E-04	7.86E-05	4.17E-06	3.30E-03	24.4%
6	06_KA06_03_WSCOOL_V	1.57E-03	5.98E-04	2.67E-04	3.14E-05	8.95E-07	2.46E-03	18.2%
7	07_KA06_03_GASPLN_V	8.40E-04	3.76E-04	2.03E-04	3.56E-05	4.22E-06	1.46E-03	10.8%
8	08_KA06_03_CONPLN_L	1.01E-03	4.41E-04	2.40E-04	1.79E-05	2.72E-06	1.71E-03	12.7%
9	09_KA06_03_GASPIG_V	1.14E-06	5.93E-07	3.29E-07	8.87E-08	2.65E-08	2.18E-06	0.02%
10	10_KA06_03_CONPIG_L	1.13E-06	5.86E-07	3.25E-07	1.62E-07	5.27E-11	2.20E-06	0.02%
12	12_KA06_04_METNK2_L	3.82E-04	2.74E-04	1.19E-04	5.00E-06	5.00E-06	7.85E-04	5.8%
TOTAL		7.86E-03	3.49E-03	1.80E-03	2.45E-04	1.07E-04	1.35E-02	100.0%
% Contribution		58%	26%	13%	1.8%	0.8%		

The total leak frequency for KA-6/17 wellsite (for the base case) is 1.35E-02 per year, which is equivalent to one leak every 74 years. Most of the leaks are predicted to be from small leaks, where 84% of the leaks are from hole sizes less than 10 mm diameter.

The leak frequencies for KA-6 and KA-17 sections for the sensitivity case are shown in Table 10-3.

Table 10-3: Hydrocarbon Release Frequencies for KA-6 (Sensitivity Case)

No	QRA Event	1 - 3 mm	3 - 10 mm	10 - 50 mm	50 - 150 mm	> 150 mm	TOTAL	% Contrib.
14	14_KA06_05_GASPLN_V	7.53E-05	3.61E-05	1.89E-05	5.56E-06	8.86E-07	1.37E-04	1.0%
15	15_KA06_06_CONPLN_L	5.93E-05	2.46E-05	1.07E-05	1.76E-06	3.85E-07	9.67E-05	0.7%
TOTAL (Base Case and Sensitivity)		8.00E-03	3.56E-03	1.83E-03	2.52E-04	1.08E-04	1.37E-02	
% Contribution		58%	26%	13%	2%	0.8%		

The total leak frequency for KA-6/17 wellsite (including the sensitivity cases) is 1.37E-02 per year, which is equivalent to one leak every 73 years.

10.3 Risk Results

The risk results are presented in this section. The risk contours are contributed from both flammable and toxic risks from all release scenarios based on all the hazardous materials onsite.

The only toxic risk onsite is due to methanol toxicity from the methanol tank. As the methanol tank is stored at atmospheric condition with limited inventory (2.2 m^3 at maximum capacity) and bunded, the methanol toxic risk is very minor and localised. Hence no separate toxic risk contour was provided. Methanol toxic effect was modelled by using the probit method as detailed in the Assumptions Register [Ref. 5].

10.3.1 Base Case

The base case risk contour for KA-6/17 wellsite is presented in Figure 10-1.

Figure 10-1: LSIR Contours for KA-6/17 Wellsite (Base Case)

The risk assessed against the HIPAP4 criteria are summarised in Table 10-4.

Table 10-4: LSIR Results Assessed Against the HIPAP4 Land Use Criteria for KA-6/17 (Base Case)

LSIR	Risk Contour	HIPAP4 Land Use Criteria	Result
5E-05 / year	Blue	5E-5 / year risk contour should, as a target, be contained within the boundaries of the industrial site where applicable.	Criteria met. The risk level is lower than 5E-05 / year.
1E-6 / year	Red	1E-6 / year risk contour should not extend to residential developments, hotels, tourist resorts.	Criteria met. There are no residential developments, hotels, tourist resorts within the contour.

10.3.2 Sensitivity Case

The LSIR for KA-6/17 wellsite sensitivity case, which include the gathering pipeline sections is presented in Figure 10-2.

Figure 10-2: LSIR Contours for KA-6/17 Wellsite (Sensitivity Case)

The risk contours for the sensitivity case are slightly larger compared to the base case due to the additional sections, however the assessment against the HIPAP4 criteria is the same. Hence is it not repeated.

10.4 Risk Contributors

The risk contributors to offsite risks at selected location (point A) as shown in Figure 6-2 can be identified from the QRA model.

Figure 10-3: Location Selected to Identify Risk Contributors at KA-6/17 wellsite

10.4.1 Base Case

The risk contributors for the base case with the risk contributors and percentage of contribution are shown in Table 10-5.

Table 10-5: Risk Contributors to Selected Locations for KA-6/17 (Base Case)

Point	LSIR (per year)	Contributor	% Contribution	Consequence
A	1.83E-06	07_KA06_03_GASPLN_V_85 mm (horizontal release) (Wellstream fluid from Wellstream Cooler (E-2651) to gas export pipeline)	44.1%	Fireball from early ignition
		07_KA06_03_GASPLN_V_85 mm (vertical release) (Wellstream fluid from Wellstream Cooler (E-2651) to gas export pipeline)	18.9%	Fireball from early ignition
		07_KA06_03_GASPLN_V_194 mm (horizontal release) (Wellstream fluid from Wellstream Cooler (E-2651) to gas export pipeline)	18.4%	Fireball from early ignition (96%) Flash fire from delayed ignition (4%)

The risk contributor analysis shows that the offsite risk contributors are contributed by one scenario, which is the wellstream fluid from the Wellstream Cooler (E-2651) to the gas export pipeline isolation valve from large releases. This is because the leak frequency from this section is relatively high (contributed 10.8% to the total wellsite leak frequency) and the equipment are close to the boundary at the north.

10.4.2 Sensitivity Case

The risk contributors for the sensitivity case with the risk contributors and percentage of contribution are shown in Table 10-6.

Table 10-6: Risk Contributors to Selected Locations for KA-6/17 (Sensitivity Case)

Point	LSIR (per year)	Contributor	% Contribution	Consequence
A	1.86E-06	07_KA06_03_GASPLN_V_85 mm (horizontal release) (Wellstream fluid from Wellstream Cooler (E-2651) to gas export pipeline)	43.4%	Fireball from early ignition
		07_KA06_03_GASPLN_V_85 mm (vertical release) (Wellstream fluid from Wellstream Cooler (E-2651) to gas export pipeline)	18.6%	Fireball from early ignition
		07_KA06_03_GASPLN_V_194 mm (horizontal release) (Wellstream fluid from Wellstream Cooler (E-2651) to gas export pipeline)	18.1%	Fireball from early ignition (96%) Flash fire from delayed ignition (4%)

The risk contributors for the sensitivity case are almost consistent with the base case, where the offsite risk contributors are contributed the same scenario, which is the which is the wellstream fluid from the Wellstream Cooler (E-2651) to the gas export pipeline isolation valve from large release.

It should be noted that Safeti cannot consider the effect of the obstacles / objects located along the way where the heat is radiated from the release source. In reality heat may be shielded by some process equipment / piping before extending offsite.

11. WELLSITE KA-8, KA-12, KA-15 AND KA-18

11.1 Release Scenarios

The P&IDs indication the isolatable sections presented in Appendix 6 for KA-8 and KA-18, which are the producing wells at this wellsite. The wellsite modification from CUSP Phase 3 has been considered in this revision of the report, which include the installation of two slug catcher pumps (P-28201/28202). Table 11-1 details the section description and the respective operating conditions that are used in the QRA.

Table 11-1: Release Scenarios and Operating Conditions for KA-8 and KA-18

No.	Section ID	Description	Material / Stream Note 1	Pressure (barg)	Temp. (°C)	Largest Connection Size (mm)	Section Inventory (m^3)	Isolatable Inventory (m^3)
1	01_KA08_01_WLHEAD_V	Wellstream fluid from KA-08 wellhead (XSV-2801) to XSV-2820	28	23.83	28.09	100	*Unlimited* Note 2	
2	02_KA08_02_FLWLNE_V	Wellstream fluid from XSV-2820 (KA-08) to XCV-2858E, XCV-2858D, XCV-2858C, XCV-2840C, XCV-2840E, XCV-2840F and XSV-2800	28	23.83	28.09	150	1.65	1.65
3	03_KA18_03_WLHEAD_V	Wellstream fluid from KA-18 wellhead (XSV-2850A) to SDV-2850B	21	29.68	34.01	100	*Unlimited* Note 2	
4	04_KA18_04_CHKLNE_V	Wellstream fluid from SDV-2850b to choke valve HCV-2850A	21	29.68	34.01	150	0.10	0.21
5	05_KA18_04_CHKLNE_V	Wellstream fluid from choke valve HCV-2850A to XCV2840D and XCV-2840F	22	22.06	30.76	150	0.11	0.21
6	06_KA18_05_SLGCAT_V	Wellstream fluid from XCV-2840D to Slug Catcher (V-2858) and SDV-2858A and HCV2858A	23	19.5	21.54	250	2.62	34.30
7	07_KA18_05_SLGCAT_V	Vapour from Slug Catcher (V-2858) to Separators V-9010 and V-9020, XCV-2858E and XCV-2858C	27	19.52	21.54	250	31.68	34.30
8	08_KA08_06_COMGAS_V	Compressed Gas from Compressors A-9101 and A-9201 (from SDV-9101G, SDV-9201G, XCV-2840E, XCV-2858D) to SDV-2808A and XCV-2840C	32	51.67	34.50	150	3.57	3.57

No.	Section ID	Description	Material / Stream Note 1	Pressure (barg)	Temp. (°C)	Largest Connection Size (mm)	Section Inventory (m^3)	Isolatable Inventory (m^3)
9	09_KA18_07_WGSLTS_V	Wet Gas from XSV-2863A, TCV-2808B, Gas Exchangers E-2801/2 and LTS Vessel V-2804 and Pig Receiver (A-2863) to SDV-2858A and HCV-2858A, Pig Launchers A-2913 and A2814 and through Fuel Gas Heater E-9030 to SDV-9030A	43	39.17	15.25	150	6.18	15.52
10	10_KA18_07_PIGL13_V	Pig Launcher A-2813	33(2)	39.05	26.45	150	1.02	15.52
11	11_KA18_07_PIGL14_V	Pig Launcher A-2814	33(2)	39.05	26.45	100	0.01	15.52
12	12_KA08_07_GASEXC_V	Hydrocarbon Gas from XSV-2800 through Tube side Gas/condensate exchanger E-2800, though LTS vessel V-2804 to HPKO V-2803	32	51.67	34.50	150	0.73	15.52
13	13_KA08_07_HPKOGS_V	Hydrocarbon Gas from HP KO V-2803 to PCVs 2804A/E	40	51.17	23.74	150	2.94	15.52
14	*14_KA08_07_CLSSFR_L*	*Hydrocarbon Liquid from HP KO V-2803 through Classifier V-2805 to LCV-2805 Note 4*	*38*	*39.17*	*34.00*	-	-	-
15	15_KA08_07_CONEXC_L	Hydrocarbon Liquid from LTS V-2804 and LCV-2805 to TICV-2804A	46	39.15	20.00	50	2.24	15.52
16	16_KA18_08_LPIG64_L	Wellstream liquids from SDV-2808C and SDV-2858B to Pig Launcher A-2864	33	17.21	30.00	100	0.31	26.08
17	17_KA18_08_LPIG64_L	Pig Launcher A-2864	33	17.21	30.00	100	1.01	26.08
18	18_KA08_09_SEPRTR_V	Hydrocarbon Gas from Separator V-9010 to shut down valves SDV-9101C/D	31	19.43	22.18	200	4.68	8.41
19	*19_KA08_09_SEPRTR_L*	*Hydrocarbon Liquid from Separator V-9010 to SDV-9015C Note 4*	*30*	*19.43*	*22.18*	-	-	-
20	*20_KA08_09_BLWCSE_L*	*Hydrocarbon liquid from SDV-9141C to Separator V-9010 Note 4*	-	-	-	-	-	-
21	*21_KA08_09_PUMPBP_L*	*Hydrocarbon Liquid from SDV-9015C through P-9015 to SDV-9015A Note 4*	*30*	*19.43*	*22.18*	-	-	-
22	22_KA08_09_BLWCSE_V	Hydrocarbon gas from SDVs SDV-9101H, SDV-9141B, SDV-9141A through Blowcase V-9141 to Suction Scrubber V-9111	32	51.67	34.50	80	0.10	8.41

No.	Section ID	Description	Material / Stream Note 1	Pressure (barg)	Temp. (°C)	Largest Connection Size (mm)	Section Inventory (m³)	Isolatable Inventory (m³)
23	23_KA08_09_COOLER_V	Hydrocarbon Gas from SDV-9101C/D to suction scrubbers V-9111 & V-9121, TCV-9101A and PCV-9101C	31	19.43	22.18	100	0.01	8.41
24	24_KA08_09_SS9111_V	Hydrocarbon Gas from Suction Scrubber V-9111 and SDV-9131A to Compressor K-9101A	31	19.43	22.18	150	1.73	8.41
25	25_KA08_09_SS9121_V	Hydrocarbon Gas from Suction Scrubber V-9121 to Compressor K-9101B	31	19.43	22.18	150	1.69	8.41
26	26_KA08_09_COMPSR_V	Hydrocarbon Gas from Compressors K-9101A/B through Afterstage Coolers E-9131A/B to SDV-9101F, SDV-9101G, PCV-9101C and TCV-9101A	32	51.67	34.50	100	0.19	8.41
27	27_KA18_10_SEPRTR_V	Hydrocarbon Gas from Separator V-9020 to shut down valves SDV-9201C/D	31	19.43	22.18	200	4.68	6.76
28	*28_KA18_10_SEPRTR_L*	*Hydrocarbon Liquid from Separator V-9020 to SDV-9025C Note 4*	*30*	*19.43*	*22.18*	-	-	-
29	*29_KA18_10_BLWCSE_L*	*Hydrocarbon Liquid from SDV-9241C to Separator V-9020 Note 4*	-	-	-	-	-	-
30	30_KA18_10_COOLER_V	Hydrocarbon Gas from SDV-9201C/D, TCV-9201A and PCV-9201C	31	19.43	22.18	150	0.01	6.76
31	31_KA18_10_SS9111_V	Hydrocarbon Gas from Suction Scrubber V-9211 and SDV-9241A to Compressor K-9201A	32	51.67	34.50	150	1.73	6.76
32	32_KA18_10_SS9101_V	Hydrocarbon Gas from Suction Scrubber V-9221 to Compressor K-9201B	31	19.43	22.18	150	0.03	6.76
33	*33_KA18_10_PUMPBP_L*	*Hydrocarbon Liquid from SDV-9025C through P-9025 to SDV-9025A Note 4*	*30*	*19.43*	*22.18*	-	-	-
34	34_KA18_10_BLWCSE_V	Hydrocarbon Liquid from SDVs SDV-9201H, SDV-9241B, SDV-9241A through Blowcase V-9241 to SDV-9241C	32	51.67	34.50	50	0.10	6.76
35	35_KA18_10_COMPSR_V	Hydrocarbon Gas from Compressors K-9201A/B through Afterstage Coolers E-9231A/B to SDV-9201F, SDV-9201G, PCV-9201C and TCV-9201A	32	51.67	34.50	100	0.19	6.76

No.	Section ID	Description	Material / Stream Note 1	Pressure (barg)	Temp. (°C)	Largest Connection Size (mm)	Section Inventory (m^3)	Isolatable Inventory (m^3)
36	36_KA18_07_FUELGS_V	Fuel Gas from SDV-9030A to PCVs 9030B/C	33(2)	39.05	26.45	50	0.01	15.52
37	37_KA18_07_FLGSSS_V	Fuel Gas from PCVs 9030B/C through Fuel Gas Scrubber V-9031 to SDV-9101A and SDV-9201A	33(2)	7	26.45	80	0.13	15.52
38	38_KA08_07_FLGSEP_V	Fuel gas from SDV-9101A through fuel gas coalescing separator (F-9171) to PCV-9101D and PCV-9101E	33(2)	3.45	26.45	50	0.59	15.52
39	39_KA18_07_FLGSEP_V	Fuel Gas from SDV-9201A through fuel gas coalescing separator (F-9271) to PCV-9201D and PCV-9201E	33(2)	3.45	26.45	50	0.63	15.52
40	40_KA18_11_GASEXC_V	Dry Gas from LTS Unit B V-2080 through Gas exchangers E-2816, E-2817 and E-2818 to TCV-2808B	33(2)	39.05	26.45	150	2.41	2.41
41	41_KA18_08_LTSUNB_V	Dry Gas from PCV-2808A to LTS Unit B V-2080	33(2)	39.05	26.45	100	7.73	9.99
42	42_KA18_08_LTSUNB_L	Liquid from LTS Unit B V-2080 to SDV-2808C	33	17.21	30.00	80	7.66	26.08
43	43_KA18_08_SHLEXC_V	Gas from LTS V-2808 through Gas exchangers (E-2816/7/8) back to LTS V-2808	32	51.67	34.50	150	2.25	9.99
44	44_KA18_07_GPIG63_V	Pig Receiver A-2863	33(2)	39.05	26.45	250	1.05	15.52
45	45_KA18_14_MTHNOL_L	Methanol storage tank (T-2866) to Pumps P-2884/2876/2877/2878	Methanol	Atm.	Amb.	50	4.68	6.24
46	46_KA18_14_MT2884_L	Methanol from Pump P-2884 to KA-18	Methanol	30	14	15	0.54	6.24
47	47_KA18_14_MT2876_L	Methanol from Pump P-2876 to LTS Units 8 and B	Methanol	30	14	15	0.51	6.24
48	48_KA18_14_MT2877_L	Methanol from Pump P-2878 to LTS Unit B	Methanol	30	14	25	0.52	6.24
49	*49_KA18_05_SLGCAT_L*	*Liquid from Slug Catcher (V-2858) to Slug Catcher Pumps (P-28201/28202) Note 4*	*24*	*19.52*	*21.54*	-	-	-
54	*47_KA18_05_SCPUMP_L*	*Slug Catcher Pumps (P28201/28202) to condensate pipeline Note 4*	*24*	*19.52*	*21.54*	-	-	-

No.	Section ID	Description	Material / Stream Note 1	Pressure (barg)	Temp. (°C)	Largest Connection Size (mm)	Section Inventory (m^3)	Isolatable Inventory (m^3)
Sensitivity Cases								
50	50_KA18_15_KA4WGP_V	Wet gas from KA-4 & 14 to XSV-2863A	33(2)	39.05	26.45	250	112.9 Note 3	112.9
51	51_KA18_16_KA4P13_V	Dry gas from XSV-2813A to wellsite KA-4	33(2)	39.05	26.45	150	38.7 Note 3	38.7
52	52_KA18_17_KA4P14_V	Dry gas from XSV-2814 to wellsite KA-4	33(2)	39.05	26.45	100	18.1 Note 3	18.1
53	53_KA18_18_KA1PPL_L	Condensate from XSV-2864A to wellsite KA-1 & 7	33	17.21	30.00	100	17.1 Note 3	17.1

Notes:

1. Stream composition refers to the stream numbers in the HMB. The full HMB for all wellsites is attached Appendix 8.
2. Inventory from the wellhead section is considered to be unlimited because they can be supplied from the downhole reservoir.
3. Sections connecting to the pipeline inventories due to the lack of isolation valve.
4. Sections are not considered in the QRA due to either the sections are Normally No Flow (NNF) or the material constituting of high water content (% water cut is >125%) and considered as not flammable (Streams 24, 30 and 38).

11.2 Release Frequency

The leak frequencies for the process releases are estimated for each representative hole size using parts count results and the historical leak frequencies. The leak frequencies for KA-8 and KA-18 sections for the base case are shown in Table 11-2.

Table 11-2: Hydrocarbon Release Frequencies for KA-8 and KA-18 (Base Case)

No	QRA Event	1 - 3 mm	3 - 10 mm	10 - 50 mm	50 - 150 mm	> 150 mm	TOTAL	% Contrib.
1	01_KA08_01_WLHEAD_V	3.37E-05	1.38E-05	5.67E-06	1.84E-06		5.50E-05	0.03%
	KA-08 Blowout				4.20E-05		4.20E-05	0.02%
2	02_KA08_02_FLWLNE_V	1.73E-03	7.57E-04	3.99E-04	3.56E-05	8.21E-06	2.94E-03	1.4%
3	03_KA18_03_WLHEAD_V	3.37E-05	1.38E-05	5.67E-06	1.84E-06		5.50E-05	0.03%
	KA-18 Blowout				4.20E-05		4.20E-05	0.02%
4	04_KA18_04_CHKLNE_V	3.01E-04	1.31E-04	6.61E-05	7.13E-06	1.93E-06	5.07E-04	0.2%
5	05_KA18_04_CHKLNE_V	1.25E-03	5.33E-04	2.84E-04	1.34E-05	3.74E-06	2.08E-03	1.0%
6	06_KA18_05_SLGCAT_V	8.53E-04	3.71E-04	1.91E-04	2.27E-05	3.62E-06	1.44E-03	0.7%
7	07_KA18_05_SLGCAT_V	1.66E-03	7.40E-04	3.87E-04	6.69E-05	7.46E-06	2.87E-03	1.4%
8	08_KA08_06_COMGAS_V	1.33E-03	5.87E-04	2.95E-04	3.89E-05	1.05E-05	2.27E-03	1.1%
9	09_KA18_07_WGSLTS_V	1.26E-02	5.05E-03	2.21E-03	5.33E-04	1.12E-05	2.04E-02	9.9%
10	10_KA18_07_PIGL13_V	3.73E-07	1.93E-07	1.07E-07	5.30E-08	7.35E-11	7.27E-07	0.0004%
11	11_KA18_07_PIGL14_V	1.15E-06	5.98E-07	3.32E-07	1.65E-07		2.25E-06	0.001%
12	12_KA08_07_GASEXC_V	9.22E-04	4.58E-04	2.73E-04	1.20E-04	4.90E-07	1.77E-03	0.9%
13	13_KA08_07_HPKOGS_V	1.33E-03	6.03E-04	3.16E-04	7.79E-05	3.01E-06	2.33E-03	1.1%
14	*14_KA08_07_CLSSFR_L*	*Section not included*						
15	15_KA08_07_CONEXC_L	7.83E-04	3.53E-04	1.83E-04	4.96E-05		1.37E-03	0.7%
16	16_KA18_08_LPIG64_L	2.17E-03	9.91E-04	5.02E-04	1.41E-04		3.81E-03	1.8%
17	17_KA18_08_LPIG64_L	5.43E-06	2.82E-06	1.56E-06	7.77E-07		1.06E-05	0.01%
18	18_KA08_09_SEPRTR_V	1.09E-03	4.83E-04	2.42E-04	4.33E-05	6.11E-06	1.87E-03	0.9%
19	*19_KA08_09_SEPRTR_L*	*Section not included*						
20	*20_KA08_09_BLWCSE_L*	*Section not included*						
21	*21_KA08_09_PUMPBP_L*	*Section not included*						
22	22_KA08_09_BLWCSE_V	6.80E-04	2.91E-04	1.43E-04	2.57E-05		1.14E-03	0.6%
23	23_KA08_09_COOLER_V	7.95E-04	3.34E-04	1.57E-04	2.43E-05		1.31E-03	0.6%
24	24_KA08_09_SS9111_V	1.28E-03	6.02E-04	3.28E-04	1.07E-04	2.10E-07	2.32E-03	1.1%
25	25_KA08_09_SS9121_V	1.52E-03	7.04E-04	3.75E-04	1.14E-04	2.10E-07	2.71E-03	1.3%
26	26_KA08_09_COMPSR_V	3.04E-02	1.25E-02	5.25E-03	1.68E-03		4.98E-02	24.2%
27	27_KA18_10_SEPRTR_V	1.02E-03	4.47E-04	2.21E-04	3.52E-05	6.11E-06	1.73E-03	0.8%
28	*28_KA18_10_SEPRTR_L*	*Section not included*						

No	QRA Event	1 - 3 mm	3 - 10 mm	10 - 50 mm	50 - 150 mm	> 150 mm	TOTAL	% Contrib.
29	*29_KA18_10_BLWCSE_L*	*Section not included*						
30	30_KA18_10_COOLER_V	7.92E-04	3.32E-04	1.57E-04	2.35E-05	1.40E-07	1.30E-03	0.6%
31	31_KA18_10_SS9111_V	1.26E-03	5.95E-04	3.25E-04	1.07E-04	2.10E-07	2.28E-03	1.1%
32	32_KA18_10_SS9101_V	1.48E-03	6.86E-04	3.73E-04	1.07E-04	2.10E-07	2.64E-03	1.3%
33	*33_KA18_10_PUMPBP_L*	*Section not included*						
34	34_KA18_10_BLWCSE_V	1.21E-03	5.41E-04	2.70E-04	7.57E-05		2.10E-03	1.0%
35	35_KA18_10_COMPSR_V	3.01E-02	1.24E-02	5.21E-03	1.67E-03		4.94E-02	23.9%
36	36_KA18_07_FUELGS_V	4.07E-04	1.74E-04	7.57E-05	2.50E-05		6.82E-04	0.3%
37	37_KA18_07_FLGSSS_V	2.01E-03	8.53E-04	4.24E-04	5.92E-05		3.35E-03	1.6%
38	38_KA08_07_FLGSEP_V	3.33E-03	1.37E-03	6.08E-04	1.60E-04		5.47E-03	2.7%
39	39_KA18_07_FLGSEP_V	3.22E-03	1.33E-03	5.89E-04	1.55E-04		5.29E-03	2.6%
40	40_KA18_11_GASEXC_V	1.88E-03	1.00E-03	6.21E-04	3.52E-04	1.61E-06	3.86E-03	1.9%
41	41_KA18_08_LTSUNB_V	8.76E-04	3.98E-04	2.14E-04	4.94E-05		1.54E-03	0.7%
42	42_KA18_08_LTSUNB_L	1.93E-03	8.56E-04	4.59E-04	8.51E-05		3.33E-03	1.6%
43	43_KA18_08_SHLEXC_V	5.16E-03	2.35E-03	1.21E-03	3.29E-04	3.60E-06	9.05E-03	4.4%
44	44_KA18_07_GPIG63_V	1.12E-06	5.80E-07	3.22E-07	8.49E-08	2.65E-08	2.13E-06	0.001%
45	45_KA18_14_MTHNOL_L	1.73E-03	7.74E-04	2.73E-04	7.29E-05	5.00E-06	2.85E-03	1.4%
46	46_KA18_14_MT2884_L	1.44E-03	8.23E-04	1.03E-03			3.29E-03	1.6%
47	47_KA18_14_MT2876_L	1.50E-03	8.76E-04	1.10E-03			3.48E-03	1.7%
48	48_KA18_14_MT2877_L	1.57E-03	8.96E-04	1.10E-03			3.56E-03	1.7%
49	*49_KA18_05_SLGCAT_L*	*Section not included*						
54	*54_KA18_05_SCPUMP_L*	*Section not included*						
TOTAL		1.22E-01	5.22E-02	2.59E-02	6.45E-03	7.35E-05	2.06E-01	100.0%
% Contribution		59%	25%	13%	3%	0.04%		

The total leak frequency for KA-8 and KA-18 wellsite (for the base case) is 2.06E-01 per year, which is equivalent to one leak every 4.9 years. Most of the leaks are predicted to be from small leaks, where 84% of the leaks are from hole sizes less than 10 mm diameter.

The leak frequencies for KA-8 and KA-18 sections for the sensitivity case are shown in Table 11-3.

Table 11-3: Hydrocarbon Release Frequencies for KA-8 and KA-18 (Sensitivity Case)

No	QRA Event	1 - 3 mm	3 - 10 mm	10 - 50 mm	50 - 150 mm	> 150 mm	TOTAL	% Contrib.
50	50_KA18_15_KA4WGP_V	1.29E-04	5.72E-05	2.84E-05	6.52E-06	1.07E-06	2.22E-04	0.1%
51	51_KA18_16_KA4P13_V	2.35E-05	1.01E-05	5.44E-06	3.20E-07	7.00E-08	3.94E-05	0.02%
52	52_KA18_17_KA4P14_V	4.29E-05	2.01E-05	1.13E-05	3.09E-06		7.74E-05	0.04%
53	53_KA18_18_KA1PPL_L	2.79E-05	1.21E-05	6.73E-06	3.90E-07		4.71E-05	0.02%
TOTAL (Base Case and Sensitivity)		1.22E-01	5.23E-02	2.59E-02	6.46E-03	7.47E-05	2.07E-01	0.2%
% Contribution		59%	25%	13%	3%	0.04%		

The total leak frequency for KA-8 and KA-18 wellsite (including the sensitivity cases) is 2.07E-01 per year (with only 3.9E-04 per year increment compared with the base case), which is equivalent to one leak every 4.8 years.

11.3 Risk Results

The risk results are presented in this section. The risk contours are contributed from both flammable and toxic risks from all release scenarios based on all the hazardous materials onsite.

The only toxic risk onsite is due to methanol toxicity from the methanol injection system. As the methanol tank is stored at atmospheric condition with limited inventory (4.7 m^3 at maximum capacity) and bunded, the methanol toxic risk is very minor and localised. Hence no separate toxic risk contour was provided. Methanol toxic effect was modelled by using the probit method as detailed in the Assumptions Register [Ref. 5].

11.3.1 Base Case

The base case risk contour for KA-8 and KA-18 wellsite is presented in Figure 11-1.

Figure 11-1: Risk Contour for KA-8 and KA-18 Wellsite (Base Case)

The risk assessed against the HIPAP4 criteria for the base case are summarised in Table 11-4.

Table 11-4: LSIR Results Assessed Against the HIPAP4 Land Use Criteria for KA-8 and KA-18 (Base Case)

LSIR	Risk Contour	HIPAP4 Land Use Criteria	Result
5E-05 / year	**Blue**	5E-5 / year risk contour should, as a target, be contained within the boundaries of the industrial site where applicable.	The 5E-05 / year risk contour exceeds the site boundary at the north as the compressor buildings are located at the northern side of the wellsite.
1E-6 / year	**Red**	1E-6 / year risk contour should not extend to residential developments, hotels, tourist resorts.	Criteria met. There are residential developments, hotels, tourist resorts within the contour.

11.3.2 Sensitivity Case

The LSIR for KA-8 and KA-18 wellsite sensitivity case, which include the gathering pipeline sections is presented in Figure 11-2.

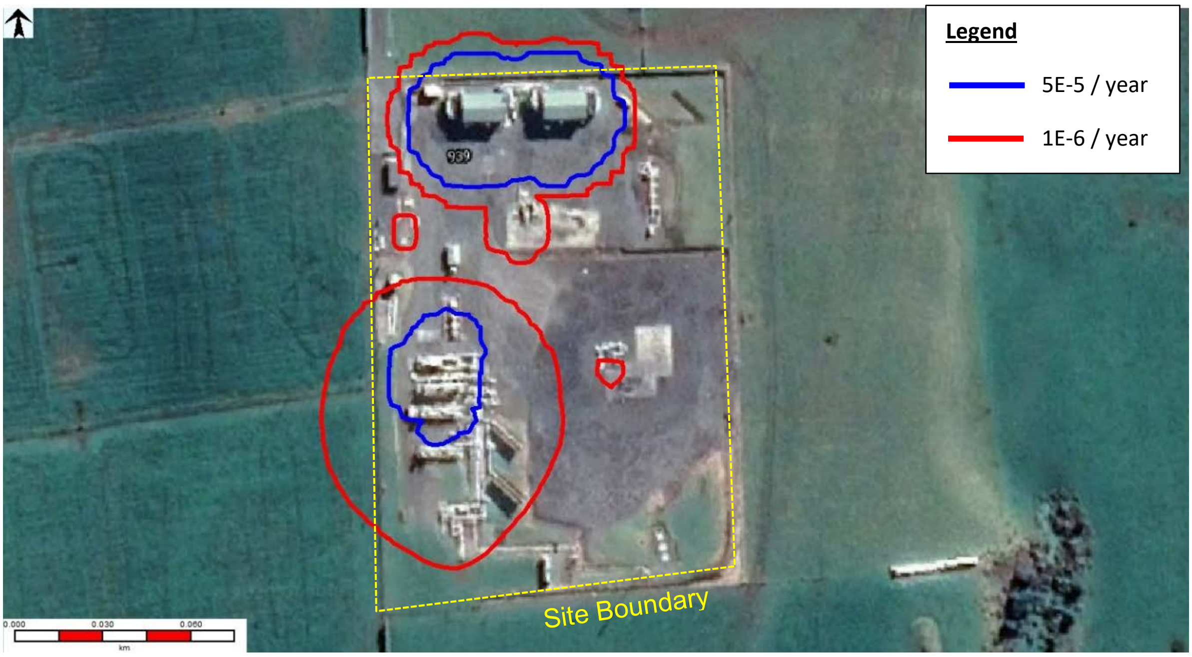


Figure 11-2: LSIR Contours for KA-8 and KA-18 Wellsite (Sensitivity Case)

The risk contours for the sensitivity case are slightly larger compared to the base case due to the additional sections, however the assessment against the HIPAP4 criteria is the same. Hence is it not repeated.

11.4 Risk Contributors

The risk contributors to offsite risks at selected locations (points A, B and C) as shown in Figure 11-3 can be identified from the QRA model.

Figure 11-3: Location Selected to Identify Risk Contributors at KA-8 and KA-18 Wellsite

11.4.1 Base Case

The risk contributors for the base case with the risk contributors and percentage of contribution are shown in Table 11-5.

Table 11-5: Risk Contributors to Selected Locations for KA-8/18 (Base Case)

Point	LSIR (per year)	Contributor	% Contribution	Consequence
A	5.99E-05	35_KA18_10_COMPSR_V_71 mm (Hydrocarbon Gas from Compressors K-9201A/B discharge)	90%	Fireball from early ignition
B	5.78E-05	26_KA08_09_COMPSR_V_71 mm (Hydrocarbon Gas from Compressors K-9101A/B discharge)	94%	Fireball from early ignition
C	3.02E-05	09_KA18_07_WGSLTS_V_85 mm (Wet Gas from LTS (V-2804) to the gathering pipelines)	61%	Fireball from early ignition
		12_KA08_07_GASEXC_V_85 mm (Hydrocarbon Gas from KA-08 wellhead to HPKO V-2803)	12%	Fireball from early ignition

The risk contributor analysis shows that for both locations at plant north, the offsite risk contributors are mainly contributed by a single scenario, which are the rupture case from the compressors due to the proximity of the compressor buildings to the wellsite boundary. Compressors also have high leak frequencies as shown in Table 11-2, where these compressor discharge sections contributed approximately 24% each to the overall plant release frequencies.

For the offsite point at the plant west (point C), the risks are mainly contributed by the equipment (scenario 09 is from the vapour section of the LT Separator and scenario 12 is the gas feeding into the LTS unit) from the LTS units due to proximity of the LTS unit to the wellsite western boundary.

11.4.2 Sensitivity Case

The risk contributors for the sensitivity case with the contributors and percentage of contribution are shown in Table 11-6.

Table 11-6: Risk Contributors to Selected Locations for KA-8/18 (Sensitivity Case)

Point	LSIR (per year)	Contributor	% Contribution	Consequence
A	5.99E-05	35_KA18_10_COMPSR_V_71 mm (Hydrocarbon Gas from Compressors K-9201A/B discharge)	90%	Fireball from early ignition
B	5.78E-05	26_KA08_09_COMPSR_V_71 mm (Hydrocarbon Gas from Compressors K-9101A/B discharge)	94%	Fireball from early ignition
C	3.02E-05	09_KA18_07_WGSLTS_V_85 mm (Wet Gas from LTS (V-2804) to the gathering pipelines)	61%	Fireball from early ignition
		12_KA08_07_GASEXC_V_85 mm (Hydrocarbon Gas from KA-08 wellhead to HPKO V-2803)	12%	Fireball from early ignition

The risk contributors for the sensitivity case are consistent with the base case, where the sensitivity cases contributed very low incremental risk to the wellsite due to the low release frequencies from the additional pipeline sections.

It should be noted that Safeti cannot consider the effect of the obstacles / objects located along the way where the heat is radiated from the release source. In reality heat may be shielded by some process equipment / piping before extending offsite.

12. WELLSITE KA-13

12.1 Release Scenarios

The P&IDs showing the isolatable sections for KA-3 are presented in Appendix 7. Table 12-1 details the section description and the respective operating conditions that are used in the QRA.

Table 12-1: Release Scenarios and Operating Conditions for KA-3

No.	Section ID	Description	Material / Stream Note 1	Pressure (barg)	Temp. (°C)	Largest Connection Size (mm)	Section Inventory (m^3)	Isolatable Inventory (m^3)
1	01_KA13_01_WLHEAD_L	Wellstream fluid from KA-13 wellhead to XSV-21330	35	18.7	23.8	100	*Unlimited* Note 2	
2	02_KA13_02_FLWLNE_L	Wellstream fluid from XSV-21330 to Condensate Pipeline SDV-21310B	36	18.6	23.7	150	2.06	2.06
3	03_KA13_03_METNK1_L	Methanol Tank (T-21331) to Methanol Pump (P-21309)	Methanol	Atm	Amb	50	0.10	0.10
4	04_KA13_04_METNK2_L	Methanol Tank (T-21316) to Methanol Pump (P-21320)	Methanol	Atm	Amb	50	0.10	0.10
Sensitivity Cases								
5	05_KA13_05_LIQPIP_L	Wellstream fluid from SDV-21310B feed into liquid pipeline from KA-05 to KPS	36	18.6	23.7	150	55.50 Note 3	55.50
6	06_KA13_06_GASPPL_V	Hydrocarbon gas from wellsites KA-5, 6 and 11 to KPS	34	17.7	20.4	250	152.90 Note 3	152.90

Notes:

1. Stream composition refers to the stream numbers in the HMB. The full HMB for all wellsites is attached Appendix 8.
2. Inventory from the wellhead section is considered to be unlimited because they can be supplied from the downhole reservoir.
3. Sections connecting to the pipeline inventories due to the lack of isolation valve.

12.2 Release Frequency

The leak frequencies for the process releases are estimated for each representative hole size using parts count results and the historical leak frequencies. The leak frequencies for KA-13 sections for the base case are shown in Table 12-2. KA-13 is only in operation periodically for around 1 out of every 3 months.

Table 12-2: Hydrocarbon Release Frequencies for KA-13 (Base Case)

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	TOTAL	% Contrib.
1	01_KA13_01_WLHEAD_L	1.12E-05	4.61E-06	1.89E-06	6.14E-07		1.83E-05	0.6%
	KA-13 Blowout				1.40E-05		1.40E-05	0.7%
2	02_KA13_02_FLWLNE_L	6.11E-04	2.62E-04	1.40E-04	8.00E-06	1.69E-06	1.02E-03	41.3%
3	03_KA13_03_METNK1_L	4.33E-04	1.97E-04	6.01E-05	2.01E-05	1.67E-06	7.12E-04	28.7%
4	04_KA13_04_METNK2_L	4.33E-04	1.97E-04	6.01E-05	2.01E-05	1.67E-06	7.12E-04	28.7%
TOTAL		1.49E-03	6.62E-04	2.62E-04	6.27E-05	5.02E-06	2.48E-03	100.0%
% Contribution		60%	27%	11%	2%	0.2%		

The total leak frequency for KA-3 wellsite (for the base case) is 2.48E-03 per year, which is equivalent to one leak every 403 years. Most of the leaks are predicted to be from small leaks, where 87% of the leaks are from hole sizes less than 10 mm diameter.

The leak frequencies for KA-13 sections for the sensitivity case are shown in Table 12-3.

Table 12-3: Hydrocarbon Release Frequencies for KA-13 (Sensitivity Case)

No	QRA Event	1 - 3 mm	3 - 10 mm	10 - 50 mm	50 - 150 mm	> 150 mm	TOTAL	% Contrib.
5	05_KA13_05_LIQPIP_L	6.72E-04	2.88E-04	1.55E-04	1.17E-05	8.89E-07	1.13E-03	25.5%
6	06_KA13_06_GASPPL_V	3.97E-04	1.73E-04	9.25E-05	7.26E-06	2.43E-06	6.73E-04	15.2%
TOTAL (Base Case and Sensitivity)		2.56E-03	1.12E-03	5.09E-04	8.17E-05	8.34E-06	4.28E-03	
% Contribution		60%	26%	12%	2%	0.2%		

The total leak frequency for KA-13 wellsite (including the sensitivity cases) is 4.28E-03 per year, which is equivalent to one leak every 234 years.

12.3 Risk Results

The risk results are presented in this section. The risk contours are contributed from both flammable and toxic risks from all release scenarios based on all the hazardous materials onsite.

The only toxic risk onsite is due to methanol toxicity from the methanol tanks. As the methanol tanks are stored at atmospheric condition with limited inventory (typically 0.1 m^3 at each tank) and bunded, the methanol toxic risk is very minor and localised. Hence no separate toxic risk contour was provided. Methanol toxic effect was modelled by using the probit method as detailed in the Assumptions Register [Ref. 5].

12.3.1 Base Case

The base case LSIR for KA-13 wellsite is presented in Figure 12-1.

Figure 12-1: LSIR Contours for KA-13 Wellsite (Base Case)

The risk assessed against the HIPAP4 criteria are summarised in **Table 12-4**.

Table 12-4: LSIR Results Assessed Against the HIPAP4 Land Use Criteria for KA-13 (Base Case)

LSIR	Risk Contour	HIPAP4 Land Use Criteria	Result
5E-05 / year	Blue	5E-5 / year risk contour should, as a target, be contained within the boundaries of the industrial site where applicable.	Criteria met. The 5E-05 / year risk contour is within the site boundary.
1E-6 / year	Red	1E-6 / year risk contour should not extend to residential developments, hotels, tourist resorts.	Criteria met. There are no residential developments, hotels, tourist resorts within the contour.

12.3.2 Sensitivity Case

The LSIR for KA-13 wellsite sensitivity case, which include the gathering pipeline sections is presented in Figure 12-2.

Figure 12-2: LSIR Contours for KA-13 Wellsite (Sensitivity Case)

The risk contours for the sensitivity case are significantly larger than the base case risk contour, especially for the 1E-06/ year risk. This is mainly contributed by jet fire events from the gathering pipelines which can be feed by large pipeline inventories. The risk assessed against the HIPAP4 criteria are summarised in Table 12-4.

Table 12-5: LSIR Results Assessed Against the HIPAP4 Land Use Criteria for KA-13 (Base Case)

LSIR	Risk Contour	HIPAP4 Land Use Criteria	Result
5E-05 / year	Blue	5E-5 / year risk contour should, as a target, be contained within the boundaries of the industrial site where applicable.	Criteria met. The 5E-05 / year risk contour is within the site boundary.
1E-6 / year	Red	1E-6 / year risk contour should not extend to residential developments, hotels, tourist resorts.	Criteria met. There are no residential developments, hotels, tourist resorts within the contour.

12.4 Risk Contributors

For both the base case and the sensitivity case, the 5E-05 / year risk contour and the 1E-06 /year risk contour remain within the site boundary. This is because there are only very limited equipment onsite. As the risk contours did not extend offsite, no locations were selected for risk contributor identification.

13. CONCLUSIONS

This QRA study represents a comprehensive assessment of risks from Kapuni wellsites, commensurate in detail to the information available at the time. Table 13-1 presents the summary of main findings of the risk assessments.

Table 13-1: Summary of Main Findings

Wellsite	**HIPAP4 Land Use Criteria** *(Proposed development of a potentially hazardous nature, or for land use planning in the vicinity of existing hazardous installations)*	
	5E-05 / year *(5E-5 / year risk contour should, as a target, be contained within the boundaries of the industrial site where applicable)*	**1E-6 / year** *(1E-6 / year risk contour for residential developments and places of continuous occupancy such as hotels, tourist resorts)*
	KA-1/7/19/20	
Base Case	Criteria met. The 5E-05 / year risk contour is within the site boundary.	Criteria met. There are no residential developments, hotels, tourist resorts within the contour.
Sensitivity Case	Same as Base Case	Same as Base Case
	KA-2	
Base Case	Criteria met. The 5E-05 / year risk contour is within the site boundary.	Criteria met. There are no residential developments, hotels, tourist resorts within the contour.
	KA-4/14	
Base Case	Criteria met. The 5E-05 / year risk contour is within the site boundary.	Criteria met. There are no residential developments, hotels, tourist resorts within the contour.
Sensitivity Case	Same as Base Case	Same as Base Case
	KA-5/10	
Base Case	Criteria met. The 5E-05 / year risk contour is within the site boundary.	Criteria met. There are no residential developments, hotels, tourist resorts within the contour.
Sensitivity Case	Same as Base Case	Same as Base Case
	KA-6/11/17	
Base Case	Criteria met. The risk level is lower than 5E-05 / year.	Criteria met. There are no residential developments, hotels, tourist resorts within the contour.
Sensitivity Case	Same as Base Case	Same as Base Case
	KA-8/12/15/18	
Base Case	**The 5E-05 / year risk contour exceeds the site boundary at the north as the compressor buildings are located at the northern side of the wellsite.**	Criteria met. There are no residential developments, hotels, tourist resorts within the contour.
Sensitivity Case	Same as Base Case	Same as Base Case

Wellsite	HIPAP4 Land Use Criteria *(Proposed development of a potentially hazardous nature, or for land use planning in the vicinity of existing hazardous installations)*	
	5E-05 / year *(5E-5 / year risk contour should, as a target, be contained within the boundaries of the industrial site where applicable)*	**1E-6 / year** *(1E-6 / year risk contour for residential developments and places of continuous occupancy such as hotels, tourist resorts)*
KA-13		
Base Case	Criteria met. The 5E-05 / year risk contour is within the site boundary.	Criteria met. There are no residential developments, hotels, tourist resorts within the contour.
Sensitivity Case	Same as base case	Same as base case

For almost all the wellsites, the HIPAP4 Land Use Criteria are met except for KA-8/18 wellsite where the 5E-05/year risk contour exceeds the site boundary at the north as the compressor buildings are located at the northern side of the wellsite.

For all sensitivity cases (where the aboveground sections of the gathering pipelines are included), the risk contours are only slightly larger compared to the base case. This is due to the low release frequencies from the additional pipeline sections which do not contribute significantly to the overall risk. The assessment against the HIPAP4 criteria are all consistent with the base case findings.

Risk contributors to offsite risks are also identified to help to identify the equipment / section of wellsites that are leading to offsite impact. For wellsites that have no offsite impact, risk contributor analyses were not conducted.

14. REFERENCES

1. Todd Energy, Safety Case – Kapuni Production Station, Doc. No. NOL649981, Rev 1, January 2018.
2. Todd Energy Fire and Explosion Analysis and Quantitative Risk Assessment Methodology Guideline, NZ-1005-TECD721654, Rev. 0.
3. Worley New Zealand Ltd Onshore QRA Procedure (Using Phast Risk), PCD-473.
4. DNV Safeti software version 8.22.
5. Kapuni Wellsites QRA, Assumptions Register, 610114-RPT-R0001, Rev. 0, August 2020.
6. New Zealand National Climate Database (http://cliflo.niwa.co.nz/)
7. OGP 434-1, Process Release Frequencies, September 2019
8. TNO Purple Book, Guidelines for Quantitative Risk Assessment, December 2005
9. OGP 434-2, Blowout Frequencies, 2019
10. IP research report, Ignition probability review, model development and look-up correlations, January 2006
11. OGP 434-6, Ignition Probabilities, September 2019
12. Methods for the Determination of Possible Damage (TNO Green Book)
13. Oil and Gas UK, Fire and Explosion Guidance, Issue 1 May 2007
14. Flammability of Hydrocarbon / CO2 mixtures: Part 1, Ignition and Explosion Characteristic, Symposium Series No. 156, 2011.
15. Taranaki Regional Council, https://maps.trc.govt.nz/LocalMapsViewer/?map=5113f49337a84cf098db177c728b1361
16. New South Wales Hazardous Industry Planning Advisory Paper No. 4, Risk Criteria for Land Use Safety Planning, January 2011
17. South Taranaki District Council, District Plan 2004 (https://www.southtaranaki.com/our-council/plans-strategies-and-reports/district-plan)

Appendix 1.
P&ID Sectionalisation for KA-19

NOTES:

1. METHANOL INJECTION LINES TO BE 6mm SS BY INSTRUMENTS. SEE DWG 941-10-00102/2 FOR INJECTION SYSTEM.
2. START UP OVERRIDE ACTS ON PALL-2140F.
3. ALL TUBING IS IMPERIAL STANDARD.
4. SDV-2140A IS FITTED WITH A QUICK VENT WHICH RELIEVES BACK TO THE HYDRAULIC TANK T-2140. THE QUICK VENT RETURN FROM SDV-2140A HAS TWO LO VALVES.
5. BACK PRESSURE REGULATOR STOPS CELLAR PUMP FROM OPERATING BELOW 6.7 BARG AIR PRESSURE.
6. XSDV-2140A CLOSES 20 SECONDS AFTER SDV-2140A. WELL VALVE OPEN SEQUENCE IS MANUALLY CONTROLLED (NO TIMERS).
7. VALVE IS SS FOR LOW TEMP OF -90éC.
8. VOID.
9. XCV-2140B/C OVERRIDE STEM LOCKED OPEN.
10. REFER TO DEPRESSURING PROCEDURE FOR CONTROL OF LOW TEMPERATURES DURING DEPRESSURISATION.
11. CORROSION PROBE.
12. DROP-OUT SPOOL FOR DESANDER CONNECTION.

NO	DATE	BY	CONSTRUCTION ISSUE	CHKD	APPR.	CHKD	APPR.	NO	DATE	BY	ECP	DESCRIPTION	CHKD	APPR.	CHKD	APPR.	NUMBER	TITLE
								07	10/16	BB	ECP	ECP XK16002 AS BUILT TO SITE MARK UP ASB 16399KW	JMP	AB	.	SF	.	.
~~C2~~	~~02/18~~	~~CSM~~	~~K1729 CUSP RE-APPR. FOR CONSTRUCTION~~	~~GD~~	~~SJG~~		~~SF~~	06	08/16	BB	ECP	ECP K1666 AS BUILT TO SITE MARK UP ASB 16315KW	JMP	AB	.	SF	.	.
~~C1~~	~~09/17~~	~~CSM~~	~~K1729 CUSP APPR. FOR CONSTRUCTION~~	~~ML~~	~~GD~~		~~SF~~	05	04/16	BB	ECP	ECP XK16002 AS BUILT TO SITE MARK UP ASB 16131KW	JMP	AB	.	SF	.	.
~~C0~~	~~03/17~~	~~JMP~~	~~ECP K1729 APPROVED FOR DESIGN~~	~~ML~~	~~SG~~	.	~~SF~~	04	11/15	BB	ECP	ECP K1630 AS BUILT TO SITE MARK UP ASB 15425KW	JMP	AB	.	ATH	.	.
~~B2~~	~~02/16~~	~~NR~~	~~ECP K1666 APPROVED FOR CONSTUCTION~~	~~ML~~	~~AB~~	.	~~ATH~~	03	10/15	BB	ECP	ECP X0213 AS BUILT TO SITE MARK UP ASB 15422KW	JMP	AB	.	ATH	.	.
~~B1~~	~~08/15~~	~~JL~~	~~ECP K1666 APPROVED FOR DESIGN~~	~~ML~~	~~AB~~	.	~~ATH~~										.	.
~~B0~~	~~07/15~~	~~NR~~	~~ECP K1666 ISSUED FOR HAZOP~~	~~ML~~	~~AB~~	.	.	09	08/19	SH	ECP	PCR_3_2019_5 AS BUILT TO SITE MARK UP ASB T19012KW	JMP	SG	.	MW	.	.
~~A9~~	~~01/14~~	~~JMP~~	~~ECP K1334 APPROVED FOR CONSTRUCTION~~	~~JR~~	~~AB~~		~~ATH~~	08	08/18	BB	ECP	ECP K1729 AS BUILT TO SITE MARK UP ASB T18022KW	JMP	GD	.	KB	.	.
			CONSTRUCTION ISSUE	CONSULTANT		TODD						REVISIONS	CONSULTANT		TODD		REFERENCE DRAWINGS	

DESIGNED	.
DRAWN	D WATEMBURG
CHECKED	K CHANNON
APPROVED	
APPROVED	.
SCALE	.
STICKFILE	.

KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM
WELLHEAD KA-19
WELLSITE KA-1 & 7

Todd Energy

SHEET No 1 OF 2

REVISION 09

DRAWING No 941-10-00128

NOTES:

1. VOID.
2. 50mm RCS ACCESS FITTING WITH CORROSION PROBE. ELASTOMERS IN ACCESS FITTING ONLY SUITABLE FOR -34°C
3. FLOWLINE CHOKE TO BE RAMPED CLOSED UNDER USD / ESD, OR ALL KPS INLET VALVES CLOSED.
4. CRITICAL HEAT TRACING PROTECTS SAFEGUARDING INSTRUMENT FROM WAX/HYDRATE BLOCKAGE.
5. TWO PHASE AND/OR SLUG FLOW.
6. TARGET TEES FOR POTENTIAL SAND PRODUCTION.
7. REMOVABLE INSULATION ON MONO BLOCKS.
8. VOID.
9. VOID.
10. INJECTION REQUIRED ONLY WHEN OPERATING KA-20. (KA-19 SHUTDOWN AND ISOLATED).
11. VOID
12. ECCENTRIC ORIFICE.
13. DROP-OUT SPOOL REMOVED TEMPORARILY.
14. ORIFICE PLATE SIZED FOR ASME 4" 1500# RTJ FLANGE USING R39 RING GASKET. THIS IS ALSO THE API STANDARD GASKET FOR API 5000# 4-1/16" FLANGE AND THEREFORE ACCEPTABLE FOR USE WITH STOS SPEC 50 (API5000#) PIPING.

NO	DATE	BY	CONSTRUCTION ISSUE	CONSULTANT CHKD	CONSULTANT APPR.	TODD CHKD	TODD APPR.	NO	DATE	BY	ECP	REVISIONS DESCRIPTION	CONSULTANT CHKD	CONSULTANT APPR.	TODD CHKD	TODD APPR.	REFERENCE DRAWINGS NUMBER	REFERENCE DRAWINGS TITLE
~~E0~~	~~10/16~~	~~AMP~~	~~CUSP PROJECT ISSUED FOR HAZOP~~	~~SG~~	~~ML~~			07	02/17	CB	ECP	ECP K1707 AS BUILT TO SITE MARK UP ASB 17025KW	JMP	AB	.	SF	·	.
~~D0~~	~~09/16~~	~~JMP~~	~~ECP K1707 POST FRACKING AFC~~	~~ML~~	~~OCK~~		~~SF~~	06	10/16	BB	ECP	ECP XK16002 AS BUILT TO SITE MARK UP ASB 16399KW	JMP	AB	.	SF	·	.
~~C2~~	~~02/16~~	~~NR~~	~~ECP K1666 APPROVED FOR CONSTRUCTION~~	~~ML~~	~~AB~~	.	~~ATH~~	05	09/16	BB	ECP	ECP XS16001 AS BUILT TO SITE MARK UP ASB 16369KW	JMP	AB	.	SF	·	.
~~C1~~	~~08/15~~	~~JL~~	~~ECP K1666 APPROVED FOR DESIGN~~	~~ML~~	~~AB~~	.	~~ATH~~	04	08/16	BB	ECP	ECP K1666 AS BUILT TO SITE MARK UP ASB 16.315KW	JMP	AB	.	SF	·	.
								03	10/15	BB	ECP	ECP K1593 & X0213 AS BUILT TO SITE MARK UP ASB 15419KW & 15422KW	JMP	AB	.	ATH	·	.
~~E3~~	~~02/18~~	~~CSM~~	~~K1729 CUSP RE-APPR. FOR CONSTRUCTION~~	~~GD~~	~~SJG~~		~~SF~~	02	10/14	NR	ECP	ECP K1593 AS BUILT TO SITE MARK UP ASB 14217KW	JMP	AB	.	ATH	·	.
~~E2~~	~~09/17~~	~~CSM~~	~~K1729 CUSP APPR. FOR CONSTRUCTION~~	~~ML~~	~~GD~~		~~SF~~	.	.	.	.	.	.	.	.	.	·	.
~~E1~~	~~03/17~~	~~JMP~~	~~ECP K1729 APPROVED FOR DESIGN~~	~~ML~~	~~SG~~		~~SF~~	08	08/16	BB	ECP	ECP K1729 AS BUILT TO SITE MARK UP ASB T18022KW	JMP	GD	.	KB	·	.

DESIGNED	.	DATE
DRAWN	L.MEADS	07/10
CHECKED	K CHANNON	07/10
APPROVED	N.STONIER	07/10
APPROVED	.	.
SCALE	.	
STICKFILE	.	

KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM
WELLHEAD KA-19
WELLSITE KA-1 & 7

Todd Energy

SHEET No 2 OF 2 | REVISION . 08

DRAWING No 941-10-00128

ITEM No. H-2194
NAME UNIT 7 WELLSTREAM HEATER
SIZE
DESIGN
OPER.
DUTY

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	CONSULTANT CHKD	CONSULTANT APPR.	TODD CHKD	TODD APPR.
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.
~~D3~~	~~02/18~~	~~CSM~~	~~K1729 CUSP RE-APPR. FOR CONSTRUCTION~~	~~GD~~	~~SJG~~		~~SF~~
~~D2~~	~~09/17~~	~~CSM~~	~~K1729 CUSP APPR. FOR CONSTRUCTION~~	~~ML~~	~~GD~~		~~SF~~
~~D1~~	~~03/17~~	~~JMP~~	~~ECP K1729 APPROVED FOR DESIGN~~	~~ML~~	~~SG~~		~~SF~~
~~D0~~	~~10/16~~	~~AMP~~	~~CUSP PROJECT ISSUED FOR HAZOP~~	~~SG~~	~~ML~~		
~~C1~~	~~09/16~~	~~JMP~~	~~ECP K1707 FRACK FLOWBACK AFC~~				~~ATH~~
~~C0~~	~~08/16~~	~~JMP~~	~~ECP K1707 ISSUED FOR HAZOP~~				

NO	DATE	BY	ECP	DESCRIPTION (REVISIONS)	CONSULTANT CHKD	CONSULTANT APPR.	TODD CHKD	TODD APPR.	REFERENCE DRAWINGS NUMBER	REFERENCE DRAWINGS TITLE
.	.	.	.	.	.	.	.	.	-	.
06	11/19	JJP	ECP	ECP K1827 AS BUILT TO SITE MARK UP ASB T19019KW	JMP	SG	.	MW	-	.
05	08/18	BB	ECP	ECP K1729 AS BUILT TO SITE MARK UP T18022KW	JMP	GD	.	KB	-	.
04	06/17	BB	ECP	ECP XK17172 AS BUILT TO SITE MARK UP ASB 17187KW	JMP	TD	.	SF	-	.
03	08/16	BB	ECP	ECP K1666 AS BUILT TO SITE MARK UP ASB 16315KW	JMP	AB	.	SF	-	.
02	11/15	BB	ECP	ECP K1630 AS BUILT TO SITE MARK UP ASB 15425KW	JMP	AB	.	ATH	-	.
01	04/14	DG	ECP	ECP K1334 AS BUILT TO SITE MARK UP ASB 14036KW	JMP	AB	.	ATH	-	.
00	.	DW	ECP	ECP K1334 FIRST ISSUE	.	.	.	.	-	.

DESIGNED .	DATE	KAPUNI WELLSITES
DRAWN D WATEMBURG	.	PIPING & INSTRUMENT DIAGRAM
CHECKED .	.	WELLSTREAM HEATER
APPROVED .	.	WELLSITE KA-1 & 7
APPROVED .	.	
SCALE .		
STICKFILE .		.

Todd Energy

SHEET No 1 OF 2
REVISION . 06
DRAWING No 941-10-00129

NOTES:
1. VOID.
2. VOID.
3. FOR MeOH INJECTION.
4. VALVE USED FOR REPRESSURATION.
5. VOID.
6. TIE-IN POINTS FOR PRODUCTION TESTING V-2154.
7. VOID.
8. FLT DENOTES THE ANALOG INPUT FIELD LOOP MONITORED FOR FAULTS.
9. FO DENOTES FIRST OUT ALARM SEQUENCE ON DCS
10. THIS PIPING INCLUDING SPOOL FLANGES IS SPEC 15 SCH160.
11. VOID.
12. TAL-2154B WILL SHUT DOWN FANS OF E-2153.
13. VOID.
14. VOID.
15. RELIEF VALVE TAIL PIPE IS NOT ROUTED TO SAFE LOCATION AS PER STOS UNMANNED WELLSITE BURN DOWN PHILOSOPHY.
16. WELLSTREAM COOLER FREE DRAINS TO WHKO
17. VSHH-2153A/B WILL SHUT DOWN THE CORRESPONDING FAN.
18. SINGLE/DUAL FAN MODE SELECTED FROM DCS.

NO	DATE	BY	CONSTRUCTION ISSUE	CONSULTANT CHKD	CONSULTANT APPR.	TODD CHKD	TODD APPR.	NO	DATE	BY	ECP	REVISIONS DESCRIPTION	CONSULTANT CHKD	CONSULTANT APPR.	TODD CHKD	TODD APPR.	REFERENCE DRAWINGS NUMBER	TITLE
~~Q1~~	~~10/16~~	~~AMP~~	~~CUSP PROJECT ISSUED FOR HAZOP~~	~~SG~~	~~ML~~			24	10/16	BB	ECP	ECP XK16002 AS BUILT TO SITE MARK UP ASB 16399KW	JMP	AB		SF	.	.
.	.	.	.	.	.	.	.	23	08/16	BB	ECP	ECP K1666 AS BUILT TO SITE MARK UP ASB 16315KW	JMP	AB		SF	.	.
~~S1~~	~~05/18~~	~~JMP~~	~~KA-7 FACILITIES APPR. FOR CONSTRUCTION~~	.	.	~~AH~~	~~KB~~	22	08/14	NR	ECP	ECP K1596 AS BUILT TO SITE MARK UP ASB 14145KK	JMP	AB		ATH	.	.
~~S0~~	~~03/18~~	~~JMP~~	~~KA-7 FACILITIES ISSUED FOR HAZOP~~	.	.	~~SB~~	~~KB~~	21	04/14	DG	ECP	ECP K1334 AS BUILT TO SITE MARK UP ASB 14036KW	JMP	AB		ATH	.	.
~~Q5~~	~~02/18~~	~~CSM~~	~~K1729 CUSP RE-APPR. FOR CONSTRUCTION~~	~~GD~~	~~SJG~~		~~SF~~	20	02/14	MH	ECP	ECP K1459 & K189 AS BUILT TO SITE MARK UPS ASB 13285KW & ASB 14025KW	JMP	AB		ATH	.	.
~~Q4~~	~~11/17~~	~~CSM~~	~~K1729 CUSP RE-APPR. FOR CONSTRUCTION~~	~~ML~~	~~GD~~		~~SF~~	.	.	.	.	.	.	.	.	.	.	.
~~Q3~~	~~09/17~~	~~CSM~~	~~K1729 CUSP APPR. FOR CONSTRUCTION~~	~~ML~~	~~GD~~		~~SF~~	26	08/18	BB	ECP	ECP K1729 & KA-7 REMEDIATION AS BUILT TO ASB T18022KW & T18050KW	JMP	GD	.	KB	.	.
~~Q2~~	~~03/17~~	~~JMP~~	~~ECP K1729 APPROVED FOR DESIGN~~	~~ML~~	~~SG~~	.	~~SF~~	25	06/17	BB	ECP	ECP XK17172` AS BUILT TO SITE MARK UP ASB 17187KW	JMP	TD	.	SF	.	.

DESIGNED	.	DATE
DRAWN	R.P.WILLIAMS	24.4.91
CHECKED	.	.
APPROVED	M.WEST	8/91
APPROVED	.	.
SCALE	-	
STICKFILE	.	

KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM
WELLHEAD KA-20 (OBSERVATION WELL)
WELLSITE KA-1 & 7

Todd Energy

SHEET No 2 OF 2 | REVISION 26

DRAWING No 941-10-00103

NOTES

1. REFER TO DWG. 941-10-102 INJECTION SYSTEM.
2. CONNECTION FOR PRODUCTION TESTING.
3. CRITICAL HEAT TRACING.
4. CONNECTION FOR WELL TESTING.
5. HC, WATER TOTALIZED FLOW BASED ON ASSUMED LIQUID DENSITIES & CORIOLIS MASS FLOW AND DENSITY MEASUREMENT.
6. RV TAIL PIPES ARE NOT ROUTED TO SAFE LOCATION AS PER STOS UNMANNED WELLSITE AND BURNDOWN PHILOSOPHY. HEAT TRACE RV DISCHARGE PIPE UPTO THE WEEP HOLE/FIRST ELBOW.
7. THE GOVERNING CASE FOR RV-2853B IS HP GAS BREAKTHROUGH VIA WELLHEAD KO LEVEL CONTROL VALVE LCV-2854A.
8. VOID.
9. DO NOT HYDROTEST FLANGES ARE 316SS /316L

NO	DATE	BY		CHKD	APPR.	CHKD	APPR.	NO	DATE	BY	EWR	DESCRIPTION	CHKD	APPR.	CHKD	APPR.	NUMBER	TITLE
C8	01/14	JMP	ECP K1334 APPROVED FOR CONSTRUCTION	JR	AB		ATH	07	04/14	DG	ECP	ECP K1334 AS BUILT TO SITE MARK UP ASB 14036KW	JMP	AB		ATH	.	.
C7	09/13	MH	ECP K1334 RE-APPROVED FOR CONSTRUCTION	JR	AB		ATH	06	04/13	JC	ECP	ECP K1544 AS BUILT TO SITE MARK UP ASB 13063KW	JMP	AC		ATH	.	.
C6	09/12	SG	ECP K1334 RE-ISSUED APPROVED FOR CONST.	IRG	MK	.	ATH	05	09/11	SG	ECP	ECP K1392 AS BUILT TO SITE MARK UP ASB 11199KW	VB	JS	.	AI	.	.
C5	05/12	SG	ECP K1334 APPROVED FOR CONSTRUCTION	MF	PB	.	ATH	04	01/11	KP	ECP	ECP K1379 AS BUILT TO SITE MARK UP ASB 10250KW	VB	LM	.	AI	.	.
C4	08/11	LMM	ECP K1334 RE-ISSUED APPROVED FOR DESIGN	MK	KS	.	AI	03	10/10	MH	ECP	ECP K1400 AS BUILT TO SITE MARK UP ASB 10222KW	VB	AP		AI	.	.
C3	07/11	BA	ECP K1334 RE-ISSUED FOR HAZOP	MK	KS	.	.	02	05/10	BA	ECP	ECP K1379 AS BUILT TO SITE MARK UP ASB 10094KW	VB	AP		AI	.	.
D0	06/11	VB	ECP K1392 APPROVED FOR CONSTRUCTION	GD	AP	.	AI	01	12/08	DW	ECP	ECP K1152 AS BUILT TO SITE MARK UP ASB 8198KW	VB	PWM	.	AI	.	.
C1	09/10	LMM	ECP K1334 ISSUED FOR HAZOP	KC	NS	.	AI	00	07/08	VB	ECP	FIRST ISSUE	CSM				.	.
CONSTRUCTION ISSUE				CONSULTANT		STOS		REVISIONS					CONSULTANT		STOS		REFERENCE DRAWINGS	

DESIGNED	.	
DRAWN	R SHEARSTONE	8.9.82
CHECKED	ML SHWER	23.10.82
APPROVED	ML SHWER	23.10.82
APPROVED	P.BARRON	26.10.82
SCALE	NONE	
STICKFILE	.	W0100299

KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM
UNIT 7 HPKO & CLASSIFIER
KAPUNI WELLSITE No 1 & 7

SHELL TODD OIL SERVICES LIMITED
PRIVATE BAG NEW PLYMOUTH NEW ZEALAND

SHEET No 2 OF 2 REVISION . 07

DRAWING No 941-10-00119

NOTES

1. THE 200NB SECTION OF THIS LINE IS SCH 80.
2. VOID.
3. SDV-2852C HAS DELAYED CLOSURE COMPARED TO KA-TG-B WELLHEAD SDV TO ALLOW THE LTS SKID TO DROP TO GATHERING LINE PRESSURE
4. VENT POINT ONLY TO BE USED ONCE THE SYSTEM HAS BEEN FULLY VENTED VIA KIWI DEPRESSURING LINE.
5. REFER TO DEPRESSURING/REPRESSURING PROCEDURE FOR CONTROL OF LOW TEMPERATURES ISSUES.

NO	DATE	BY	CONSTRUCTION ISSUE	CHKD (CONSULTANT)	APPR. (CONSULTANT)	CHKD (TODD)	APPR. (TODD)	NO	DATE	BY	ECP	DESCRIPTION (REVISIONS)	CHKD (CONSULTANT)	APPR. (CONSULTANT)	CHKD (TODD)	APPR. (TODD)	NUMBER	TITLE
~~E3~~	~~09/17~~	~~CSM~~	~~K1729 CUSP APPR. FOR CONSTRUCTION~~	~~ML~~	~~GD~~		~~SF~~										.	.
~~E2~~	~~03/17~~	~~JMP~~	~~ECP K1729 APPROVED FOR DESIGN~~	~~ML~~	~~SG~~		~~SF~~										.	.
~~E1~~	~~10/16~~	~~AMP~~	~~CUSP PROJECT ISSUED FOR HAZOP~~	~~SG~~	~~ML~~			05	08/18	BB	ECP	ECP K1729 AS BUILT TO SITE MARK UP ASB T18022KW	JMP	GD	.	KB	.	.
~~E0~~	~~08/16~~	~~JMP~~	~~CUSP PROJECT ISSUED FOR REVIEW~~	~~ML~~	~~SG~~			04	03/15	DG	ECP	ECP K1334 AS BUILT TO SITE MARK UP ASB 15019KW	JMP	AB		ATH	.	.
~~B6~~	~~09/12~~	~~LMM~~	~~ECP K1334 RE-ISSUED APP FOR CONSTRUCTION~~	~~RG~~	~~MK~~	.	~~ATH~~	03	04/14	DG	ECP	ECP K1334 AS BUILT TO SITE MARK UP ASB 14036KW	JMP	AB		ATH	.	.
~~B5~~	~~05/12~~	~~VB~~	~~ECP K1334 APPROVED FOR CONSTRUCTION~~	~~MF~~	~~PB~~		~~ATH~~	02	01/11	KP	ECP	ECP K1379 AS BUILT TO SITE MARK UP ASB 10250KW	VB	LM	.	AI	.	.
~~B4~~	~~08/11~~	~~LMM~~	~~ECP K1334 APPROVED FOR DESIGN~~	~~MK~~	~~KS~~	.	~~AI~~	01	11/08	MH	ECP	ECP K1152 AS BUILT TO SITE MARK UP ASB 8198KW	VB	LS		AI	.	.
								A0	08/07	VB		FIRST ISSUE			.		.	.

DESIGNED	.	
DRAWN	V BRENNAN	08/07
CHECKED	N STONIER	08/07
APPROVED	D LIND	08/07
APPROVED	.	.
SCALE	-	
STICKFILE	.	

KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM
KA-7 LTS
KAPUNI WELLSITE KA-1 & 7

Todd Energy

SHEET No 2 OF 2 | REVISION . | 05

DRAWING No 941-10-00121

NOTES

1. VOID.
2. VOID.
3. THIS LINE HAS BEEN DERATED FROM SPEC 50/50A TO SPEC 15.
   FLANGES REMAIN AT 5000#.
4. SAFETY CRITICAL HEAT TRACING
5. WIRELESS INSTRUMENT.
6. VALVE IS SUITABLE FOR LOW TEMP OF -90éC.
7. VOID
8. SIGNAL DISCONNECTED IN DCS LOGIC AS KA-1 IS SUSPENDED (K1334) 46
9. FLOWLINE CHOKE TO BE RAMPED CLOSED UNDER USD, ESD, KPS ESD OR ALL
   KPS INLET VALVES CLOSED.

NO	DATE	BY	CONSTRUCTION ISSUE	CONSULTANT CHKD	CONSULTANT APPR.	TODD CHKD	TODD APPR.
~~W1~~	~~05/18~~	~~JMP~~	~~KA-7 FACILITIES APPR. FOR CONSTRUCTION~~	.	.	~~AH~~	~~KB~~
~~W0~~	~~03/18~~	~~JMP~~	~~KA-7 FACILITIES ISSUED FOR HAZOP~~	.	.	~~SB~~	~~KB~~
~~U1~~	~~09/17~~	~~CSM~~	~~ECP K1729 APPROVED FOR DESIGN~~	~~ML~~	~~SG~~	.	~~SF~~
~~U0~~	~~05/17~~	~~JMP~~	~~ECP K1729 APPROVED FOR DESIGN~~	~~ML~~	~~SG~~	.	~~SF~~
~~R0~~	~~07/15~~	~~TW~~	~~ECP K1666 ISSUED FOR HAZOP~~	~~ML~~	~~AB~~	.	.
~~T0~~	~~08/16~~	~~JMP~~	~~ECP K1707 ISSUED FOR HAZOP~~	.	.	.	.
~~S1~~	~~02/16~~	~~NR~~	~~ECP K1677 APPROVED FOR CONSTRUCTION~~	~~ML~~	~~AB~~	.	~~ATH~~
~~S0~~	~~08/15~~	~~JL~~	~~ECP K1677 APPROVED FOR DESIGN~~	~~ML~~	~~AB~~	.	~~ATH~~

NO	DATE	BY	ECP	DESCRIPTION (REVISIONS)	CONSULTANT CHKD	CONSULTANT APPR.	TODD CHKD	TODD APPR.
46	08/18	BB	ECP	ECP K1729, K1666 & KA-7 REMEDIATION AS BUILT TO ASB T18022KW & T18050KW	JMP	GD	.	KB
45	06/17	BB	ECP	ECP XJ 17172 AS BUILT TO SITE MARK UP ASB 17187KW	JMP	TD	.	SF
44	10/16	BB	ECP	ECP XK16002 AS BUILT TO SITE MARK UP ASB 16399KW	JMP	AB	.	SF
43	06/16	NR	ECP	ECP K1677 AS BUILT TO SITE MARK UP ASB 16206KW	JMP	AB	.	SF
42	04/16	BB	ECP	ECP XK16002 AS BUILT TO SITE MARK UP ASB 16131KW	JMP	AB	.	SF
41	07/15	BB	ECP	ECP K1579 AS BUILT TO SITE MARK UP ASB 15211KW	JMP	AB	.	ATH
40	03/15	NR	ECP	ECP X0213 AS BUILT TO SITE MARK UP ASB 15056KW	JMP	AB	.	ATH
39	04/14	DG	ECP	ECP K1334 AS BUILT TO SITE MARK UP ASB 14036KW	JMP	AB	.	ATH

REFERENCE DRAWINGS NUMBER	TITLE

		DATE
DESIGNED	.	
DRAWN	R. H. SYME	10.10.78
CHECKED	.	.
APPROVED	.	.
APPROVED	.	.
SCALE	NTS	
STICKFILE	.	

KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM
WELLHEAD KA-7
KAPUNI WELLSITE KA 1 & 7

Todd Energy

SHEET No 1 OF 2

REVISION . 46

DRAWING No 941-10-00101

18_KA19_05_GPIG65_V
22_KA19_06_GPIG66_V
28_KA19_10_KA8GPL_V
23_KA19_07_VECGAS_V
17_KA19_05_GASPIP_V
05_KA19_02_WLHKOT_V
19
20_KA19_06_GASPP2_V
27_KA19_09_KA4GPL_V
21_KA19_06_GPIG67_V
19_KA19_05_GPIG63_V
16_KA19_04_CONPIP_L
18
Flow connecting wellsite into the pipeline, no isolation valve - will contain pipeline inventory
A-2165
A-2166
A-2167
A-2163
A-2165 A-2167 SCRAPER TRAPS
A-2166 A-2163 SCRAPER TRAP
ITEM No.
NAME
SIZE
DESIGN
OPER.
DUTY
TO W/SITE ESD LOGIC 941-10-00101/1
FROM W/SITE ESD LOGIC 941-10-00101/1
FROM PSL-2164A 941-10-00113/1
WET GAS TO KA-8 VIA KA-4/14 941-10-00407/1
FROM V-2154 USD 941-10-00103/2
FROM V-2152
GAS FROM V-2154 941-10-00103/2
DRY GAS FROM LTS-7 941-10-00121/2
DRY GAS FROM KA-4/14 WELLSITE 941-10-00407/2
GAS FROM KA-7 SKID 941-10-00121/2
FROM SUCTION SCRUBBER 941-10-00108/1
COND FROM KA-12/14 941-10-00407/1
COND FROM UNIT 7 SKID 941-10-00119/2
COND FROM SLUG CATCHER V-2152 941-10-00103/2
COND FROM V-2154 941-10-00103/2
TO KPS FLARE 941-10-00126/1
TO WELLSITE ESD LOGIC 941-10-00101/1
DRY GAS TO KPS A-502A 943-10-00001/1
TO A-2169 941-10-00118/1
GAS TO V-2123 941-10-00108/1
GAS TO V-2124 941-10-00109/1
FUEL GAS BY-PASS 941-10-00113/1
VECTOR TREATED GAS 941-10-00113/1
WET GAS FROM A-5002 943-10-00001/2
UTILITY & FUEL GAS 941-10-00113/1
COND TO RECEIVER 943-10-00002/2 A-502B
ABANDONED IN SITU
HIGH POINT VENT
BARRED TEE
NOTES:
1. 250NB SCH 30 ERW API 5L X46 MDPE COATED CLASS 600 FLANGES 94.5 BARG @ 60oC TO NZS 5223 : PART 1 1986
2. VOID.
3. CRITICAL HEAT TRACING - PREVENTS WAX BLOCKAGE IN SAFEGUARDING INSTRUMENT.
7. AVOID USING PIG TRAP VENT LINES FOR DEPRESSURISING KA 1/7 TO KA 4/14 FLOWLINE.
8. PIPELINE DESIGN CONDITIONS 94.5 BARG @ 60oC
9. VOID.
10. MINIMUM LENGTH BETWEEN PIG TRAP VALVE AND PL/PRI EQUAL TO MAXIMUM LENGTH IF PIG.
11. VOID.
12. VOID.
KAPUNI WELLSITES
PIPING & INSTRUMENT DIAGRAM
GAS & CONDENSATE LINES
KAPUNI WELLSITE KA 1 & 7
DRAWN C.VANCE 15.11.83
SCALE NONE
SHEET No 1 OF 1
REVISION 36
DRAWING No 941-10-00106
Todd Energy
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.

PROJECT NOTES

NOTES:
1. FLOWSHEET SHOWN IN RECYCLED GAS MODE
2. LSHH-2116A DOES NOT CLOSE SDV-2116A (FUEL GAS K.O INLET)
3. LSL-2189 UNIT = NORGREN S/666/126.
4. LOCAL MIMIC SCREEN AT WELLSITE.

NO	DATE	BY	CONSTRUCTION ISSUE	CHKD	APPR.	CHKD	APPR.	NO	DATE	BY	EWR	DESCRIPTION	CHKD	APPR.	CHKD	APPR.	NUMBER	TITLE
~~J7~~	~~04/13~~	~~CMJ~~	~~ECP K1334 APPROVED FOR DESIGN~~	~~JR~~	~~AB~~	.	~~ATH~~	23	07/04	RJR	SMR	SMR K55212 AS BUILT TO SITE MARK UP	BB	CS		MSR	.	.
~~J6~~	~~01/13~~	~~JJS~~	~~ECP K1334 RE-ISSUED FOR HAZOP NO CHANGE~~	~~JR~~	~~AJC~~	.	.	22	06/03	BRT	K995	AS BUILT TO SITE MARK UP ASB 979K & 990K	MG	JP	.	MSR	.	.
~~J5~~	~~10/12~~	~~MH~~	~~ECP K1334 RE-ISSUED FOR HAZOP~~	~~JR~~	~~MK~~												.	.
~~J4~~	~~09/12~~	~~SG~~	~~ECP K1334 RE-ISSUED APP FOR CONSTRUCTION~~	~~BRG~~	~~MK~~	.	~~ATH~~	28	06/17	AMP	ECP	ECP XK17172 AS BUILT TO SITE MARK UP ASB 17181KK	JMP	TD	.	SF	.	.
~~K0~~	~~08/12~~	~~VB~~	~~ECP K1334 APPROVED FOR CONSTRUCTION~~	~~JR~~	~~MK~~		~~ATH~~	27	04/14	DG	ECP	ECP K1334 AS BUILT TO SITE MARK UP ASB 14036KW	JMP	AB		ATH	.	.
								26	07/13	MH	ECP	ECP K1544 AS BUILT TO SITE MARK UP ASB 13155KW	JMP	AC		ATH	.	.
~~J9~~	~~09/13~~	~~MH~~	~~ECP K1334 RE-APPROVED FOR CONSTRUCTION~~	~~JR~~	~~AB~~		~~ATH~~	25	02/11	JW	ECP	ECP K1379 AS BUILT TO SITE MARK UP ASB 10238KW	VB	RW		AI	.	.
~~J8~~	~~05/13~~	~~JC~~	~~ECP K1334 IAPPROVED FOR CONSTRUCTION~~	~~JR~~	~~AB~~	.	~~ATH~~	24	07/09	MH	ECP	ECP K1328 AS BUILT TO SITE MARK UP ASB 9155KW	VB	PWM		AI	.	.
			CONSTRUCTION ISSUE	CONSULTANT		STOS						REVISIONS	CONSULTANT		STOS		REFERENCE DRAWINGS	

DESIGNED	.	DATE
DRAWN	P.A	8-3-79
CHECKED	L.H	15-3-79
APPROVED	E BUYCK	16-3-79
APPROVED	R PREBBLE	16-3-79
SCALE	-	

KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM
TURBINE FUEL GAS & HEATER SYST
KAPUNI WELLSITE KA-1 & 7

STICKFILE . W0100008

SHELL TODD OIL SERVICES LIMITED
PRIVATE BAG NEW PLYMOUTH NEW ZEALAND

SHEET No 1 OF 1 | REVISION . 28

DRAWING No 941-10-00113

NOTES:

1. LOCAL MIMIC SCREEN AT WELLSITE.
2. INJECTION FITTING & NOZZLE TO ENSURE INHIBITOR IS ATOMISED.
3. REMOVABLE SPOOL FOR FUTURE COMPRESSOR TIE-INS.
4. PIPELINE DESIGN PRESSURE 70 BARG.
5. INSTRUMENT IMPULSE LINES TO BE HEAT TRACED.
6. PRESSURE NOT TO EXCEED 5 BARG.
7. PIPE SURFACE TEMPERATURE.
8. SWAGELOK DIELECTRIC FITTING INSTALLED TO MAINTAIN CATHODIC PROTECTION.
9. KSW-XSV-2169A TO ALLOW ESD TESTING WITHOUT STOPPING GAS SUPPLY TO VECTOR/FONTERRA PIPELINE. 11

NO	DATE	BY	CONSTRUCTION ISSUE	CONSULTANT CHKD	CONSULTANT APPR.	TODD CHKD	TODD APPR.
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.
~~C1~~	~~07/09~~	~~VB~~	~~ECP K1328 APPROVED FOR CONSTRUCTION~~	~~MK~~	~~PWM~~	.	.
~~C0~~	~~06/09~~	~~LMM~~	~~ECP K1328 APPROVED FOR DESIGN~~	~~MK~~	~~PWM~~	.	~~AI~~
~~B1~~	~~6/99~~	~~MW~~	~~EWR K497 ISSUED FOR CONSTRUCTION~~	~~LP~~	~~CRP~~	~~ECT~~	~~KJE~~
~~B0~~	~~5/99~~	~~CSM~~	~~EWR K497 APPROVED FOR DESIGN~~	~~MW~~	~~CRP~~	~~ECT~~	~~KJE~~

NO	DATE	BY	ECP	DESCRIPTION (REVISIONS)	CONSULTANT CHKD	CONSULTANT APPR.	TODD CHKD	TODD APPR.
07	01/11	KP	ECP	ECP K1379 AS BUILT TO SITE MARK UP ASB 10250KW	VB	LM	.	AI
06	07/09	MH	ECP	ECP K1328 AS BUILT TO SITE MARK UP ASB 9155KW	VB	PWM	.	AI
05	12/08	MH	ECP	ECP K1282 AS BUILT TO SITE MARK UP ASB 8214KK	VB	LS	.	AI
							.	
11	08/19	SH	ECP	ECP K1720 AS BUILT TO SITE MARK UP ASB T18006KK	JMP	AB	.	MW
10	03/17	BB	ECP	ECP XK17172 AS BUILT TO SITE MARK UP ASB 17079KK	JMP	TD		SF
09	04/12	LMM	ECP	ECP K1334 AS BUILT TO SITE MARK UP ASB 12058KW	VB	PB	.	ATH
08	03/12	MH	ECP	ECP K1470 AS BUILT TO SITE MARK UP ASB 12049KW	VB	JS	.	AI

REFERENCE DRAWINGS NUMBER	TITLE
·	.
·	.
·	.
·	.
·	.
·	.
·	.
·	.

		DATE
DESIGNED	.	
DRAWN	G ROBERTSON	2/95
CHECKED	M WEST	2/95
APPROVED	K ALLUM	2/95
APPROVED	S HARVEY	2/95
SCALE	.	
STICKFILE	.	W0100158

KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM
GAS SCRAPER LAUNCHER A-2169
KA-1&7 (KIWI PIPELINE)

Todd Energy

SHEET No 1 OF 1 | REVISION 11

DRAWING No 941-10-00118

NOTES:

1. ALL TUBING IS IMPERIAL STANDARD.
2. FUEL GAS USD WILL REQUIRE TO BE RESET TO OPERATE METHANOL PUMP P-0137, EVEN IF INJECTING METHANOL TO ANOTHER LOCATION.
3. P-0137 WILL BE LINED OUT TO THE FUEL GAS SYSTEM WHEN THE SITE IS UNMANNED. THE PUMP WILL BE SET TO MINIMUM STROKE (APPROX 0.53 L/H).
4. FUTURE CONNECTION

NO	DATE	BY	CONSTRUCTION ISSUE	CONSULTANT CHKD	CONSULTANT APPR.	TODD CHKD	TODD APPR.
H1	03/17	JMP	ECP K1729 APPROVED FOR DESIGN	ML	SG		SF
H0	10/16	AMP	CUSP PROJECT ISSUED FOR HAZOP	SG	ML	.	.
G1	03/12	LMM	ECP K1459 APPROVED FOR DESIGN	GD	JA	.	AI
F6	05/13	JC	ECP K1334 APPROVED FOR CONSTRUCTION	JR	AB		ATH
.	.	.	.	.	.	.	.
J1	05/18	JMP	KA-7 FACILITIES APPR. FOR CONSTRUCTION	.	,	AH	KB
J0	03/18	JMP	KA-7 FACILITIES ISSUED FOR HAZOP	.	.	SB	KB
H2	09/17	CSM	K1279 CUSP APPR. FOR CONSTRUCTION	ML	GD		SF

NO	DATE	BY	ECP	DESCRIPTION (REVISIONS)	CONSULTANT CHKD	CONSULTANT APPR.	TODD CHKD	TODD APPR.
07	07/08	MH	ECP	ECP K1245 AS BUILT TO SITE MARK UP ASB 8126KW	VB	PWM	.	AI
.	.	.	.	.	.	.	.	.
13	08/19	BB	ECP	ECP XK18002 AS BUILT TO SITE MARK UP ASB T19007KK	JMP	AB	.	MW
12	08/18	BB	ECP	ECP K1729 & KA-7 REMEDIATION AS BUILT TO ASB T18022KW & T18050KW	JMP	GD	.	KB
11	01/17	CB	ECP	ECP XK16137 AS BUILT TO SITE MARK UP ASB 16522KW	JMP	AB		SJ
10	04/14	DG	ECP	ECP K1334 AS BUILT TO SITE MARK UP ASB 14036KW	JMP	AB		ATH
09	02/14	MH	ECP	ECP K1459 AS BUILT TO SITE MARK UP ASB 13285KW	JMP	AB		ATH
08	12/08	DW	ECP	ECP K1152 AS BUILT TO SITE MARK UP ASB 8198KW	VB	PWM	.	AI

REFERENCE DRAWINGS NUMBER	TITLE
·	.
·	.
·	.
·	.
·	.
·	.
·	.
·	.

DESIGNED	K ALLUM	DATE
DRAWN	G ROBERTSON	3/95
CHECKED	M WEST	3/95
APPROVED	K ALLUM	3/95
APPROVED	S HARVEY	3/95
SCALE	.	
STICKFILE	.	

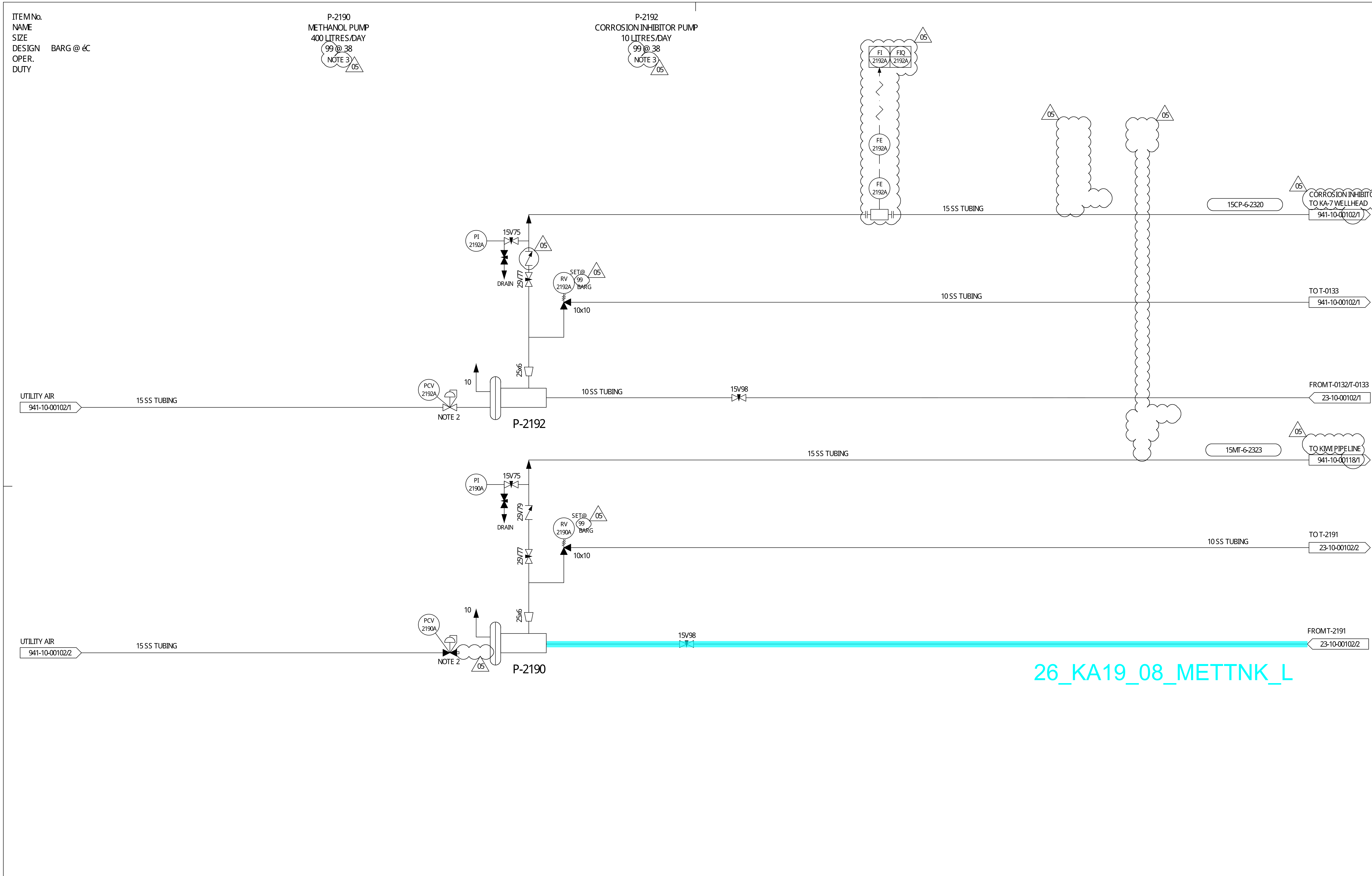
KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM
METHANOL INHIBITOR
KAPUNI WELLSITE 1 & 7

Todd Energy

SHEET No 2 OF 3 | REVISION . 13

DRAWING No 941-10-00102



NOTES:

1. ALL TUBING IS IMPERIAL STANDARD.
2. 6NPT IS SUPPLIED WITH PUMP.
3. TEXSTEAM PUMPS DESIGNED FOR PRESSURES UP TO 345 BARG. PRESSURE RESTRICTED TO 99 BARG FOR HYDROTEST REQUIREMENTS.
4. WIRELESS INSTRUMENT.

NO	DATE	BY	CONSTRUCTION ISSUE	CONSULTANT CHKD	CONSULTANT APPR.	TODD CHKD	TODD APPR.
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.
B1	05/18	JMP	KA-7 FACILITIES APPR. FOR CONSTRUCTION	.	.	AH	KB
B0	03/18	JMP	KA-7 FACILITIES ISSUED FOR HAZOP	.	.	SB	KB
A2	11/11	BA	ECP K1334 ISSUED FOR HAZOP	JR	KS	.	.
A1	11/10	MH	ECP K1344 APPROVED FOR DESIGN	KC	NS		AI
A0	10/10	VB	ECP K1334 REDRAWN AS SHEET 3	KC	NS	.	

NO	DATE	BY	ECP	DESCRIPTION (REVISIONS)	CONSULTANT CHKD	CONSULTANT APPR.	TODD CHKD	TODD APPR.
05	08/18	BB	ECP	ECP KA-7 REMEDIATION AS BUILT TO SITE MARK UP ASB T18050KW	JMP	GD	.	KB
04	01/17	CB	ECP	ECP XK16137 AS BUILT TO SITE MARK UP ASB 16522KW	JMP	AB		SF
03	05/16	NR	ECP	ECP XK16002 AS BUILT TO SITE MARK UP ASB 16147KW	JMP	AB	.	ATH
02	04/14	DG	ECP	ECP K1334 AS BUILT TO SITE MARK UP ASB 14036KW	JMP	AB		ATH
01	03/12	VB		REDRAWN FROM 941-10-00102/2 ASB 12063KW	VB	PB		ATH
00	10/10	VB	.	FIRST ISSUE				

NUMBER	TITLE (REFERENCE DRAWINGS)
·	.
·	.
·	.
·	.
·	.
·	.
·	.
·	.

DESIGNED	K CHANNON	DATE
DRAWN	V BRENNAN	10/10
CHECKED	K CHANNON	10/10
APPROVED	N STONIER	10/10
APPROVED	.	.
SCALE	.	
STICKFILE	.	.

KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM KIWI CHEMICAL INJECTION KAPUNI WELLSITE 1 & 7 (KIWI PI

Todd Energy

SHEET No 3 OF 3

REVISION . 05

DRAWING No 941-10-00102

Appendix 2.
P&ID Sectionalisation for KA-2

9. FLT DENOTES THE ANALOG INPUT FIELD LOOP IS MONITORED FOR FAULTS.
10. CLOSES FLOWLINE XSV-0200A, UNIT MUST BE RESET BEFORE VALVE RE-OPENS.
11. CORROSION INHIBITOR INJECTION POINT IN BACK OF SOLID BLOCK XMAS TREE
12. MINIMUM DISTANCE BETWEEN XCP-0200E AND XMAS TREE IS 10m.
13. CORROSION PROBE IN 6 O'CLOCK POSITION.
14. RV-0202A HAS BEEN SIZED BASED ON A MAX CITHP OF 71 BARG. IF CITHP INCREASES AS A RESULT OF WELL INTERVENTION, THE RV MAY NEED TO BE REPLACED. (26)

NOTES

1. KA-2 STARTUP OVERRIDE WORKS ON PSLL-0200A, PSL-0201A & PSL-0215A & TIMES OUT AFTER 40 MINUTES, OR ON KS-0200C DISABLE.
3. VALVES INDICATING SIZE ONLY ARE NOT GIVEN A V NUMBER AS THEY DO NOT CONFORM TO SPEC. 5.1.
4. ALL TUBING IS IMPERIAL STANDARD.
5. XSDV 0200A CLOSES 20 SECONDS AFTER XSV-0200C AND OPENS 60 SECONDS BEFORE XSV-0200C
6. RATE OF CHANGE
7. MONOFLANGE ISOLATION (AGCO HD27)
8. FO DENOTES FIRST OUT ALARM SEQUENCE ON DCS.

NO	DATE	BY	EWR	DESCRIPTION	CHKD	APPR.	CHKD	APPR.
L0	09/18	DB	EWR K1816 ISSUED FOR REVIEW		MAW	IWB MA	.	KB
23	07/13	MH	ECP	ECP K1544 AS BUILT TO SITE MARK UP ASB 13134KW	JMP	AC		ATH
22	04/13	JC	ECP	ECP K1544 AS BUILT TO SITE MARK UP ASB 13053KW	JMP	AC	.	ATH
21	06/12	MH	ECP	ECP K1470 AS BUILT TO SITE MARK UP ASB 12111KW	VB	PB		ATH
20	01/12	MH	ECP	ECP K1394 AS BUILT TO SITE MARK UP ASB 12012KW	VB	JS		AI
26	11/18	AdB	K1816	AS BUILT - PROJECT 12115 (K1816)	GRP	MA		KB
25	10/16	NR	ECP	ECP XK16002 AS BUILT TO SITE MARK UP ASB 16386KK	JMP	AB	.	SF
24	27/04	BB	ECP	ECP XK16002 AS BUILT TO SITE MARK UP ASB 16131KW	JMP	AB	.	SF

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

DESIGNED		DATE
DRAWN	MF/WZ	28-8-73
CHECKED	MB/DK	28-8-73
APPROVED	C BEATH	28-8-80
APPROVED		
SCALE	NONE	

KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM
WELLHEAD KA-2
WELLSITE 2

STICKFILE W0100010

Todd Energy

SHEET No 1 OF 2 — REVISION . 26

DRAWING No 941-10-00201

05

NOTES:

1. RAILED CURTAINS INSTALLED ON COOLER TO CONTROL AIR FLOW.

NO	DATE	BY	CONSTRUCTION ISSUE	CONSULTANT CHKD	CONSULTANT APPR.	STOS CHKD	STOS APPR.	NO	DATE	BY	EWR	REVISIONS DESCRIPTION	CONSULTANT CHKD	CONSULTANT APPR.	STOS CHKD	STOS APPR.	REFERENCE DRAWINGS NUMBER	REFERENCE DRAWINGS TITLE
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	·	.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	·	.
~~E0~~	~~08/11~~	~~VB~~	~~ECP K1394 APROVED FOR CONSTRUCTION~~	~~AH~~	~~AP~~	.	~~AI~~	05	06/14	NR	ECP	ECP K1463 AS BUILT TO SITE MARK UP ASB 14129KW	JMP	AB	.	ATH	·	.
~~D0~~	~~03/08~~	~~KN~~	~~ECP K1154 PRELIMINARY ISSUE-CANCELLED~~	~~NS~~	~~PWM~~	.	.	04	01/12	MH	ECP	ECP K1394 AS BUILT TO SITE MARK UP ASB 12012KW	VB	JS	.	IA	·	.
~~C0~~	~~03/03~~	~~HKS~~	~~EWR K542 ISSUED FOR DESIGN~~	~~AH~~	.	.	~~PAA~~	03	05/06	HKS	-	ECP K1086 TEMPERATURE UPGRADE	FE	JEA	.	RP	·	.
~~B1~~	~~07/02~~	~~DS~~	~~EWR K534 APPROVED FOR CONSTRUCTION~~	~~CWM~~	.	.	~~PAA~~	02	08/03	HKS	-	K542 & K534 AS BUILT	DS	PM	.	MSR	·	.
~~B0~~	~~05/02~~	~~HKS~~	~~EWR K534 APPROVED FOR CONSTRUCTION~~	~~CWM~~	.	.	~~PAA~~	01	7/94	GR	K433	AS BUILT TO ASB NO 102K	MW	KA	CB	SH	·	.
~~A2~~	~~7/94~~	~~GR~~	~~K433 CONSTR. UPDATE~~	~~MW~~	~~KA~~	~~CB~~	~~SH~~	0	5/93	DP	K433	FIRST ISSUE	MW	RBS	PA	CB	·	.

DESIGNED	.	DATE
DRAWN	D PARKER	5/93
CHECKED	M WEST	5/93
APPROVED	.	.
APPROVED	C BROUWERS	5/93
SCALE	NONE	
STICKFILE	.	W0100149

KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM
WELLSTREAM COOLERS
WELLSITE 2

SHELL TODD OIL SERVICES LIMITED

PRIVATE BAG NEW PLYMOUTH NEW ZEALAND

SHEET No 2 OF 2 | REVISION . 05

DRAWING No 941-10-00201


ITEM No.
NAME
SIZE
DESIGN BARG & éC
OPER.
DUTY
V-201A
H.P. KNOCKOUT
686x4572
238/85éc
E-201A
GAS/COND. EXCHANGER
SURFACE 45.9sqm
SHELL 62/71éc TUBE 238/85éc
V-204A
SECONDARY KNOCKOUT
914x3048
63/38
04_KA02_03_WSCOL1_V
150WF-15-2001B
WELLSTREAM FLUID FROM E-2210
941-10-00201/2
TO KA-2A UNIT SHUTDOWN
941-10-00202/2
NOTE 2
100WF-15-2039
NOTE 1
WELLSTREAM FLUID TO F-0902
NOTE 2
100WF-15-2040
WELLSTREAM FLUID FROM F-0902
CORROSION INHIBITOR FROM P-0202A
15CP-15-2020A
941-10-00210/2
WELLSTREAM FLUID FROM KA-2
941-10-00201/2
07_KA02_03_LTSEPR_V
150HG-15-2004A
HYDROCARBON GAS FROM V-0202A
941-10-00202/2
150HG-15-2005A
HYDROCARBON GAS TO E-0202A
941-10-00202/2
08_KA02_03_HPKNOT_V
10_KA02_03_SCDKOT_V
50HG-6-2029A
HYDROCARBON GAS TO V-0202A
941-10-00202/2
V-0201A
V-0204A
TO ATMOS
NOTE 3
TO GRADE
11_KA02_03_SCDKOB_L
50HL-15-2007A
50HL-6-2037A
50HL-6-2007A
09_KA02_03_HPKNOB_L
18_KA02_03_GCEXCS_L
100HL-6-2015A
HYDROCARBON LIQUID TO PIPELINE
941-10-00208/1
05_KA02_03_WSCOL2_V
E-0201A
150HG-15-2002A
HYDROCARBON GAS TO V-0202A
941-10-00202/2
06_KA02_03_GCEXCT_V
50HL-6-2015A
HYDROCARBON LIQUID FROM V-0202A
941-10-00202/2
17_KA02_03_LTSEPB_L
ABANDONED IN-SITU
NOTES
1. 1500# FLANGES HAVE BEEN USED
2. THIS LINE HAS BEEN DERATED FROM SPEC 50/50A TO SPEC 15. FLANGES REMAIN AT 5000#.
3. SCREWED INJECTION QUILL INSTALLED.
KAPUNI WELLSITES
PIPING & INSTRUMENT DIAGRAM
LTS UNIT 2A (BS & B SKID)
WELLSITE 2
SHELL TODD OIL SERVICES LIMITED
1 of 3
28
941-10-00202

NOTES
1. VOID.
2. FOR CONTINUATION OF METHANOL INJECTION SEE DRG 941-10-210/1.
3. FOR CONTINUATION OF CHEMICAL INJECTION SEE DRG 941-10-210/2.
4. FOR CONTINUATION OF INSTR. AIR SEE DRG 941-10-204/1.
5. WHEN X-OVER SELECTED, EITHER LTS USD WILL SHUT THE OTHER.
6. PCV-0212A/B SIZED TO LIMIT HP BREAKTHROUGH FOR 71 BARG UPSTREAM PRESSURE (MAX CTHP).

This drawing is confidential and is the property of SHELL TODD OIL SERVICES LTD. It must not be disclosed to any third party or lent without written consent from Shell Todd Oil Services Ltd

NO	DATE	BY	CONSTRUCTION ISSUE	CHKD	APPR.	CHKD	APPR.
~~P4~~	~~09/18~~	~~DB~~	~~RE ISSUED FOR CONSTRUCTION PROJECT 12115 (K1816)~~	~~MAW~~	~~MVSK~~	~~.~~	~~KB~~

NO	DATE	BY	EWR	DESCRIPTION	CHKD	APPR.	CHKD	APPR.
31	11/18	AdB	K1816	AS BUILT - PROJECT 12115 (K1816)	GRP	MA	.	KB
30	07/16	BB	ECP	ECP XK16002 AS BUILT TO SITE MARK UP ASB 16250KK	JMP	AB	.	SF
29	06/14	NR	ECP	ECP K1589 AS BUIL TO SITE MARK UP ASB 14061KW	JMP	AB		ATH
28	06/12	MH	ECP	ECP K1470 AS BUILT TO SITE MARK UP ASB 12111KW	VB	PB		ATH
27	10/11	JC	ECP	ECP K1396 AS BUILT TO SITE MARK UP ASB 11232KK	VB	JS		AI
26	01/11	KP	ECP	ECP K1379 AS BUILT TO SITE MARK UP ASB 10250KW	VB	LM	.	AI
25	02/10	MH	ECP	ECP K1379 AS BUILT TO SITE MARK UP ASB 10016KW	VB	PWM		AI
24	11/09	MH	ECP	ECP K1311 AS BUILT TO SITE MARK UP ASB 9198KW	VB	PWM		AI

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

DESIGNED	CB	DATE
DRAWN	P HINES	21-1-80
CHECKED	.	27-8-80
APPROVED	C BEATH	28-8-80
APPROVED	.	.
SCALE	.	
STICKFILE	.	WX100052

KAPUNI WELLSITES

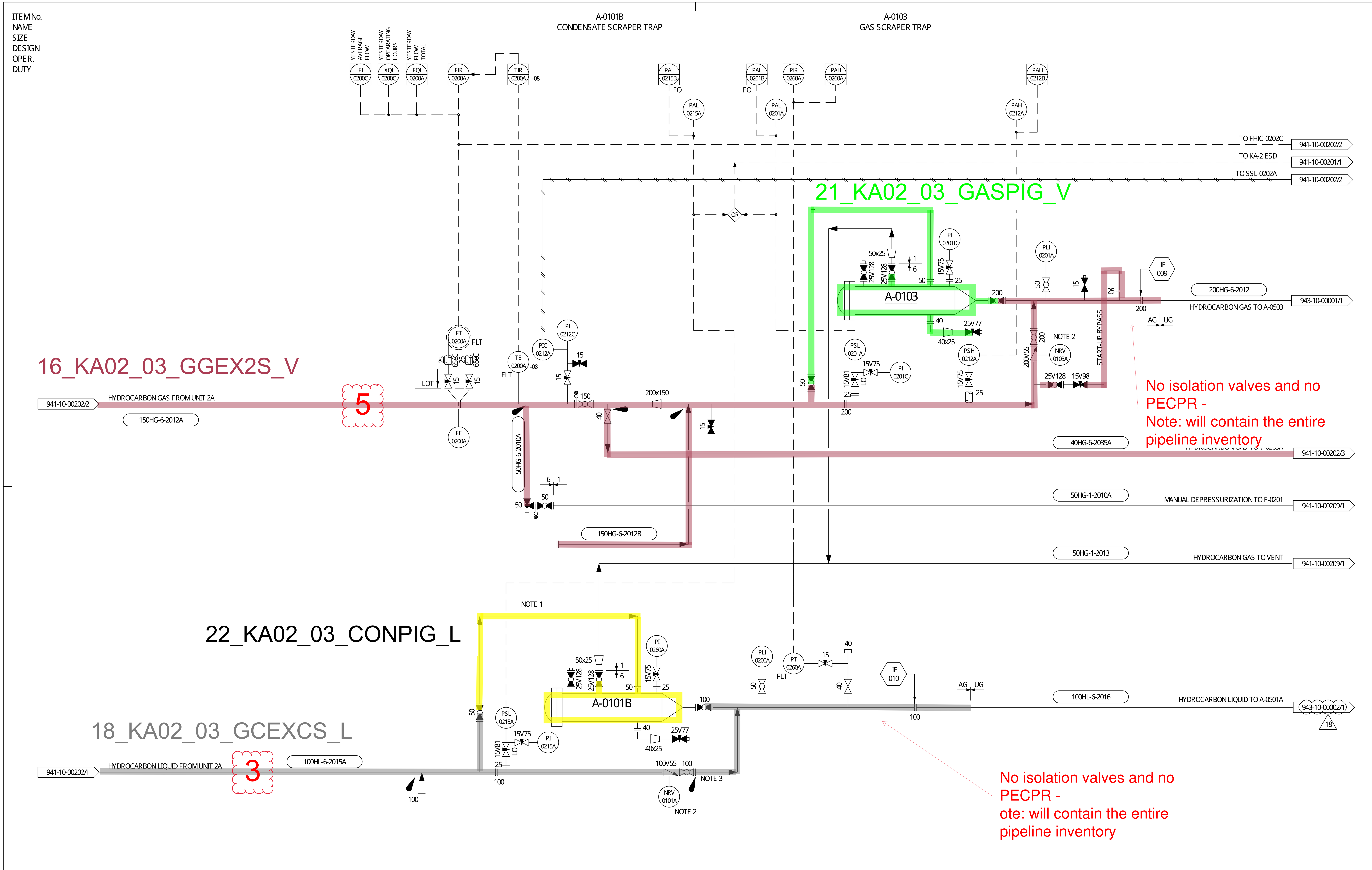
PIPING & INSTRUMENT DIAGRAM
LTS UNIT 2A (BS&B SKID)
WELLSITE 2

Todd Energy

SHEET No 2 OF 3

REVISION T0 30

DRAWING No 941-10-00202



NOTES

1. PIG LAUNCHER KICK LINE REMOVED FOR PRODUCTION TESTING.
2. CLASS 1 CHECK VALVE.
3. MUST BE CLOSED WHENEVER KA-2 WELLSITE ESD OCCURS.

NO	DATE	BY	CONSTRUCTION ISSUE	CONSULTANT CHKD	CONSULTANT APPR.	TODD CHKD	TODD APPR.	NO	DATE	BY	ECP	REVISIONS DESCRIPTION	CONSULTANT CHKD	CONSULTANT APPR.	TODD CHKD	TODD APPR.	REFERENCE DRAWINGS NUMBER	REFERENCE DRAWINGS TITLE
E0	04/07	JMP	ECP K1161 APPROVED FOR DESIGN	PM	CS	.	AI	15	07/15	BB	ECP	ECP X0213 AS BUILT TO SITE MARK UP ASB 15254KK	JMP	AB		ATH	.	.
D0	06/02	DS	EWR K534 AFC	CWM	.	.	PAA	14	06/12	MH	ECP	ECP K1470 AS BUILT TO SITE MARK UP ASB 12111KW	VB	PB		ATH	.	.
C2	03/00	JK	EWR K168 RE-ISSUED FOR CONSTRUCTION	PM	AM	.	KJE	13	01/11	KP	ECP	ECP K1379 AS BUILT TO SITE MARK UP ASB 10250KW	VB	LM	.	AI	.	.
C1	12/99	AGM	EWR K168 ISSUED FOR CONSTRUCTION	PM	AM	.	TAF	12	10/10	MH	ECP	ECP K1400 AS BUILT TO SITE MARK UP ASB 10222KW	VB	AP		AI	.	.
																	.	.
G0	10/10	LMM	ECP K1220 APPROVED FOR DESIGN	DJ	AP	.	AI	18	08/19	SH	ECP	ECP XK18002 AS BUILT TO SITE MARK UP ASB T19008KK	JMP	SG		MW	.	.
F0	03/08	KN	ECP K1154 PRELIMINARY ISSUE CANCELLED	NS	PWM	.	.	17	02/17	AMP	ECP	ECP XK17172 AS BUILT TO SITE MARK UP ASB 17004KK	JMP	AB	.	SF	.	.
E1	06/07	VB	ECP K1161 APPROVED FOR CONSTRUCTION	PM	CS	.	.	16	07/16	BB	ECP	ECP XK16002 AS BUILT TO SITE MARK UP ASB 16250KK	JMP	AB	.	SF	.	.

DESIGNED	.	
DRAWN	N BAILEY	12-9-91
CHECKED	.	.
APPROVED	.	.
APPROVED	.	.
SCALE	.	
STICKFILE	.	

KAPUNI WELLSITES

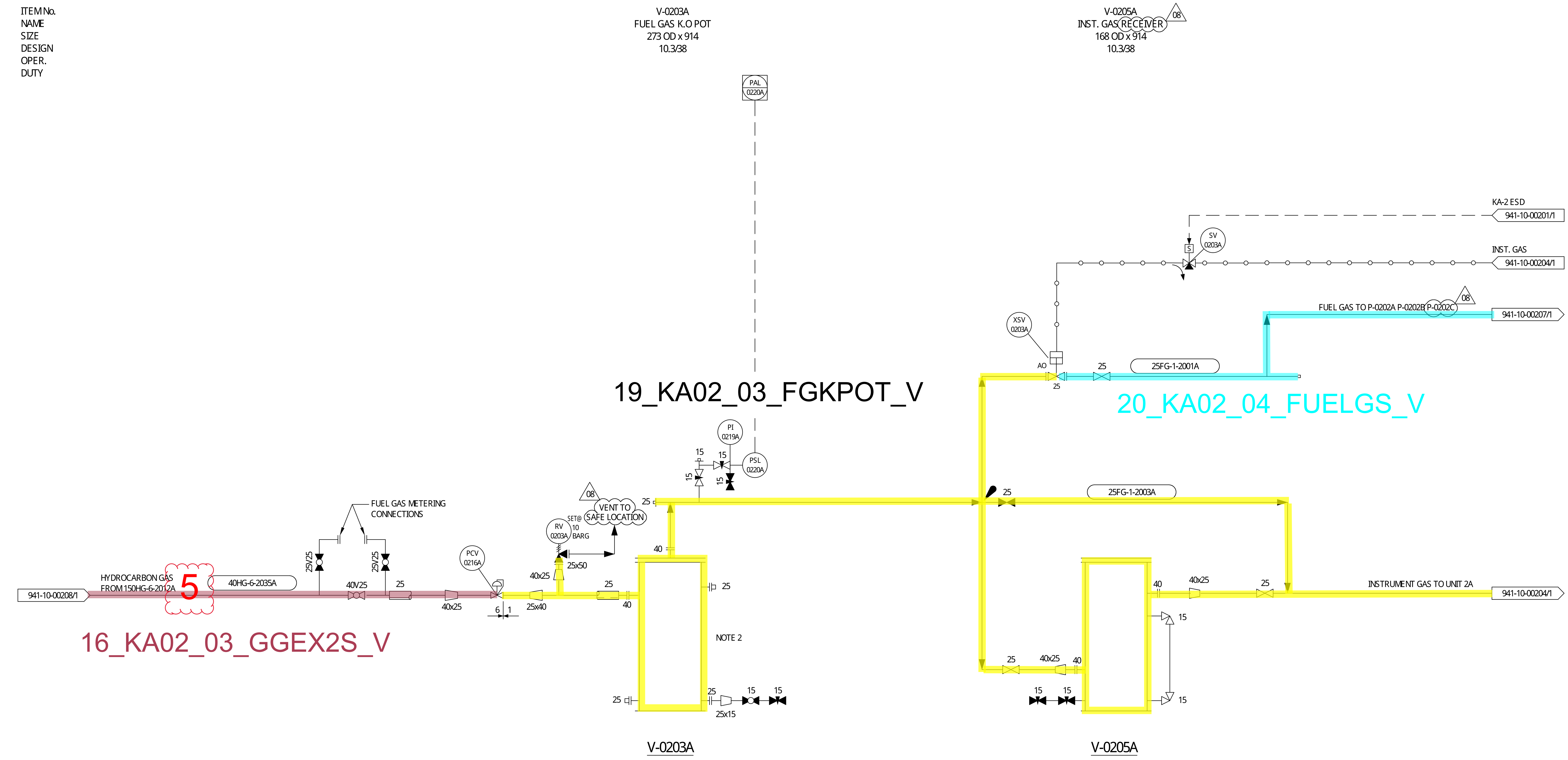
PIPING & INSTRUMENT DIAGRAM GAS & CONDENSATE EXPORT WELLSITE 2

Todd Energy

SHEET No 1 OF 1

REVISION . 18

DRAWING No 941-10-00208



NOTES

1. VALVES INDICATING SIZE ONLY ARE NOT GIVEN A V NUMBER AS THEY DO NOT CONFORM WITH SPEC. 5.1
2. V-0203A HAS A FLOAT ARRANGEMENT WHICH SHUTS OFF FLOW TO OUTLET IF VESSEL IS FULL OF LIQUID.

NO	DATE	BY	CONSTRUCTION ISSUE	CONSULTANT CHKD	CONSULTANT APPR.	SBPT CHKD	SBPT APPR.
~~J0~~	~~03/08~~	~~KN~~	~~ECP K1154 PRELIMINARY ISSUE-CANCELS~~		~~PWM~~		
~~H0~~	~~03/03~~	~~DS~~	~~DRAWING CANCELLED~~	~~JT~~	.	.	~~PAA~~
~~G1~~	~~12/99~~	~~AGM~~	~~EWR K168 ISSUED FOR CONSTRUCTION~~	~~PM~~	~~AM~~	.	~~TAF~~
~~G0~~	~~08/99~~	~~VB~~	~~EWR K168 ISSUED FOR DESIGN~~	~~PM~~	~~AM~~	.	~~TAF~~
~~F0~~	~~4/94~~	~~GR~~	~~K373 CONSTRUCTION~~	~~MW~~	~~MS~~	~~AD~~	~~SH~~

NO	DATE	BY	EWR	DESCRIPTION (REVISIONS)	CONSULTANT CHKD	CONSULTANT APPR.	SBPT CHKD	SBPT APPR.
07	11/09	MH	ECP	ECP K1311 AS BUILT TO SITE MARK UP ASB 9198KW	VB	PWM		AI
06	12/01	BRT	K988	AS BUILT TO SITE MARK UP ASB 886K	VB			KJE
05	07/00	RJR	K168	AS-BUILT TO SITE MARK UP	KCB	AM	.	KJE
04	6/96	PCA	K373	AS-BUILT TO SITE MARK-UP ASB 232K	.	.	PCA	SH
3	3.3.93	JMc	1398	KAPUNI TSA HAZOPS AS BUILT	NB	GPV		PN
2	2/9/91	NB	K385	GENERAL AS BUILT				
08	07/16	BB	ECP	ECP XK16002 AS BUILT TO SITE MARK UP ASB 16250KK	JMP	AB		SF

REFERENCE DRAWINGS

NUMBER	TITLE

		DATE
DESIGNED		
DRAWN	CB	21-1-80
CHECKED	P HINES	27-8-80
APPROVED	C BEATH	28-8-80
APPROVED		
SCALE	NONE	

KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM FUEL & INSTRUMENT GAS TO UNIT 2A WELLSITE 2

STICKFILE

SHELL BP AND TODD OIL SERVICES LIMITED
PRIVATE BAG NEW PLYMOUTH NEW ZEALAND

SHEET No 3 OF 3
REVISION . 08
DRAWING No 941-10-202

W0100053

KA-16 WELL ABANDONED MAR '03. THE PARTIALLY COMPLETED DESIGN HAS BEEN HELD FOR USE WITH A POSSIBLE FUTURE WELL ON SKETCH 941-210-093

NOTES

~~1. THIS LINE HAS BEEN DERATED FROM SPEC 5050A TO SPEC 15. FLANGES REMAIN AT 5000#.~~

This drawing is confidential and is the property of SHELL TODD OIL SERVICES LTD. It must not be disclosed to any third party or lent without written consent from Shell Todd Oil Services Ltd

NO	DATE	BY	CONSTRUCTION ISSUE	CONSULTANT CHKD	CONSULTANT APPR.	STOS CHKD	STOS APPR.
~~H0~~	~~03/08~~	~~KN~~	~~ECP K1154 PRELIMINARY ISSUE-CANCELLED~~	~~NS~~	~~PWM~~	.	.
~~G0~~	~~03/03~~	~~DS~~	~~APPROVED FOR CONSTRUCTION~~	~~JT~~	.	.	~~PAA~~
~~F0~~	~~1/03~~	~~TMA~~	~~EWR K531 APPROVED FOR DESIGN~~	~~GR~~	.	.	~~PAA~~
~~E0~~	~~06/02~~	~~DS~~	~~EWR K534 AFC~~	~~CWM~~	.	.	~~PAA~~
~~DI~~	~~12/99~~	~~AGM~~	~~EWR K168 ISSUED FOR CONSTRUCTION~~	~~PM~~	~~AM~~	.	~~TAF~~
~~J1~~	~~12/08~~	~~LMM~~	~~ECP K1256 APPROVED FOR DESIGN~~	~~MK~~	~~LS~~		~~AI~~
~~J0~~	~~11/08~~	~~VB~~	~~ECP K1256 ISSUED FOR HAZOP~~	~~MK~~	~~LS~~	.	.

NO	DATE	BY	EWR	DESCRIPTION (REVISIONS)	CONSULTANT CHKD	CONSULTANT APPR.	STOS CHKD	STOS APPR.	REFERENCE DRAWINGS NUMBER	REFERENCE DRAWINGS TITLE
									.	.
14	07/16	BB	ECP	ECP XK16002 AS BUILT TO SITE MARK UP ASB 16275KW	JMP	AB		SF	.	.
13	01/11	KP	ECP	ECP K1379 AS BUILT TO SITE MARK UP ASB 10250KW	VB	LM	.	AI	.	.
12	11/09	MH	ECP	ECP K1311 AS BUILT TO SITE MARK UP ASB 9198KW	VB	PWM		AI	.	.
11	06/09	JL	ECP	ECP K1256 AS BUILT TO SITE MARK UP ASB 9124KW	VB	PWM		AI	.	.
10	08/12	BN	K1278	AS-BUILT TO ASB 8213KW	CWM			RG	.	.
09	08/07	MH	ECP	ECP K1201 AS BUILT TO SITE MARK UP ASB 7117KW	VB	PWM		AI	.	.
08	04/03	AMH	K534	AS-BUILT TO SITE MARKUP	DS	.	.	MSR	941-10-207X	P&ID

DESIGNED	.	DATE
DRAWN	N BAILEY	26/8/91
CHECKED	.	.
APPROVED	.	.
APPROVED	.	.
SCALE	.	
STICKFILE	.	W0100128

KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM WELLSTREAM HEATER & WATER TANK WELLSITE 2

SHELL TODD OIL SERVICES LIMITED

PRIVATE BAG NEW PLYMOUTH NEW ZEALAND

SHEET No 1 OF 1

REVISION . 14

DRAWING No 941-10-00207

NOTES:

1. LINE NOT TO BE BLOCKED WHILE PERFORMING MAINTENANCE ON T-0202.
2. WIRELESS INSTRUMENT.
3. ✳ VENDOR SUPPLIED.
4. VOID.
5. ELEVATION OF CALIBRATION TUBE VENT TO BE GREATER THAN TANK VENTS.
6. STANDARD 40 MESH STRAINER
7. VOID.
8. TO SAFE LOCATION. TUBING DESIGN/SIZE AS PER DEP & PUMP VENDOR RECOMMENDATION.
9. CATCH PIT CONTENTS TO BE SAMPLED & CHECKED BEFORE RELEASE TO GRADE. IF CONTAMINATED, STANDARD OPERATING PROCEDURE FOR HANDLING/DISPOSING THE CONTAMINATED FLUID TO BE FOLLOWED.

NO	DATE	BY	CONSTRUCTION ISSUE	CHKD (CONSULTANT)	APPR. (CONSULTANT)	CHKD (STOS)	APPR. (STOS)	NO	DATE	BY	EWR	DESCRIPTION (REVISIONS)	CHKD (CONSULTANT)	APPR. (CONSULTANT)	CHKD (STOS)	APPR. (STOS)	NUMBER	TITLE
~~G0~~	~~07/14~~	~~NR~~	~~ECP K1575 APPROVED FOR CONSTRUCTION~~	~~AB~~	~~ML~~	.	~~ATH~~	07	01/10	MH	ECP	ECP K1379 AS BUILT TO SITE MARK UP ASB 10008KW	VB	PWM	.	AI	·	.
~~F0~~	~~06/11~~	~~VB~~	~~ECP K1324 APP. FOR DESIGN - NOT REQ'D~~	~~AKH~~	~~PW~~	.	~~AI~~	06	06/09	JL	ECP	ECP K1256 AS BUILT TO SITE MARK UP ASB 9124KW	VB	PWM	.	AI	·	.
~~E1~~	~~12/08~~	~~LMM~~	~~ECP K1256 APPRROVED FOR DESIGN~~	~~MK~~	~~LS~~		~~AI~~	05	08/03	JPJ	MULTI	EWR K534 & K542 AS BUILT TO SITE MARK UP	BB	PM	.	MSR	·	.
~~E0~~	~~11/08~~	~~VB~~	~~ECP K1256 ISSUED FOR HAZOP~~	~~MK~~	~~LS~~	.	.	04	04/03	AMH	K534	AS BUILT TO SITE MARK UP	DS	.	.	MSR	·	.
~~D0~~	~~03/08~~	~~KN~~	~~ECP K1154 PRELIMINARY ISSUE-CANCELLED~~	~~NS~~	~~PWM~~	.	.										·	.
~~C0~~	~~03/03~~	~~DS~~	~~APPROVED FOR CONSTRUCTION~~	~~JT~~	.	.	~~PAA~~	10	03/17	BB	ECP	ECP XK17172 AS BUILT TO SITE MARK UP ASB 17070KK	JMP	TD	.	SF	·	.
~~B0~~	~~07/02~~	~~DS~~	~~K534 AFC~~	~~CWM~~	.	.	~~PAA~~	09	01/15	NR	ECP	ECP K1575 AS BUILT TO SITE MARK UP ASB 15017KW	JMP	AB	.	ATH	·	.
~~A0~~	~~4/94~~	~~MW~~	~~K373 CONSTUCTION~~	~~MW~~	~~MS~~	~~AD~~	~~SH~~	08	01/11	KP	ECP	ECP K1379 AS BUILT TO SITE MARK UP ASB 10250KW	VB	LM	.	AI	·	.

DESIGNED	.	DATE
DRAWN	N BAILEY	2/9/91
CHECKED	.	.
APPROVED	.	.
APPROVED	.	.
SCALE	.	
STICKFILE	.	W0100134

KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM
CHEMICAL INJECTION
WELLSITE 2

SHELL TODD OIL SERVICES LIMITED
PRIVATE BAG NEW PLYMOUTH NEW ZEALAND

SHEET No 2 OF 2 | REVISION 10

DRAWING No 941-10-00210

NOTES

1. VOID.
2. * VENDOR SUPPLIED
3. VOID.
4. LEVEL GAUGE VISIBLE FROM FILLING POINT/CONNECTION TO TRUCK.
5. VALVE TO REMAIN CLOSED UNLESS INJ ECTING TO DOWNSTREAM INJ ECTION POINTS. VALVES 15V77 AND 10V77 MUST BE CLOSED BEFORE 15V82 IS OPENED

NO	DATE	BY	EWR	DESCRIPTION	CHKD	APPR.	CHKD	APPR.
15	11/18	AdB	K1816	AS BUILT PER SITE MARK UP	GRP	MA	.	SF
14	02/17	AMP	ECP	ECP XK17172 AS BUILT TO SITE MARK UP ASB 17004KK	JMP	AB	.	SF
13	10/16	NR	ECP	ECP XK16002 AS BUILT TO SITE MARK UP ASB 16386KK	JMP	AB	.	SF
12	01/11	KP	ECP	ECP K1379 AS BUILT TO SITE MARK UP ASB 10250KW	VB	LM	.	AI
11	02/10	MH	ECP	ECP K1379 AS BUILT TO SITE MARK UP ASB 10016KW	VB	PWM		AI
10	06/09	JL	ECP	ECP K1256 AS BUILT TO SITE MARK UP ASB 9124KW	VB	PWM	.	AI
09	08/03	JPJ	MULTI	EWR K534 & K542 AS BUILT TO SITE MARK UP	BB	PM		MSR
08	04/03	AMH	K534	AS BUILT TO SITE MARK UP	DS	.	.	MSR
G1	12/08	LMM		ECP K1256 APPROVED FOR DESIGN	MK	LS	.	AI

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

DESIGNED	.	DATE	
DRAWN	N BAILEY	2/9/91	
CHECKED	.	.	
APPROVED	.	.	
APPROVED	.	.	
SCALE	.		
STICKFILE	.		W0100310

KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM
METHANOL PUMP & TANK
WELLSITE 2

Todd Energy

SHEET No 1 OF 1 — REVISION 14

DRAWING No 941-10-00210

Appendix 3.
P&ID Sectionalisation for KA-4 and KA-14

NOTES:

1. REFER TO DWG 941-10-00409 FOR INJECTION SYSTEM.
2. VALVE IS SS SUITABLE FOR LOW TEMP OF -90éC.
3. THIS LINE HAS BEEN DERATED FROM SPEC 50/50A TO SPEC 15. FLANGES REMAIN 5000#.
4. SAFETY CRITICAL HEAT TRACING.
5. LOCAL MIMIC SCREEN AT WELLSITE.
6. CUSHION TEE.
7. 50mm RCS ACCESS FITTING.
8. BACK PRESSURE REGULATOR STOPS CELLAR PUMP FROM OPERATING BELOW 7.5 BARG AIR PRESSURE.
9. WHERE `NS' (NON SPEC) IS USED IN THE LINE NUMBER REFER TO ISOMETRIC FOR SPOOL MATERIALS.
10. MeOH USED FOR START UP.
11. EXISTING VALVE REPLACED WITH BLINDED DUMMY SPOOL.
12. USED FOR START UP. WIDE OPEN IN NORMAL OPERATION.
13. SAND PROBE
14. 2 NON RETURN VALVES OF DISSIMILAR TYPE REQUIRED.
15. FLOWLINE CHOKE TO BE RAMPED CLOSED UNDER USD OR ALL KPS INLET VALVES CLOSED (CONDENSATE).
16. TARGET TEE.
17. VALVE USED FOR DEPRESSURISATION DOWN STREAM OF NRV THROUGH WELLHEAD.
18. MONOBLOCK C/W INTEGRAL CHECK VALVE.
19. 5000 PSI DOUBLE BLOCK & BLEED VALVES & CHECK VALVES FITTED DIRECTLY TO INSTRUMENT FLANGE BETWEEN KILL WING WALVES.
20. MONOBLOCK & BLEED C/W INJECTION QUILL.

NO	DATE	BY	ECP	DESCRIPTION	CHKD	APPR.	CHKD	APPR.
33	03/16	BB	ECP	ECP XK16002 AS BUILT TO SITE MARK UP ASB 16095KW & 16131KW	JMP	AB	.	SF
32	10/15	NR	ECP	ECP K1334 AS BUILT TO SITE MARK UP ASB 15428KK	JMP	AB	.	ATH
31	03/14	MH	ECP	ECP K1334 AS BUILT TO SITE MARK UP ASB 14036KW	JMP	AB		ATH
.	.	.	.	.	.	.	.	.
37	09/18	BB	.	PCR_3_2018_5 A BUILT TO SITE MARK UP ASB T19012KW	JMP	AB	.	MW
36	09/18	AdB	ECP	ECP K3817 (12221) AS-BUILT	GRP	.	.	MCW
35	05/19	KC	ECP	ECP K3817 (12221) AS-BUILT	MAW			KB
34	05/18	CSM	ECP	ECP K1729 AS BUILT TO SITE MARK UP ASB 18001KW	JMP	GD	.	KB

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

CONSTRUCTION ISSUE: NO, DATE, BY, CHKD, APPR. (CONSULTANT), CHKD, APPR. (TODD) — M0

DESIGNED	.	
DRAWN	MF/WZ	28-8-73
CHECKED	MB/DK	28-8-73
APPROVED	C BEATH	28-8-80
APPROVED	.	.
SCALE	NONE	
STICKFILE	.	

KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM WELLHEAD KA-4 WELLSITE 4 & 14

Todd Energy

SHEET No 1 OF 1

REVISION 37

DRAWING No 941-10-00401

NOTES:

1. WIRELESS SIGNAL.
2. VALVE IS SS SUITABLE FOR LOW TEMP OF -90ºC
3. XSV-2430A AND SDV-2430F ARE FITTED WITH A QUICK VENT WHICH RELIEVES BACK TO THE HYDRAULIC TANK T-2430. THE QUICK VENT RETURN FROM SDV-2430F HAS TWO LO VALVES.
4. LOCAL MIMIC AT WELLSITE.
5. BACK PRESSURE REGULATOR STOPS CELLAR PUMP FROM OPERATING BELOW 7.5 BARG AIR PRESSURE.
6. CRITICAL HEAT TRACING.
7. VOID.
8. XCV-2430 A/B/C OVER RIDE STEM LOCKED OPEN.
9. REFER TO DEPRESSURING PROCEDURE FOR CONTROL OF LOW TEMPERATURE CONCERNS DURING DEPRESSURISATION.
10. CONNECTION POINT FOR PPD SKID IF REQUIRED.

NO	DATE	BY	CONSTRUCTION ISSUE	CHKD	APPR.	CHKD	APPR.
N3	09/17	RR	K1729 CUSP APPR. FOR CONSTRUCTION	ML	GD	.	SF
N2	05/17	JMP	ECP K1729 RE ISSUED AFC	ML	SG		SF
N1	02/17	JMP	ECP K1729 APPROVED FOR DESIGN	ML	NS		SF
N0	10/16	AMP	CUSP PROJECT ISSUED FOR HAZOP	SG	ML		.
M0	07/13	JC	ECP K1334 RE ISSUED AFC	AH	AC	.	ATH
K8	11/12	MH	ECP K1334 RE ISSUED AFC	AKH	MK	.	ATH

NO	DATE	BY	ECP	DESCRIPTION	CHKD	APPR.	CHKD	APPR.
26	05/18	CSM	ECP	ECP K1729 AS BUILT TO SITE MARK UP ASB 18001KW	JMP	GD		KB
25	05/17	RR	ECP	ECP K1708 AS BUILT TO SITE MARK UP ASB 17177KW	JMP	TD		SF
24	03/16	BB	ECP	ECP KK16002 AS BUILT TO SITE MARK UP ASB 16095KW	JMP	AB		S
23	11/15	BB	ECP	ECP K1630 AS BUILT TO SITE MARK UP ASB 15425KW	JMP	AB	.	ATH
22	10/15	BB	ECP	ECP X0213 AS BUILT TO SITE MARK UP ASB 15422KW	JMP	AB	.	ATH
21	07/15	NR	ECP	ECP K1481 AS BUILT TO SITE MARK UP ASB 15159KW	JMP	AB	.	ATH

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

DESIGNED	.	
DRAWN	M SASSMAN	6-87
CHECKED	G HENEULT	6-87
APPROVED	G HENULT	6-87
APPROVED	BF	8-87
SCALE	NTS	
STICKFILE	.	WX100017

KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM
WELLHEAD KA-14
WELLSITE KA-4 & 14

SHEET No 1 OF 2 — REVISION 26

Todd Energy

DRAWING No 941-10-00403

NOTES.

1. METHANOL INJECTION LINES TO BE 1/4" SS BY INSTRUMENTS. SEE DWG 941-10-409/2 FOR METHANOL INJECTION SYSTEM.
2. CLAMP ON SAND FILTER MONITOR.
3. ALL TUBING IS IMPERIAL STANDARD.
4. TARGET TEE INCLUDED FOR POTENTIAL SAND PRODUCTION.
5. VOID.
6. ANTI-TAMPER MANUAL RESET SOLENOIDS, CANNOT BE RESET UNTIL PAHH SYSTEM IS RESET
7. VOID.
8. REMOVEABLE INSULATION ON MONOBLOCKS.
9. 50mm RCS ACCESS FITTING WITH CORROSION PROBE. ELASTOMERS IN ACCESS FITTING ONLY SUITABLE FOR -34éC.
10. VALVE OPENING TO BE CONTROLLED AND SET BY OPERATOR.
11. TWO PHASE AND/OR SLUG FLOW.
12. COTTON REEL SPOOL INSTALLED BETWEEN 100V93 VALVES
13. VOID.
14. C3 TO BE INSTALLED AT LEAST 2m FROM CHOKE VALVE.
15. LOCAL MIMIC SCREEN AT WELLSITE.
16. FLOWLINE CHOKE CONTROL SWITCHED TO MANUAL AND FULLY CLOSED (0%) UPON USD, OR ALL KPS INLET VALVES CLOSED.
17. VOID.
18. AXIAL FLOW SHUT OFF VALVE.
19. CONNECTIONS FOR PORTABLE WELL TESTING SEPARATOR.

CONSTRUCTION ISSUE

NO	DATE	BY		CHKD (CONSULTANT)	APPR. (CONSULTANT)	CHKD (TODD)	APPR. (TODD)
.	.	.	.	.	.	.	.
~~C4~~	~~09/17~~	~~JMP~~	~~K1729 CUSP APPR. FOR CONSTRUCTION~~	~~ML~~	~~GD~~	.	~~SF~~
~~C3~~	~~05/17~~	~~JMP~~	~~ECP K1249 RE APPROVED FOR DESIGN~~	~~ML~~	~~SG~~	.	~~SF~~
~~C2~~	~~02/17~~	~~JMP~~	~~ECP K1729 APPROVED FOR DESIGN~~	~~ML~~	~~NS~~	.	~~SF~~
~~C1~~	~~08/16~~	~~AMP~~	~~CUSP PROJECT ISSUED FOR HAZOP~~	~~SG~~	~~ML~~	.	.
~~C0~~	~~08/16~~	~~AMV~~	~~CUSP PROJ,. ISSUED FOR REVIEW~~	~~ML~~	~~SG~~	.	,
B1	08/14	NR	ECP KA-14 REMEDIATION AFC	.	.	.	.
B0	07/14	JMP	KA-14 REMEDIATION FOR HAZOP	ML	AB	.	.

REVISIONS

NO	DATE	BY	ECP	DESCRIPTION	CHKD (CONSULTANT)	APPR. (CONSULTANT)	CHKD (TODD)	APPR. (TODD)
.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.
05	08/19	SH	ECP	ECP XK18002 AS BUILT TO SITE MARK UP ASB T19011KK	JMP	SG	.	MW
04	05/18	CSM	ECP	ECP K1729 AS BUILT TO SITE MARK UP ASB 18001KW	JMP	GD	.	KB
03	05/17	RR	ECP	ECP K1708 AS BUILT TO SITE MARK UP ASB 17177KW	JMP	TD	.	SF
02	09/15	NR	ECP	ECP K1334 AS BUILT TO SITE MARK UP ASB 15314KW	JMP	AB	.	ATH
01	03/14	MH	ECP	ECP K1334 AS BUILT TO SITE MARK UP ASB 14036KW	JMP	AB	.	ATH

REFERENCE DRAWINGS

NUMBER	TITLE

		DATE
DESIGNED	.	
DRAWN	M SASSMAN	6-87
CHECKED	G HENEULT	6-87
APPROVED	G HENEULT	6-87
APPROVED	BF	8-87
SCALE	.	
STICKFILE	.	

KAPUNI WELLSITES

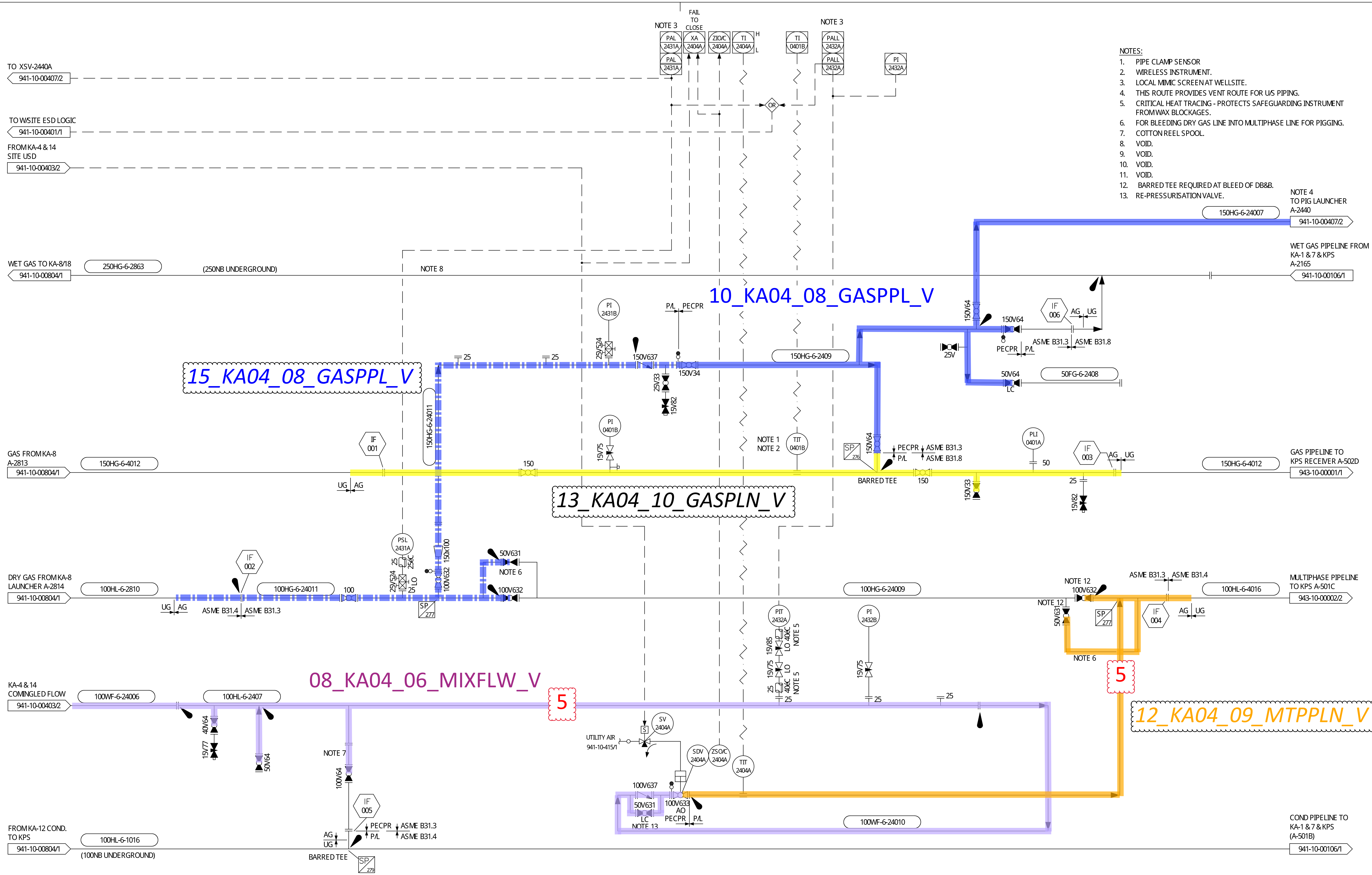
PIPING & INSTRUMENT DIAGRAM
WELLHEAD KA-14
WELLSITE KA-4 & 14

Todd Energy

SHEET No 2 OF 2

REVISION . 05

DRAWING No 941-10-00403



NOTES:

1. PIPE CLAMP SENSOR.
2. WIRELESS INSTRUMENT.
3. LOCAL MIMIC SCREEN AT WELLSITE.
4. THIS ROUTE PROVIDES VENT ROUTE FOR U/S PIPING.
5. CRITICAL HEAT TRACING - PROTECTS SAFEGUARDING INSTRUMENT FROM WAX BLOCKAGES.
6. FOR BLEEDING DRY GAS LINE INTO MULTIPHASE LINE FOR PIGGING.
7. COTTON REEL SPOOL.
8. VOID.
9. VOID.
10. VOID.
11. VOID.
12. BARRED TEE REQUIRED AT BLEED OF DB&B.
13. RE-PRESSURISATION VALVE.

CONSTRUCTION ISSUE

NO	DATE	BY		CONSULTANT CHKD	CONSULTANT APPR.	TODD CHKD	TODD APPR.
.	.	.	.	.	.	.	.
~~S4~~	~~09/17~~	~~JMP~~	~~K1729 CUSP APPR. FOR CONSTRUCTION~~	~~ML~~	~~GD~~	~~.~~	~~SF~~
~~S3~~	~~05/17~~	~~JMP~~	~~ECP K1729 RE APPROVED FOR DESIGN~~	~~ML~~	~~SG~~	~~.~~	~~SF~~
~~S2~~	~~02/17~~	~~JMP~~	~~ECP K1729 APPROVED FOR DESIGN~~	~~ML~~	~~NS~~	~~.~~	~~SF~~
~~S1~~	~~10/16~~	~~AMP~~	~~CUSP PROJECT ISSUED FOR HAZOP~~	~~SG~~	~~ML~~		
~~N1~~	~~10/13~~	~~JC~~	~~ECP K1334-05 APPROVED FOR CONST.~~	~~AKH~~	~~ML~~	~~.~~	~~ATH~~
~~N0~~	~~09/13~~	~~MH~~	~~ECP K1334-05 ISSUED FOR HAZOP~~	~~AKH~~	~~ML~~	~~.~~	~~.~~
~~L0~~	~~10/10~~	~~LMM~~	~~ECP K1220 APPROVED FOR DESIGN~~	~~DJ~~	~~AP~~	~~.~~	~~AI~~

REVISIONS

NO	DATE	BY	ECP	DESCRIPTION	CONSULTANT CHKD	CONSULTANT APPR.	TODD CHKD	TODD APPR.
23	05/18	CSM	ECP	ECP K1729 AS BUILT TO SITE MARK UP ASB 18001KW	JMP	GD		KB
22	06/17	AMP	ECP	ECP XK17172 AS BUILT TO SITE MARK UP ASB 17181KK	JMP	TD	.	SF
21	08/13	NR	ECP	ECPs K1334-05 & K1334 AS BUILT TO SITE MARK UP ASBs 13184KW & 14036KW	JMP	AC	.	ATH
20	10/12	JC	ECP	ECP K1470 & K1324 AS BUILT TO SITE MARK UP ASB 12213KW & 12288KW	DBM	AC		ATH
19	03/12	LMM	ECP	ECP K1334 AS BUILT TO SITE MARK UP ASB 12058KW	VB	PB	.	ATH
18	01/11	KP	ECP	ECP K1379 AS BUILT TO SITE MARK UP ASB 10250KW	VB	LM	.	AI
24	11/19	CL	ECP	ECP XK18002 AS BUILT TO SITE MARK UP ASB T19007KK	JMP	SG	.	MW

REFERENCE DRAWINGS

NUMBER	TITLE
·	.
·	.
·	.
·	.
·	.
·	.
·	.
·	.

DESIGNED	.	
DRAWN	M SASSMAN	6-87
CHECKED	T HEWETT	8-87
APPROVED	T HEWETT	8-87
APPROVED	BG	8-87
SCALE	NONE	
STICKFILE	.	WX100021

KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM GATHERING LINES KA 14 WELLSITE 4 & 14

Todd Energy

SHEET No 1 OF 2

REVISION . 24

DRAWING No 941-10-00407

NOTES

1. AVOID USING PIG TRAP VENT LINE FOR DEPRESSURISING KA-1/7 TO KA-4/14 FLOWLINE.
2. 250NB SCH 30 ERW API 5L X46 MDPE COATED CLASS 600 FLANGES 94.5 BARG @ 60°C TO NZS 5223 : PART 1 1986

NO	DATE	BY	CONSTRUCTION ISSUE	CONSULTANT CHKD	CONSULTANT APPR.	TODD CHKD	TODD APPR.	NO	DATE	BY	ECP	REVISIONS DESCRIPTION	CONSULTANT CHKD	CONSULTANT APPR.	TODD CHKD	TODD APPR.	REFERENCE DRAWINGS NUMBER	REFERENCE DRAWINGS TITLE
~~G4~~	~~08/11~~	~~LMM~~	~~ECP K1334 UNIT A RE-ISS APPR. FOR DESIGN~~	~~MK~~	~~KS~~	.	~~AI~~	07	04/12	LMM	ECP	ECP K1334 AS BUILT TO SITE MARK UP ASB 12058KW	VB	PB	.	ATH	.	.
.	.	.	.	.	.	.	.	06	01/11	KP	ECP	ECP K1379 AS BUILT TO SITE MARK UP ASB 10250KW	VB	LM	.	AI	.	.
~~H4~~	~~09/17~~	~~RR~~	~~K1729 CUSP APPR. FOR CONSTRUCTION~~	~~ML~~	~~GD~~	.	~~SF~~	05	12/08	DW	ECP	ECP K1152 AS BUILT TO SITE MARK UP ASB 8198KW	VB	PWN	.	AI	.	.
~~H3~~	~~05/17~~	~~JMP~~	~~ECP K1729 RE APPROVED FOR DESIGN~~	~~ML~~	~~SG~~	.	~~SF~~	04	05/06	DW	ECP	ECP K1041 AS BUILT TO SITE MARK UP ASB 6063KW	VB	PWN		AI	.	.
~~H2~~	~~02/17~~	~~JMP~~	~~ECP K1729 APPROVED FOR DESIGN~~	~~ML~~	~~NS~~	.	~~SF~~	03	05/07	JMP	ECP	ECP K1004 AS BUILT TO SITE MARK UP ASB 5052KW	VB	JA	.	RP	.	.
~~H1~~	~~10/16~~	~~AMP~~	~~CUSP PROJECT ISSUED FOR HAZOP~~	~~SG~~	~~ML~~	.	.	02	06/04	SK	K546	AS BUILT TO SITE MARK UPS	JHT	JA	.	KJE	.	.
~~H0~~	~~08/16~~	~~AMC~~	~~CUSP PROJECT ISSUED FRO REVIEW~~	~~ML~~	~~SG~~	.	.										.	.
G5	12/11	SG	ECP K1334 CWS-10005 AFC	KS	AP	.	AI	08	05/18	CSM	ECP	ECP K1729 AS BUILT TO SITE MARK UP ASB 18001KW	JMP	GD		KB	.	.

DESIGNED	.	DATE
DRAWN	M WEST	5/93
CHECKED	J CARLEY	5/93
APPROVED	P NARASHIMAN	5/93
APPROVED	S HARVEY	5/93
SCALE	NTS	
STICKFILE	.	WX100150

KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM GAS SCRAPER LAUNCHER A-2440 WELLSITE 4 & 14

Todd Energy

SHEET No 2 OF 2 | REVISION . 08

DRAWING No 941-10-00407


ITEM No.
NAME
SIZE
DESIGN
OPER.
DUTY
P-2426
METHANOL PUMP
0.3m3/DAY
99 BARG @ 38èC
P-2424
METHANOL PUMP
0.3m3/DAY
99 BARG @ 38èC
P-2429
METHANOL PUMP
0.6m3/DAY
345 BARG @ 38èC
T-2429
METHANOL TANK(SS)
1974 ID x 1525 HIGH
ATMOS
P-2427
METHANOL PUMP
0.163m3/DAY
69 BARG @ 38èC
FROM KA-4 & 14 USD
941-10-00403/2
AIR COMP. SHUTDOWN OR
AIR PRESS. LOW PAL-1439A
941-10-00416/1
NOTE 3
NOTE 4
80NB FILL CONN.
09_KA04_07_METTNK_L
T-2429
PIPING
INST
10mmSS TUBING
6mmSS TUBING
3/4" SS TUBING
M14 WELLHEAD KA-14 403/1
M21 WELLHEAD KA-14 CHOKE 403/2
M17 WELLHEAD KA-4 401
WELLHEAD KA-4 CHOKE 401
Pumps only used during start-up (very infrequent) - section not included.
P-2426
P-2424
P-2429
P-2427
DRAIN
ATMOS
INST. AIR
TUBING
PIPING
TO CI SOLENOID VALVES
941-10-00412/1
TO P-2425
941-10-00409/3
FROM P-2425
941-10-00409/3
25CA-1-2402
FROM P-0404
941-10-00409/2
NOTES.
1. VOID.
2. VOID.
3. FLAME ARRESTOR SUPPLIED WITH TANK.
4. VOID.
5. VOID.
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.
KAPUNI WELLSITES
PIPING & INSTRUMENT DIAGRAM
METHANOL KA-4 & 14
WELLSITE KA-4 & 14
Todd Energy
SHEET No 1 OF 3
REVISION 26
DRAWING No 941-10-00409

Appendix 4.
P&ID Sectionalisation for KA-5 and KA-10

NOTES:

1. FOR CONTINUATION OF CORROSION INHIBITOR SEE DWG 941-10-503/1
2. FOR CONTINUATION OF METHANOL INJECTION SEE DWG 941-10-503/1
3. CORROSION PROBE IN 6 O'CLOCK POSITION.
4. CLAMP ON SAND MONITOR. NOT ALL FUNCTIONS SHOWN.
5. RATE OF CHANGE ALARM
6. VOID.
7. THIS LINE HAS BEEN DERATED FROM SPEC 50/50A TO SPEC 15. FLANGES REMAIN AT 5000#
8. VOID.
9. VOID.
10. TARGET TEE.

This drawing is confidential and is the property of SHELL TODD OIL SERVICES LTD. It must not be disclosed to any third party or lent without written consent from Shell Todd Oil Services Ltd

CONSTRUCTION ISSUE

NO	DATE	BY		CHKD (CONSULTANT)	APPR. (CONSULTANT)	CHKD (STOS)	APPR. (STOS)
~~K1~~	~~02/17~~	~~JMP~~	~~ECP K1709 (PHASE 2) APPR. FOR CONST.~~	~~AB~~	~~TD~~	.	~~SF~~
~~J6~~	~~12/16~~	~~JMP~~	~~ECP K1709 STAGE 2 RE-APPR. FOR DESIGN~~	~~AB~~	~~TD~~		~~SF~~
~~J5~~	~~10/16~~	~~BB~~	~~ECP K1709 RE ISSUED FOR HAZOP~~	~~AB~~	~~OCK~~		
~~K0~~	~~09/16~~	~~JMP~~	~~ECP K1709 PHASE 2 APPROVED FOR DESIGN~~	~~AB~~	~~TD~~		~~SF~~
~~J4~~	~~08/16~~	~~JMP~~	~~ECP K1709 (PHASE 1) RE AFC~~	~~AB~~	~~TD~~		~~AF~~
.	.	.	.	.	.	.	.
~~K3~~	~~05/17~~	~~JMP~~	~~ECP K1709 (PHASE 2) RE APPR. FOR CONST.~~	~~AB~~	~~TD~~	.	~~SF~~
~~K2~~	~~03/17~~	~~JMP~~	~~ECP K1709 (PHASE 2) RE APPR. FOR CONST.~~	~~AB~~	~~TD~~	.	~~SF~~

REVISIONS

NO	DATE	BY	EWR	DESCRIPTION	CHKD (CONSULTANT)	APPR. (CONSULTANT)	CHKD (STOS)	APPR. (STOS)
29	01/11	KP	ECP	ECP K1379 AS BUILT TO SITE MARK UP ASB 10250KW	VB	LM	.	AI
28	05/08	MH	ECP	ECP K1278 AS BUILT TO SITE MARK UP ASB 8083KW - CANCELLED	VB	PWM		AI
.	.	.	.	.	.	.	.	.
34	07/17	BB	ECP	ECP K1709 AS BUILT TO SITE MARK UP ASB 17222KW	JMP	ATD	.	SF
33	03/16	BB	ECP	ECP XK16002 AS BUILT TO SITE MARK UP ASB 16080KW	JMP	AB		SF
32	07/13	MH	ECP	ECP K1544 AS BUILT TO SITE MARK UP ASB 13134KW	JMP	AC		ATH
31	06/12	MH	ECP	ECP K1470 AS BUILT TO SITE MARK UP ASB 12112KW	VB	PB		ATH
30	01/12	MH	ECP	ECP K1394 AS BUILT TO SITE MARK UP ASB 12012KW	VB	JS		AI

REFERENCE DRAWINGS

NUMBER	TITLE
.	.
.	.
.	.
.	.
.	.
.	.
.	.
.	.

SHEET 2 NOW OBSOLETE EWR 1065

		DATE
DESIGNED	.	
DRAWN	B MORE	25.11.81
CHECKED	.	.
APPROVED	M SHWER	15.2.82
APPROVED	C BEATH	16.2.82
SCALE	NONE	
STICKFILE	.	

KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM
WELLHEAD 5
WELLSITE 5 & 10

SHELL TODD OIL SERVICES LIMITED
PRIVATE BAG NEW PLYMOUTH NEW ZEALAND

SHEET No 1 OF 1
REVISION 34
DRAWING No 941-10-00501

NOTES:

1. GATHERING LINE MATERIAL IS: API 5L GR X-52 SCH 30 (GAS)
   API 5L GR X-52 SCH 60 (CONDENSATE)
2. TIE-IN POINT FOR PRODUCTION TESTING.
3. VOID.
4. PIPE CLAMP SENSOR WIRELESS INSTRUMENT, INSULATION 150mm EITHER SIDE OF THE SENSOR.
5. EROSION PROBE INSTALLED.
6. CAMLOCK MALE ADAPTOR.
7. TEMPERATURE TRANSMITTER IS STEADY STATE TEMPERATURE MONITORING.
8. TEMPERATURE TRANSMITTER IS FOR TRANSIENT STATE TEMPERATURE MONITORING TO PROTECT PIPELINE FROM LOW TEMPERATURE.
9. FLOWLINE CHOKE VALVE PCV-0514A WILL RAMP CLOSED ON KA-5 WELLSITE USD OR WHEN ALL THREE KPS INLET CONDENSATE VALVES XCV-0501A / 0502A & 5006A CLOSE.

NO	DATE	BY	CONSTRUCTION ISSUE	CONSULTANT CHKD	CONSULTANT APPR.	STOS CHKD	STOS APPR.
~~P1~~	~~05/16~~	~~NR~~	~~ECP K1709 ISSUED FOR HAZOP (PHASE 1)~~	~~AB~~	~~AB~~		
.	.	.	.	.	.	.	.
~~R3~~	~~03/17~~	~~JMP~~	~~ECP K1709 (PHASE 2) RE APPR. FOR CONST.~~	~~AB~~	~~TD~~		~~SF~~
~~R2~~	~~02/17~~	~~JMP~~	~~ECP K1709 (PHASE 2) APPR. FOR CONSTR.~~	~~AB~~	~~TD~~		~~SF~~
~~R1~~	~~12/16~~	~~JMP~~	~~ECP K1709 STAGE 2 RE APPR. FOR DESIGN~~	~~AB~~	~~TD~~		~~SF~~
~~R0~~	~~09/16~~	~~JMP~~	~~ECP K1709 PHASE 2 APPROVED FOR DESIGN~~	~~AB~~	~~TD~~		~~SF~~
~~P3~~	~~07/16~~	~~JMP~~	~~ECP K1709 APPROVED FOR CONSTRUCTION~~	~~AB~~	~~TD~~		~~SF~~
~~P2~~	~~07/16~~	~~JMP~~	~~ECP K1709 (PHASE 1) APPR. FOR DESIGN~~	~~AB~~	~~TD~~	.	~~SF~~

NO	DATE	BY	EWR	REVISIONS DESCRIPTION	CONSULTANT CHKD	CONSULTANT APPR.	STOS CHKD	STOS APPR.
42	10/15	BB	ECP	ECP K1665 AS BUILT TO SITE MARK UP ASB 15412KW	JMP	AB		ATH
41	10/14	NR	ECP	ECP K1589 AS BUILT TO SITE MARK UP ASB 14218KW	JMP	AB		ATH
40	11/12	MH	ECP	ECP K1324 AS BUILT TO SITE MARK UP ASB 12288KW	JMP	AC		ATH
39	06/12	MH	ECP	ECP K1470 AS BUILT TO SITE MARK UP ASB 12112KW	VB	PB		ATH
38	03/12	MH	ECP	ECP K1467 AS BUILT TO SITE MARK UP ASB 12050KW	VB	JS		AI
37	01/11	KP	ECP	ECP K1379 AS BUILT TO SITE MARK UP ASB 10250KW	VB	LM	.	AI
.	.	.	.	.	.	.	.	.
43	07/17	BB	ECP	ECP K1729 AS BUILT TO SITE MARK UP ASB 17222KW	JMP	TD	.	SF

REFERENCE DRAWINGS NUMBER	TITLE
.	.
.	.
.	.
.	.
.	.
.	.
.	.
.	.

DESIGNED	.	DATE
DRAWN	B MORE	6.1-82
CHECKED	M SHWER	1.82
APPROVED	M SHWER	15.2.82
APPROVED	C BEATH	16.2.82
SCALE	-	
STICKFILE	.	.

KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM
GATHERING LINES
WELLSITE 5 & 10

SHEET No 1 OF 1 | REVISION . 43

SHELL TODD OIL SERVICES LIMITED

PRIVATE BAG NEW PLYMOUTH NEW ZEALAND

DRAWING No 941-10-00506

NOTES

1. LG HAS A.S.V (AUTOMATICALLY SAFETY VALVE) FITTED.
2. *VENDOR SUPPLY
3. VOID
4. ELEVATION OF CALIBRATION TUBE VENT TO BE GREATER THAN TANK VENT.
5. CALIBRATION TUBE ELEVATION & TUBING ARRANGEMENT SUITABLE FOR GRAVITY FILLING FROM T-0508. MINIMIZE TUBING LENGTH.
6. WIRELESS INSTRUMENT.

NO	DATE	BY	CONSTRUCTION ISSUE	CHKD (CONSULTANT)	APPR. (CONSULTANT)	CHKD (STOS)	APPR. (STOS)
G0	07/14	NR	ECP K1575 APPROVED FOR CONSTRUCTION	AB	ML	.	ATH
F1	11/11	LMM	ECP K1324 APPROVED FOR CONSTRUCTION	GD	AP	.	AI
F0	06/11	VB	ECP K1324 APPROVED FOR DESIGN	AKH	PW		AI
E3	07/09	VB	ECP K1249 RE-ISSUED APP FOR CONST.	GH	PWM		AI
J0	09/16	JMP	ECP K1709 PHASE 2 APPROVED FOR DESIGN	AB	TD	.	SF
H1	07/16	JMP	ECP K1709 APPROVED FOR CONSTRUCTION	AB	TD		SF
H0	04/16	JMP	ECP K1709 ISSUED FOR FEED			SF	SF

NO	DATE	BY	EWR	DESCRIPTION (REVISIONS)	CHKD (CONSULTANT)	APPR. (CONSULTANT)	CHKD (STOS)	APPR. (STOS)	NUMBER (REFERENCE DRAWINGS)	TITLE
26	11/12	MH	ECP	ECP K1324 AS BUILT TO SITE MARK UP ASB 12288KW	JMP	AC		ATH	.	.
25	02/12	MH	ECP	ECP K1353 AS BUILT TO SITE MARK UP ASB 12026KW	VB	JS		AI	.	.
24	01/11	KP	ECP	ECP K1379 AS BUILT TO SITE MARK UP ASB 10250KW	VB	LM	.	AI	.	.
.	.	.	.	.	.	.	.	.	.	.
30	07/17	BB	ECP	ECP K1709 AS BUILT TO SITE MARK UP ASB 17222KW	JMP	TD		SF	.	.
29	11/16	BB	ECP	ECP K1743 AS BUILT TO SITE MARK UP ASB 16461KW	JMP	AB	.	SF	.	.
28	07/16	NR	ECP	ECP XK16002 AS BUILT TO SITE MARK UP ASB 16261KW	JMP	AB	.	SF	.	.
27	01/15	NR	ECP	ECP K1575 AS BUILT TO SITE MARK UP ASB 15017KW	JMP	AB	.	ATH	.	.

DESIGNED	.	
DRAWN	L McINTOSH	19.7.84
CHECKED	J CARLEY	25.8.84
APPROVED	.	.
APPROVED	MSHWER	11.10.84
SCALE	-	
STICKFILE	.	

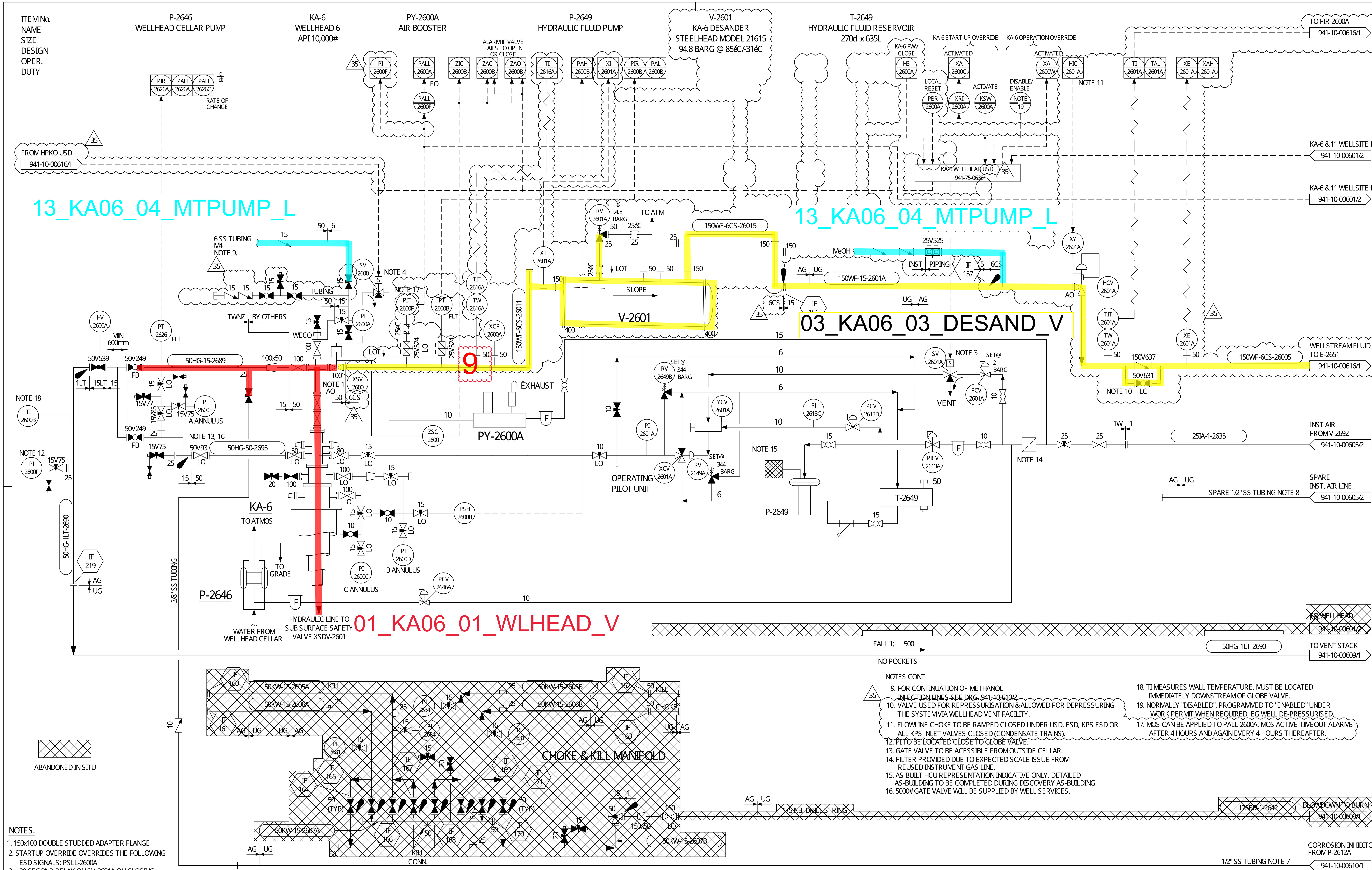
KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM CHEMICAL INJECTION (WELLSITE AREA) WELLSITE 5 & 10

SHELL TODD OIL SERVICES LIMITED
PRIVATE BAG NEW PLYMOUTH NEW ZEALAND

SHEET No 1 OF 1
REVISION . 30
DRAWING No 941-10-00503

Appendix 5.
P&ID Sectionalisation for KA-6 and KA-17



NOTES.

1. 150x100 DOUBLE STUDDED ADAPTER FLANGE
2. STARTUP OVERRIDE OVERRIDES THE FOLLOWING ESD SIGNALS: PSLL-2600A
3. 20 SECOND DELAY ON SV-2601A ON CLOSING
4. 20 SECOND DELAY ON SV-2600 ON OPENING
5. KSW-2600A OPERATES A SOFTWARE TIMER.
6. SITE AS BUILT ONLY. NOT AS BUILT ACCORDING TO ECP K1320 DESIGN REQUIREMENTS.
7. 25CP-15-2671A REPLACED WITH 1/2" SS TUBING UNDER K1618. MIN. THICKNESS OF 1/2" SECTION REQ'D 0.049".
8. SPARE 1/2" SS TUBING INSTALLED UNDER K1618. MIN. REQ'D THICKNESS OF BURIED SECTION IS 0.049". TUBING MAY BE USED FOR INST. AIR IN FUTURE.

NO	DATE	BY	CONSTRUCTION ISSUE	CONSULTANT CHKD	CONSULTANT APPR.	TODD CHKD	TODD APPR.
~~K1~~	~~08/12~~	~~JJS~~	~~ECP K1459 NOT REQUIRED~~	~~JR~~	~~AJC~~		
~~K0~~	~~07/12~~	~~VB~~	~~ECP K1459 ISSUED FOR HAZOP~~	~~JR~~	~~JA~~		
~~L4~~	~~03/18~~	~~CSM~~	~~K1729 CUSP RE-APPR. FOR CONSTRUCTION~~	~~GD~~	~~SJG~~		~~SF~~
~~L3~~	~~11/17~~	~~CSM~~	~~K1729 CUSP APPR. FOR CONSTRUCTION~~	~~ML~~	~~GD~~		~~SF~~
~~L2~~	~~08/17~~	~~JMP~~	~~K1729 CUSP APPROVED FOR DESIGN~~	~~ML~~	~~GD~~	.	~~SF~~
~~L1~~	~~10/16~~	~~AMP~~	~~CUSP PROJECT ISSUED FOR HAZOP~~	~~SG~~	~~ML~~		
~~L0~~	~~08/16~~	~~AMC~~	~~CUSP PROJECT ISSUED FOR REVIEW~~	~~ML~~	~~SG~~	.	.

NO	DATE	BY	ECP	DESCRIPTION (REVISIONS)	CONSULTANT CHKD	CONSULTANT APPR.	TODD CHKD	TODD APPR.
33	04/16	BB	ECP	ECP XK16002 AS BUILT TO SITE MARK UP ASB 16131KK & ASB 16159KK	JMP	AB		SF
32	01/16	DG	ECP	ECP K1618 AS BUILT TO SITE MARK UP ASB 15583KW	JMP	AB		ATH
31	07/13	MH	ECP	ECP K1544 AS BUILT TO SITE MARK UP ASB 13134KW	JMP	AC	.	ATH
30	08/12	MH	ECP	ECP K1470 AS BUILT TO SITE MARK UP ASB 12180KW	DBM	AC	.	ATH
29	06/12	MH	ECP	ECP K1470 AS BUILT TO SITE MARK UP ASB 12113KW	VB	PB		ATH
.	.	.	.	.	.	.	.	.
35	08/18	NR	ECP	ECP K1729 AS BUILT TO SITE MARK UP ASB T18031KW	JMP	GD	.	KB
34	01/18	LS	ECP	ECP XK17172 AS BUILT TO SITE MARK UP ASB T171202	JMP	TD	.	KB

REFERENCE DRAWINGS NUMBER	TITLE
·	.
·	.
·	.
·	.
·	.
·	.
·	.
·	.

DESIGNED	.	DATE
DRAWN	D WHITELAW	3-12-73
CHECKED	DB	29-2-74
APPROVED	C BEATH	28-8-80
APPROVED	.	.
SCALE	NONE	
STICKFILE	.	WX100033

KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM
WELLHEAD KA-6
WELLSITE 6 & 11

Todd Energy

SHEET No 1 OF 2 | REVISION . 35

DRAWING No 941-10-00601

NOTES:

1. METHANOL INJECTION LINES TO BE 6mm SS BY INSTRUMENTS SEE DWG NUMBER 941-10-00610/2 FOR INJECTION SYSTEM.
2. FO DENOTES FIRST OUT ALARM SEQUENCE ON DCS.
3. ALL TUBING IS IMPERIAL STANDARD.
4. TI MEASURES WALL TEMP. MUST BE LOCATED IMMEDIATELY DOWNSTREAM OF GLOBE VALVE.
5. FLT DENOTES THE ANALOG INPUT FIELD LOOP IS MONITORED FOR FAULTS.
6. VOID.
7. 50mm RCS ACCESS FITTING.
8. BACK PRESSURE REGULATOR STOPS CELLAR PUMP & PPD SKID FROM OPERATING BELOW 7 BARG AIR PRESSURE.
9. XSDV-2680A CLOSES 20 SECONDS AFTER XSV-2680A. WELL VALVE OPEN SEQUENCE IS MANUALLY CONTROLLED (NO TIMERS).
10. SECOND CONNECTION POINT FOR XCP-2680A.
11. VALVE CLOSED TO PREVENT CROSS-CONTAMINATION & TANK OVERFILL OF T-2609 DUE TO REVERSE FLOW FROM P-2608A.
12. PROVISION FOR CHOKE VALVE AND FLOW METER INSTALLATION IN FUTURE.
13. TWO PHASE AND/OR SLUG FLOW.
14. TARGET TEE INCLUDED FOR POTENTIAL SAND PRODUCTION.
15. TUBING IS 1/2" OD AND 0.049" WALL THICKNESS, AND HAS A PRESSURE RATING OF 254 BAR.
16. PI TO BE LOCATED CLOSE TO GLOBE VALVE.
17. GATE VALVE TO BE ACCESSIBLE FROM OUTSIDE CELLAR.
18. 5000# GATE VALVE SUPPLIED BY WELL SERVICES.
19. DISCREPANCY BETWEEN PIT-2680C & PIT-2680D ALARMED.
20. STARTUP OVERRIDE OVERRIDES THE FOLLOWING ESD SIGNALS:PIT-2680D.
21. KSW-2680A OPERATES A SOFTWARE TIMER.
22. MOS CAN BE APPLIED TO PIT-2680D. OPERATOR TO MONITOR PIT-2680C WHILE MOS IS ACTIVE. MOS ACTIVE TIMEOUT ALARMS AFTER 4 HOURS AND AGAIN EVERY 4 HOURS THEREAFTER..
23. NORMALLY "DISABLED". PROGRAMMED TO "ENABLED" UNDER WORK PERMIT WHEN REQUIRED, E.G. WELL DE-PRESSURISED.
24. SITE AS BUILT ONLY. NOT AS BUILT ACCORDING TO ECP K1320 DESIGN REQUIREMENTS.
25. VOID.
26. VOID. 09
27. VOID. 09
28. TUBING RATED FOR 280 BARG OR MORE.
29. VOID.
30. HV-2680A IS STAINLESS STEEL, EXTENDED BONNET 2500# VALVE.
31. PAHH-2680D STARTS TIMER IN SIS WHICH CLOSES SUBSURFACE SAFETY VALVE IF >236BARG FOR 50 HOURS PER EVENT OR 500 HOURS A YEAR.
32. CRITICAL TRACE HEATING 40éC FOR WAX PREVENTION.
33. VOID.
34. PIPING TO FIRST ELBOW IS SCH 40S FOR PIPE STRESSING.
35. LINE CONTAINS CLASS 150 FITTINGS AND SHOULD NOT BE PRESSURED ABOVE 19 BARG.

CONSTRUCTION ISSUE

NO	DATE	BY		CHKD (CONSULTANT)	APPR. (CONSULTANT)	CHKD (TODD)	APPR. (TODD)
D0	07/16	AMC	CUSP PROJECT ISSUED FOR REVIEW	ML	SG	.	.
C7	10/13	MH	ECP K1459 RE-ISSUED FOR AFC	JR	AB		ATH
C6	08/13	JMP	ECP K1459 RE-ISSUED AFC	AH	AC		ATH
D4	03/18	CSM	K1729 CUSP RE-APPR. FOR CONSTRUCTION	GD	SJG		SF
D3	11/17	CSM	K1729 CUSP APPR. FOR CONSTRUCTION	ML	GD		SF
D2	08/17	JMP	K1729 CUSP APPROVED FOR DESIGN	ML	GD		SF
D1	10/16	AMP	CUSP PROJECT ISSUED FOR HAZOP	SG	ML	.	.

REVISIONS

NO	DATE	BY	ECP	DESCRIPTION	CHKD (CONSULTANT)	APPR. (CONSULTANT)	CHKD (TODD)	APPR. (TODD)
07	07/16	BB	ECP	ECP XK16002 AS BUILT TO SITE MARK UP ASB 16250KK	JMP	AB		SF
06	05/16	BB	ECP	ECP XK16002 AS BUILT TO SITE MARK UP ASB 16131KW	JMP	AB		SF
05	08/14	NR	ECP	EDP K1589 AS BUILT TO SITE MARK UP ASB 14211KW	JMP	AB	.	ATH
04	12/14	MH	ECP	ECP K1459 AS BUILT TO SITE MARK UP ASB 13285KW	JMP	AB		ATH
03	07/13	MH	ECP	ECP K1544 AS BUILT TO SITE MARK UP ASB 13134KW	JMP	AC		ATH
.	.	.	.	.	.	.	.	.
09	08/18	NR	ECP	ECP K1729 AS BUILT TO SITE MARK UP ASB 18031KW	JMP	GD		KB
08	01/17	CB	ECP	ECP XK16137 AS BUILT TO SITE MARK UP ASB 16522KW	JMP	AB	.	SF

REFERENCE DRAWINGS

NUMBER	TITLE
·	.
·	.
·	.
·	.
·	.
·	.
·	.
·	.

		DATE
DESIGNED	.	
DRAWN	D WATEMBURG	05/09
CHECKED	M KUMAR	05/09
APPROVED	P MINCHIN	05/09
APPROVED	A INWOOD	05/09
SCALE	NONE	
STICKFILE	.	

KAPUNI WELLSITES

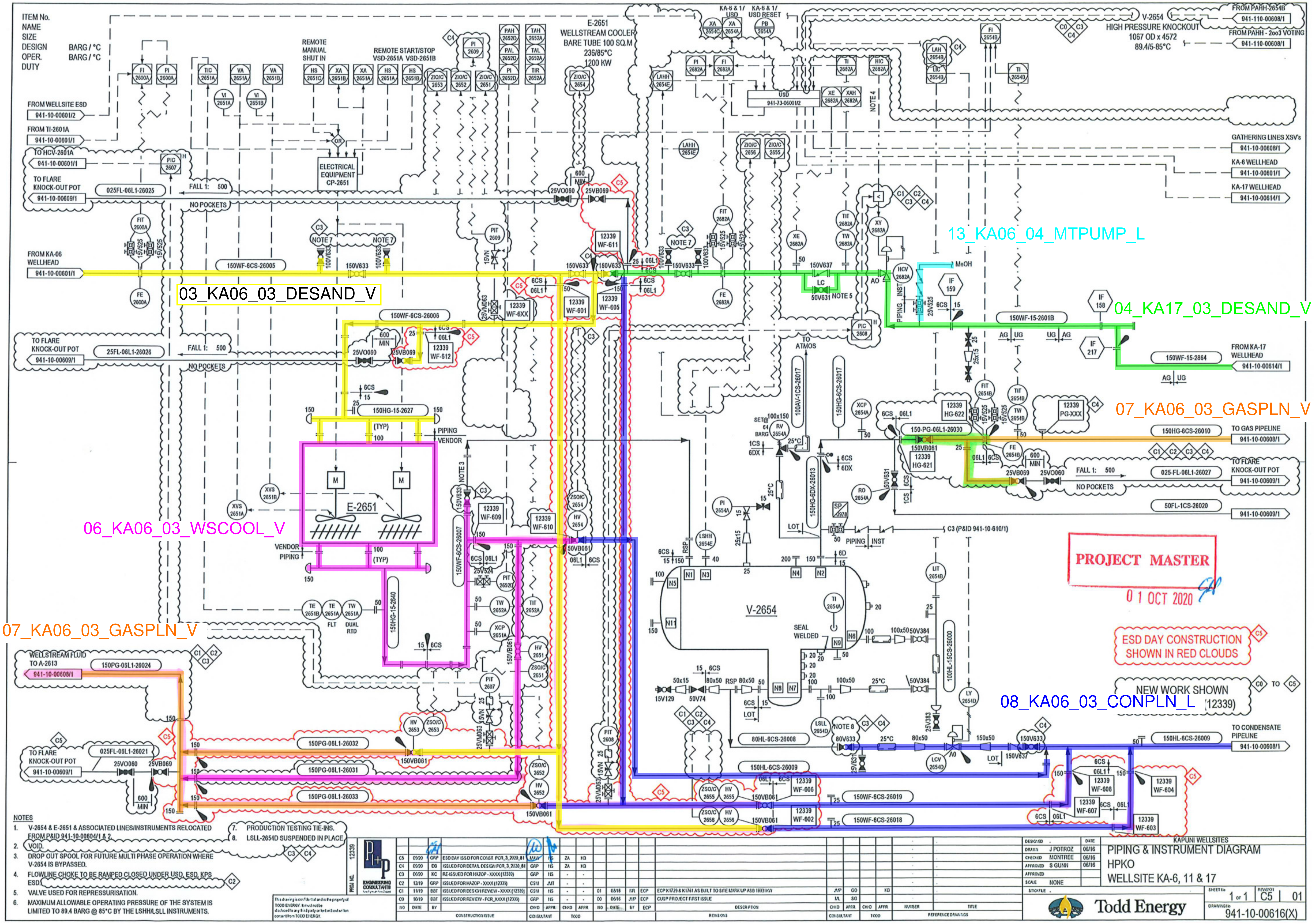
PIPING & INSTRUMENT DIAGRAM
WELLHEAD KA-17
WELLSITE 6 & 11

Todd Energy

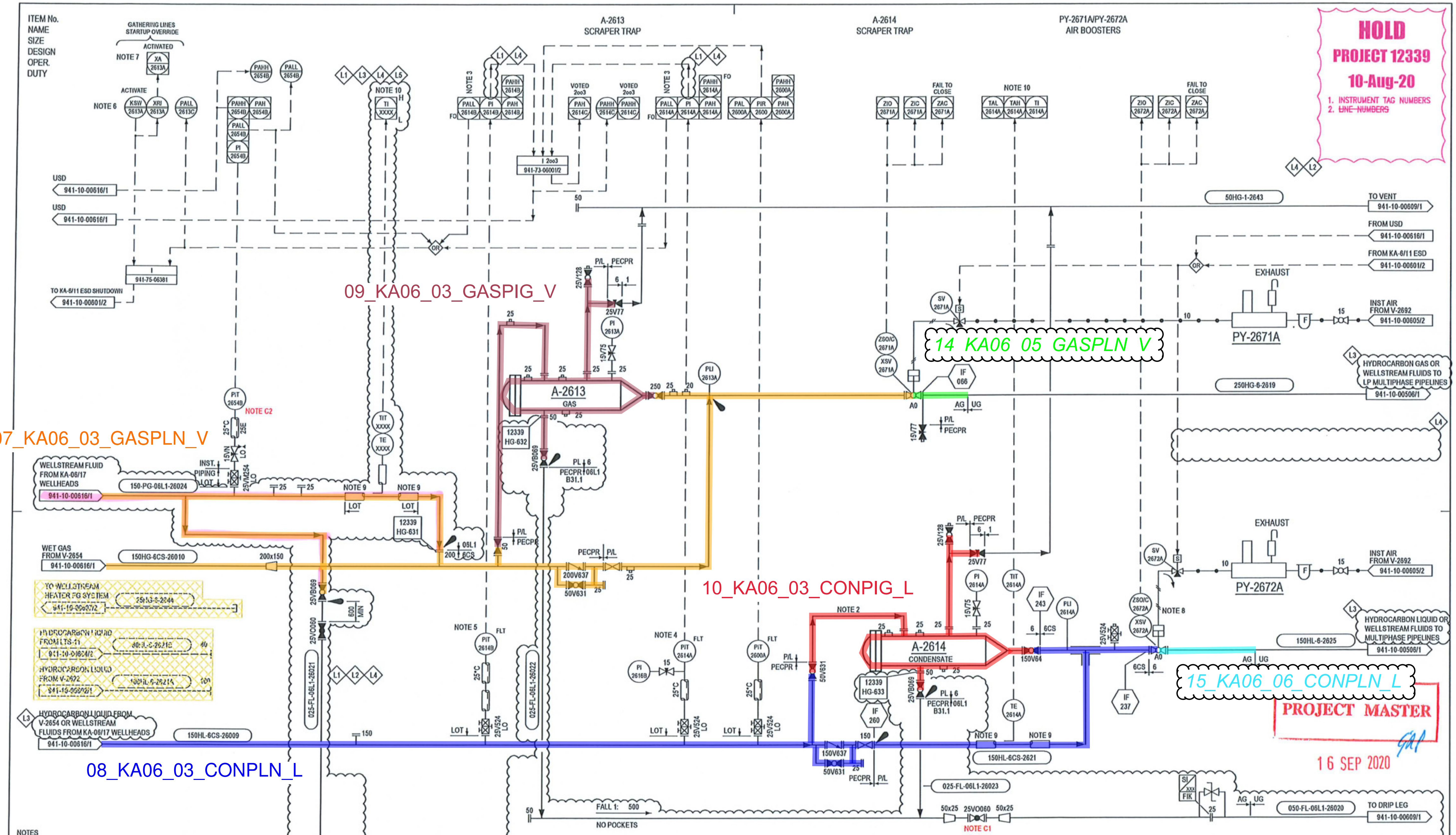
SHEET No 1 OF 2

REVISION . 09

DRAWING No 941-10-00614



03_KA06_03_DESAND_V
04_KA17_03_DESAND_V
06_KA06_03_WSCOOL_V
07_KA06_03_GASPLN_V
08_KA06_03_CONPLN_L
13_KA06_04_MTPUMP_L
E-2651
WELLSTREAM COOLER
BARE TUBE 100 SQ.M
236/85°C
1200 KW
V-2654
HIGH PRESSURE KNOCKOUT
1067 OD x 4572
89.4/5-85°C
FROM KA-06 WELLHEAD
FROM KA-17 WELLHEAD
TO GAS PIPELINE
TO CONDENSATE PIPELINE
TO FLARE KNOCK-OUT POT
PROJECT MASTER
01 OCT 2020
ESD DAY CONSTRUCTION SHOWN IN RED CLOUDS
NEW WORK SHOWN (12339)
NOTES
1. V-2654 & E-2651 & ASSOCIATED LINES/INSTRUMENTS RELOCATED FROM P&ID 941-10-00604/1 & 2.
2. VOID.
3. DROP OUT SPOOL FOR FUTURE MULTI PHASE OPERATION WHERE V-2654 IS BYPASSED.
4. FLOWLINE CHOKE TO BE RAMPED CLOSED UNDER USD, ESD, KPS ESD.
5. VALVE USED FOR REPRESSURISATION.
6. MAXIMUM ALLOWABLE OPERATING PRESSURE OF THE SYSTEM IS LIMITED TO 89.4 BARG @ 85°C BY THE LSHH/LSLL INSTRUMENTS.
7. PRODUCTION TESTING TIE-INS.
8. LSLL-2654D SUSPENDED IN PLACE.
KAPUNI WELLSITES
PIPING & INSTRUMENT DIAGRAM
HPKO
WELLSITE KA-6, 11 & 17
Todd Energy
941-10-00616(X)



NOTES

1. GATHERING LINE MATERIAL IS : API 5L GR X-52 SCH 30 (GAS)
   : API 5L GR X-52 SCH 60 (CONDENSATE)
2. PIG LAUNCHER KICK LINE REMOVED FOR PRODUCTION TESTING.
3. DISCREPANCY BETWEEN PIT-2614A AND PIT-2614B IS ALARMED.
4. MOS CAN BE APPLIED TO PIT-2614A MOS ACTIVE TIMEOUT ALARMS AFTER 4 HOURS AND AGAIN EVERY 4 HOURS THEREAFTER.
5. MOS CAN BE APPLIED TO PIT-2614B. MOS ACTIVE TIMEOUT ALARMS AFTER 4 HOURS AND AGAIN EVERY 4 HOURS THEREAFTER.
6. KSW-2613A OPERATES A SOFTWARE TIMER.
7. STARTUP OVERRIDE OVERRIDES THE FOLLOWING ESD SIGNALS PIT-2614A, PIT-2614B AND PIT-2654B.
8. INSULATED CONNECTION ON S/S TUBING
9. 25 mm INSULATION REQUIRED FOR 150mm UPSTREAM & 150mm DOWNSTREAM OF CLAMP ON TIT AND SENSOR EXTENSION.
10. TIT/TI 2614A & TIT/TE-XXXX TO INDICATE POTENTIAL OVER-TEMP OF PIPE COATING (50°C).
11. VOID.

NEW WORK SHOWN
PCR_3_2020_81 (12339)
L1 TO L5

PROJ NO. 12339

DESIGNED	.	DATE	KAPUNI WELLSITES
DRAWN	J. TERRILL	6/91	PIPING & INSTRUMENT DIAGRAM
CHECKED	G VINCENT	9/91	CONDENSATE & GAS EXPORT
APPROVED	M WEST	9/91	WELLSITE KA-6 & 11
APPROVED	D.M. STEWERT	9/91	
SCALE	.		
STICKFILE	.		

Todd Energy

SHEET No 1 of 1 — REVISION L5 | 20

DRAWING No 941-10-00608(X)

NOTES

1. SITE AS BUILT ONLY. NOT AS BUILT ACCORDING TO ECP K1320 DESIGN REQUIREMENTS.
2. WIRELESS INSTRUMENT.
3. STANDARD 90 MICRON T TYPE SWAGELOK FILTER (STRAINER) TO PROTECT FLOWMETER FROM BLOCKAGE.
4. ELEVATION OF CALIBRATION TUBE VENT TO BE GREATER THAN TANK VENT.
5. CALIBRATION TUBE ELEVATION & TUBING ARRANGEMENT SUITABLE FOR GRAVITY FILLING FROM T-2608A/T-2608B. MINIMISE TUBING LENGTH.
6. 25NB BLINDED FG CONNECTION SITUATED AT EDGE OLD KA-6 SKID.
7. STRAINER & FLOW METER LOCATION WILL BE REVIEWED ON THE BASIS OF FLOW METER PERFORMANCE AT KA-02 SITE.
8. VOID
9. VOID
10. BOTH TANK TOPS TO BE AT THE SAME ELEVATION. ALL LEVEL GAUGE VENTS TO BE AT HIGHER ELEVATION THAN TANK TOPS.
11. BUND SHARED WITH CORROSION INHIBITOR AND METHANOL TANKS (REFER DWG 941-10-610/2)
12. BURIED TUBING IS 1/2 OD & 0.049" WALL THICKNESS AND HAS PRESSURE RATING OF 254 BAR.
13. MINIMISE POTENTIAL FOR AIR LOCK TO PREVENT DAMAGE TO FLOW METERS.
14. 25CP-15-2671A REPLACED WITH 1/2" SS TUBING UNDER K1618. MIN. TUBING THICKNESS REQ'D 0.049".
15. 25CP-15-2671B HAS BEEN ABANDONED IN SITU UNDER K1716

NO	DATE	BY	DESCRIPTION
K2	08/17	JMP	K1729 CUSP APPROVED FOR DESIGN
K1	10/16	JMP	CUSP PROJECT ISSUED FOR HAZOP
K0	07/16	AMC	CUSP PROJECT ISSUED FOR REVIEW
J4	10/12	LMM	ECP K1450 AFC
J3	07/12	VB	ECP K1450 RE ISSUED FOR HAZOP
K4	03/18	CSM	K1729 CUSP RE-APPR. FOR CONSTRUCTION
K3	11/17	CSM	K1729 CUSP APPR. FOR CONSTRUCTION
20	08/18	NR	ECP K1729 AS ABUILT TO SITE MARK UP ASB 18031KW
19	08/16	BB	ECP K1666 AS BUILT TO SITE MARK UP ASB 16315KW
18	06/16	NR	ECP K1716 AS BUILT TO SITE MARK UP ASB 16208KW
17	03/16	BB	ECP XK16002 AS BUILT TO SITE MARK UP ASB 16080KW

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.

DESIGNED	.	
DRAWN	J TERRILL	6/91
CHECKED	G VINCENT	9/91
APPROVED	M WEST	9/91
APPROVED	DM STEWART	9/91

KAPUNI WELLSITES
PIPING & INSTRUMENT DIAGRAM
CORROSION INHIBITOR
WELLSITE 6 & 11

Todd Energy

SHEET No 1 OF 2 — REVISION 20 — DRAWING No 941-10-00610

NOTES:

1. SITE AS BUILT ONLY. NOT AS BUILT ACCORDING TO ECP K1320 DESIGN REQUIREMENTS.
2. VOID.
3. BURIED METHANOL TUBING IS 1/4" WITH WALL THICKNESS 0.035" AND HAS A PRESSURE RATING OF 351 BAR.
4. BUND SHARED WITH CORROSION INHIBITOR AND METHANOL TANKS AND PUMPS. (REFER DWG 941-10-610/1)
5. LEVEL GAUGE VENT TO BE AT HIGHER ELEVATION THAN TANK TOP.
6. EXISTING PI-2609B IS REUSED AS PI-2609C.

NO	DATE	BY	CONSTRUCTION ISSUE	CHKD (CONSULTANT)	APPR. (CONSULTANT)	CHKD (TODD)	APPR. (TODD)	NO	DATE	BY	ECP	DESCRIPTION (REVISIONS)	CHKD (CONSULTANT)	APPR. (CONSULTANT)	CHKD (TODD)	APPR. (TODD)	NUMBER	TITLE
H4	03/18	CSM	K1729 CUSP RE-APPR. FOR CONSTRUCTION	GD	SJG		SF	15	02/17	AMP	ECP	ECP XK17172 AS BUILT TO SITE MARK UP ASB 17004KK	JMP	AB	.	SF	.	.
H3	11/17	CSM	K1729 CUSP APPR. FOR CONSTRUCTIION	ML	GD		SF	14	06/16	NR	ECP	ECP K1716 AS BUILT TO SITE MARK UP ASB 16208KW	JMP	AB	.	SF	.	.
H2	08/17	JMP	K1729 CUSP APPROVED FOR DESIGN	ML	GD	.	SF	13	01/16	BB	ECP	ECP X0213 AS BUILT TO SITE MARK UP ASB 15582KW	JMP	AB		ATH	.	.
H1	10/16	JMP	CUSP PROJECT ISSUED FOR HAZOP	SG	ML	.	.	12	12/13	MH	ECP	ECP K1459 AS BUILT TO SITE MARK UP ASB 13285KW	JMP	AB		ATH	.	.
H0	07/16	AMC	CUSP PROJECT ISSUED FOR REVIEW	ML	SG			11	11/13	MH	ECP	ECP K1371 AS BUILT TO SITE MARK UP ASB 13257KW	JMP	AB		ATH	.	.
G1	07/13	JC	ECP K1371 REISSUED FOR CONSTRUCTION	AB	AC		ATH	.	.	.	.	.	.	.		.	.	.
F5	06/13/	MH	ECP K1459 RE-ISSUED FOR AFC	JR	AB		ATH	17	08/18	NR	ECP	ECP K1729 AS BUILT TO SITE MARK UP ASB 18031KW	JMP	GD	.	KB	.	.
								16	04/17	BB	ECP	ECP XK17172 AS BUILT TO SITE MARK UP ASB 17126KW	JMP	TD		SF	.	.

DESIGNED	DATE	DATE
DRAWN	J. TERRILL	6/91
CHECKED	G. VINCENT	9/91
APPROVED	M. WEST	9/91
APPROVED	D.M. STEWERT	9/91
SCALE		
STICKFILE	.	

KAPUNI WELLSITES
PIPING & INSTRUMENT DIAGRAM
METHANOL INJECTION
WELLSITE 6 & 11

Todd Energy

SHEET No 2 OF 2 — REVISION 17

DRAWING No 941-10-00610

Appendix 6.
P&ID Sectionalisation for KA-8 and KA-18

NOTES:

1. MOVED FROM 941-10-00808/3.
2. 150x100 DOUBLE STUDDED FLANGE ADAPTOR.
3. START UP OVERRIDE XS-2820A ACTS ON PSLL-2820.
4. SUBSURFACE SAFTEY VALVE CLOSES 20 SEC. AFTER SURFACE SAFTEY VALVE.
5. THIS LINE HAS BEEN DERATED FROM SPEC 50/50A TO SPEC 15. FLANGES REMAIN AT 5000#.
6. REMOVEABLE SPOOL FOR FUTURE SAND FILTER/WELLSTREAM COOLER TIE-IN/DROP OUT ISOLATION SPOOL.
7. PCV-2846B BACK PRESSURE REGULATOR TO SHUT DOWN P-2846 BELOW 8.0 BARG SUPPLY AIR PRESSURE.
8. DROP OUT ISOLATION SPOOL.
9. RATE OF CHANGE.
10. VOID.

NO	DATE	BY	CONSTRUCTION ISSUE	CONSULTANT CHKD	CONSULTANT APPR.	TODD CHKD	TODD APPR.
J1	06/14	NR	ECP K1501 ISSUED FOR HAZOP (NOT AS BUILT)	ML	AB		
J0	05/14	LPR	ECP K1501 ISSUED FOR REVIEW	GD	ML		.
H0	05/10	VB	ECP K1214 APPROVED FOR CONSTRUCTION	AC	AP		AI
K3	02/18	CSM	K1729 CUSP RE-APPR. FOR CONSTRUCTION	GD	SJG	.	SF
K2	10/17	CSM	K1729 CUSP APPR. FOR CONSTRUCTION	ML	GD		SF
K1	07/17	NR	ECP K1729 APPROVED FOR DESIGN	ML	GD		SF
K0	10/16	JMP	CUSP PROJECT ISSUED FOR HAZOP	SG	ML		

NO	DATE	BY	ECP	DESCRIPTION (REVISIONS)	CONSULTANT CHKD	CONSULTANT APPR.	TODD CHKD	TODD APPR.	NUMBER	TITLE
36	10/15	NR	ECP	ECP K1667 AS BUILT TO SITE MARK UP ASB 15413KW	JMP	AB	.	ATH	·	.
35	07/14	NR	ECP	ECP K1589 AS BUILT TO SITE MARK UP ASB 14064KW	JMP	AB		ATH	·	.
.	.	.	.	.	.	.	.	.	·	.
41	05/18	CSM	ECP	ECP K1729 AS BUILT TO SITE MARK UP ASB T18025KW	JMP	GD	.	KB	·	.
40	12/17	LS	ECP	ECP XK17172 AS BUILT TO SITE MARK UP ASB T171202	JMP	TD		KB	·	.
39	01/17	CB	ECP	ECP XK16002 AS BUILT TO SITE MARK UP ASB 16526KK	JMP	AB		SF	·	.
38	05/16	BB	ECP	ECP XK16002 AS BUILT TO SITE MARK UP ASB 16131KK	JMP	AB		SF	·	.
37	03/16	BB	ECP	ECP XK16002 AS BUILT TO SITE MARK UP ASB 16095KW	JMP	AB		SF	·	.

DESIGNED	.	
DRAWN	R SHEARSTONE	27/8/82
CHECKED	M SHWER	23/10/82
APPROVED	M SHWER	23/10/82
APPROVED	P BARON	26/10/82
SCALE	NONE	
STICKFILE	.	

KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM WELLHEAD KA-8 WELLSITE 8, 12 & 15

Todd Energy

SHEET No 1 of 5 — REVISION 41

DRAWING No 941-10-00801

NOTES.

1. METHANOL INJECTION LINES TO BE 6mm SS BY INSTRUMENTS.
   SEE DWG 941-10-806/2 FOR INJECTION SYSTEM.
2. FO DENOTES FIRST OUT ALARM SEQUENCE ON DCS
3. ALL TUBING IS IMPERIAL STANDARD.
4. FLT DENOTES THE ANALOG INPUT FIELD LOOP IS
   MONITORED FOR FAULTS.
5. TEMPORAY SANDCATCHER
6. 50mm RCS CORROSION PROBE SOCKET
7. BACK PRESSURE REGULATOR STOPS CELLAR PUMP FROM
   OPERATING BELOW 7.5 BARG AIR PRESSURE.
8. XSDV-2850A CLOSES 20 SECONDS AFTER XSV-2850B. WELL VALVE OPEN
   SEQUENCE IS MANUALLY CONTROLLED (NO TIMERS)
9. 50KW-15-4031 TO BE FILLED WITH INHIBITED WATER & BLINDED OFF.
10. PP FOR FLOWING FLUID TEMPERATURE OF 75éC.
11. PROVISION FOR FLOW METER INSTALLATION IN FUTURE.
    U/S, D/S LENGTH FOR FLOWMETER AS PER VENDOR.
12. TWO PHASE AND/OR SLUG FLOW.
13. TARGET TEE INCLUDED FOR POTENTIAL SAND PRODUCTION.
14. VALVE OPENING TO BE CONTROLLED AND SET BY OPERATOR.
15. 50mm RCS ACCESS FITTING WITH CORROSION PROBE ON OUTSIDE OF ELBOW.
16. CHOKE VALVE FOR WELL STARTUP, WHC CAN BE USED IF
    KA-18 FLOWS TO KA-8 LTS ONLY.
17. LOCATE CLOSE TO DEPRESSURISATION KO POT (50FL-1KT-2180B)
18. START UP OVER-RIDE ACTS ON PALL-2850E
19. RV-2850A SIZE DETERMINED BY HCV-2850D TRIM. ADD RED TAG
    AT INSTALLED VALVE.
20. ACCESS POINT FOR ER PROBE ONCE FLOW REGIME IS STRATIFIED.
21. VALVE IS SS FOR LOW TEMP OF -70éC TO -90éC.
22. LOCATE CLOSE TO 50D SPEC BREAK.

CONSTRUCTION ISSUE

NO	DATE	BY		CHKD (CONSULTANT)	APPR. (CONSULTANT)	CHKD (TODD)	APPR. (TODD)
A7	06/10	LMM	ECP K1326 APPROVED FOR CONSTRUCTION	CRP	AP		AI
E0	10/18	DG	620038 APPROVED FOR CONSTRUCTION				KB
D2	02/18	CSM	K1729 CUSP RE-APPR. FOR CONSTRUCTION	GD	SJG	.	SF
D1	10/17	CSM	K1729 CUSP APPR. FOR CONSTRUCTION	ML	GD	.	SF
D0	07/17	NR	ECP K1729 APPROVED FOR DESIGN	ML	GD	.	SF
C1	10/12	LMM	ECP K1517 APPROVED FOR CONSTRUCTION	CB	AJC	.	ATH
C0	09/12	SG	ECP K1517 ISSUED FOR HAZOP	CB	AC	.	.
B0	06/11	VB	ECP K1326 APPROVED FOR CONSTRUCTION	AP	RW	.	AI

REVISIONS

NO	DATE	BY	ECP	DESCRIPTION	CHKD (CONSULTANT)	APPR. (CONSULTANT)	CHKD (TODD)	APPR. (TODD)
07	03/16	NR	ECP	ECP XK16002 AS BUILT TO SITE MARK UP ASB 16048KW	JMP	AB	.	ATH
06	07/13	MH	ECP	ECP K1544 AS BUILT TO SITE MARK UP ASB 13134KW	JMP	AC		ATH
12	09/19	SH	ECP	ECP XK18002 AS BUILT TO SITE MARK UP ASB T19011KK	JMP	AB	.	MW
11	05/18	CSM	ECP	ECP K1729 AS BUILT TO SITE MARK UP ASB T18025KW	JMP	GD	.	KB
10	03/17	BB	ECP	ECP K1746 AS BUILT TO SITE MARK UP ASB 17071KW	JMP	TD		SF
09	06/16	BB	ECP	ECP K1702 AS BUILT TO SITE MARK UP ASB 16245KW	JMP	AB	.	SF
08	04/16	BB	ECP	ECP XK16002 AS BUILT TO SITE MARK UP ASB 16131KW	JMP	AB	.	ATH

REFERENCE DRAWINGS

NUMBER	TITLE
.	.
.	.
.	.
.	.
.	.
.	.
.	.
.	.

DESIGNED	.	DATE
DRAWN	D WATEMBURG	07/09
CHECKED	G DAVIDSON	07/09
APPROVED	P MINCHIN	07/09
APPROVED	A INWOOD	07/09
SCALE	NONE	

KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM
WELLHEAD KA-18
WELLSITE 8, 12 & 15

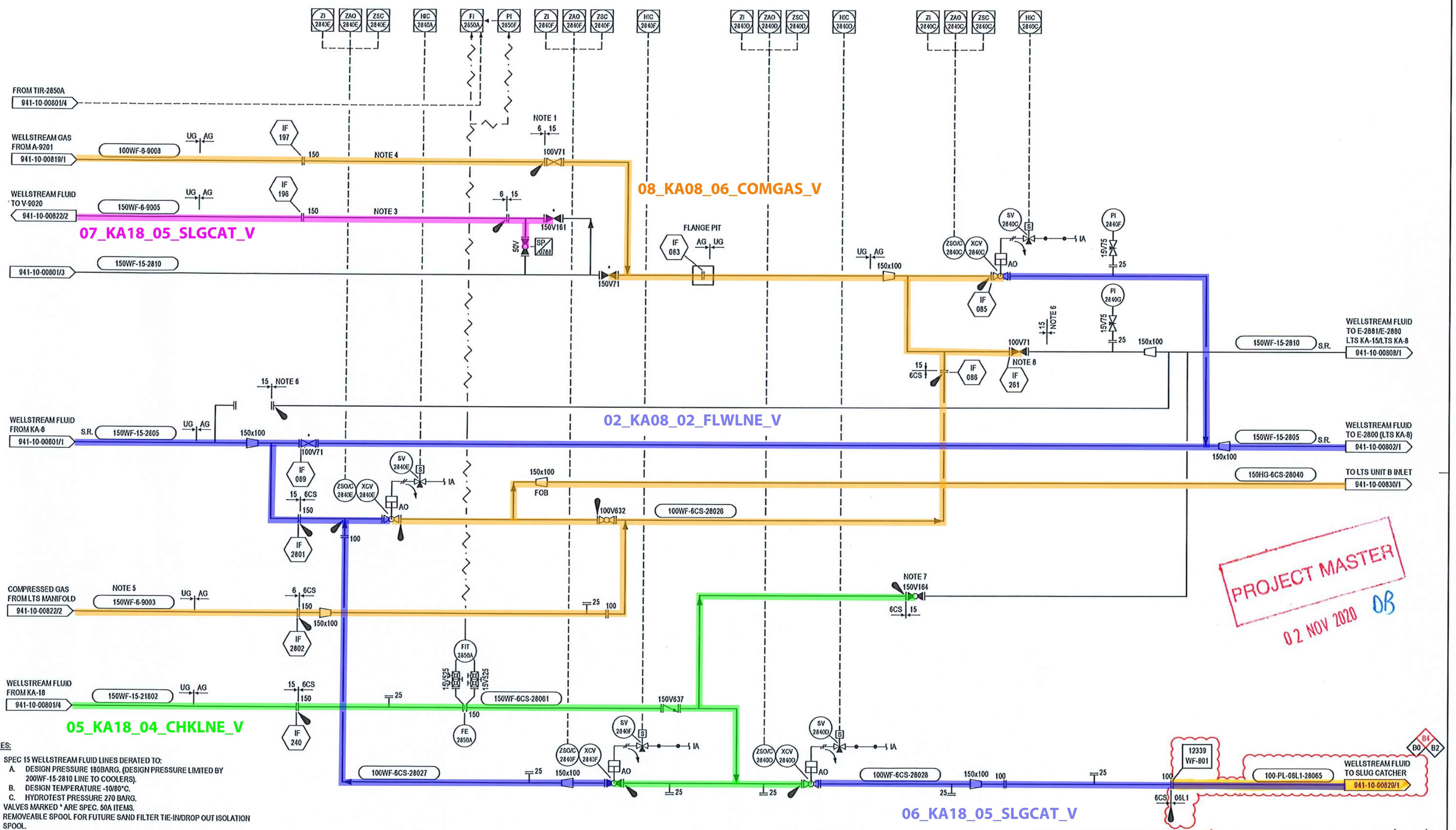
STICKFILE . W0100312

Todd Energy

SHEET No 4 OF 5

REVISION . 12

DRAWING No 941-10-00801



ESD DAY CONSTRUCTION SHOWN IN RED CLOUDS (B4)

NEW WORK SHOWN PCR_3_2020_81 (12339) (B0 TO B4)

NOTES:

1. SPEC 15 WELLSTREAM FLUID LINES DERATED TO:
   A. DESIGN PRESSURE 180BARG. (DESIGN PRESSURE LIMITED BY 200WF-15-2810 LINE TO COOLERS).
   B. DESIGN TEMPERATURE -10/80°C.
   C. HYDROTEST PRESSURE 270 BARG.
2. VALVES MARKED * ARE SPEC. 50A ITEMS.
3. REMOVEABLE SPOOL FOR FUTURE SAND FILTER TIE-IN/DROP OUT ISOLATION SPOOL.
4. DROP OUT ISOLATION SPOOL.
5. ADD LOW TEMP DESIGN CASE -26°C @ 26 BARG.
6. SCH.160 PIPE WAS USED INSTEAD OF XXS PIPE (REQUIRED AS PER SPEC. 15). THE DESIGN PRESSURE HAS BEEN SET TO 237 BARG (COINCIDENT WITH MAXIMUM FLANGE RATING FOR 1500# @ 85°C). FOR HIGHER DESIGN PRESSURE A RE-CHECK IS REQUIRED. DESIGN PRESSURE BASED ON ACTUAL WALL THICKNESS('0' MILL TOLERANCE). THE HYDROTEST PRESSURE TO BE USED IS 383 BARG @ 38°c. DESIGN PRESSURE BASED O ACTUAL THICKNESS ('0' MILL TOLERANCE).
7. 150V164 ONLY TO BE OPENED IF KA-18 IS FLOWING NATURALLY TO LTS-15, IF 150V164 IS OPEN & EITHER COMPRESSOR RUNNING, NOTE 8 VALVE MUST BE CLOSED.
8. 100V71 PASSES FROM RIGHT TO LEFT WITH GREATER THAN 5 BAR DIFFERENTIAL. IT HOLDS FULL PRESSURE OF SYSTEM FROM OTHER SIDE.

PROJ. NO. 12339

P+P ENGINEERING CONSULTANTS

NO	DATE	BY	CONSTRUCTION ISSUE	CONSULTANT CHKD	CONSULTANT APPR	TODD CHKD	TODD APPR
B4	10/20	GRP	ESD DAY ISSD FOR CONST. PCR_3_2020_81	MAW	NS	ZA	KB
B3	09/20	DB	ISSUED FOR DETAIL DESIGN PCR_3_2020_81	GRP	NS	ZA	KB
B3	09/20	DB	ISSUED FOR DETAIL DESIGN PCR_3_2020_81	GRP	NS	ZA	KB
B2	06/20	KC	RE-ISSUED FOR HAZOP - PCR_XXXX (12339)	GRP	NS	-	-
B1	12/19	EBT	ISSUED FOR HAZOP - PCR_XXXX (12339)	CSM	JWT	-	-
B0	11/19	EBT	ISSUED FOR DESIGN REVIEW - PCR_XXXX (12339)	CSM	NS	-	-

NO	DATE	BY	ECP	REVISIONS DESCRIPTION
01	05/18	CSM	K1729	AS BUILT TO SITE MARK UP AS 18002
00	07/17	JWP	K1729	FIRST ISSUE

DESIGNED		DATE
DRAWN	J POTROZ	07/17
CHECKED	MONTREE	07/17
APPROVED		
APPROVED		
SCALE		
STICKFILE		

KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM INTERCONNECTING LINES WELLSITE 8, 12 & 15

Todd Energy

SHEET No 5 OF 5 | REVISION B4 | 01

DRAWING No 941-10-00801(X)

NOTES

1. REFER DWG. 941-10-806/2 FOR INJECTION SYSTEM
2. CLOSES UNIT INLET XSV-2800. UNIT MUST BE RESET BEFORE VALVE RE-OPENS.
3. INJECTION QUILL.

NO	DATE	BY	CONSTRUCTION ISSUE	CHKD	APPR.	CHKD	APPR.	NO	DATE	BY	ECP	DESCRIPTION	CHKD	APPR.	CHKD	APPR.	NUMBER	TITLE
~~J4~~	~~01/10~~	~~LMM~~	~~ECP K1326 APPROVED FOR DESIGN~~	~~MK~~	~~PWM~~	.	~~AI~~	.	.	.	.	.	.	.	.	.	.	.
~~J3~~	~~12/09~~	~~MH~~	~~ECP K1326 RE-ISSUED FOR HAZOP~~	~~MK~~	~~PWM~~			39	05/18	CSM	ECP	ECP K1729 AS BUILT TO SITE MARK UP ASB T18025KW	JMP	GD	.	KB	.	.
~~J2~~	~~09/09~~	~~VB~~	~~ECP K1326 ISSUED FOR FEED~~	~~MK~~	~~PWM~~		.	38	01/17	CB	ECP	ECP XK16002 AS BUILT TO SITE MARK UP ASB 16526KK	JMP	AB	.	SF	.	.
								37	01/16	CMP	ECP	ECP X0213 AS BUILT TO SITE MRK UP ASB 15545KW	JMP	AB	.	ATH	.	.
~~K2~~	~~02/18~~	~~CSM~~	~~K1729 CUSP RE-APPR. FOR CONSTRUCTION~~	~~GD~~	~~SJG~~	.	~~SF~~	36	10/15	NR	ECP	ECP K1647 AS BUILT TO SITE MARK UP ASB 15326KW	JMP	AB	.	ATH	.	.
~~K1~~	~~10/17~~	~~CSM~~	~~K1729 CUSP APPR. FOR CONSTRUCTION~~	~~ML~~	~~GD~~	.	~~SF~~	35	07/13	MH	ECP	ECP K1544 AS BUILT TO SITE MARK UP ASB 13134KW	JMP	AC		ATH	.	.
~~K0~~	~~07/17~~	~~JMP~~	~~ECP K1729 APPROVED FOR DESIGN~~	~~ML~~	~~GD~~	.	~~SF~~	34	05/13	JC	ECP	ECP K1477 AS BUILT TO SITE MARK UP ASB 13112KW	JMP	AC		ATH	.	.
~~J5~~	~~04/10~~	~~VB~~	~~ECP K1326 APPROVED FOR CONSTRUCTION~~	~~CRP~~	~~AP~~		~~AI~~	33	05/11	JC	ECP	ECP K1326 AS BUILT TO SITE MARK UP 11083KW	VB	AP	.	AI	.	.

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

		DATE
DESIGNED	.	
DRAWN	G.McKIE	20-9-76
CHECKED	L.HAZLETT	3-10-76
APPROVED	L.HAZLETT	3-10-76
APPROVED	C.BEATH	28-8-80
SCALE		
STICKFILE	.	

KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM
LTS UNIT 8 (HIGH PRESSURE)
WELLSITE 8, 12 & 15

Todd Energy

SHEET No 1 OF 1 — REVISION 39

DRAWING No 941-10-00802

NOTES:

1. REFER TO DWG. 941-10-806/2 FOR INJECTION SYSTEM.
2. ALARMS SHOWN IN BOXS ANNUNCIATE KPS S.E.M. & GROUP ALARMS.
3. SHUTDOWN LOGIC SHOWN FOR NORMAL FLOWMODE ie. WELLHEAD KA-8 FLOWING THROUGH LTS 8 & WELLHEAD KA-12 FLOWING THROUGH LTS 12. CROSSOVER:- ANY COMBINATION OF WELLHEAD AND LTS UNITS.
4. TRAVEL STOP INSTALLED TO REDUCE CV TO 60 TO LIMIT FLOW TO RV-2804A.

NO	DATE	BY	CONSTRUCTION ISSUE	CONSULTANT CHKD	CONSULTANT APPR.	TODD CHKD	TODD APPR.	NO	DATE	BY	ECP	DESCRIPTION (REVISIONS)	CONSULTANT CHKD	CONSULTANT APPR.	TODD CHKD	TODD APPR.	REFERENCE DRAWINGS NUMBER	REFERENCE DRAWINGS TITLE
								32	05/11	JC	ECP	ECP K1326 AS BUILT TO SITE MARK UP ASB 11083KW	VB	AP	.	AI	.	.
G1	02/18	CSM	K1729 CUSP RE-APPR. FOR CONSTRUCTION	GD	SJG		SF	31	01/11	KP	ECP	ECP K1379 AS BUILT TO SITE MARK UP ASB 10250KW	VB	LM	.	AI	.	.
G0	10/17	CSM	K1729 CUSP APPR. FOR CONSTRUCTION	ML	GD		SF	30	06/10	BA	ECP	ECP K1379 AS BUILT TO SITE MARK UP ASB 10131KW	VB	AP		AI	.	.
F3	11/12	MH	ECP K1517 RE-ISSUED FOR AFC	CB	AJC		ATH	.	.	.	.	.	.	.	.	.	.	.
F2	10/12	LMM	ECP K1517 APPROVED FOR CONSTRUCTION	CB	AJC	.	ATH	36	05/18	CSM	ECP	ECP K1729 AS BUILT TO SITE MARK UP ASB T18025KW	JMP	GD	.	KB	.	.
F1	09/12	SG	ECP K1517 ISSUED FOR HAZOP	CB	AC			35	03/16	NR	ECP	ECP XK16002 AS BUILT TO SITE MARK UP ASB 16048KW	JMP	AB	.	ATH	.	.
E6	06/10	VB	ECP K1326 RE-ISSUED APP FOR CONST.	CRP	AP		AI	34	04/13	MH	ECP	ECP K1517 AS BUILT TO SITE MARK UP ASB 13076KW	JMP	AC		ATH	.	.
E5	04/10	VB	ECP K1326 APPROVED FOR CONSTRUCTION	GW	AP	.		33	12/12	CG	ECP	ECP K1426 AS BUILT TO SITE MARK UP ASB 12270KK	JMP	AC		ATH	.	.

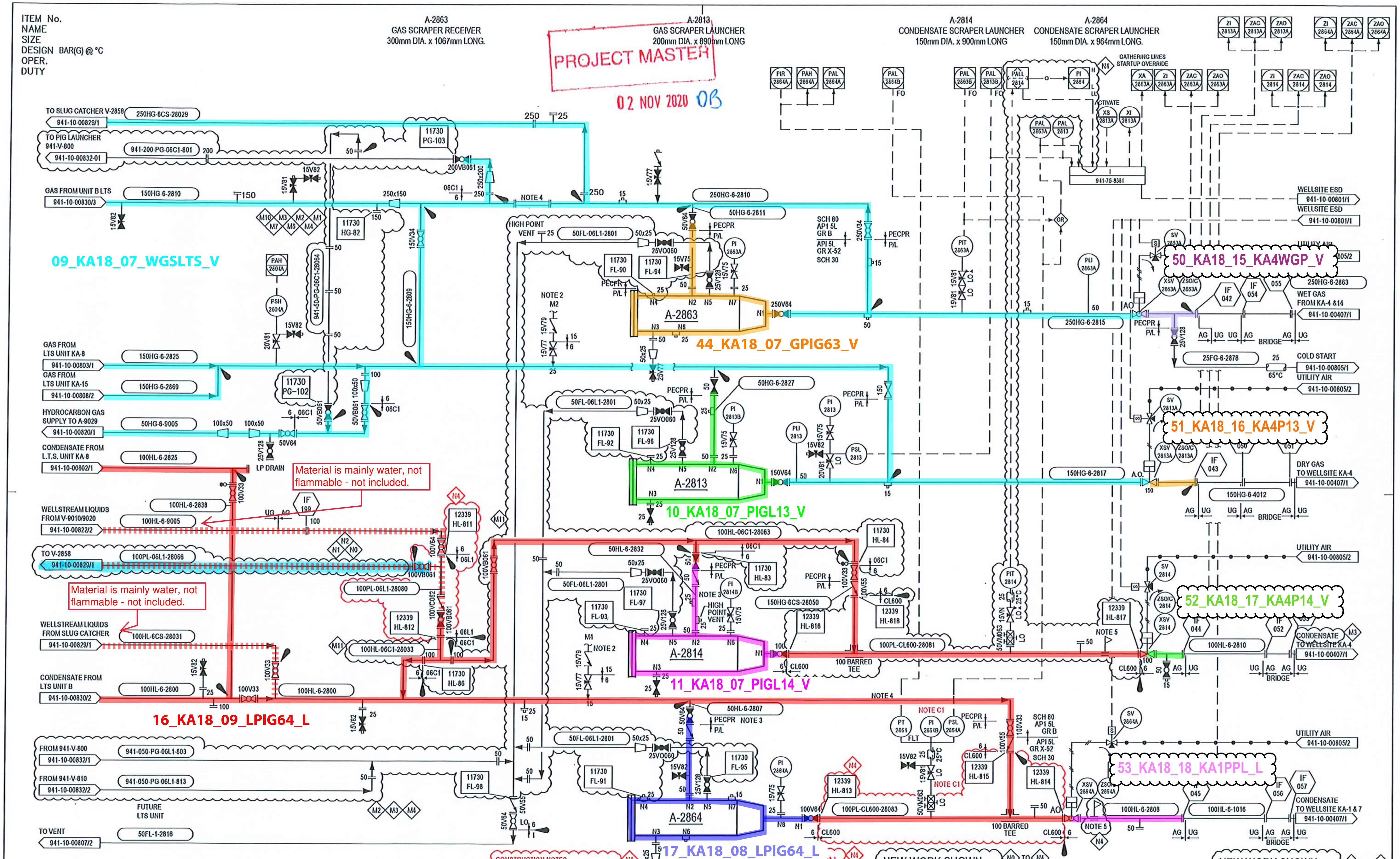
DESIGNED	.	
DRAWN	G McKIE	21-9-76
CHECKED	L HAZLETT	3-10-76
APPROVED	L HAZLETT	3-10-76
APPROVED	C BEATH	28-8-80
SCALE	NONE	
STICKFILE	.	

KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM
L.T.S UNIT KA-8
KAPUNI WELLSITE KA-8, 12 & 15

Todd Energy

SHEET No 1 OF 1
REVISION . 36
DRAWING No 941-10-00803



CONSTRUCTION NOTES
C1. INSTRUMENTS & VALVES TO BE REUSED.

NOTES:

1. MANUAL SHUTDOWN OF ALL KA-8, KA-12 & KA-15 WELLS/LTS UNITS FROM KPS UNITS FROM KPS BY OPERATOR REQUIRED AFTER VERIFICATION OF ALARMS ABOVE OR PAL-2166A OR PAL-2114A BY PR-2804 OR PR-2852A OR PR-2814 OR PR-500A (FROM KPS INLET) OR PR-2114A (FROM KA-1/7).
2. REFER TO DWG 941-10-806 FOR INJECTION SYSTEM.
3. PIG LAUNCHER KICK LINE REMOVED FOR PRODUCTION TESTING.
4. COTTON REEL SPOOL.
5. CLAMP ON TYPE PIG SIGNALLER. N4

PROJ NO. 12339

ENGINEERING CONSULTANTS

NO	DATE	BY	CONSTRUCTION ISSUE	CONSULTANT CHD	CONSULTANT APPR	TODD CHD	TODD APPR
N4	10/20	GRP	ISS'D FOR CONSTRUCTION PCR_3_2020_81	[illegible]	[illegible]	ZA	KB
N3	09/20	DB	ISSUED FOR DESIGN PCR_3_2020_81 (12339)	GRP	JS	ZA	KB
N2	05/20	KC	RE-ISSUED FOR HAZOP - PCR_XXXX (12339)	GRP	JS	-	-
N1	12/19	AdB	ISSUED FOR HAZOP - PCR_XXXX (12339)	CSM	JMT	-	-
M11	03/20	GRP	RE-ISSUED FOR CONST. - K1706 (11730)	MAW	JMT	RAC	KB
M10	11/19	GRP	ISSUED FOR CONSTRUCTION - K1706 (11730)	CSM	JMT	RAC	MCW
M9	10/19	AdB	ISSUED FOR CONSTRUCTION - K1706 (11730)	GRP	JMT	RAC	MCW

NO	DATE	BY	ECP	DESCRIPTION (REVISIONS)	CONSULTANT CHD	CONSULTANT APPR	TODD CHD	TODD APPR
28	07/13	MH	ECP	ECP K1544 AS BUILT TO SITE MARK UP ASB 13134KW	JVP	AC		ATH
27	06/11	JC	ECP	ECP K1326 AS BUILT TO SITE MARK UP ASB 11083KW	VB	RW		AI
33	08/19	SH	ECP	ECP XK18002 AS BUILT TO SITE MARK UP T19008KK	JVP	SG		MW
32	05/18	CSM	ECP	ECP K1729 AS BUILT TO SITE MARK UP ASB T18025KW	JVP	GD		KB
31	12/16	BB	ECP	ECP XK16137 AS BUILT TO SITE MARK UP ASB 16474KW	JVP	AB		SF
30	08/16	NR	ECP	ECP XK16002 AS BUILT TO SITE MARK UP ASB 16333KW	JVP	AB		SF
29	08/13	JC	ECP	ECPs K1334 & K1334-05 AS BUILT TO SITE MARK UP ASB 13184KW	JVP	AC		ATH

REFERENCE DRAWINGS NUMBER	TITLE

DESIGNED		DATE
DRAWN	L DOUGHTY	25-8-82
CHECKED	M SHWER	23-10-82
APPROVED	M SHWER	23-10-82
APPROVED	M SHWER	23-10-82
SCALE		
STICKFILE		

KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM
SCRAPER LAUNCHERS
KAPUNI WELLSITE KA-8, 12 & 15

Todd Energy

SHEET No 1 OF 1 | REVISION N4 | 33

DRAWING No 941-10-00804(X)

NOTES.

1. FLAME ARRESTOR SUPPLIED WITH TANK.
2. VOID.
3. P-2876, P-2877 & P-2878 EXISTING PUMPS RETAGGED AND RELOCATED.
4. VOID
5. EXISTING SP RETAINED.
6. STANDARD 40 MESH T TYPE SWAGELOCK FILTER (STRAINER)

NO	DATE	BY	CONSTRUCTION ISSUE	CHKD (CONSULTANT)	APPR. (CONSULTANT)	CHKD (TODD)	APPR. (TODD)
G5	06/10	VB	ECP K1326 APPROVED FOR CONSTRUCTION	CRP	AP		AI
G4	01/10	LMM	ECP K1326 APPROVED FOR DESIGN	MK	PWM	.	AI
J2	02/18	CSM	RE-APPR. FOR CONSTRUCTION	GD	SJG	.	SF
J1	10/17	CSM	K1729 CUSP APPR. FOR CONSTRUCTION	ML	GD	.	SF
J0	10/16	JMP	CUSP PROJECT ISSUED FOR HAZOP	SG	ML	.	.
H1	06/14	NR	ECP K1501 ISS. FOR HAZOP NOT ISSUED GD	ML	AB	.	.
H0	05/13	LPR	ECP K1501 ISS. FOR REVIEW NOT ISSUED	GD	ML	.	.

NO	DATE	BY	ECP	DESCRIPTION (REVISIONS)	CHKD (CONSULTANT)	APPR. (CONSULTANT)	CHKD (TODD)	APPR. (TODD)	NUMBER	TITLE
15	05/18	CSM	ECP	ECP K1729 AS BUILT TO SITE MARK UP ASB T18025KW	JMP	GD	.	KB	·	.
14	01/17	CB	ECP	ECP XK16002 AS BUILT TO SITE MARK UP ASB 16526KK	JMP	AB	.	SF	·	.
13	12/15	NR	ECP	ECP K1326 AS BUILT TO SITE MARK UP ASB 14051KW	JMP	AB	.	ATH	·	.
12	05/11	JC	ECP	ECP K1326 AS BUILT TO SITE MARK UP ASB 11083KW - HOLD	.	.	.	.	·	.
11	01/11	KP	ECP	ECP K1379 AS BUILT TO SITE MARK UP ASB 10250KW	VB	LM	.	AI	·	.
10	12/08	DW	ECP	ECP K1152 AS BUILT TO SITE MARK UP ASB 8198KW	VB	PWM	.	AI	·	.
09	07/08	MH	ECP	ECP K1245 AS BUILT TO SITE MARK UP ASB 8126KW	VB	PWM		AI	·	.
.	.	.	.	.	.	.	.	.	·	.

DESIGNED	.	
DRAWN	H PIMM	1/91
CHECKED	M WEST	4/91
APPROVED	D M STEWART	4/91
APPROVED	.	.
SCALE	NONE	
STICKFILE	.	

KAPUNI WELLSITES
PIPING & INSTRUMENT DIAGRAM
METHANOL INJECTION
WELLSITE 8, 12 & 15

Todd Energy

SHEET No 2 OF 2 REVISION 15
DRAWING No 941-10-00806

NOTES.

1. REFER TO DWG. 941-10-806/2 FOR INJECTION SYSTEM.
2. PIPING U/S, D/S OF PCV TO BE SYMETRICAL. MINIMISE PIPING DOWNSTREAM OF PCV.
3. MOVED FROM 941-10-00808/2
4. PCV-2882A & E TO BE CONTROLLED IN BACKPRESSURE CONTROL DURING STARTUP. PRESSURE SETPOINT PROVIDED BY OPERATOR.

								.	.	.	.	.	.	.	.	.	·	.
F4	02/18	CSM	K1729 CUSP RE-APP. FOR CONSTRUCTION	GD	SJG	.	SF	22	05/18	CSM	ECP	ECP K1729 AS BUILT TO SITE MARK UP ASB T18025KW	JMP	GD	.	KB	·	.
F3	10/17	CSM	K1729 CUSP APPR. FOR CONSTRUCTION	ML	GD	.	SF	21	12/16	BB	ECP	ECP XK16137 AS BUILT TO SITE MARK UP ASB 16474KW	JMP	AB		SF	·	.
F2	07/17	NR	ECP K1729 APPROVED FOR DESIGN	ML	GD		SF	20	05/13	JC	ECP	ECP K1477 AS BUILT TO SITE MARK UP ASB 13112KW	JMP	AC	.	ATH	·	.
F1	10/16	JMP	CUSP PROJECT ISUED FOR HAZOP	SG	ML			19	12/12	CG	ECP	ECP K1426 AS BUILT TO SITE MARK UP ASB 12270KK	JMP	AC		ATH	·	.
F0	08/16	AMC	CUSP PROJECT ISSUED FOR REVIEW	ML	SG			18	05/11	JC	ECP	ECP K1326 AS BUILT TO SITE MARK UP ASB 11083KW	VB	AP		AI	·	.
E6	06/10	VB	ECP K1326 RE-ISSUED APP FOR CONST.	CRP	AP		AI	17	01/11	KP	ECP	ECP K1379 AS BUILT TO SITE MARK UP ASB 10250KW	VB	LM	.	AI	·	.
E5	04/10	VB	ECP K1326 APPROVED FOR CONSTRUCTION	GW	AP	.		16	12/08	MH	ECP	ECP K1282 AS BUILT TO SITE MARK UP ASB 8214KK	VB	LS	.	AI	·	.
NO	DATE	BY		CHKD	APPR.	CHKD	APPR.	NO	DATE	BY	ECP	DESCRIPTION	CHKD	APPR.	CHKD	APPR.	NUMBER	TITLE
			CONSTRUCTION ISSUE	CONSULTANT		TODD						REVISIONS	CONSULTANT		TODD		REFERENCE DRAWINGS	

DESIGNED	.	DATE
DRAWN	J. TERRILL	11.6.91
CHECKED	G VINCENT	9/91
APPROVED	M.WEST	9/91
APPROVED	D.M.STEWART	9/91
SCALE	NONE	
STICKFILE	.	

KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM
LTS UNIT KA-15
WELLSITE 8, 12 & 15

Todd Energy

SHEET No 2 OF 4

REVISION . 22

DRAWING No 941-10-00808

NOTES:

1. ⊗ DENOTES "VENDOR COUPLING"
< DENOTES "LOW SELECT"
2. VALVE 50V26 ON PROCESS BLOWDOWN IS CERTIFIED TO -29°C.

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.
D3	10/17	CSM	K1729 CUSP APPR. FOR CONSTRUCTION	ML	GD	.	SF
D2	07/17	NR	ECP K1729 APPROVED FOR DESIGN	ML	GD	.	SF
D1	10/16	JMP	CUSP PROJECT ISSUED FOR HAZOP	SG	ML	.	.
D0	08/16	AMC	CUSP PROJECT ISSUED FOR REVIEW	ML	SG	.	.
C1	06/07	VB	ECP K1216 APPROVED FOR DESIGN	CC	PM	.	AI
C0	04/07	VB	ECP K1216 ISSUED FOR HAZOP	CC	PM	.	.
B2	11/06	VB	CWR K521 APPROVED FOR CONSTRUCTION	PWM	AVE	.	.

NO	DATE	BY	ECP	DESCRIPTION	CHKD	APPR.	CHKD	APPR.
05	05/18	CSM	ECP	ECP K1729 AS BUILT TO SITE MARK UP ASB T18025KW	JMP	GD	.	KB
04	10/16	BB	ECP	ECP XK16002 AS BUILT TO SITE MARK UP ASB 16386KK	JMP	AB	.	SF
03	08/07	MH	ECP	ECP K1216 AS BUILT TO SITE MARK UP ASB 7078KW	VB	PWM	.	AI
02	06/07	KN	K521	AS BUILT TO SITE MARK UP ASB 7052KW	VB	PWM	.	RP
01	04/06	DW	K521	AS BUILT TO SITE MARK UP ASB 6052KW	VB	AvdE	.	RP
0	06/04	GR	K521	FIRST ISSUE	WF	JA	SF	NB

NUMBER	TITLE
941-10-00818	VENDOR SUPPLIED P&IDS Shts 2 to 10

DESIGNED	C.MacKINNON	
DRAWN	G.ROBERTSON	06/04
CHECKED	W.FLETCHER	06/04
APPROVED	J. AIKEN	06/04
APPROVED	N. BEALE	06/04
SCALE	NONE	

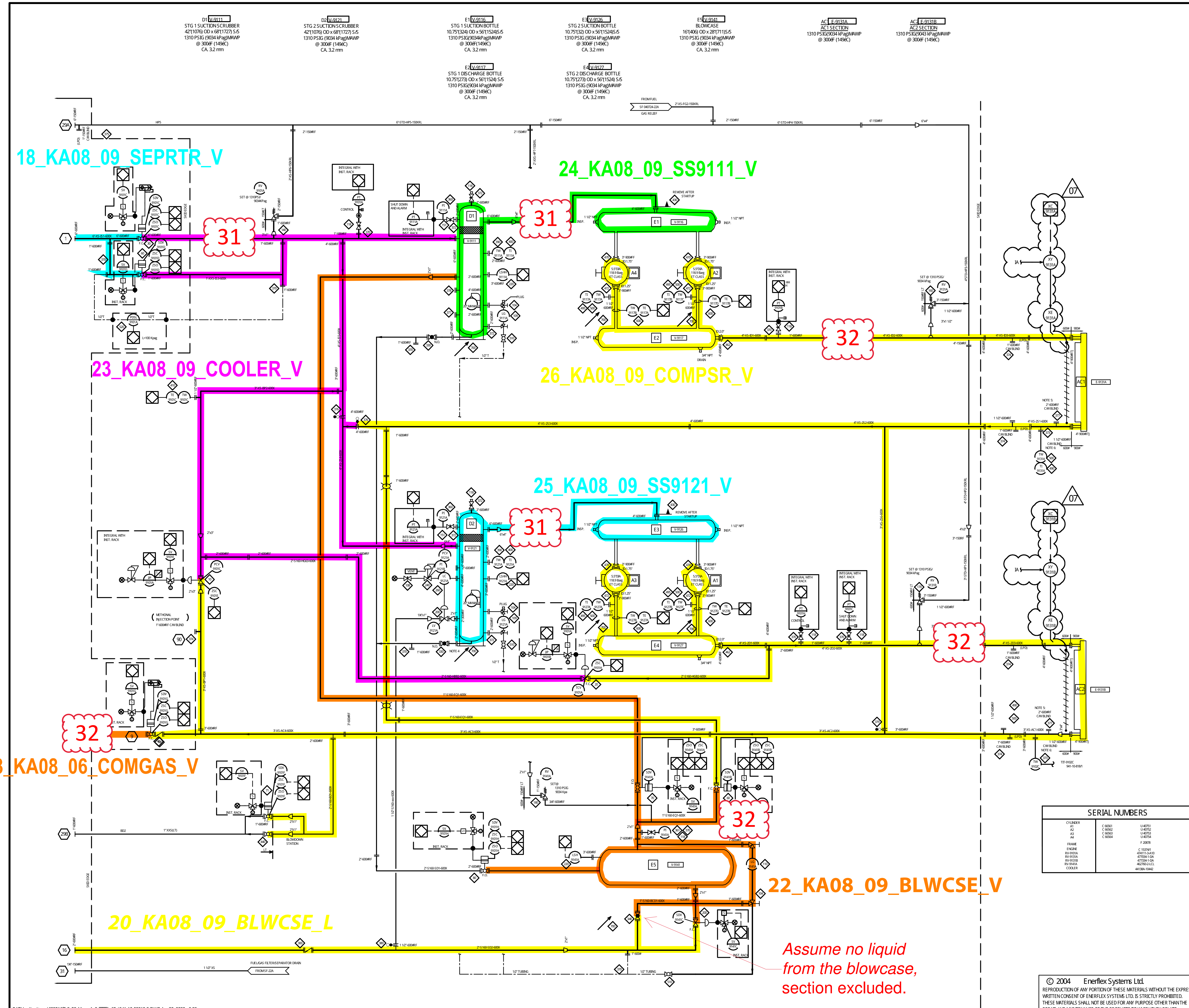
KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM
KA-8 COMPRESSOR
WELLSITE KA-8,12&15

SHEET No 1 OF 10 — REVISION 05

Todd Energy

DRAWING No 941-10-00818



BILL OF MATERIAL

ITEM	QTY	EFX CODE	DESCRIPTION
10	1	NPN-REQ	VALVE, CONTROL, 2" 600# RF, WCC, 2-15/16", FO, 6-30 PSI C/W LIMIT SWITCH 73-1352AA2 TOPWORXS SAA [FISHER, 657-ET-40]
20	1	NPN-REQ	VALVE, CONTROL, 2" 600# RF, WCB, E%#57, FC, 6-30 PSI C/W LIMIT SWITCH 73-1352AA2 TOPWORXS SAA [FISHER, 667-ET-40]
30	1	NPN-REQ	>>VALVE, CONTROL, 6" 600# RF, FP, LCC C/W BALL VALVE, TRUNNION, NACE [TK, DF06F06RGLBCCIX] & ACT [BETTIS CBA10305SR80
		-11-CW] FAIL CLOSED C/W & WESTLOCK 2249-BY POSITION MONITOR, C/W QUICK VENT, 1/4" X 3/8" NPT [WABCO, P52935-2]	
40	1	NPN-REQ	>>VALVE, CONTROL, 3" 600# RF, FP, LCC C/W BALL VALVE, TRUNNION, NACE [TK, DF03F06RLLBCCIN] & ACT [EL-O-MATIC, ESA600
		-4/A/L2-LT] FAIL CLOSED, C/W & WESTLOCK 2249-BY POSITION MONITOR, C/W QUICK VENT, 1/4" X 3/8" NPT [WABCO, P52935-2]	
60	2	NPN-REQ	>>VALVE, CONTROL, 1" 600# RF, FP, WCC C/W BALL VALVE, FLOATING, NACE [TK, FF00F06RLNNCCVN]&
		ACT [EL-O-MATIC, ESA200-4/A/L2-LT] F AIL CLOSED, C/W & WESTLOCK 2249-BY POSITION MONITOR.	
70	1	NPN-REQ	>>VALVE, CONTROL, 1" 600# RF, FP, WCC C/W BALL VALVE, FLOATING, NACE [TK, FF00F06RLNNCCVN]&
		ACT [EL-O-MATIC, ESA200-4/A/L2-LT] FAIL OPEN, C/W & WESTLOCK 2249-BY POSITION MONITOR.	
71	1	NPN-REQ	>>VALVE, CONTROL, 1" 600# RF, FP, WCC C/W BALL VALVE, FLOATING, NACE [TK, FF00F06RLNNCCVN]&
		ACT [EL-O-MATIC, ESA200-4/A/L2-LT] FAIL CLOSED, C/W & WESTLOCK 2249-BY POSITION MONITOR.	
80	1	NPN-REQ	>>VALVE, CONTROL, 2" 600# RF, RP, LCC C/W BALL VALVE, FLOATING, NACE [TK, FF02R06RLNNCCVN]&
		ACT [EL-O-MATIC, ESA200-4/A/L2-LT] FAIL OPEN, C/W & WESTLOCK 2249-BY POSITION MONITOR.	
100	1	103715	VALVE, CHECK, PISTON, 3" 600# RF, CS, SS TRIM, NACE [DANIEL, 305AA]
104	3	112629	VALVE, SET GAUGE, SWEET, 1/2" FNPT X 3/4" MNPT, CS, 3815# [PENBERTHY, 330J 3/4"]
108	1	117694	VALVE, NEEDLE, 1/4" MNPT X 1/4" FNPT, 316SS BODY [AGCO, H1VDS-22]
109	2	104428	GAUGE, LEVEL, CS WITH REFLEX FLAT GLASS, 1820# [PENBERTHY, 1RL7]
110	1	116959	GAUGE, LEVEL, CS WITH REFLEX FLAT GLASS, 2020# [PENBERTHY, 2RL4]
118	7	118246	VALVE, NEEDLE, 3/4" MNPT X 1/2" FNPT, 316SS, NACE [AGCO, H7VIS-46Q-SG]
140	1	122724	VALVE, PSV, 1" 600#RF X 2" 150#RF, .110 "D" OR, NACE I, [FARRIS, 26DA13-120/00]
151	2	114010	VALVE, NEEDLE, 3/4" MNPT X 1/2" FNPT, 316SS, NACE [AGCO, M5VIS-46-SG]
160	1	121626	VALVE, PSV, PILOT, 1-1/2" 600#RF X 3" 150#RF, .785 OR, [FARRIS, 38HC13-120/00]
170	1	121626	VALVE, PSV, PILOT, 1-1/2" 600#RF X 3" 150#RF, .785 OR, [FARRIS, 38HC13-120/00]
180	1	122476	VALVE, PSV, 3/4" 600# X 1" 150#RF, .110 OR, NACE I [FARRIS, 27DA23-320/00]
200	2	120642	VALVE, CONTROL, 1" 600# RF, LCC, 1/4" OR, FC, NACE, 0-35 PSI [FISHER, D4]
220	3	119416	SWITCH, LEVEL, 3" 600#RF, 316SS, XP, ATEX C/W SS FLOAT [MAGNETROL, T35-003C-212]
240	1	104872	REGULATOR, 1/4" NPT, ALUM., 0-125#, TAPPED (W/O PI) [FISHER, 67CFR-601/SPEC]
260	1	NPN-REQ	CONTROLLER, LEVEL, 4" 600# RF, SNAP-ACTING, NACE C/W PVC DISPLACER [FISHER, L2] - Direct Snap Acting
300	1	120634	VALVE, CHECK, WAFER, 2" 600# RF DUAL, CS, NACE [TOPFLOW, AW-023149-VX-99]
330	2	NPN-REQ	VALVE, GLOBE, 2" 600# RF, WOG, RP, NACE [CRANE, 2B-3644LUN-F] SA105N BODY, API TRIM 12
340	1	NPN-REQ	VALVE, GLOBE, 1" 600# RF, WOG, RP, NACE [CRANE, 1B-3644LUN-F] SA105N BODY, API TRIM 12
360	2	107929	GAUGE, PRESSURE, BM, 4" LF, 0-600 PSI DUAL, 1/2" NPT [WIKA, 233.54]
361	1	107890	GAUGE, PRESSURE, BM, 4" LF, 0-1500 PSI DUAL, 1/2" NPT [WIKA, 233.54]
370	12	106375	FLANGE, RF RED HUB, 1" 600# X 3/4" NPT SA105N
372	8	106407	FLANGE, RF RED HUB, 2" 600# X 3/4" NPT SA105N
373	2	106224	FLANGE, RF BLIND, 1-1/2" 600# SA105N
374	5	106237	FLANGE, RF BLIND, 1" 600# SA105N
375	1	106231	FLANGE, RF BLIND, 1" 150# SA105N
376	2	109128	SPECTACLE BLIND, 4" 600# RF, SA516-70N, 5/8" THK
377	3	106262	FLANGE, RF BLIND, 2" 600# SA105N
378	1	106296	FLANGE, RF BLIND, 4" 600# SA105N
379	1	109125	SPECTACLE BLIND, 3" 600# RF, SA516-70N, 1/2" THK0
380	1	118536	SPECTACLE BLIND, 1-1/2" 600# RF, SA516-70N, 1/4" THK
390	2	115414	***T'WELL, FLANGED, 316LSS, 2" 600# RF, 1/2" FNPT, .260" BORE, TAPERED
400	2	103577	GAUGE, TEMP, 5" DIAL, 12" STEM, 0-250 DEG.F DUAL, 1/2" NPT [TREND, 50120]
410	1	NPN-REQ	T'COUPLE ASSY, CSA, XP C/W 1-1/2" 600#RF T'WELL, 316LSS, [PYROMATION, #K48G-HF415R60708-8HN71-SL] K-STYLE
430	2	104245	STRAINER, CONE, 4" 600# CS, 40 MESH, 150% FLOW AREA
440	1	NPN-REQ	VALVE, BALL, 1" 600# RF, FP, LCC, NACE C/W LOCKING HANDLE [TK, FF00F06RLNNCCVN] - Floater type full port ball valve -
462	2	105326	***ORIFICE PLATE, TYPE 520, 316LSS, 1/8" THK, 4" 600# RF, 2.0" ID.
470	4	105266	***ORIFICE PLATE, TYPE 520, 316LSS, 1/8" THK, 3" 900# RF, 1.75" ID.
472	4	105266	***ORIFICE PLATE, TYPE 520, 316LSS, 1/8" THK, 3" 900# RF, 1.25" ID.
490	2	107949	GAUGE, TEMP, 3" DIAL, 9" STEM, 0-250 DEG.F DUAL, 1/2" NPT [TREND, 33090]
495	4	107959	GAUGE, TEMP, 3" DIAL, 9" STEM, 50-500 DEG.F DUAL, 1/2" NPT [TREND, 33090]
500	6	115408	***T'WELL, FLANGED, 316LSS, 1-1/2" 600# RF, 1/2" FNPT, .260" BORE, TAPERED
510	3	102949	VALVE, BALL, 1/2" NPT, 2000# WOG, RP, 316SS, NACE C/W [NAVCO, C1-R05S20A]
520	1	NPN-REQ	SWITCH, PRESSURE, DIFFERENTIAL, RANGE 30-300 PSID (210 - 2070 kPaD, IECEX [UE, J 120K-38-M403-QC1-M201]
		MWP 1000 PSIG, MOUNTED ON INSTRUMENT RACK.	
600	4	119659	T'COUPLE, SURFACE MOUNT., 24" LONG, TYPE K, SAA [MOORE, SEN1/CL24/D25/S316/-WSTCKU-CLAMP-GRIP-TB6-SAA (LH2NSA)]
700	7	102752	FTG, TUBE, 3/8"T FUSIBLE PLUG, 255 DEG.F, 316SS [SWAGELOK, SS-6-FTA-255]
			**
			BILL OF MATERIAL: W 040724-50 : -PROCESS FLOW, 1/2 STAGE, SWEET
			DATE-TIME EXPORTED: 2005-04-07-13.01

NOTES:

1. BLOWDOWN + VENT PIPING MATERIAL TO BE LOW TEMP.
2. ↗ FUSIBLE PLUGS OF FIRE LOOP.
3. ORIFICE PLATE TO BE REPLACE FOR APPLICATION.
4. VALVE CLOSED IN TWO STAGE OPERATION
5. FOR CI INJECTION BY PURCHASER
6. FOR FUTURE TW/TE FOR COOLER FD CONTROL

SERIAL NUMBERS

CYLINDER A1 A2 A3 A4	C 66561 U 40751 C 66562 U 40752 C 66563 U 40753 C 66564 U 40754
FRAME	F 20878
ENGINE	C 15374/1
RV-9101A	474111-3-A10
RV-9131A	477034-1-DA
RV-9131B	477334-1-DA
RV-9141A	462760-2-LCL
COOLER	44138A-10442

STOS DWG No.: 941-10-00818 W0100275

SHT No.: 2 of 10

REV	DESCRIPTION	DATE	DRAWN BY	CHECKED BY
5	EWR K521 AS BUILT TO ASB 6052KW	05/06	DW	VB/AvdE/RP
07	ECP K1729 AS BUILT TO SITE MARK UP ASB T18025KW	05/18	CSM	JMP / GD / KB
~~A1~~	~~K1729 CUSP RE-APPROVED FOR CONSTRUCTION~~	~~02/18~~	~~CSM~~	~~GD / SJG / SF~~
~~A0~~	~~K1729 CUSP APPROVED FOR CONSTRUCTION~~	~~10/17~~	~~CSM~~	~~ML / GD / SF~~
6	ECP KI379 AS BUILT TO SITE MARK UP - ASB 10178KW	09/10	JC	VB/AP/AI

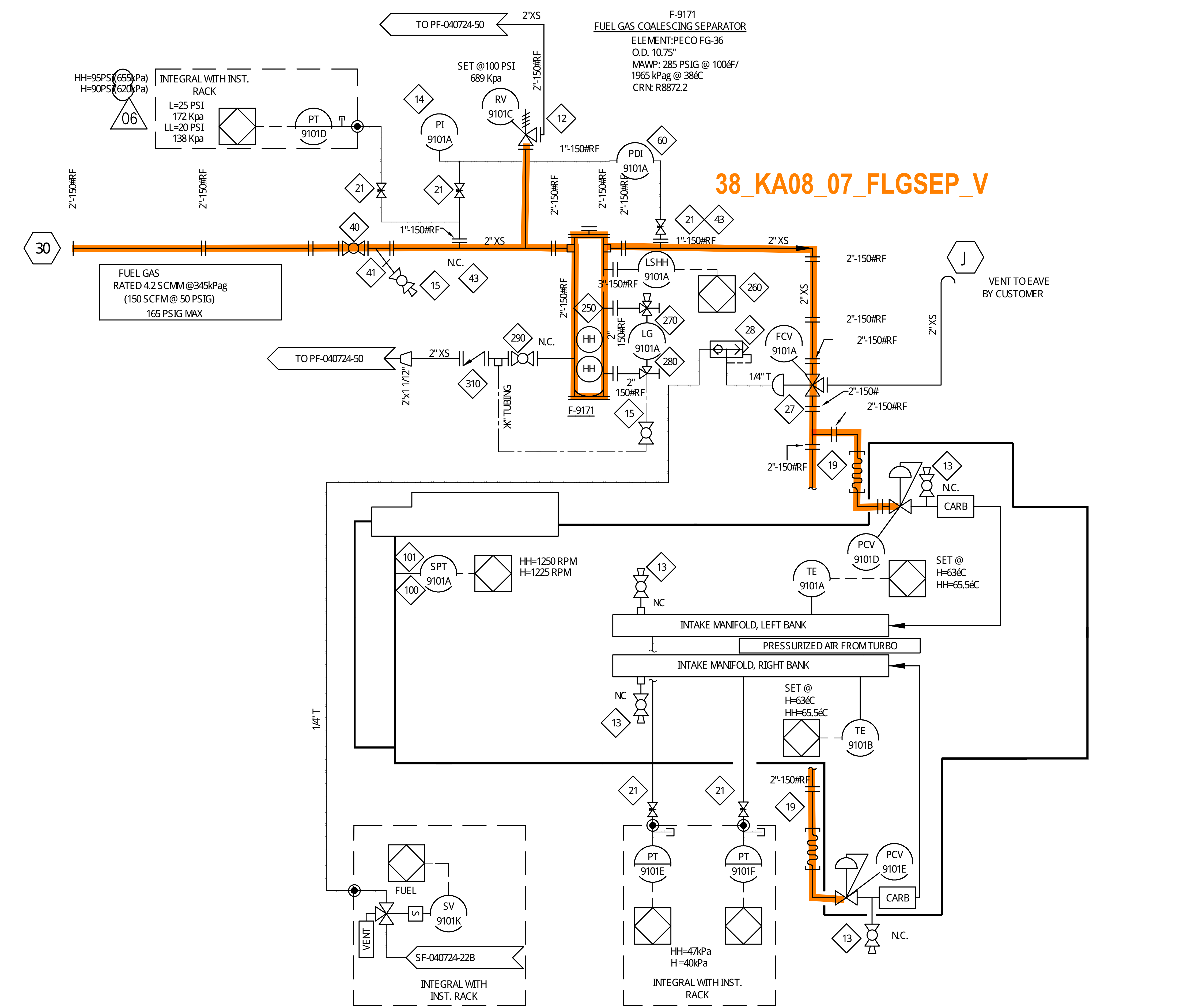
EFX Compression

4700 47 Street SE Calgary AB Canada T2B 3R1 Canada Tel. +1.403.236.6800 Fax +1.403.279.0367
www.enerflex.com

TITLE:
PROCESS AND INSTRUMENTATION DIAGRAM
ARIEL JGE/4, WAUK. L5790 GL, AIR-X LTD 156 EF-112-24
1/2 STAGE COMPRESSOR PACKAGE

FOR: SHELL TODD OIL SERVICES
TAG NO.: A-9101 (KA-815 WELL HEAD COMPRESSOR)
CONSULTANT: TRANSFIELD WORLEY NEW ZEALAND
P.O.: 504568
LSD:TARANAKI NEW ZEALAND
JOB No.: 040724

DRWN BY: DH	DESIGN BY: PLM	DATE: 04/10/22	DWG. No.	OP #
DATE: 04/12/08	CHKD BY: PLM	DATE: 04/12/08	PF-040724-50	50
SCALE: NTS	APPVD BY: PLM	DATE:		



BILL OF MATERIAL

ITEM	QTY	EFX CODE	DESCRIPTION
12	1	121317	VALVE, PSV, 1" 150#RF X 2" 150#RF, .110 OR, NACE I, [FARRIS, 26DA10-120/00]
13	4	102950	VALVE, BALL, 1/4" NPT, 2000# WOG, RP, 316SS, NACE C/W [NAVCO, C1-R02S20A]
14	1	107911	GAUGE, PRESSURE, BM, 2-1/2" LF, 0-300 PSI DUAL, 1/4" NPT [WIKA, 233.53]
15	2	102949	VALVE, BALL, 1/2" NPT, 2000# WOG, RP, 316SS, NACE C/W [NAVCO, C1-R05S20A]
19	2	NPN-REQ	HOSE, BRAIDED STEEL, 2" 150# RF X 2" NPT X 18" LONG
21	5	117694	VALVE, NEEDLE, 1/4" MNPT X 1/4" FNPT, 316SS BODY [AGCO, H1VDS-22]
27	1	118300	VALVE, GAS, 3-WAY, 2" 150#RF, 316SS BODY, AUTOMATED [XOMOX, 034-FT-D-6-6-P1-A]
28	1	104804	VALVE, QUICK VENT, 1/4" X 3/8" NPT [WABCO, P52935-2]
40	1	100898	VALVE, BALL, 2" 150# RF, FP, CS, NACE C/W HANDLE [TK, FF02F01RLNNCCTT]
41	1	118163	STRAINER, Y, 2" 150# RF, 285 PSIG MAWP, CS, 1/32" SS SCREEN [ALTA, NYF-150]
43	2	106364	FLANGE, RF RED HUB, 1" 150# X 1/2" NPT SA105N
60	1	122036	GAUGE, PRESSURE, DIFF., 3" DIAL, 0-30 PSID DUAL, BACK MT, 316SS [WIKA, 700.04]
100	1	104467	MAGNETIC PICK-UP, 5/8"-18 THREAD X 2-1/2" LONG, CSA, IS [DYNALCO, M204]
101	1	NPN-REQ	JUNCTION BOX ASSEMBLY, FLAMEPROOF, RANGE 3000, Zone 1 EExd IIB T6 IP66 ATEX
			certified fitted with MK6/6 terminal block.
250	1	NPN-REQ	>>VESSEL, FUEL GAS, 10-3/4" OD, 285 MAWP @ 100DEG.F, SWEET C/W FG-36 ELEMENT,
			EFX DWG# V040724L
260	1	119414	SWITCH, LEVEL, 3" 150#RF, 316SS, XP, ATEX C/W SS FLOAT [MAGNETROL, T31-003A-212]
270	1	112629	VALVE, SET GAUGE, SWEET, 1/2" FNPT X 3/4" MNPT, CS, 3815# [PENBERTHY, 330J 3/4"]
280	1	104433	GAUGE, LEVEL, CS WITH REFLEX FLAT GLASS, 2240# [PENBERTHY, 1RL1]
290	1	100247	VALVE, BALL, 2" 150# RF, RP, CS, NACE C/W HANDLE [TK, FF02R01RLNZCCTT]
310	1	116009	VALVE, CHECK, SWING, 2" 150# RF, CS, NACE [NAVCO, CS-F20R01S]
			**
			BILL OF MATERIAL: W 040724-22A-AB : FEUL GAS SYSTEMS
			DATE-TIME EXPORTED: 2005-04-07-11.33

NOTES:

1. INSTRUMENTS USING INSTRUMENT AIR MUST BE VENTED TO ATMOSPHERE.
2. ALL SERVICE LINES OPERATING ABOVE 15 PSIG MUST BE PRESSURE TESTED PER TI PROCEDURE IN THE QC MANUAL.
3. MANIFOLD BOOST PRESSURE TO BE SET ONCE SITE CONDITIONS ARE DETERMINED
4. ALL TUBING IS 316SS C/W SWAGELOCK FITTINGS.

STOS DWG. NO.: 941-10-00818 W0100278 SHT. NO.: 5 of 10

REV	DESCRIPTION	DATE	DRAWN BY	CHECKED BY
5	EWR K521 AS BUILT TO ASB 6052KW	04/06	DW	VB/AvdE/RP
4	FIELD AS BUILT, PER CUSTOMER COMMENTS	05/12/06	PLM	PLM
3	AS BUILT, PER CUSTOMER COMMENTS	05/07/01	PLM	PLM
2	AS BUILT	05/04/11	MGN	PLM
06	ECP X0213 AS BUILT TO SITE MARK UP ASB 15217KW	08/15	BB	JMP/AB/ATH

EFX Compression

4700 47 Street SE Calgary AB Canada T2B 3R1 Canada Tel. +1.403.236.6800 Fax +1.403.279.0367
www.enerflex.com

TITLE: SERVICE FLOW
FUEL GAS SYSTEMS
WAUKESHA L5790GL

FOR: SHELL TODD OIL SERVICES LIMITED
TAG NO.: A-9101 (KA-8/15 WELL HEAD COMPRESSOR)
CONSULTANT: TRANSFIELD WORLEY NEW ZEALAND
LSD: TARANAKI NEW ZEALAND
P.O.: 504568
JOB No.: 040724

DRWN BY: DH
DATE: 04/12/20
SCALE: NTS
DESIGN BY: PLM DATE: 04/11/22
CHKD BY: PLM DATE: 04/12/20
APPVD BY: DATE:
DWG. No. SF-040724-22
OP# 22A

NOTES:

1. ⊗ DENOTES "VENDOR COUPLING"
   < DENOTES "LOW SELECT"
2. VALVE 50V26 ON PROCESS BLOWDOWN IS CERTIFIED TO -29ºC.

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 (CONSULTANT)	APPR. (CONSULTANT)	CHKD (TODD)	APPR. (TODD)
~~B0~~	~~11/06~~	~~VB~~	~~EWR K521 APPROVED FOR CONSTRUCTION~~	~~PWM~~	~~AVE~~	.	.
~~A6~~	~~08/05~~	~~VB~~	~~EWR K521 RE ISSUED AFC~~	~~JA~~	~~AvdE~~	.	~~KJE~~
~~A5~~	~~24/12/04~~	~~CSM~~	~~EWR K521 APPROVED FOR CONSTRUCTION~~	~~WF~~	~~JA~~	.	~~KJE~~
~~D1~~	~~10/17~~	~~CSM~~	~~K1729 CUSP APPR. FOR CONSTRUCTION~~	~~ML~~	~~GD~~	.	~~SF~~
~~D0~~	~~07/17~~	~~JMP~~	~~ECP K1729 APPROVED FOR DESIGN~~	~~ML~~	~~GD~~	.	~~SF~~
~~C1~~	~~06/07~~	~~VB~~	~~ECP K1216 APPROVED FOR DESIGN~~	~~CC~~	~~PM~~	.	~~AI~~
~~C0~~	~~04/07~~	~~VB~~	~~ECP K1216 ISSUED FOR HAZOP~~	~~CC~~	~~PM~~	.	.

NO	DATE	BY	ECP	DESCRIPTION (REVISIONS)	CHKD (CONSULTANT)	APPR. (CONSULTANT)	CHKD (TODD)	APPR. (TODD)
.	.	.	.	.	.	.	.	.
06	05/18	CSM	ECP	ECP K1729 AS BUILT TO SITE MARK UP ASB T18025KW	JMP	GD	.	KB
05	10/16	BB	ECP	ECP XK16002 AS BUILT TO SITE MARK UP ASB 16386KK	JMP	AB	.	SF
04	12/08	DW	ECP	ECP K1152 AS BUILT TO SITE MARK UP ASB 8198KW	VB	PWM	.	AI
03	08/07	MH	ECP	ECP K1216 AS BUILT TO SITE MARK UP ASB 7078KW	VB	PWM	.	AI
02	06/07	KN	K521	AS BUILT TO SITE MARK UP ASB 7052KW	VB	PWM	.	RP
01	04/06	DW	K521	AS BUILT TO SITE MARK UP ASB 6052KW	VB	AvdE	.	RP
0	06/04	GR	K521	FIRST ISSUE	WF	JA	SF	NB

NUMBER	TITLE (REFERENCE DRAWINGS)
941-10-00819	VENDOR SUPPLIED P&IDS Shts 2 to 10

DESIGNED	C.MacKINNON	DATE
DRAWN	G.ROBERTSON	06/04
CHECKED	W.FLETCHER	06/04
APPROVED	J. AIKEN	06/04
APPROVED	N. BEALE	06/04
SCALE	NONE	
STICKFILE	.	

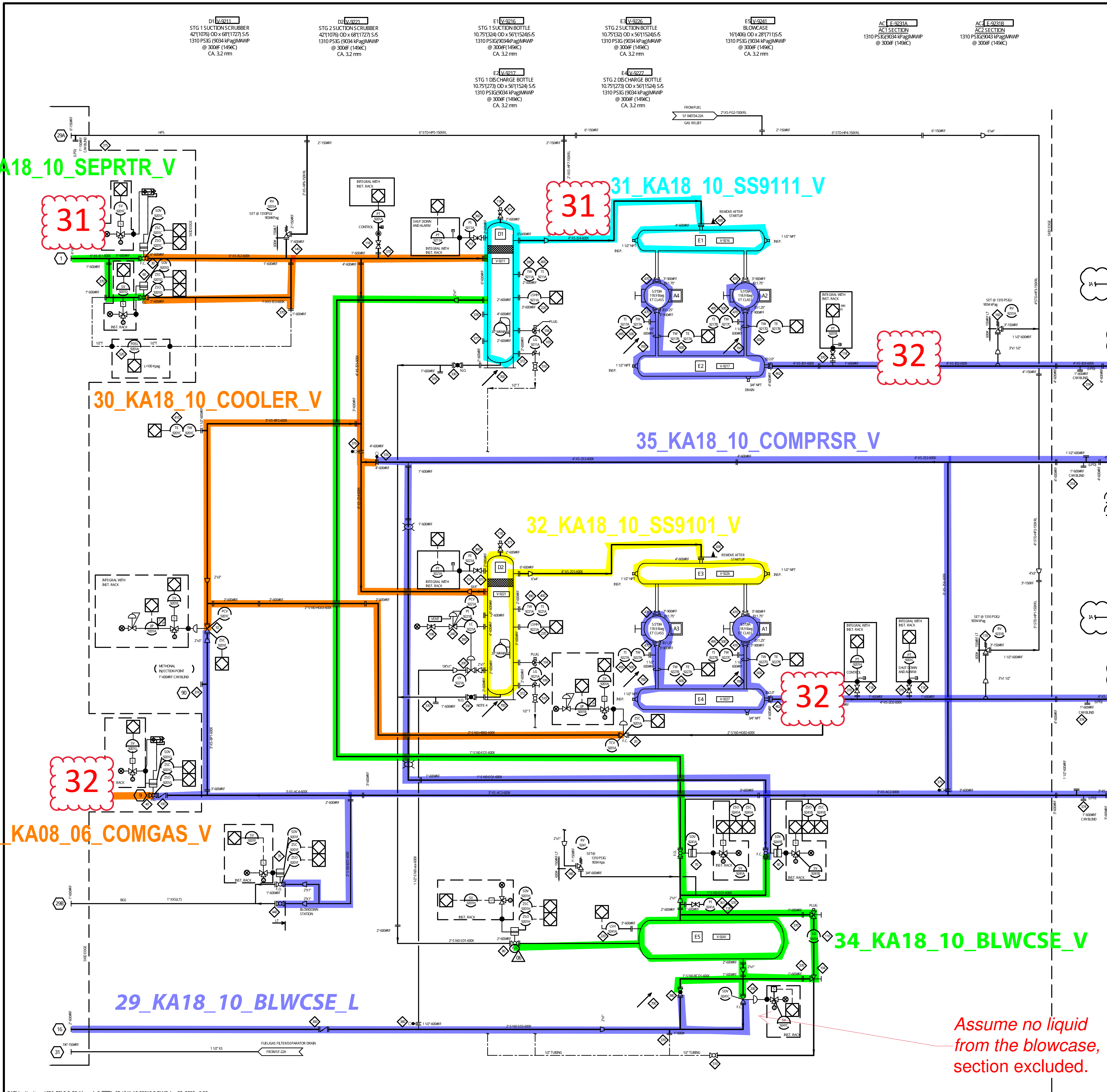
KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM GAS COMPRESSOR PACKAGE A-9201 WELLSITE KA-8,12&15

Todd Energy

SHEET No 1 OF 10 REVISION 06

DRAWING No 941-10-00819



BILL OF MATERIAL

ITEM	QTY	EFX CODE	DESCRIPTION
10	1	NPN-REQ	VALVE, CONTROL, 2" 600# RF, WCC, 2-15/16", FO, 6-30 PSI C/W LIMIT SWITCH 73-1352AA2 TOPWORXS SAA [FISHER, 657-ET-40]
20	1	NPN-REQ	VALVE, CONTROL, 2" 600# RF, WCB, E%#57, FC, 6-30 PSI C/W LIMIT SWITCH 73-1352AA2 TOPWORXS SAA [FISHER, 667-ET-40]
30	1	NPN-REQ	>>VALVE, CONTROL, 6" 600# RF, FP, LCC C/W BALL VALVE, TRUNNION, NACE [TK, DF06F06RGLBCCIX] & ACT [BETTIS CBA10305SR80
			-11-CW] FAIL CLOSED C/W & WESTLOCK 2249-BY POSITION MONITOR, C/W QUICK VENT, 1/4" X 3/8" NPT [WABCO, P52935-2]
40	1	NPN-REQ	>>VALVE, CONTROL, 3" 600# RF, FP, LCC C/W BALL VALVE, TRUNNION, NACE [TK, DF03F06RLLBCCIN] & ACT [EL-O-MATIC, ESA600
			-4/A/L2-LT] FAIL CLOSED, C/W & WESTLOCK 2249-BY POSITION MONITOR, C/W QUICK VENT, 1/4" X 3/8" NPT [WABCO, P52935-2]
60	2	NPN-REQ	>>VALVE, CONTROL, 1" 600# RF, FP, WCC C/W BALL VALVE, FLOATING, NACE [TK, FF00F06RLNNCCVN]&
			ACT [EL-O-MATIC, ESA200-4/A/L2-LT] F AIL CLOSED, C/W & WESTLOCK 2249-BY POSITION MONITOR.
70	1	NPN-REQ	>>VALVE, CONTROL, 1" 600# RF, FP, WCC C/W BALL VALVE, FLOATING, NACE [TK, FF00F06RLNNCCVN]&
			ACT [EL-O-MATIC, ESA200-4/A/L2-LT] FAIL OPEN, C/W & WESTLOCK 2249-BY POSITION MONITOR.
71	1	NPN-REQ	>>VALVE, CONTROL, 1" 600# RF, FP, WCC C/W BALL VALVE, FLOATING, NACE [TK, FF00F06RLNNCCVN]&
			ACT [EL-O-MATIC, ESA200-4/A/L2-LT] FAIL CLOSED, C/W & WESTLOCK 2249-BY POSITION MONITOR.
80	1	NPN-REQ	>>VALVE, CONTROL, 2" 600# RF, RP, LCC C/W BALL VALVE, FLOATING, NACE [TK, FF02R06RLNNCCVN]&
			ACT [EL-O-MATIC, ESA200-4/A/L2-LT] FAIL OPEN, C/W & WESTLOCK 2249-BY POSITION MONITOR.
100	1	103715	VALVE, CHECK, PISTON, 3" 600# RF, CS, SS TRIM, NACE [DANIEL, 305AA]
104	3	112629	VALVE, SET GAUGE, SWEET, 1/2" FNPT X 3/4" MNPT, CS, 3815# [PENBERTHY, 330J 3/4"]
108	1	117694	VALVE, NEEDLE, 1/4" MNPT X 1/4" FNPT, 316SS BODY [AGCO, H1VDS-22]
109	2	104428	GAUGE, LEVEL, CS WITH REFLEX FLAT GLASS, 1820# [PENBERTHY, 1RL7]
110	1	116959	GAUGE, LEVEL, CS WITH REFLEX FLAT GLASS, 2020# [PENBERTHY, 2RL4]
118	7	118246	VALVE, NEEDLE, 3/4" MNPT X 1/2" FNPT, 316SS, NACE [AGCO, H7VIS-46Q-SG]
140	1	122724	VALVE, PSV, 1" 600#RF X 2" 150#RF, .110 "D" OR, NACE I, [FARRIS, 26DA13-120/00]
151	2	114010	VALVE, NEEDLE, 3/4" MNPT X 1/2" FNPT, 316SS, NACE [AGCO, M5VIS-46-SG]
160	1	121626	VALVE, PSV, PILOT, 1-1/2" 600#RF X 3" 150#RF, .785 OR, [FARRIS, 38HC13-120/00]
170	1	121626	VALVE, PSV, PILOT, 1-1/2" 600#RF X 3" 150#RF, .785 OR, [FARRIS, 38HC13-120/00]
180	1	122476	VALVE, PSV, 3/4" 600# X 1" 150#RF, .110 OR, NACE I [FARRIS, 27DA23-320/00]
200	2	120642	VALVE, CONTROL, 1" 600# RF, LCC, 1/4" OR, FC, NACE, 0-35 PSI [FISHER, D4]
220	3	119416	SWITCH, LEVEL, 3" 600#RF, 316SS, XP, ATEX C/W SS FLOAT [MAGNETROL, T35-003C-212]
240	1	104872	REGULATOR, 1/4" NPT, ALUM., 0-125#, TAPPED (W/O PI) [FISHER, 67CFR-601/SPEC]
260	1	NPN-REQ	CONTROLLER, LEVEL, 4" 600# RF, SNAP-ACTING, NACE C/W PVC DISPLACER [FISHER, L2] - Direct Snap Acting
300	1	120634	VALVE, CHECK, WAFER, 2" 600# RF DUAL, CS, NACE [TOPFLOW, AW-023149-VX-99]
330	2	NPN-REQ	VALVE, GLOBE, 2" 600# RF, WOG, RP, NACE [CRANE, 2B-3644LUN-F] SA105N BODY, API TRIM 12
340	1	NPN-REQ	VALVE, GLOBE, 1" 600# RF, WOG, RP, NACE [CRANE, 1B-3644LUN-F] SA105N BODY, API TRIM 12
360	2	107929	GAUGE, PRESSURE, BM, 4" LF, 0-600 PSI DUAL, 1/2" NPT [WIKA, 233.54]
361	1	107890	GAUGE, PRESSURE, BM, 4" LF, 0-1500 PSI DUAL, 1/2" NPT [WIKA, 233.54]
370	12	106375	FLANGE, RF RED HUB, 1" 600# X 3/4" NPT SA105N
372	8	106407	FLANGE, RF RED HUB, 2" 600# X 3/4" NPT SA105N
373	2	106224	FLANGE, RF BLIND, 1-1/2" 600# SA105N
374	5	106237	FLANGE, RF BLIND, 1" 600# SA105N
375	1	106231	FLANGE, RF BLIND, 1" 150# SA105N
376	2	109128	SPECTACLE BLIND, 4" 600# RF, SA516-70N, 5/8" THK
377	3	106262	FLANGE, RF BLIND, 2" 600# SA105N
378	1	106296	FLANGE, RF BLIND, 4" 600# SA105N
379	1	109125	SPECTACLE BLIND, 3" 600# RF, SA516-70N, 1/2" THK0
380	1	118536	SPECTACLE BLIND, 1-1/2" 600# RF, SA516-70N, 1/4" THK
390	2	115414	***T'WELL, FLANGED, 316LSS, 2" 600# RF, 1/2" FNPT, .260" BORE, TAPERED
400	2	103577	GAUGE, TEMP, 5" DIAL, 12" STEM, 0-250 DEG.F DUAL, 1/2" NPT [TREND, 50120]
410	1	NPN-REQ	T'COUPLE ASSY, CSA, XP C/W 1-1/2" 600#RF T'WELL, 316LSS, [PYROMATION, #K48G-HF415R60708-8HN71-SL] K-STYLE
430	2	104245	STRAINER, CONE, 4" 600# CS, 40 MESH, 150% FLOW AREA
440	1	NPN-REQ	VALVE, BALL, 1" 600# RF, FP, LCC, NACE C/W LOCKING HANDLE [TK, FF00F06RLNNCCVN] - Floater type full port ball valve -
462	2	105326	***ORIFICE PLATE, TYPE 520, 316LSS, 1/8" THK, 4" 600# RF, 2.0" ID.
470	4	105266	***ORIFICE PLATE, TYPE 520, 316LSS, 1/8" THK, 3" 900# RF, 1.75" ID.
472	4	105266	***ORIFICE PLATE, TYPE 520, 316LSS, 1/8" THK, 3" 900# RF, 1.25" ID.
490	2	107949	GAUGE, TEMP, 3" DIAL, 9" STEM, 0-250 DEG.F DUAL, 1/2" NPT [TREND, 33090]
495	4	107959	GAUGE, TEMP, 3" DIAL, 9" STEM, 50-500 DEG.F DUAL, 1/2" NPT [TREND, 33090]
500	6	115408	***T'WELL, FLANGED, 316LSS, 1-1/2" 600# RF, 1/2" FNPT, .260" BORE, TAPERED
510	3	102949	VALVE, BALL, 1/2" NPT, 2000# WOG, RP, 316SS, NACE C/W [NAVCO, C1-R05S20A]
520	1	NPN-REQ	SWITCH, PRESSURE, DIFFERENTIAL, RANGE 30-300 PSID (210 - 2070 kPaD, IECEX [UE, J 120K-38-M403-QC1-M201]
			MWP 1000 PSIG, MOUNTED ON INSTRUMENT RACK.
600	4	119659	T'COUPLE, SURFACE MOUNT., 24" LONG, TYPE K, SAA [MOORE, SEN1/CL24/D25/S316/-WSTCKU-CLAMP-GRIP-TB6-SAA (LH2NSA)]
700	7	102752	FTG, TUBE, 3/8"T FUSIBLE PLUG, 255 DEG.F, 316SS [SWAGELOK, SS-6-FTA-255]
			**
			BILL OF MATERIAL: W 040724-50 : -PROCESS FLOW, 1/2 STAGE, SWEET
			DATE-TIME EXPORTED: 2005-04-07-13.01

NOTES:

1. BLOWDOWN + VENT PIPING MATERIAL TO BE LOW TEMP.
2. FUSIBLE PLUGS OF FIRE LOOP.
3. ORIFICE PLATE TO BE REPLACE FOR APPLICATION.
4. VALVE CLOSED IN TWO STAGE OPERATION
5. FOR CI INJECTION BY PURCHASER
6. FOR FUTURE TW/TE FOR COOLER FD CONTROL

SERIAL NUMBERS

CYLINDER		
A1	C 66565	U 40755
A2	C 66566	U 40756
A3	C 66567	U 40757
A4	C 66568	U 40758
FRAME		F 20879
ENGINE		C 15374/2
RV-9201A		474088-3-A10
RV-9231A		477998-1-DA
RV-9231B		475668-1-DA
RV-9241A		462760-3-LCL
RV-9241C		465112-4-A10
COOLER		44138B-10443

STOS DWG No.: 941-10-00819 W0100284 SHT No.: 2 of 10

REV	DESCRIPTION	DATE	DRAWN BY	CHECKED BY
5	ECP K1379 AS BUILT TO SITE MARK UP - ASB 10178KW	09/10	JC	VB/AP/AI
07	ECP K1729 AS BUILT TO SITE MARK UP ASB T18025KW	05/18	CSM	JMP / GD / KB
~~A1~~	~~K1729 CUSP RE-APPROVED FOR CONSTRUCTION~~	~~02/18~~	~~CSM~~	~~GD / SJG / SF~~
~~A0~~	~~K1729 CUSP APPROVED FOR CONSTRUCTION~~	~~10/17~~	~~CSM~~	~~ML / GD / SF~~
06	ECP XK17172 AS BUILT TO SITE MARK UP ASB 17230KW	07/17	RR	JMP/TD/SF

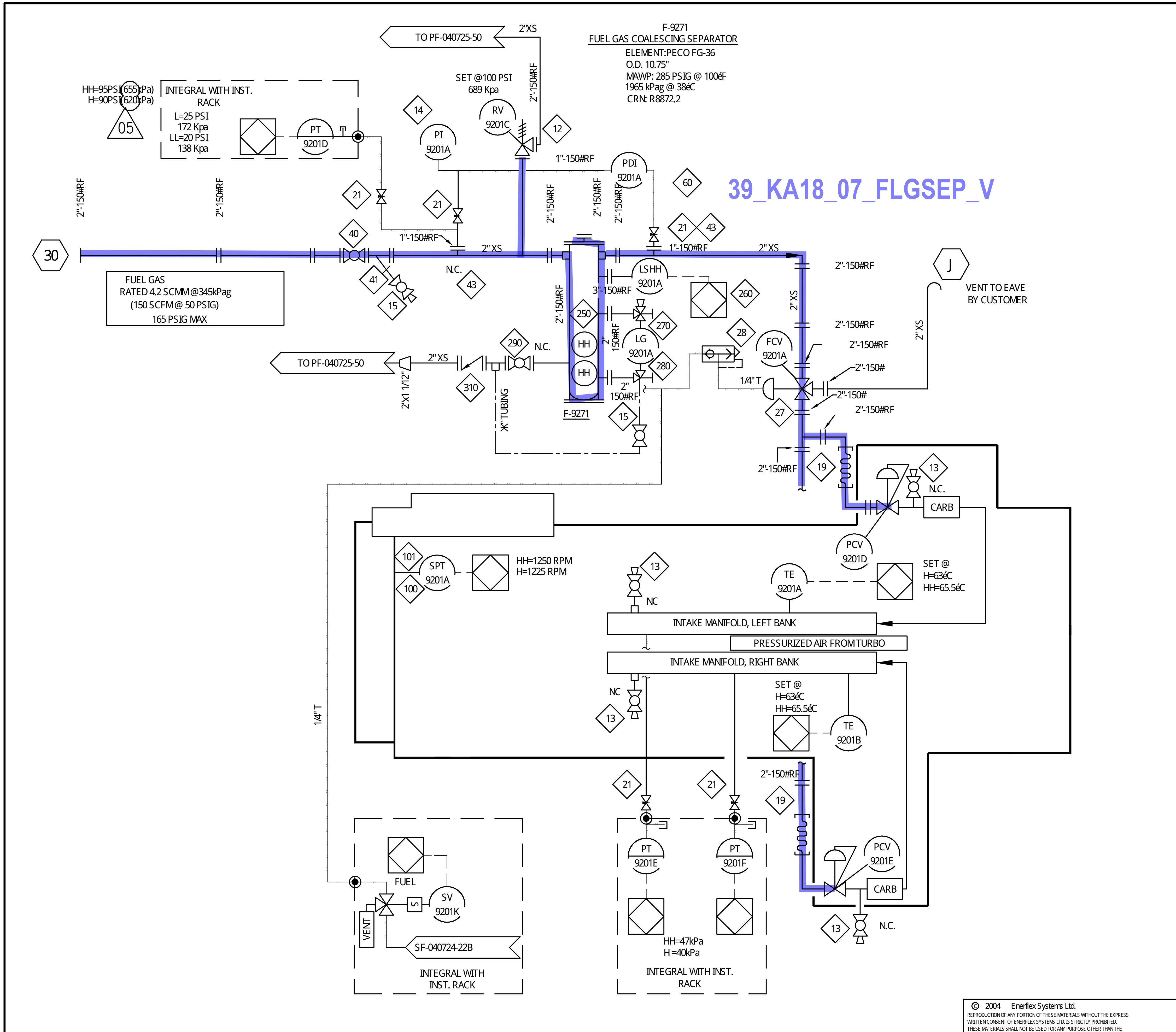
EFX Compression
4700 47 Street SE Calgary AB Canada T2B 3R1 Canada Tel. +1.403.236.6800 Fax +1.403.279.0367
www.enerflex.com

TITLE:
PROCESS AND INSTRUMENTATION DIAGRAM
ARIEL JGE/4, WAUK. L5790 GL, AIR-X LTD 156 EF-112-24
1/2 STAGE COMPRESSOR PACKAGE

FOR: SHELL TODD OIL SERVICES
TAG NO.: A-9201 (KA-815 WELL HEAD COMPRESSOR)
CONSULTANT: TRANSFIELD WORLEY NEW ZEALAND
LSD:TARANAKI NEW ZEALAND
P.O.: 504568
JOB No.: 040725

						DWG. No.	OP #
DRWN BY:	MGN	DESIGN BY:		DATE:		PF-040725-50	50
DATE:	04/10/15	CHKD BY:	PLM	DATE:	04/10/20		
SCALE:	NTS	APPVD BY:	PLM	DATE:			

PATH: c:\im\temp\...\941-10-00819-2.DWG Apr 30, 2020 - 9:29pm



BILL OF MATERIAL

ITEM	QTY	EFX CODE	DESCRIPTION
12	1	121317	VALVE, PSV, 1" 150#RF X 2" 150#RF, .110 OR, NACE I, [FARRIS, 26DA10-120/00]
13	4	102950	VALVE, BALL, 1/4" NPT, 2000# WOG, RP, 316SS, NACE C/W [NAVCO, C1-R02S20A]
14	1	107911	GAUGE, PRESSURE, BM, 2-1/2" LF, 0-300 PSI DUAL, 1/4" NPT [WIKA, 233.53]
15	2	102949	VALVE, BALL, 1/2" NPT, 2000# WOG, RP, 316SS, NACE C/W [NAVCO, C1-R05S20A]
19	2	NPN-REQ	HOSE, BRAIDED STEEL, 2" 150# RF X 2" NPT X 18" LONG
21	5	117694	VALVE, NEEDLE, 1/4" MNPT X 1/4" FNPT, 316SS BODY [AGCO, H1VDS-22]
27	1	118300	VALVE, GAS, 3-WAY, 2" 150#RF, 316SS BODY, AUTOMATED [XOMOX, 034-FT-D-6-6-P1-A]
28	1	104804	VALVE, QUICK VENT, 1/4" X 3/8" NPT [WABCO, P52935-2]
40	1	100898	VALVE, BALL, 2" 150# RF, FP, CS, NACE C/W HANDLE [TK, FF02F01RLNNCCTT]
41	1	118163	STRAINER, Y, 2" 150# RF, 285 PSIG MAWP, CS, 1/32" SS SCREEN [ALTA, NYF-150]
43	2	106364	FLANGE, RF RED HUB, 1" 150# X 1/2" NPT SA105N
60	1	122036	GAUGE, PRESSURE, DIFF., 3" DIAL, 0-30 PSID DUAL, BACK MT, 316SS [WIKA, 700.04]
100	1	104467	MAGNETIC PICK-UP, 5/8"-18 THREAD X 2-1/2" LONG, CSA, IS [DYNALCO, M204]
101	1	NPN-REQ	JUNCTION BOX ASSEMBLY, FLAMEPROOF, RANGE 3000, Zone 1 EExd IIB T6 IP66 ATEX
			certified fitted with MK6/6 terminal block.
250	1	NPN-REQ	>>VESSEL, FUEL GAS, 10-3/4" OD, 285 MAWP @ 100DEG.F, SWEET C/W FG-36 ELEMENT,
			EFX DWG# V040724L
260	1	119414	SWITCH, LEVEL, 3" 150#RF, 316SS, XP, ATEX C/W SS FLOAT [MAGNETROL, T31-003A-212]
270	1	112629	VALVE, SET GAUGE, SWEET, 1/2" FNPT X 3/4" MNPT, CS, 3815# [PENBERTHY, 330J 3/4"]
280	1	104433	GAUGE, LEVEL, CS WITH REFLEX FLAT GLASS, 2240# [PENBERTHY, 1RL1]
290	1	100247	VALVE, BALL, 2" 150# RF, RP, CS, NACE C/W HANDLE [TK, FF02R01RLNZCCTT]
310	1	116009	VALVE, CHECK, SWING, 2" 150# RF, CS, NACE [NAVCO, CS-F20R01S]
			**
			BILL OF MATERIAL: W 040724-22A-AB : FEUL GAS SYSTEMS
			DATE-TIME EXPORTED: 2005-04-07-11.33

NOTES:

1. INSTRUMENTS USING INSTRUMENT AIR MUST BE VENTED TO ATMOSPHERE.
2. ALL SERVICE LINES OPERATING ABOVE 15 PSIG MUST BE PRESSURE TESTED PER TI PROCEDURE IN THE QC MANUAL.
3. MANIFOLD BOOST PRESSURE TO BE SET ONCE SITE CONDITIONS ARE DETERMINED
4. ALL TUBING IS 316SS C/W SWAGELOK FITTINGS.

STOS DWG. NO.: 941-10-00819 W0100287 SHT. NO.: 5 of 10

REV	DESCRIPTION	DATE	DRAWN BY	CHECKED BY
05	ECP X0213 AS BUILT TO SITE MARK UP ASB 15217KW	08/15	BB	JMP/AB/ATH
4	EWR K521 AS BUILT TO ASB 6052KW	04/06	DW	VB/AvdE/RP
3	FIELD AS BUILT, PER CUSTOMER COMMENTS	05/12/05	PLM	PLM
2	AS BUILT, PER CUSTOMER COMMENTS	05/07/01	PLM	PLM

EFX Compression

4700 47 Street SE Calgary AB Canada T2B 3R1 Canada Tel. +1.403.236.6800 Fax +1.403.279.0367

www.enerflex.com

TITLE: SERVICE FLOW
FUEL GAS SYSTEMS
WAUKESHA L5790GL

FOR: SHELL TODD OIL SERVICES LIMITED

TAG NO.: A-9201 (KA-8/15 WELL HEAD COMPRESSOR)

CONSULTANT: TRANSFIELD WORLEY NEW ZEALAND LSD: TARANAKI NEW ZEALAND

P.O.: 504568 JOB No.: 040725

DRWN BY:	MGN	DESIGN BY:		DATE:		DWG. No.	OP#
DATE:	04/10/20	CHKD BY:	PLM	DATE:	04/10/26	SF-040725-22	22A
SCALE:	NTS	APPVD BY:	PLM	DATE:			

NOTES:

1. FAL-9031A IS AN EVENT LOG ONLY.
   AT ZERO FLOW POWER IS DENIED TO E-9030.
2. TIMED (30 MIN) OVERRIDE OF FAL-9031A TO ALLOW START-UP OF E-9030 PRIOR TO SUPPLYING FUEL GAS TO A-9101 & A-9201.
3. TAL-9030A TO BE DISABLED WHEN "A-9029 USD" IS ACTIVE.
4. OVER PRESSURE PROTECTION DEVICE CLOSES WHEN ITS SET POINT IS REACHED ISOLATING THE LINE PRESSURE FROM THE GAUGE.

03

CONSTRUCTION ISSUE

NO	DATE	BY		CHKD (CONSULTANT)	APPR. (CONSULTANT)	CHKD (TODD)	APPR. (TODD)
A7	08/05	VB	EWR K521 RE-ISSUED AFC	JA	AvdE		KJE
A6	06.05.05	VB	EWR K521 RE-ISSUED AFC	SD	JA		KJE
A5	24.12.04	CSM	EWR K521 APPROVED FOR CONSTRUCTION	WF	JA	.	KJE
A4	28.09.04	SK	EWR K521 RE-ISSUED AFD	WF	JA		KJE
A3	09/04	VB	EWR K521 APPROVED FOR DESIGN	WF	JA		KJE
B1	02/18	CSM	K1729 CUSP RE-APPR. FOR CONSTRUCTION	GD	SJG	.	SF
B0	10/17	CSM	K1729 CUSP APPR. FOR CONSTRUCTION	ML	GD	.	SF

REVISIONS

NO	DATE	BY	ECP	DESCRIPTION	CHKD (CONSULTANT)	APPR. (CONSULTANT)	CHKD (TODD)	APPR. (TODD)
03	05/18	CSM	ECP	ECP K1729 AS BUILT TO SITE MARK UP ASB T18025KW	JMP	GD	.	KB
02	12/08	MH	ECP	ECP K1282 AS BUILT TO SITE MARK UP ASB 8214KK	VB	LS		AI
01	04/06	DW	K521	AS BUILT TO SITE MARK UP ASB 6052KW	VB	AvdE		RP
0	06/04	TMA	K521	FIRST ISSUE	WF	JA	SF	NB

REFERENCE DRAWINGS

NUMBER	TITLE
941-10-806/2	METHANOL INJECTION.

DESIGNED	C.MacKINNON	DATE
DRAWN	T ALLERTON	06/04
CHECKED	W FLETCHER	06/04
APPROVED	J AIKEN	06/04
APPROVED	N BEALE	06/04
SCALE	NTS	
STICKFILE		

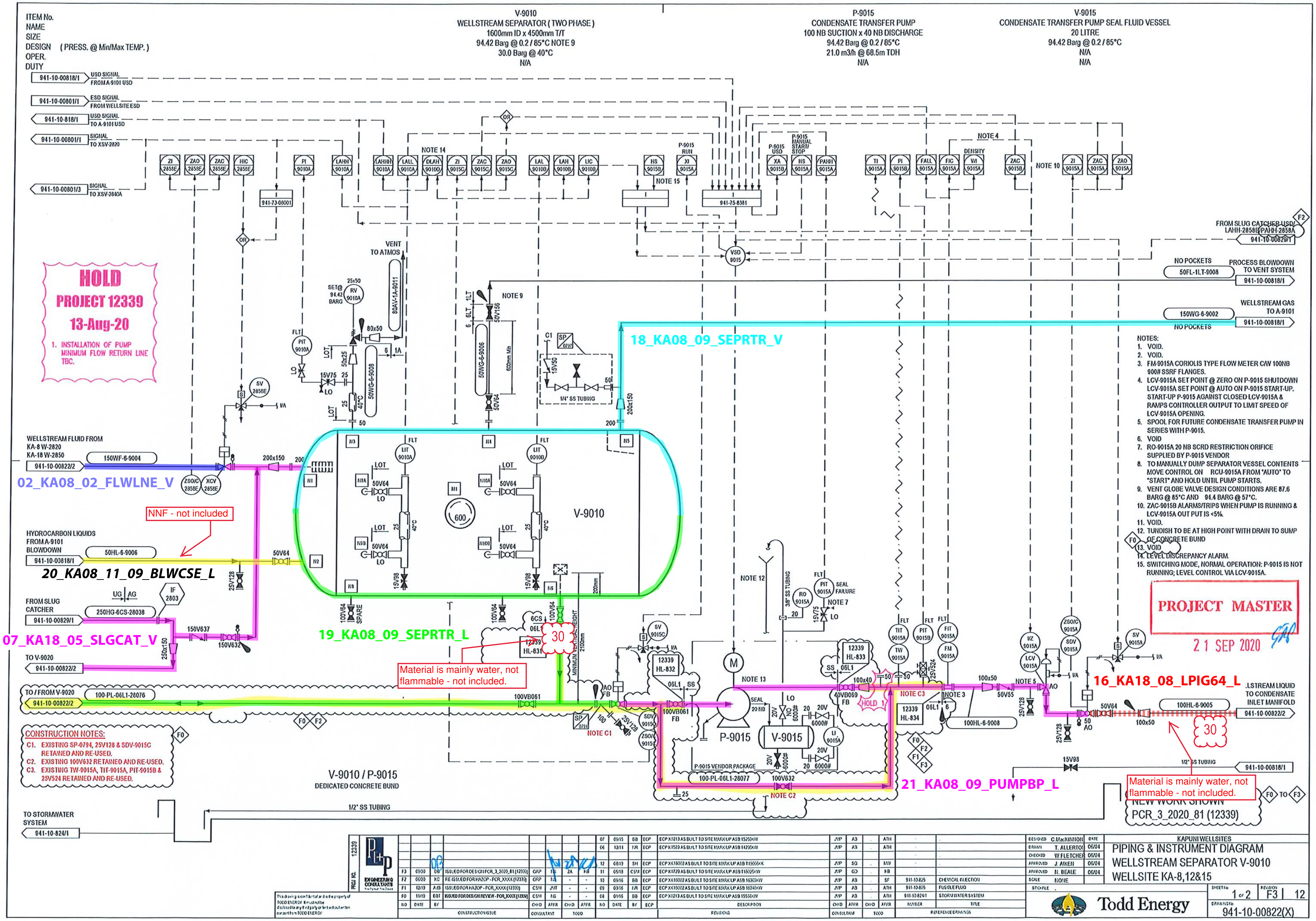
KAPUNI WELLSITES

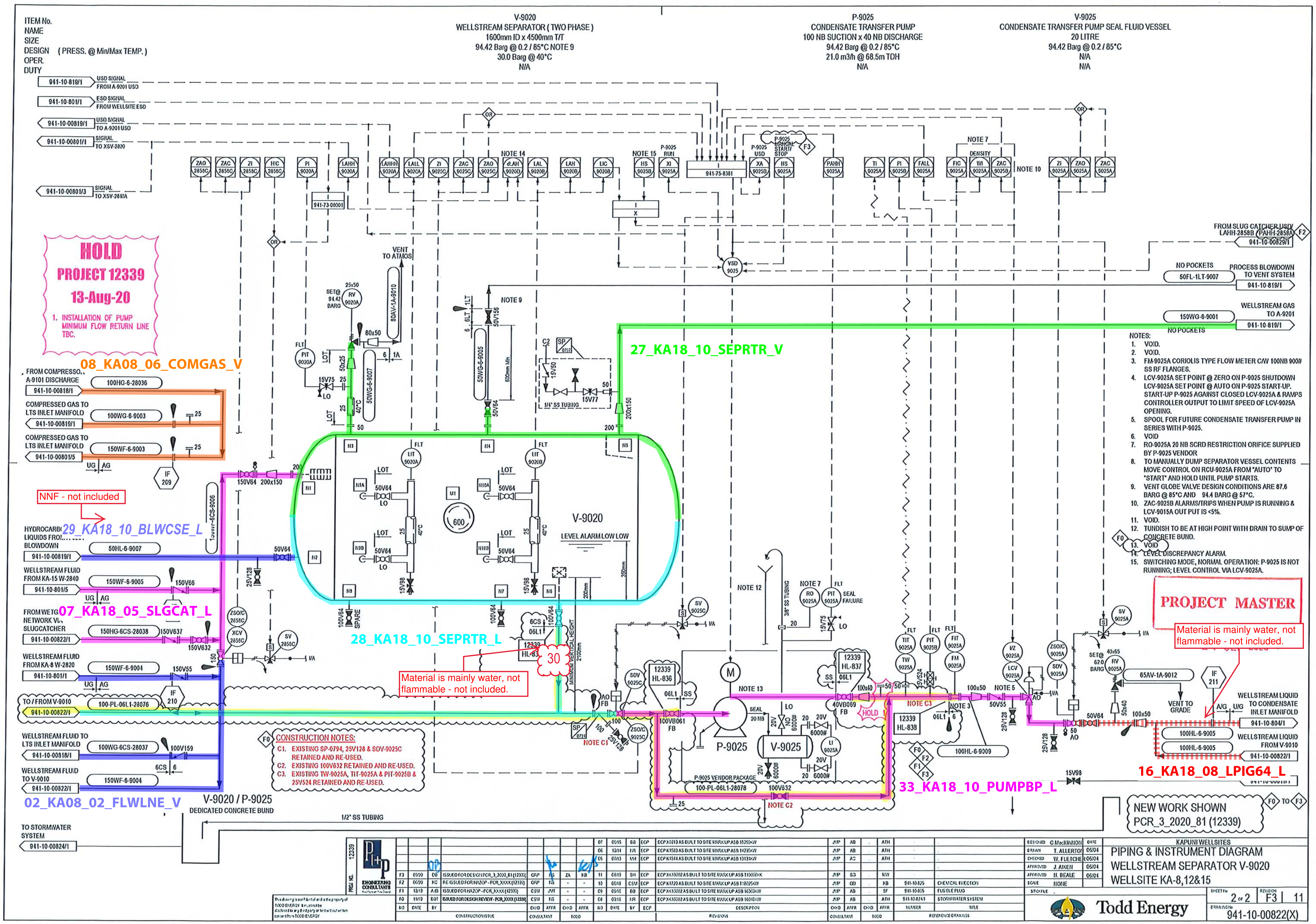
PIPING & INSTRUMENTATION DIAGRAM FUEL GAS CONDITIONING PACKAGE A-9029 WELLSITES KA-8, 12 & 15

Todd Energy

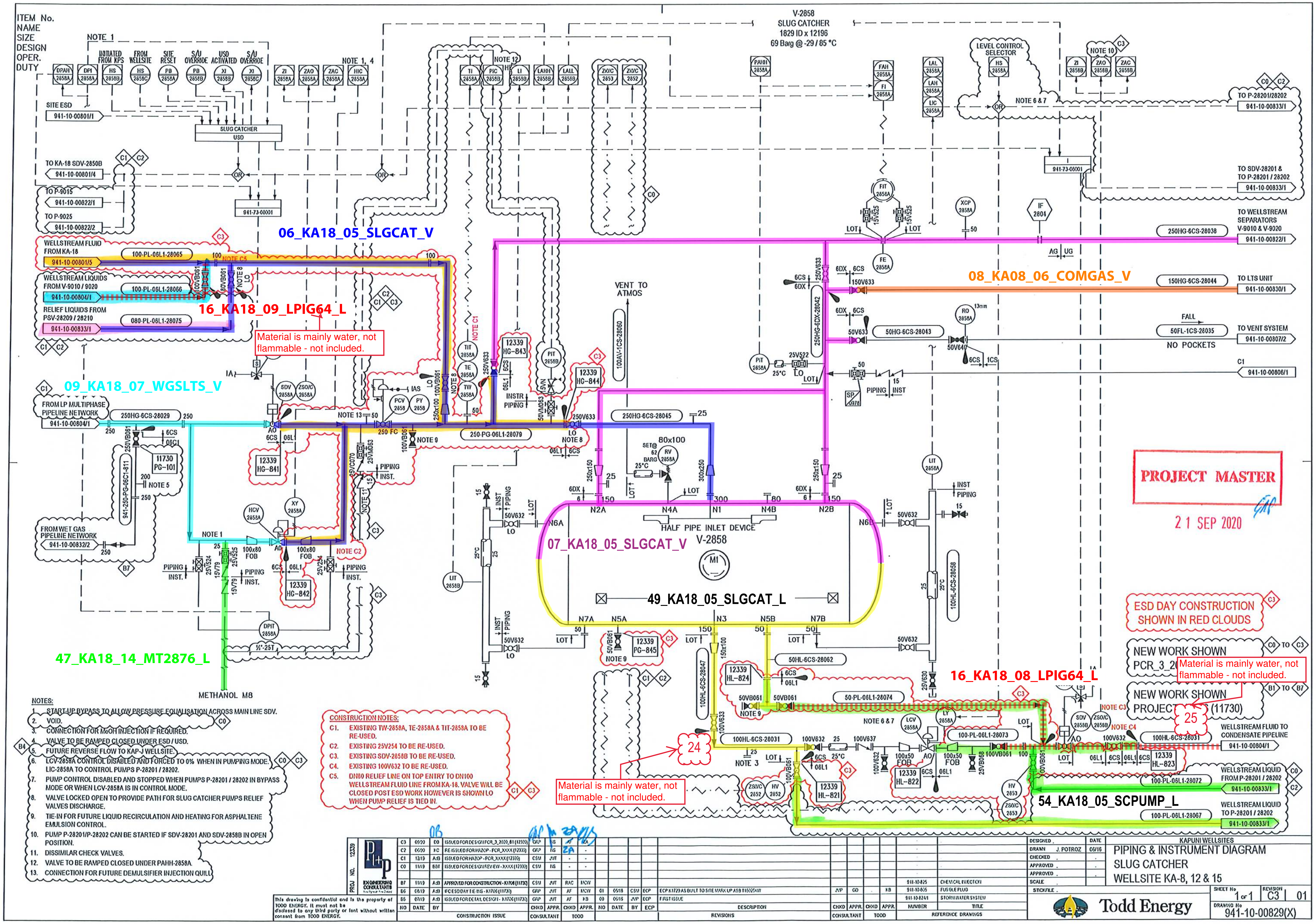
SHEET No 1 OF 1 | REVISION 03

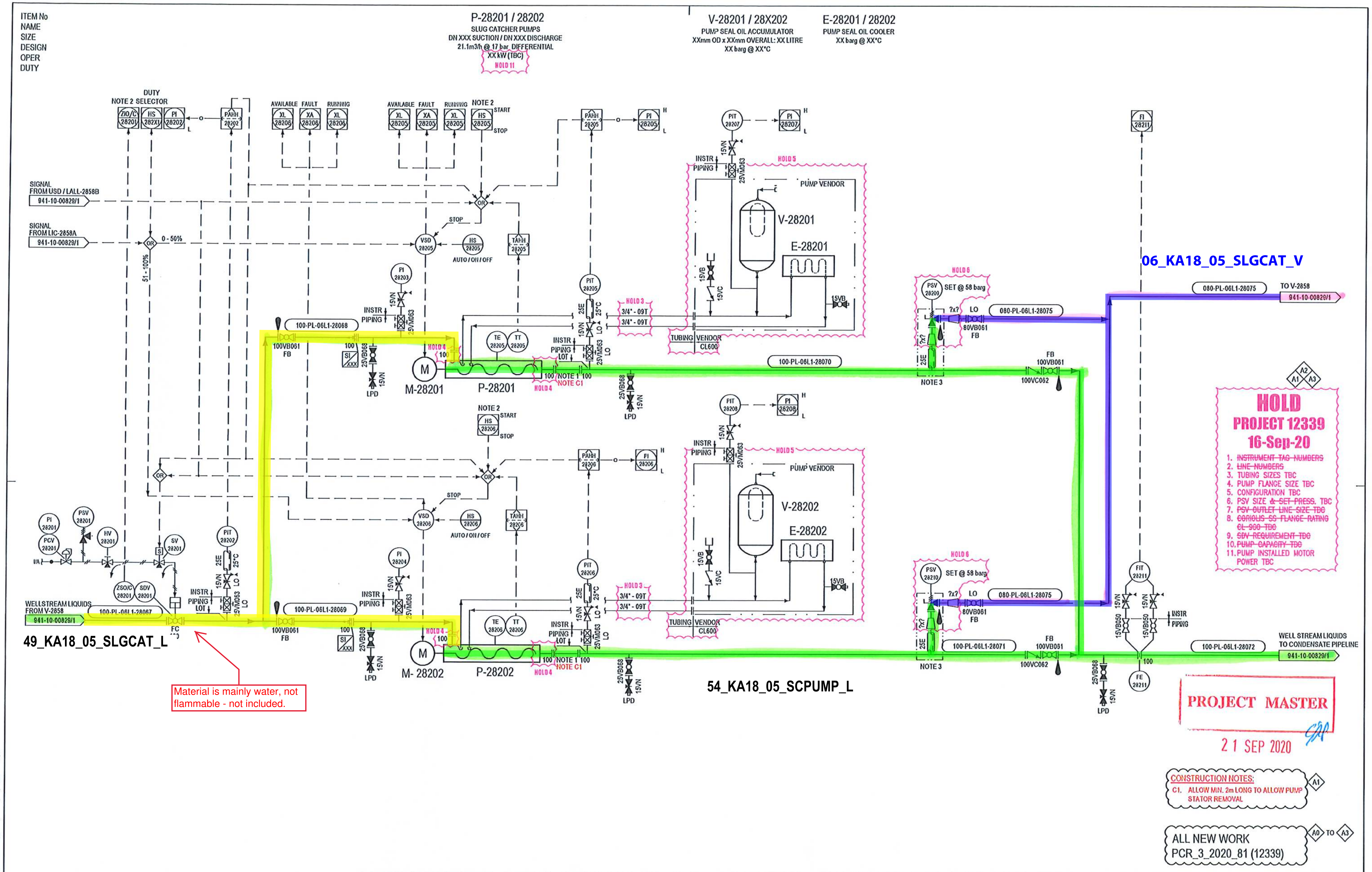
DRAWING No 941-10-00820


ITEM No.
NAME
SIZE
DESIGN (PRESS. @ Min/Max TEMP.)
OPER.
DUTY
V-9010
WELLSTREAM SEPARATOR (TWO PHASE)
1600mm ID x 4500mm T/T
94.42 Barg @ 0.2 / 85°C NOTE 9
30.0 Barg @ 40°C
N/A
P-9015
CONDENSATE TRANSFER PUMP
100 NB SUCTION x 40 NB DISCHARGE
94.42 Barg @ 0.2 / 85°C
21.0 m3/h @ 68.5m TDH
N/A
V-9015
CONDENSATE TRANSFER PUMP SEAL FLUID VESSEL
20 LITRE
94.42 Barg @ 0.2 / 85°C
N/A
N/A
941-10-00818/1 USD SIGNAL FROM A-9101 USD
941-10-00801/1 ESD SIGNAL FROM WELLSITE ESD
941-10-818/1 USD SIGNAL TO A-9101 USD
941-10-00801/1 SIGNAL TO XSV-2820
941-10-00801/3 SIGNAL TO XSV-2840A
HOLD
PROJECT 12339
13-Aug-20
1. INSTALLATION OF PUMP MINIMUM FLOW RETURN LINE TBC.
VENT TO ATMOS
18_KA08_09_SEPRTR_V
02_KA08_02_FLWLNE_V
NNF - not included
20_KA08_11_09_BLWCSE_L
07_KA18_05_SLGCAT_V
19_KA08_09_SEPRTR_L
Material is mainly water, not flammable - not included.
16_KA18_08_LPIG64_L
21_KA08_09_PUMPBP_L
Material is mainly water, not flammable - not included.
WELLSTREAM FLUID FROM KA-8 W-2820 KA-18 W-2850
941-10-00822/2
150WF-6-9004
HYDROCARBON LIQUIDS FROM A-9101 BLOWDOWN
941-10-00818/1
50HL-6-9006
FROM SLUG CATCHER
941-10-00829/1
250HG-6CS-28038
TO V-9020
941-10-00822/2
TO / FROM V-9020
941-10-00822/2
100-PL-06L1-28076
FROM SLUG CATCHER USD/ LAHH-2858E/PAHH-2858A
941-10-00829/1
NO POCKETS 50FL-1LT-9008 PROCESS BLOWDOWN TO VENT SYSTEM 941-10-00818/1
150WG-6-9002 WELLSTREAM GAS TO A-9101 941-10-00818/1 NO POCKETS
WELLSTREAM LIQUID TO CONDENSATE INLET MANIFOLD 941-10-00822/2
100HL-6-9005
100HL-6-9008
V-9010
P-9015
V-9015
P-9015 VENDOR PACKAGE
100-PL-06L1-28077
V-9010 / P-9015
DEDICATED CONCRETE BUND
1/2" SS TUBING
TO STORMWATER SYSTEM
941-10-824/1
NOTES:
1. VOID.
2. VOID.
3. FM-9015A CORIOLIS TYPE FLOW METER C/W 100NB 900# SSRF FLANGES.
4. LCV-9015A SET POINT @ ZERO ON P-9015 SHUTDOWN LCV-9015A SET POINT @ AUTO ON P-9015 START-UP. START-UP P-9015 AGAINST CLOSED LCV-9015A & RAMPS CONTROLLER OUTPUT TO LIMIT SPEED OF LCV-9015A OPENING.
5. SPOOL FOR FUTURE CONDENSATE TRANSFER PUMP IN SERIES WITH P-9015.
6. VOID
7. RO-9015A 20 NB SCRD RESTRICTION ORIFICE SUPPLIED BY P-9015 VENDOR
8. TO MANUALLY DUMP SEPARATOR VESSEL CONTENTS MOVE CONTROL ON RCU-9015A FROM "AUTO" TO "START" AND HOLD UNTIL PUMP STARTS.
9. VENT GLOBE VALVE DESIGN CONDITIONS ARE 87.6 BARG @ 85°C AND 94.4 BARG @ 57°C.
10. ZAC-9015B ALARMS/TRIPS WHEN PUMP IS RUNNING & LCV-9015A OUT PUT IS <5%.
11. VOID.
12. TUNDISH TO BE AT HIGH POINT WITH DRAIN TO SUMP OF CONCRETE BUND
13. VOID
14. LEVEL DISCREPANCY ALARM.
15. SWITCHING MODE, NORMAL OPERATION: P-9015 IS NOT RUNNING; LEVEL CONTROL VIA LCV-9015A.
PROJECT MASTER
21 SEP 2020
CONSTRUCTION NOTES:
C1. EXISTING SP-0794, 25V128 & SDV-9015C RETAINED AND RE-USED.
C2. EXISTING 100V632 RETAINED AND RE-USED.
C3. EXISTING TW-9015A, TIT-9015A, PIT-9015B & 25V524 RETAINED AND RE-USED.
NEW WORK SHOWN
PCR_3_2020_81 (12339)
KAPUNI WELLSITES
PIPING & INSTRUMENT DIAGRAM
WELLSTREAM SEPARATOR V-9010
WELLSITE KA-8,12&15
Todd Energy
941-10-00822(X)
SHEET 1 of 2
REVISION F3
12
ISSUED FOR DESIGN PCR_3_2020_81 (12339)
RE ISSUED FOR HAZOP - PCR_XXXX (12339)
ISSUED FOR HAZOP - PCR_XXXX (12339)
ISSUED FOR DESIGN REVIEW - PCR_XXXX (12339)
DESIGNED C.MacKINNON
DRAWN T. ALLERTON
CHECKED W.FLETCHER
APPROVED J. AIKEN
APPROVED N. BEALE
SCALE NONE



ITEM No.
NAME
SIZE
DESIGN (PRESS. @ Min/Max TEMP.)
OPER.
DUTY
V-9020
WELLSTREAM SEPARATOR (TWO PHASE)
1600mm ID x 4500mm T/T
94.42 Barg @ 0.2 / 85°C NOTE 9
30.0 Barg @ 40°C
N/A
P-9025
CONDENSATE TRANSFER PUMP
100 NB SUCTION x 40 NB DISCHARGE
94.42 Barg @ 0.2 / 85°C
21.0 m3/h @ 68.5m TDH
N/A
V-9025
CONDENSATE TRANSFER PUMP SEAL FLUID VESSEL
20 LITRE
94.42 Barg @ 0.2 / 85°C
N/A
N/A
HOLD
PROJECT 12339
13-Aug-20
1. INSTALLATION OF PUMP MINIMUM FLOW RETURN LINE TBC.
08_KA08_06_COMGAS_V
27_KA18_10_SEPRTR_V
NNF - not included
29_KA18_10_BLWCSE_L
07_KA18_05_SLGCAT_L
28_KA18_10_SEPRTR_L
Material is mainly water, not flammable - not included.
02_KA08_02_FLWLNE_V
33_KA18_10_PUMPBP_L
16_KA18_08_LPIG64_L
PROJECT MASTER
Material is mainly water, not flammable - not included.
V-9020
LEVEL ALARM LOW LOW
V-9020 / P-9025
DEDICATED CONCRETE BUND
TO STORMWATER SYSTEM
941-10-00824/1
NOTES:
1. VOID.
2. VOID.
3. FM-9025A CORIOLIS TYPE FLOW METER C/W 100NB 900# SS RF FLANGES.
4. LCV-9025A SET POINT @ ZERO ON P-9025 SHUTDOWN. LCV-9025A SET POINT @ AUTO ON P-9025 START-UP. START-UP P-9025 AGAINST CLOSED LCV-9025A & RAMPS CONTROLLER OUTPUT TO LIMIT SPEED OF LCV-9025A OPENING.
5. SPOOL FOR FUTURE CONDENSATE TRANSFER PUMP IN SERIES WITH P-9025.
6. VOID
7. RO-9025A 20 NB SCRD RESTRICTION ORIFICE SUPPLIED BY P-9025 VENDOR
8. TO MANUALLY DUMP SEPARATOR VESSEL CONTENTS MOVE CONTROL ON RCU-9025A FROM "AUTO" TO "START" AND HOLD UNTIL PUMP STARTS.
9. VENT GLOBE VALVE DESIGN CONDITIONS ARE 87.6 BARG @ 85°C AND 94.4 BARG @ 57°C.
10. ZAC-9025B ALARMS/TRIPS WHEN PUMP IS RUNNING & LCV-9015A OUT PUT IS <5%.
11. VOID.
12. TUNDISH TO BE AT HIGH POINT WITH DRAIN TO SUMP OF CONCRETE BUND.
13. VOID
14. LEVEL DISCREPANCY ALARM.
15. SWITCHING MODE, NORMAL OPERATION: P-9025 IS NOT RUNNING; LEVEL CONTROL VIA LCV-9025A.
CONSTRUCTION NOTES:
C1. EXISTING SP-0794, 25V128 & SDV-9025C RETAINED AND RE-USED.
C2. EXISTING 100V632 RETAINED AND RE-USED.
C3. EXISTING TW-9025A, TIT-9025A & PIT-9025B & 25V524 RETAINED AND RE-USED.
NEW WORK SHOWN
PCR_3_2020_81 (12339)
KAPUNI WELLSITES
PIPING & INSTRUMENT DIAGRAM
WELLSTREAM SEPARATOR V-9020
WELLSITE KA-8,12&15
Todd Energy
2 of 2
F3
11
941-10-00822(X)


V-2858
SLUG CATCHER
1829 ID x 12196
69 Barg @ -29 / 85 °C
06_KA18_05_SLGCAT_V
07_KA18_05_SLGCAT_V
08_KA08_06_COMGAS_V
09_KA18_07_WGSLTS_V
16_KA18_09_LPIG64_L
16_KA18_08_LPIG64_L
47_KA18_14_MT2876_L
49_KA18_05_SLGCAT_L
54_KA18_05_SCPUMP_L
Material is mainly water, not flammable - not included.
WELLSTREAM FLUID FROM KA-18
WELLSTREAM LIQUIDS FROM V-9010 / 9020
RELIEF LIQUIDS FROM PSV-28209 / 28210
FROM LP MULTIPHASE PIPELINE NETWORK
FROM WET GAS PIPELINE NETWORK
TO WELLSTREAM SEPARATORS V-9010 & V-9020
TO LTS UNIT
TO VENT SYSTEM
NO POCKETS
VENT TO ATMOS
HALF PIPE INLET DEVICE
METHANOL M8
WELLSTREAM FLUID TO CONDENSATE PIPELINE
WELLSTREAM LIQUID FROM P-28201 / 28202
WELLSTREAM LIQUID TO P-28201 / 28202
PROJECT MASTER
21 SEP 2020
ESD DAY CONSTRUCTION SHOWN IN RED CLOUDS
NEW WORK SHOWN
NOTES:
1. START-UP BYPASS TO ALLOW PRESSURE EQUALISATION ACROSS MAIN LINE SDV.
2. VOID.
3. CONNECTION FOR MeOH INJECTION IF REQUIRED.
4. VALVE TO BE RAMPED CLOSED UNDER ESD / USD.
5. FUTURE REVERSE FLOW TO KAP-J WELLSITE.
6. LCV-2858A CONTROL DISABLED AND FORCED TO 0% WHEN IN PUMPING MODE. LIC-2858A TO CONTROL PUMPS P-28201 / 28202.
7. PUMP CONTROL DISABLED AND STOPPED WHEN PUMPS P-28201 / 28202 IN BYPASS MODE OR WHEN LCV-2858A IS IN CONTROL MODE.
8. VALVE LOCKED OPEN TO PROVIDE PATH FOR SLUG CATCHER PUMPS RELIEF VALVES DISCHARGE.
9. TIE-IN FOR FUTURE LIQUID RECIRCULATION AND HEATING FOR ASPHALTENE EMULSION CONTROL.
10. PUMP P-28201/P-28202 CAN BE STARTED IF SDV-28201 AND SDV-2858B IN OPEN POSITION.
11. DISSIMILAR CHECK VALVES.
12. VALVE TO BE RAMPED CLOSED UNDER PAHH-2858A.
13. CONNECTION FOR FUTURE DEMULSIFIER INJECTION QUILL.
CONSTRUCTION NOTES:
C1. EXISTING TW-2858A, TE-2858A & TIT-2858A TO BE RE-USED.
C2. EXISTING 25V254 TO BE RE-USED.
C3. EXISTING SDV-2858B TO BE RE-USED.
C4. EXISTING 100V632 TO BE RE-USED.
C5. DN80 RELIEF LINE ON TOP ENTRY TO DN100 WELLSTREAM FLUID LINE FROM KA-18. VALVE WILL BE CLOSED POST ESD WORK HOWEVER IS SHOWN LO WHEN PUMP RELIEF IS TIED IN.
KAPUNI WELLSITES
PIPING & INSTRUMENT DIAGRAM
SLUG CATCHER
WELLSITE KA-8, 12 & 15
Todd Energy
SHEET No 1 OF 1
REVISION C3 01
DRAWING No 941-10-00829(X)
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.



NOTES:

1. DROP OUT SPOOL FOR PUMP STATOR REMOVAL.
2. PUMP P-28201 / P28202 CAN ONLY BE STARTED IF SDV-28201 AND SDV-2858B ARE IN OPEN POSITION.
3. HEAT TRACED AND INSULATED 25E.

NO	DATE	BY	DESCRIPTION				
A3	09/20	DB	ISSUED FOR DESIGN PCR_3_2020_81 (12339)	GRP		ZA	KB
A2	09/20	KC	RE-ISSUED FOR HAZOP - PCR_XXXX (12339)	GRP	NS		
A1	12/19	ASB	ISSUED FOR HAZOP - PCR_XXXX (12339)	CSM	JVT		
A0	11/19	BDT	ISSUED FOR DESIGN REVIEW - PCR_XXXX (12339)	CSM	NS		
00	11/13	BDT	FIRST ISSUE - PCR_XXXX (12339)				

DESIGNED		DATE
DRAWN	B. BERGER	11/19
CHECKED	C.S. MacKINNON	11/19
APPROVED	N. SANGUEZA	11/19
APPROVED	M.C. WENG	11/19
SCALE	NTS	

KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM
SLUG CATCHER PUMPS P-28201 & P-28202
WELLSITE KA-8,12, 15 & 18

Todd Energy

SHEET 1 of 1 | A3 | REVISION 00

DRAWING No 941-10-00833(X)

NOTES:

1. RELIEF VALVE TAIL PIPES ARE NOT ROUTED TO SAFE LOCATION AS PER STOS UNMANNED WELLSITE & BLOWDOWN PHILOSOPHY.
2. DURING MAINTENANCE OF LTS SKID EQUIPMENT, THIS SPOOL IS TO BE REMOVED & THE 3 ASSOCIATED VALVES BLANKED. PIPING DESIGN TO ENSURE EASE OF SPOOL REMOVAL.
3. STARTUP OVERRIDE XS-XXXX (TIMES OUT AFTER 45 MINS) OVERRIDES THE FOLLOWING SKID ESD SIGNALS: TSL-2808C, PSL-XXXX OVERRIDES SHOWN IN THIS DRAWING ARE FOR CLARIFICATION ONLY. SIMPLIFIED.
4. REFER TO DWG 941-10-00806/1 & 2 FOR INJECTION SYSTEMS.
5. TCV-2808A MUST BE 100% OPEN PRIOR TO START UP.
6. DO NOT HYDROTEST. FLANGES ARE 316/316L SS.
7. TRACE RV-2808A DISCHARGE PIPE UP TO THE ELBOW & UPSTREAM OF WEEP HOLE.
8. LCV-2808A TO OPERATE IN GAP CONTROL FOR TURNAROUND.
9. SURFACE MOUNTED TEMPERATURE INDICATOR WITH LOCAL LAGGING.
10. CONNECTION POINT FOR PRODUCTION TESTING.
11. LOCAL MIMIC SCREEN AT WELLSITE.
12. LTS CHOKE SWITCHED TO MANUAL & FULLY CLOSED (0%) UPON USD.
13. HC & WATER TOTALIZED FLOW BASED ON ASSUMED LIQUID DENSITIES, CORIOLIS MASS FLOW & DENSITY MEASUREMENT.
14. START UP OVERRIDE PROVIDED ON LAHH-2808A.
15. DESIGN PRESSURE OF LINE = 69 BARG.

NO	DATE	BY	CONSTRUCTION ISSUE	CHKD	APPR.	CHKD	APPR.
~~A4~~	~~02/18~~	~~CSM~~	~~K1729 CUSP RE-APPR. FOR CONSTRUCTION~~	~~GD~~	~~SJG~~		~~SF~~
~~A3~~	~~10/17~~	~~CSM~~	~~K1729 CUSP APPR. FOR CONSTRUCTION~~	~~ML~~	~~GD~~		~~SF~~
~~A2~~	~~07/17~~	~~NR~~	~~ECP K1729 APPROVED FOR DESIGN~~	~~ML~~	~~GD~~		~~SF~~
~~A1~~	~~09/16~~	~~JMP~~	~~CUSP PROJECT ISSUED FOR HAZOP~~	~~SG~~	~~ML~~		
~~A0~~	~~08/16~~	~~AMC~~	~~CUSP PROJECT ISSUED FOR REVIEW~~	~~ML~~	~~SG~~		

(CHKD/APPR.: CONSULTANT, TODD)

NO	DATE	BY	ECP	DESCRIPTION (REVISIONS)	CHKD	APPR.	CHKD	APPR.
01	05/18	CSM	ECP	ECP K1729 AS BUILT TO SITE MARK UP ASB T18025KW	JMP	GD	.	KB
00	09/16	JMP		FIRST ISSUE				

(CHKD/APPR.: CONSULTANT, TODD)

NUMBER	TITLE
.	.

REFERENCE DRAWINGS

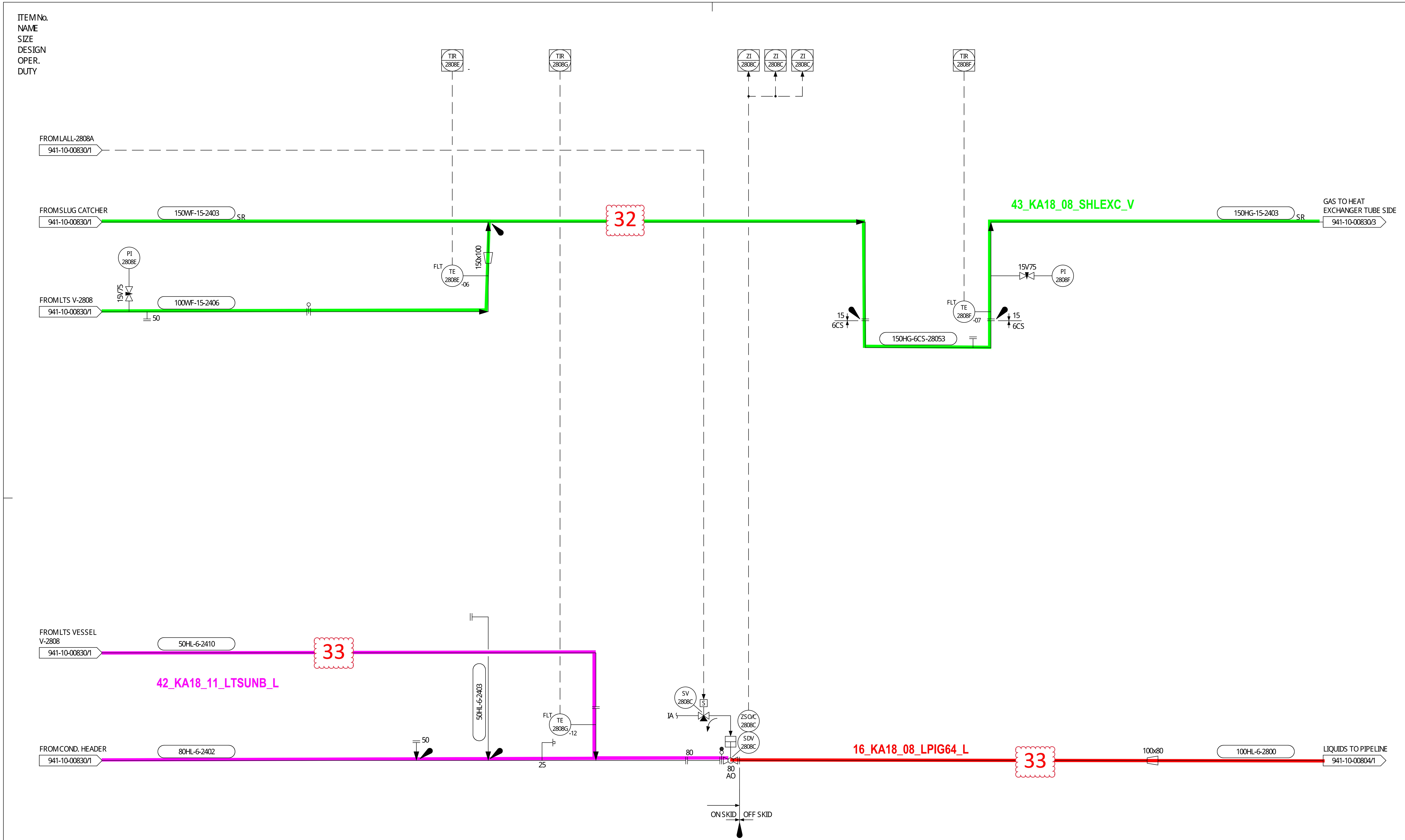
DESIGNED .
DRAWN J.POTROZ DATE 09/16
CHECKED
APPROVED
APPROVED
SCALE NTS
STICKFILE .

KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM
LTS UNIT
KA-8, 12 & 15

Todd Energy

SHEET No 1 OF 3
REVISION 01
DRAWING No 941-10-00830



								NO	DATE	BY	ECP	DESCRIPTION	CHKD	APPR.	CHKD	APPR.	NUMBER	TITLE
~~A4~~	~~02/18~~	~~CSM~~	~~K1729 CUSP RE-APPR. FOR CONSTRUCTION~~	~~GD~~	~~SJG~~		~~SF~~										.	.
~~A3~~	~~10/17~~	~~CSM~~	~~K1729 CUSP APPR. FOR CONSTRUCTION~~	~~ML~~	~~GD~~		~~SF~~										.	.
~~A2~~	~~07/17~~	~~NR~~	~~ECP K1729 APPROVED FOR DESIGN~~	~~ML~~	~~GD~~		~~SF~~										.	.
~~A1~~	~~10/16~~	~~JMP~~	~~CUSP PROJECT ISSUED FOR HAZOP~~	~~SG~~	~~ML~~			01	05/18	CSM	ECP	ECP K1729 AS BUILT TO SITE MARK UP AS B T18025KW	JMP	GD	.	KB	.	.
~~A0~~	~~09/16~~	~~JMP~~	~~CUSP PROJECT ISSUED FOR HAZOP~~	~~NS~~	~~ML~~			00	09/16	JMP		FIRST ISSUE					.	.
NO	DATE	BY		CHKD	APPR.	CHKD	APPR.											
CONSTRUCTION ISSUE				CONSULTANT		TODD		REVISIONS					CONSULTANT		TODD		REFERENCE DRAWINGS	

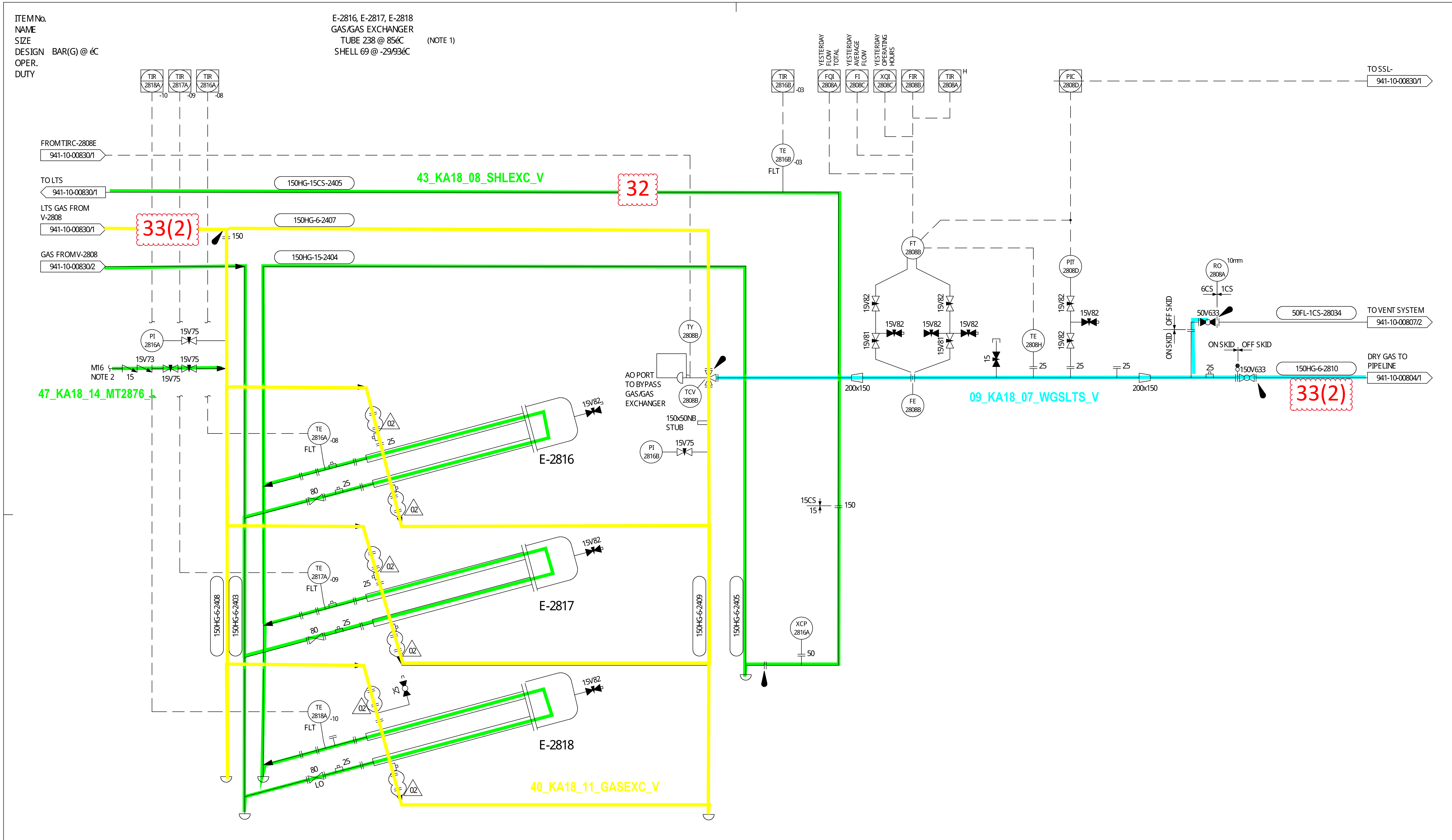
DESIGNED	.	DATE
DRAWN	J.POTROZ	09/16
CHECKED		
APPROVED		
APPROVED		
SCALE	NTS	
STICKFILE	.	

KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM
LTS UNIT
KA-8, 12 & 15

Todd Energy

SHEET No 2 OF 3
REVISION . 01
DRAWING No 941-10-00830



NOTES
1. SECONDARY DESIGN CONDITIONS 248@-3/38éC.
2. REFER DWG 941-10-00806/1 FOR INJECTION SYSTEM.

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.
~~A4~~	~~02/18~~	~~CSM~~	~~K1729 CUSP RE-APPR. FOR CONSTRUCTION~~	~~GD~~	~~SJG~~		~~SF~~
~~A3~~	~~10/17~~	~~CSM~~	~~K1729 CUSP APPR. FOR CONSTRUCTION~~	~~ML~~	~~GD~~		~~SF~~
~~A2~~	~~07/17~~	~~NR~~	~~ECP K1729 APPROVED FOR DESIGN~~	~~ML~~	~~GD~~		~~SF~~
~~A1~~	~~10/16~~	~~JMP~~	~~CUSP PROJECT ISSUED FOR HAZOP~~	~~SG~~	~~ML~~		
~~A0~~	~~09/16~~	~~JMP~~	~~CUSP PROJECT ISSUED FOR HAZOP~~	~~NS~~	~~ML~~		

NO	DATE	BY	ECP	DESCRIPTION (REVISIONS)	CHKD	APPR.	CHKD	APPR.
02	08/19	BB	.	XK18002 AS BUILT TO SITE MARK UP ASB T19010KW	JMP	AB	.	MW
01	05/18	CSM	ECP	ECP K1729 AS BUILT TO SITE MARK UP ASB T18025KW	JMP	GD	.	KB
00	09/16	JMP		FIRST ISSUE				

REFERENCE DRAWINGS	
NUMBER	TITLE

DESIGNED	.	
DRAWN	J.POTROZ	09/16
CHECKED		
APPROVED		
APPROVED		
SCALE	NTS	
STICKFILE	.	

KAPUNI WELLSITES
PIPING & INSTRUMENT DIAGRAM
UNIT B
KA-8, 12 & 15

Todd Energy

SHEET No 3 OF 3
REVISION 02
DRAWING No 941-10-00830

Appendix 7.
P&ID Sectionalisation for KA-13

NOTES:

1. TIE-IN POINT FOR SECOND KA-13 FLOWLINE CROSSOVER
2. EROSION PROBE.
3. FLOWLINES & ALL CABLES & OTHER LINES FROM TO UNIT HAVE BEEN LOCATED IN A COVERED CONCRETE SELF-DRAINING TRENCH.
4. THIS LINE HAS BEEN DERATED FROM SPEC 50/50A TO SPEC 15. FLANGES REMAIN AT 5000#.
5. 20 SECOND DELAY IN SV-21330 B1 (SUBSURFACE SAFETY VALVE) ON CLOSING. 20 SECOND DELAY ON SV-21330 A1 (FLOWLINE SAFETY VALVE) ON OPENING.
6. STARTUP OVERIDE PB-21330C (TIMES OUT AFTER 30 MINUTES OR XS-21330C TO NORMAL POSITION) OVERRIDES THE FOLLOWING ESD SIGNALS; PALL-21330A, PALL-21310B, PALL-21310C.
7. VALVES INDICATING SIZE ONLY ARE NOT GIVEN A V NUMBER AS THEY DO NOT CONFORM WITH SPEC 5.1
8. HCV-21330A IS NOT SUITABLE FOR TEMPERATURES BELOW -29°C WHICH MAY OCCUR ON LP OPERATING MODE STARTUP.
9. PCV-21346B BACK PRESSURE REGULATOR TO SHUTDOWN P-21346 BELOW 6 BARG AIR PRESSURE.
10. FLOWLINE CHOKE TO BE RAMPED CLOSED UNDER USD, ESD, KPS-ESD, OR ALL KPS INLET VAVES CLOSED.
11. DRY BREAK CONNECTION LOCATED AT CHEMICAL INJECTION SKID.

NO	DATE	BY	DESCRIPTION	CHKD	APPR.	CHKD	APPR.
G2	01/17	JMP	ECP K1729 APPROVED FOR CONSTRUCTION	ML	NS	.	SF
G1	11/16	JMP	CUSP PROJ. APPROVED FOR DESIGN	ML	NS	.	SF
G0	08/16	JMP	CUSP PROJ. ISSUED FOR HAZOP	TD	ML	.	.
F0	04/08	KN	S14366 ISSUED FOR REVIEW	ML	PWM	.	.
E1	12/99	AGM	EWR K496 ISSUED FOR CONSTRUCTION	PM	AM	.	TAF
E0	09/99	JW	EWR K496 ISSUED FOR DESIGN	PM	AM	.	TAF
G3	04/17	NR	ECP K1729 RE-APPROVED FOR CONST.	GD	SG	.	SF

NO	DATE	BY	ECP	DESCRIPTION	CHKD	APPR.	CHKD	APPR.
29	11/19	SH	ECP	ECP XK18002 AS BUILT TO SITE MARKUP ASB T19013KW	JMP	SG	.	MW
28	04/18	CSM	ECP	ECP K1729 AS BUILT TO SITE MARK UP ASB T18023KW	JMP	GD	.	KB
27	01/18	LS	ECP	ECP XK17172 AS BUILT TO SITE MARK UP ASB T171202	JMP	TD	.	KB
26	07/17	RR	ECP	ECP K1729 AS BUILT TO SITE MARK UP ASB 17243KW	JMP	TD	.	SF
25	09/16	BB	ECP	ECP XK16002 AS BUILT TO SITE MARK UP ASB 16369KW	JMP	AB	.	SF
24	05/16	BB	ECP	ECP XK16002 AS BUILT TO SITE MARK UP ASB 16131KW	JMP	AB	.	SF
23	04/13	JC	ECP	ECP K1544 ISSUED IN ERROR	.	.	.	.
22	04/13	JC	ECP	ECP K1544 AS BUILT TO SITE MARK UP ASB 13068KW	JMP	AC	.	ATH

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

DESIGNED	.	
DRAWN	VG	11-6-84
CHECKED	J.C, TTS	25-6-84
APPROVED	PL	25-6-84
APPROVED	M. SHMER	25-6-84
SCALE	NONE	
STICKFILE	.	

KAPUNI WELLSITES

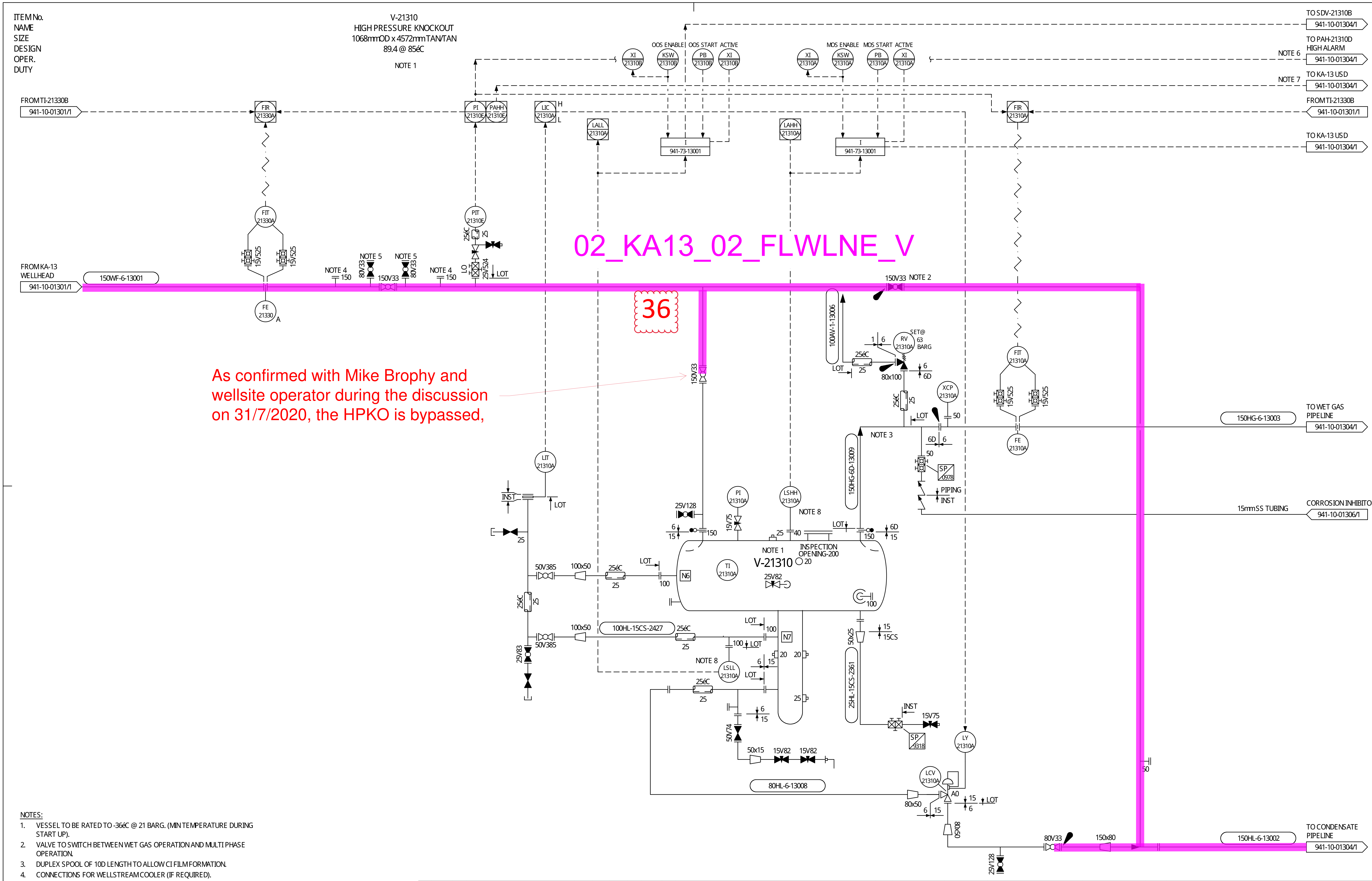
PIPING & INSTRUMENT DIAGRAM WELLHEAD WELLSITE KA-13

Todd Energy

SHEET No 1 OF 2 — REVISION 29

DRAWING No. 941-10-01301

ITEM No. V-21310
NAME HIGH PRESSURE KNOCKOUT
SIZE 1068mmOD x 4572mm TAN/TAN
DESIGN 89.4 @ 85éC
OPER.
DUTY
NOTE 1



NOTES:

1. VESSEL TO BE RATED TO -36éC @ 21 BARG. (MIN TEMPERATURE DURING START UP).
2. VALVE TO SWITCH BETWEEN WET GAS OPERATION AND MULTI PHASE OPERATION.
3. DUPLEX SPOOL OF 10D LENGTH TO ALLOW CI FILM FORMATION.
4. CONNECTIONS FOR WELLSTREAM COOLER (IF REQUIRED).
5. CONNECTIONS FOR PORTABLE WELL TESTING SEPARATOR.
6. MID-SELECT CONFIGURATION WITH SHARING OF SENSOR ELEMENT FOR PRE-ALARM (MULTI-PHASE MODE).
7. HIGH HIGH TRIP FUNCTION FOR KA-13 LIQUID LINE TO BE 2oo3 FROM PIT-21310C/D/E.
8. MAXIMUM ALLOWABLE OPERATING PRESSURE OF THE SYSTEM IS LIMITED TO 89.4 BARG @ 85éC BY THE LSHH/LSLL-21310A INSTRUMENTS.

NO	DATE	BY	CONSTRUCTION ISSUE	CHKD	APPR.	CHKD	APPR.
A3	03/17	NR	ECP K1729 RE-APPROVED FOR CONST.	GD	SG		SF
A2	01/17	JMP	ECP K1729 APPROVED FOR CONSTRUCTION	ML	NS		SF
A1	11/16	JMP	CUSP PROJECT APPROVED FOR DESIGN	ML	NS		SF
A0	06/16	JMP	CUSP PROJECT ISSUED FOR HAZOP	TD	ML		

NO	DATE	BY	EWR	REVISIONS	CHKD	APPR.	CHKD	APPR.
01	07/17	RR	ECP	ECP K1729 AS BUILT TO SITE MARK UP ASB 17243KW	JMP	TD		SF
00	06/16	JMP	ECP	CUSP PROJECT FIRST ISSUE	ML	SG		

		DATE
DESIGNED		
DRAWN	J POTROZ	06/16
CHECKED	MONTREE	06/16
APPROVED	S GUNN	06/16
APPROVED		
SCALE	NONE	

KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM
HIGH PRESSURE KNOCK OUT
KA-13

SHELL TODD OIL SERVICES LIMITED
PRIVATE BAG NEW PLYMOUTH NEW ZEALAND

SHEET No 1 of 1 REVISION 01
DRAWING No 941-10-01321

NOTES:

1. THIS FLANGE HAS BEEN DERATED FROM SPEC 50/50A TO SPEC 15. FLANGES REMAIN AT 5000-#
2. TIE -IN FOR PRODUCTION TESTING.
3. PIPE CLAMP SENSOR.
4. WIRELESS INSTRUMENT.
5. ECP K1602 VALVES 150V34 & 150V55 REMOVED. AN ADDITIONAL SURGE DIVERTER INSTALLED ACROSS IF025. 6mm BONDING CABLE ATTACHED ACROSS IF032.
6. TIT/TI-21321A/21310D TO INDICATE POTENTIAL OVER-TEMP OF PIPE COATING (50éC) AND MINIMUM TEMPERATURE. TO BE LOCATED CLOSE TO PIPELINE..
7. CAMLOCK ADAPTOR & DUST CAP VERTICAL LINE WITH NO BEND. BIOCIDE DOSING THROUGH CONNECTION.
8. 600LB FLANGE IN SPEC 1 SERVICE.
9. MID-SELECT CONFIGURATION WITH SHARING OF SENSOR ELEMENTS FOR PRE-ALARM (MULTI-PHASE MODE).
10. HIGH HIGH TRIP FOR KA-13 LIQUID LINE TO BE 2oo3 VOTING FROM PIT-21310 C/D/E.
11. PALL & PAHH-21310B & LALL-21310A TO BE DISABLED DURING MULTIPHASE OPERATION TO AVOID SPURIOUS TRIPS.
12. PAHH-21310E FORCED TRIPPED WHEN NOT IN MULTIPHASE MODE.
13. RE-PRESSURISATION VALVE.

NO	DATE	BY	CONSTRUCTION ISSUE	CHKD	APPR.	CHKD	APPR.	NO	DATE	BY	ECP	DESCRIPTION	CHKD	APPR.	CHKD	APPR.	NUMBER	TITLE
~~E2~~	~~01/17~~	~~JMP~~	~~ECP K1729 APPROVED FOR CONSTRUCTION~~	~~ML~~	~~NS~~	.	~~SF~~	23	09/15	NR	ECP	ECP K1602 AS BUILT TO SITE MARK UP ASB 15296KW	JMP	AB	.	ATH	.	.
~~E1~~	~~11/16~~	~~JMP~~	~~CUSP PROJECT APPR. FOR DESIGN~~	~~ML~~	~~NS~~	.	~~SF~~	22	07/15	BB	ECP	ECP X0213 AS BUILT TO SITE MARK UP ASB 15254KK	JMP	AB		ATH	.	.
~~E0~~	~~10/16~~	~~JMP~~	~~CUSP PROJECT ISSUED FOR HAZOP~~	~~TD~~	~~ML~~	.	.	21	12/14	JMP	ECP	ECP K1602 AS BUILT TO SITE MARK UP ASB 14228KW	NR	AB		ATH	.	.
~~D0~~	~~05/02~~	~~HKS~~	~~EWR K534 APPROVED FOR CONSTRUCTION~~	~~CM/KM~~	~~AP~~	.	~~PAA~~	20	07/13	MH	ECP	ECP K1544 AS BUILT TO SITE MARK UP ASB 13134KW	JMP	AC		ATH	.	.
~~C2~~	~~02/00~~	~~RJR~~	~~EWR K496 RE-ISSUED FOR CONSTRUCTION~~	~~PM~~	~~AM~~	.	~~TAF~~										.	.
~~C1~~	~~12/99~~	~~AGM~~	~~EWR K496 ISSUED FOR CONSTRUCTION~~	~~PM~~	~~AM~~	.	~~TAF~~	26	08/19	SH	ECP	ECP XK18002 AS BUILT TO ASB T19008KK	JMP	SG	.	MW	.	.
.	.	.	.	.	.	.	.	25	07/17	RR	ECP	ECP K1729 AS BUILT TO SITE MARK UP ASB 17243KW	JMP	TD		SF	.	.
~~E3~~	~~04/17~~	~~NR~~	~~ECP K1729 RE-APPROVED FOR CONST.~~	~~GD~~	~~SG~~	.	~~SF~~	24	09/16	BB	ECP	ECP XK16002 AS BUILT TO SITE MARK UP ASB 16369KW	JMP	AB	.	SF	.	.
CONSTRUCTION ISSUE				CONSULTANT		TODD		REVISIONS					CONSULTANT		TODD		REFERENCE DRAWINGS	

DESIGNED	.	DATE
DRAWN	R WILSON	12-6-84
CHECKED	J C, TTS	25-6-84
APPROVED	RB	25-6-84
APPROVED	MSHWER	25-6-84
SCALE	-	
STICKFILE	.	

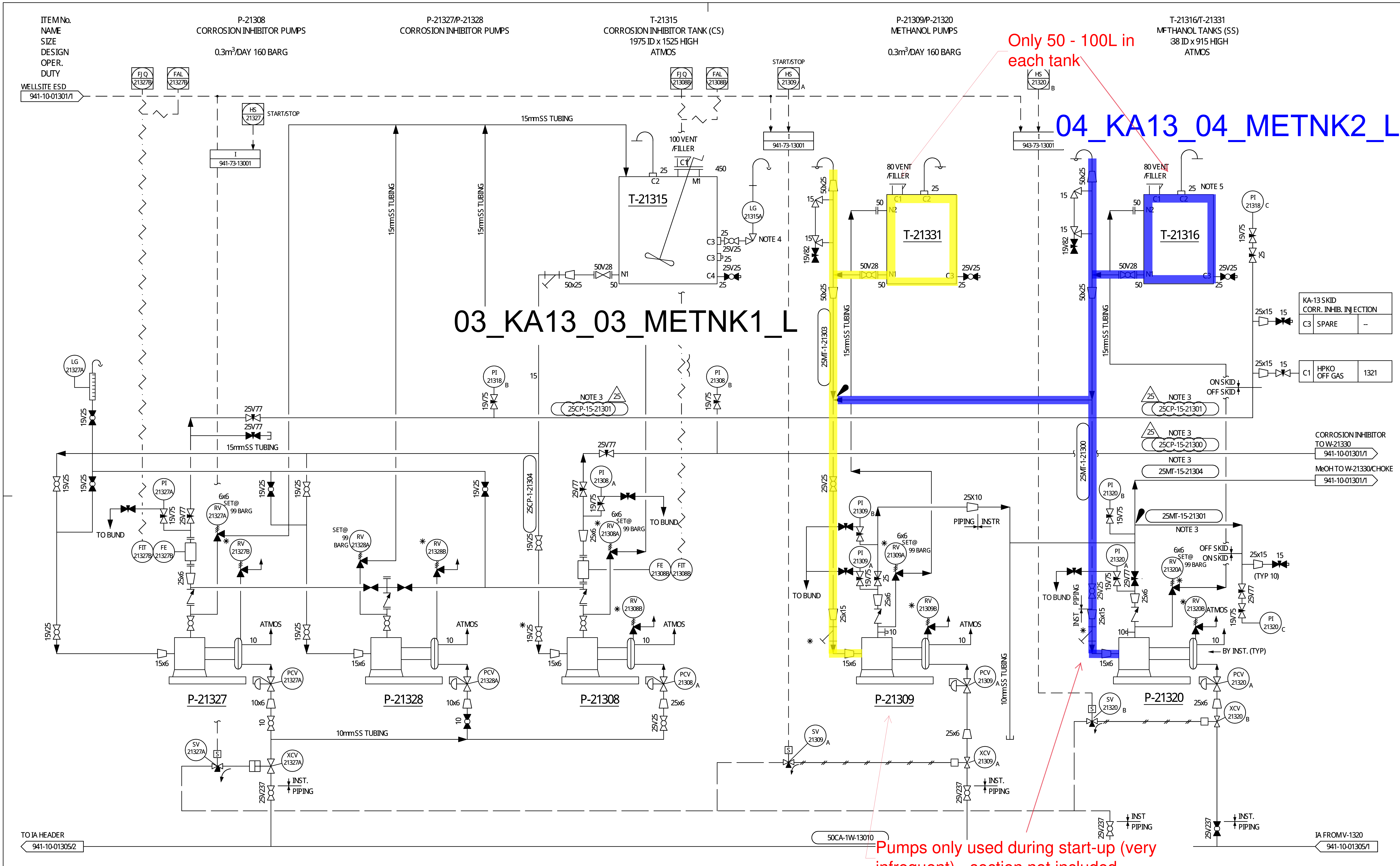
KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM GATHERING LINES WELLSITE KA-13

Todd Energy

SHEET No 1 OF 1 — REVISION . 26

DRAWING No 941-10-01304



NOTES:

- * VENDOR SUPPLY
1. FLAME ARRESTORS REPLACED BY GAUZE.
2. VOID.
3. THIS LINE HAS BEEN DERATED FROM SPEC 50/50A TO SPEC 15. FLANGES REMAIN AT 5000#
4. LG HAS A.S.V. (AUTOMATIC SAFETY VALVE) FITTED.
5. TANK WITHIN CERTIFICATION.

NO	DATE	BY	CONSTRUCTION ISSUE	CHKD (CONSULTANT)	APPR. (CONSULTANT)	CHKD (TODD)	APPR. (TODD)
~~D0~~	~~06/11~~	~~VB~~	~~ECP K1324 APPROVED FOR DESIGN - NOT REQ'D~~	~~DKH~~	~~PW~~		~~AI~~
~~C2~~	~~05/09~~	~~VB~~	~~ECP K1249 APPROVED FOR CONSTRUCTION~~	~~MK~~	~~PWM~~		
~~C1~~	~~03/09~~	~~DW~~	~~ECP K1249 APPROVED FOR DESIGN~~	~~MK~~	~~PWM~~		~~AI~~
.	.	.	.	.	.	.	
~~E3~~	~~03/17~~	~~NR~~	~~ECP K1729 RE-APPROVED FOR CONST.~~	~~GD~~	~~SG~~		~~SF~~
~~E2~~	~~01/17~~	~~JMP~~	~~ECP K1729 APPROVED FOR CONSTRUCTION~~	~~ML~~	~~NS~~		~~SF~~
~~E1~~	~~11/16~~	~~JMP~~	~~CUSP PROJECT APPR. FOR DESIGN~~	~~ML~~	~~NS~~		~~SF~~
~~E0~~	~~09/16~~	~~JMP~~	~~CUSP PROJECT ISSUED FOR HAZOP~~	~~TD~~	~~ML~~		

NO	DATE	BY	ECP	DESCRIPTION (REVISIONS)	CHKD (CONSULTANT)	APPR. (CONSULTANT)	CHKD (TODD)	APPR. (TODD)
23	02/12	MH	ECP	ECP K1353 AS BUILT TO SITE MARK UP ASB 12026KW	VB	JS		AI
22	01/11	KP	ECP	ECP K1379 AS BUILT TO SITE MARK UP ASB 10250KW	VB	LM	.	AI
21	06/10	BA	ECP	ECP K1379 AS BUILT TO SITE MARK UP ASB 10109KW	VB	AP		AI
20	03/10	BA	ECP	ECP K1249 AS BUILT TO SITE MARK UP ASB 10055KW	VB	AP		AI
19	09/09	JMP	ECP	ECP K1249 AS BUILT TO SITE MARK UP ASB 9174KW	VB	PWM		AI
25	04/18	CSM	ECP	ECP K1729 AS BUILT TO SITE MARK UP ASB T18023KW	JMP	GD	.	KB
24	07/17	RR	ECP	ECP K1729 AS BUILT TO SITE MARK UP ASB 17243KW	JMP	TD	.	SF

NUMBER	TITLE
REFERENCE DRAWINGS	

DESIGNED	.	DATE
DRAWN	A.GABLE	7-6-84
CHECKED	JC, TTS	25-6-84
APPROVED	RT	25-6-84
APPROVED	MSHWER	25-6-84
SCALE	.	
STICKFILE	.	

KAPUNI WELLSITES

PIPING & INSTRUMENT DIAGRAM
CHEMICAL INJECTION
WELLSITE KA-13

Todd Energy

SHEET No 1 OF 1 | REVISION 25

DRAWING No 941-10-01306

Appendix 8.
Full Wellsites Heat and Material Balance

	KA-02					KA-05		
Stream Number	**1**	**2**	***3*** *Note 1*	**4**	**5**	**6**	**7**	**8**
Name / Description	**KA-02_Wellfluid_to_KA-02_Wellstream_Cooler**	**KA-02_Wellstream_Cooler_to_LTS_02**	***LTS-02_Liquid_to_Liquid_Manifold***	**LTS-02_Gas_to_E-020XA**	**E-020XA_to_Gas_Manifold**	**KA-05_Wellfluid_to_KA-05_Choke**	**KA-05_Choke_to_KA-05_KA-06/17_Combined**	**KA-05_KA-06/17_Combined**
Mole Fraction								
WATER	0.2469	0.2469	0.8952	0.0004	0.0004	0.2072	0.2072	0.2858
CARBON DIOXIDE	0.3308	0.3308	0.0234	0.4476	0.4476	0.3632	0.3632	0.3163
METHANE	0.3311	0.3311	0.0052	0.4550	0.4550	0.3364	0.3364	0.2897
ETHANE	0.0398	0.0398	0.0041	0.0533	0.0533	0.0424	0.0424	0.0373
PROPANE	0.0197	0.0197	0.0065	0.0248	0.0248	0.0243	0.0243	0.0225
n-BUTANE	0.0101	0.0101	0.0081	0.0110	0.0110	0.0129	0.0129	0.0132
n-PENTANE	0.0027	0.0027	0.0046	0.0019	0.0019	0.0042	0.0042	0.0051
METHANOL	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-HEPTANE (C7)	0.0175	0.0175	0.0466	0.0059	0.0059	0.0066	0.0066	0.0210
n-DECANE (C10)	0.0015	0.0015	0.0053	0.0000	0.0000	0.0026	0.0026	0.0091
n-EICOSANE (C20)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
TOTAL	1.0001	1.0001	0.9990	0.9999	0.9999	0.9998	0.9998	1.0000

Note 1: Stream 3 is constituting of high water content (% water cut is >125%) hence is not considered as flammable.

	KA-6/17						
Stream Number	**9**	**10**	**11**	**12**	**13**	**14**	**34**
Name / Description	**KA-06_Wellfluid_to_KA-06_KA-17_Combined**	**KA-06/17_Combined_to_E-2651**	**E-2651_to_V-2654**	**V-2654_Liquid_to_KA-05_KA-06/17_Combined**	**V-2654_Gas_to_Gas_Manifold**	**KA-17_Wellfluid_to_KA-06_KA-17_Combined**	**KA-05_KA-06/17_KA-13_Combined**
Mole Fraction							
WATER	0.0218	0.0609	0.0609	0.7540	0.0016	0.1241	0.2168
CARBON DIOXIDE	0.4443	0.4370	0.4370	0.0370	0.4712	0.4253	0.3497
METHANE	0.4232	0.3949	0.3949	0.0112	0.4277	0.3491	0.3245
ETHANE	0.0529	0.0493	0.0493	0.0071	0.0529	0.0434	0.0414
PROPANE	0.0270	0.0253	0.0253	0.0119	0.0265	0.0225	0.0237
n-BUTANE	0.0125	0.0118	0.0118	0.0147	0.0115	0.0107	0.0130
n-PENTANE	0.0035	0.0033	0.0033	0.0106	0.0027	0.0029	0.0047
METHANOL	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-HEPTANE (C7)	0.0116	0.0137	0.0137	0.1066	0.0060	0.0174	0.0187
n-DECANE (C10)	0.0032	0.0037	0.0037	0.0469	0.0001	0.0046	0.0076
n-EICOSANE (C20)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
TOTAL	1.0000	0.9999	0.9999	1.0000	1.0002	1.0000	1.0000

	KA-19					
	15	16	17	18	19	20
Name	**KA-19_Wellfluid_to_KA-19_Choke**	**KA-19_Choke-to_E-2153**	**E-2153_to_V-2154**	**V-2154_Liquid_to_Liquid_Manifold**	**V-2154_Gas_to_Wet_Gas_Network**	**Wet_Gas_Network_to_Wet_Gas_KA-18_Combined**
Mole Fraction						
WATER	0.0338	0.0338	0.0338	0.6021	0.0016	0.0014
CARBON DIOXIDE	0.4380	0.4380	0.4380	0.0581	0.4596	0.4630
METHANE	0.4130	0.4130	0.4130	0.0188	0.4354	0.4352
ETHANE	0.0521	0.0521	0.0521	0.0122	0.0543	0.0535
PROPANE	0.0271	0.0271	0.0271	0.0205	0.0275	0.0265
n-BUTANE	0.0128	0.0128	0.0128	0.0254	0.0122	0.0117
n-PENTANE	0.0038	0.0038	0.0038	0.0193	0.0030	0.0027
METHANOL	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-HEPTANE (C7)	0.0144	0.0144	0.0144	0.1542	0.0065	0.0060
n-DECANE (C10)	0.0050	0.0050	0.0050	0.0892	0.0000	0.0000
n-EICOSANE (C20)	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000
TOTAL	1.0000	1.0000	1.0000	0.9999	1.0001	1.0000

	KA-8/18						
Stream Number	**21**	**22**	**23**	***24*** ***Note 1***	***25*** ***Note 1***	***26*** ***Note 1***	**27**
Name / Description	**KA-18_Wellfluid_to_KA-18_Choke**	**KA-18_Choke_to_Wet_Gas_KA-18_Combined**	**Wet_Gas_KA-18_Combined_to_V-2858**	***V-2858_Liquid_ to_LCV-2858A***	***LCV-2858A_to_KA-8_ KA-18_Liquid_ Combined***	***KA-08_KA-18_Liquid_to_Liquid_ Manifold***	**V-2858_Gas_to_KA-08_KA-18_Gas_Combined**
Mole Fraction							
WATER	0.1798	0.1798	0.0421	0.9064	0.9064	0.8556	0.0015
CARBON DIOXIDE	0.3213	0.3213	0.4306	0.0150	0.0150	0.0267	0.4502
METHANE	0.3914	0.3914	0.4252	0.0039	0.0039	0.0083	0.4450
ETHANE	0.0455	0.0455	0.0517	0.0026	0.0026	0.0052	0.0540
PROPANE	0.0257	0.0257	0.0263	0.0045	0.0045	0.0087	0.0274
n-BUTANE	0.0131	0.0131	0.0120	0.0058	0.0058	0.0107	0.0123
n-PENTANE	0.0038	0.0038	0.0029	0.0043	0.0043	0.0075	0.0028
METHANOL	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-HEPTANE (C7)	0.0172	0.0172	0.0086	0.0461	0.0461	0.0615	0.0069
n-DECANE (C10)	0.0022	0.0022	0.0006	0.0116	0.0116	0.0155	0.0000
n-EICOSANE (C20)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
TOTAL	1.0000	1.0000	1.0000	1.0002	1.0002	0.9997	1.0001

Note 1: Streams 24, 25 and 26 are constituting of high water content (% water cut are >125%) hence are not considered as flammable.

KA-8/18							
Stream Number	**28**	**29**	***30*** ***Note 1***	**31**	**32**	**33**	**33(2)**
Name / Description	**KA-08_WellFluid_to_KA-08_KA-18_Gas_Combined**	**KA-08_KA-18_Gas_Combined_to_V-9010**	***V-9010_Liquid_to_KA-8_KA-18_Liquid_Combined***	**V-9010_Gas_to_A-9101**	**A-9101_to_LTS-8**	**LTS-8_Liquid_to_KA-8_KA-18_Liquid_Combined**	**LTS-8_Gas_to_Dry_Gas_Pipeline**
Mole Fraction							
WATER	0.1279	0.0234	0.8768	0.0016	0.0016	0.2281	0.0006
CARBON DIOXIDE	0.3445	0.4318	0.0185	0.4425	0.4425	0.1913	0.4435
METHANE	0.4171	0.4402	0.0055	0.4513	0.4513	0.0696	0.4528
ETHANE	0.0483	0.0530	0.0035	0.0543	0.0543	0.0422	0.0543
PROPANE	0.0275	0.0274	0.0061	0.0279	0.0279	0.0664	0.0278
n-BUTANE	0.0142	0.0126	0.0078	0.0127	0.0127	0.0767	0.0125
n-PENTANE	0.0041	0.0031	0.0059	0.0030	0.0030	0.0491	0.0028
METHANOL	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-HEPTANE (C7)	0.0129	0.0079	0.0534	0.0068	0.0068	0.2624	0.0057
n-DECANE (C10)	0.0034	0.0006	0.0225	0.0001	0.0001	0.0138	0.0000
n-EICOSANE (C20)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
TOTAL	0.9999	1.0000	1.0000	1.0002	1.0002	0.9996	1.0000

Note 1: Stream 30 is constituting of high water content (% water cut is >125%) hence is not considered as flammable.

KA-8/18							
Stream Number	**35**	**36**	**37** Note 1	**38** Note 1	**39**	**40**	**41**
Name / Description	**E-2800_Tube_Side _to_LTS-8_Coils**	**LTS-8_Coils_Out_ to_V-2803**	**V-2803_Liquid_ to_LCV-2803A/B**	**LCV-2803A/B_ to_V-2805**	**V-2803_Gas_to_E-2801/2_Tube_Side**	**E-2801/2_Tube_ Side_to_PCV-2804A/E**	**PCV-2804A/E_to_E-2801/2_Gas_V-2805_Gas_Mix**
Mole Fraction							
WATER	0.0016	0.0016	0.9925	0.9925	0.0016	0.0016	0.0016
CARBON DIOXIDE	0.4424	0.4424	0.0075	0.0075	0.4424	0.4424	0.4424
METHANE	0.4513	0.4513	0.0000	0.0000	0.4513	0.4513	0.4513
ETHANE	0.0543	0.0543	0.0000	0.0000	0.0543	0.0543	0.0543
PROPANE	0.0279	0.0279	0.0000	0.0000	0.0279	0.0279	0.0279
n-BUTANE	0.0127	0.0127	0.0000	0.0000	0.0127	0.0127	0.0127
n-PENTANE	0.0030	0.0030	0.0000	0.0000	0.0030	0.0030	0.0030
METHANOL	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-HEPTANE (C7)	0.0067	0.0067	0.0000	0.0000	0.0067	0.0067	0.0067
n-DECANE (C10)	0.0001	0.0001	0.0000	0.0000	0.0001	0.0001	0.0001
n-EICOSANE (C20)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
TOTAL	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Note 1: Streams 37 and 38 are constituting of water and carbon dioxide only hence are not flammable.

KA-8/18								
Stream Number	**42**	**43**	**44 Note 1**	**45 Note 1**	**46**	**47**	**48**	**49**
Name / Description	**V-2805_Gas_to_E-2801/2_Gas_V-2805_Gas_Mix**	**E-2801/2_Gas_V-2805_Gas_Mix_to_LTS-8**	**V-2805_Liquid_to_LCV-2805**	**LCV-2805_to_V-2805_Liquid_LTS-8_Liquid_Mix**	**LTS-8_Liquid_to_LCV-2804A**	**LCV-2804A_to_V-2805_Liquid_LTS-8_Liquid_Mix**	**V-2805_Liquid_LTS-8_Liquid_Mix_to_E-2800_Shell_Side**	**LTS-8_Gas_to_E-2801/2_Shell_Side**
Mole Fraction								
WATER	0.0020	0.0016	0.9925	0.9925	0.2333	0.2333	0.2333	0.0007
CARBON DIOXIDE	0.5632	0.4424	0.0075	0.0075	0.1922	0.1922	0.1922	0.4434
METHANE	0.4312	0.4513	0.0000	0.0000	0.0718	0.0718	0.0718	0.4528
ETHANE	0.0036	0.0543	0.0000	0.0000	0.0420	0.0420	0.0420	0.0543
PROPANE	0.0000	0.0279	0.0000	0.0000	0.0655	0.0655	0.0655	0.0278
n-BUTANE	0.0000	0.0127	0.0000	0.0000	0.0754	0.0754	0.0754	0.0125
n-PENTANE	0.0000	0.0030	0.0000	0.0000	0.0481	0.0481	0.0481	0.0028
METHANOL	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-HEPTANE (C7)	0.0000	0.0067	0.0000	0.0000	0.2576	0.2576	0.2576	0.0057
n-DECANE (C10)	0.0000	0.0001	0.0000	0.0000	0.0140	0.0140	0.0140	0.0000
n-EICOSANE (C20)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
TOTAL	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Note 1: Streams 44 and 45 are constituting of water and carbon dioxide only hence are not flammable.

	KA-13		KA-4/14				
Stream Number Note 1	**35**	**36**	**37**	**38**	**39**	**40**	**41**
Name / Description	**KA-13_Wellfluid_to_KA-13_Choke**	**KA-13_Choke_to_Condensate_Pipeline**	**KA-4_Wellfluid_to_KA-4_Choke**	**KA-4_Choke_to_KA4/14_Combined**	**KA-4/14_Combined_to_Liquid_Manifold**	**KA-14_Wellfluid_to_KA-14_Choke**	**KA-14_Choke_to_KA-4/14_Combined**
Mole Fraction							
WATER	0.0267	0.0267	0.0437	0.0437	0.0352	0.0299	0.0299
CARBON DIOXIDE	0.4414	0.4414	0.4224	0.4224	0.4278	0.4312	0.4312
METHANE	0.4204	0.4204	0.4102	0.4102	0.4158	0.4193	0.4193
ETHANE	0.0525	0.0525	0.0511	0.0511	0.0517	0.0521	0.0521
PROPANE	0.0269	0.0269	0.0290	0.0290	0.0292	0.0293	0.0293
n-BUTANE	0.0125	0.0125	0.0153	0.0153	0.0152	0.0151	0.0151
n-PENTANE	0.0036	0.0036	0.0048	0.0048	0.0046	0.0045	0.0045
METHANOL	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-HEPTANE (C7)	0.0123	0.0123	0.0196	0.0196	0.0174	0.0161	0.0161
n-DECANE (C10)	0.0036	0.0036	0.0038	0.0038	0.0031	0.0026	0.0026
n-EICOSANE (C20)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
TOTAL	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Note 1: Stream numbers of 35 to 41 are also available for KA-8/18 wellsite, this is due to additional streams were added to the initial HMB and hence created some repeats. However, the compositions are different for the same numbers at the different wellsites.

TODD ENERGY LTD

Kapuni Wellsites QRA
Assumptions Register

610114-RPT-R0001
July 2022

Worley New Zealand Ltd
25 Gill Street, New Plymouth 4310
PO Box 705, New Plymouth 4340

Telephone +64-6-759 6300
Facsimile +64-6-759 6301

www.worley.com

Rev	Description	Originator	Reviewer	Worley Approver	Date	Client Approval	Date
A	Issued for Review/Comment	Y Lee	E Gloy	Y Lee	05/2020		
0	Approved for Use	Y Lee	L Ong	Y Lee	08/2020		
1	Re-Approved for Use	Y Lee	O Kilian	Y Lee	07/2022		

Y:\Todd\610114\2.Controlled Docs\610114-RPT-R0001-R1 (Assumptions Register).docx

TABLE OF CONTENTS

1. ABBREVIATIONS

API	American Petroleum Institute
AWS	Automatic Weather Station
BLEVE	Boiling Liquid Expanding Vapour Explosion
BOP	Blowout Preventer
DNV GL	Det Norske Veritas Germanischer Lloyd
EI	Energy Institute
ESDV	Emergency Shutdown Valve
FBR	Full Bore Rupture
GOR	Gas Oil Ratio
HCRD	Hydrocarbon Release Database
HIPAP4	NSW Hazardous Industry Planning Advisory Paper No. 4
HMB	Heat and Material Balance
HPKO	High Pressure Knock Out
IOGP	International Association of Oil and Gas Producers
IRPA	Individual Risk Per Annum
KPS	Kapuni Production Station
LFL	Lower Flammable Limit
LPG	Liquefied Petroleum Gas
LSIR	Location Specific Individual Risk
LTS	Low Temperature Separator
PFD	Process Flow Diagram
PFP	Passive Fire Protection
P&ID	Piping & Instrumentation Diagram
PLL	Potential Loss of Life
QRA	Quantitative Risk Assessment
RADD	Risk Assessment Data Directory
STDC	South Taranaki District Council
UK HSE	United Kingdom Health and Safety Executive
VCE	Vapour Cloud Explosion
WSO	Water Shut-off

2. INTRODUCTION

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

2.1 Objective

The objective of the QRA is to develop risk contours to meet the risk assessment requirements of the South Taranaki District Council (STDC) District Plan, Section 11: Hazardous Substances.

2.2 Scope

The scopes include:

1) Conduct risk assessment for seven (7) Kapuni wellsites with 17 wells; and
2) Update the existing KA-4/14 and KA-13 wellsites QRA [Ref. 1] and hence supersedes the results from the QRA.

The final report will be a combined QRA report for all nine (9) Kapuni wellsites with 20 wells.

Currently, seven (7) wellsites are producing, KA-3 is out of service and KA-9 is designed for water disposal only. The wellsite details are summarised in Table 2-1. Only producing wells will be considered in the QRA.

Table 2-1: Kapuni Wellsites

Wellsite	Number of wells	Producing	Scheduled for Abandon-ment Note 1	Suspended Note 2	Shut in Note 3	Observation / water Note 4	Notes
KA-1, KA-7, KA-19 and KA-20	4	1			1 (KA-7)	2 (KA-1 and KA-20)	
KA-2	1	1					
KA-3	1			1			
KA-4 and KA-14	2	2					KA-14 is only operating once (for 24 hours) every 10 days [Ref. 20].
KA-5 and KA-10	2	1				1 (KA-10)	
KA-6, KA-11 and KA-17	3	2		1 (KA-11)			
KA-8, KA-12, KA-15 and KA-18	4	2	1 (KA-12)		1 (KA-15)		
KA-9	2					2	A new well, KW03, is drilled in May 2021 for further water injection purposes.

Wellsite	Number of wells	Producing	Scheduled for Abandon-ment Note 1	Suspended Note 2	Shut in Note 3	Observation / water Note 4	Notes
KA-13	1	1					KA-13 is only operating in 1 out of every 3 months.
Total	20	10	1	2	2	5	

Notes:

1. Wells that are scheduled for abandonment are plugged with abandonment plans underway.
2. Suspended wells are plugged and major intervention is required to bring the well back to service.
3. Shut in wells are isolated but could be brought back into service. Note that KA-7 and KA-15 were considered as producing well in the Kapuni Safety Case [Ref. 2], however, the wells are currently shut-in and hence will not be included in the risk assessment [Ref. 3 and Ref. 4].
4. Water wells are for water injection only and will not be used for hydrocarbon / producing. Observation wells are only for monitoring reservoir conditions and informing development of reserves estimates. They are designed for instrumentation only and cannot inject or produce.

There is no plan to bring the non-producing wells back online in the future. In the unlikely event that this changes, the QRA will be updated to verify any impact on the risk contours. Engagement with STDC will be completed as part of this process and a new resource consent will be required.

2.2.1 Exclusions

The following will be excluded from the QRA scope:

- Risk from the gathering pipelines to Kapuni Production Station (KPS). The scope for each wellsite will include up to the pipeline isolation valves (if available) or when the pipelines go underground. Pipelines passing through the wellsites (e.g., at KA-4/14 and KA-5) are not considered in the base case. The pipeline sections will be assessed in the sensitivity case. Note that the pipeline (P/L) to PECPR on the P&ID will be used in some sections to identify the pipeline boundary;
- Risk other than hydrocarbon / process risk (e.g., transportation risk, seismic risk and volcanic risks);
- Decommissioned and/or mothballed equipment;
- Utilities such as produced water and instrument air as they do not contain any hydrocarbon inventory;
- Individual risk calculations, including Individual Risk Per Annum (IRPA) and Potential Loss of Life (PLL) as the wellsites are normally unmanned;
- Societal risk (F-N curve) as the wellsites are located as remote area with low populations;
- Corrosion Inhibitors present at the wellsites as they are not flammable;
- Methanol injecting pumps as they are only used during start-up (except for KA-8/12/15/18 wellsite where methanol dosing is required throughout the year). Note that methanol tanks are always full and connected to the methanol pumps, with the pumps turn off when methanol is not being injected [Ref. 19], hence the methanol tanks and tubing to the methanol pumps will be included.
- Toxic effect of carbon dioxide.

2.3 Facility Description

Kapuni is an onshore gas and condensate field located in South Taranaki, approximately 50 km south of New Plymouth. 20 Kapuni wells are located on nine (9) separate wellsites in the area surrounding the Kapuni Production Station (KPS). The production wellsite process is a simple separation of gas and liquids involving the direction of wellstream gas and liquids to a low temperature separator (LTS) unit on the wellsite. The LTS separates the gas and liquids by means of pressure reduction to cause cooling.

An aerial overview of the wellsites location with reference to KPS is shown in Figure 2-1.

The wellsites access are via vehicle gates which are normally adjacent to the main wellsite control huts for the wellsites. Each wellsite hut is a single storey building which contains the wellsite control logic systems, emergency and communications equipment.

The wellsites have an open layout with areas separated from each other to prevent knock-on effects. The open area reduces the potential for overpressure from an explosion and reduces fire damage / escalation potential.

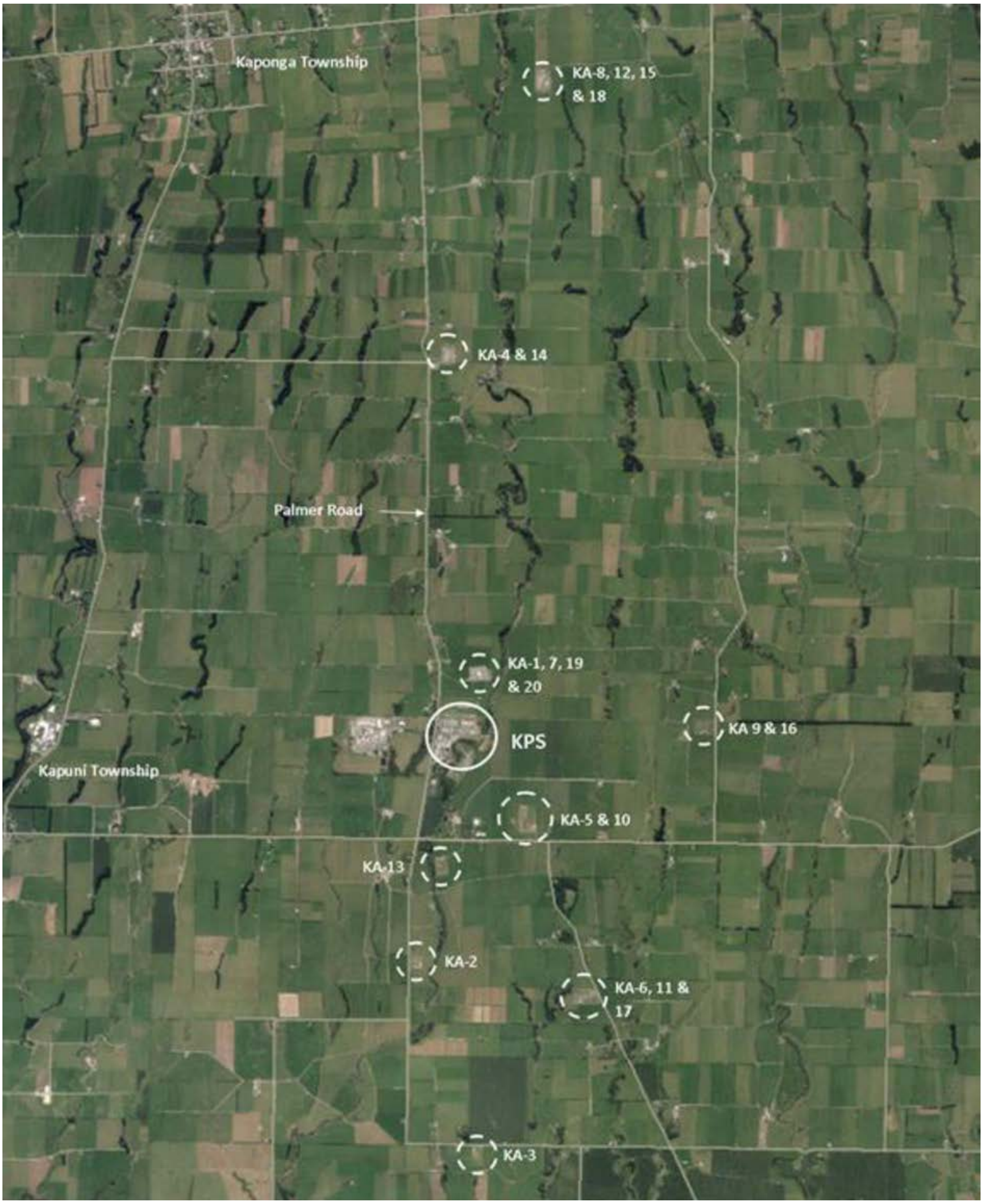


Figure 2-1: Kapuni Wellsites Location with reference to Kapuni Production Station

The details of each of the wellsite is as below.

2.3.1 Wellsite KA-1, KA-7, KA-19 and KA-20

Located just off Palmer Road, the site contains 4 wells. A wellstream heater is fitted to the KA-19 well. KA-1 well is suspended, KA-7 is not operational following the recent unsuccessful Water Shut-off (WSO) [Ref. 3] and KA-20 well is an observation well.

This site also acts as a distribution point for gas from the northern wells. It re-routes gas arriving from the gathering lines from wellsite KA-4/14 and KA-8/12/15/18 to KPS.

2.3.2 Wellsite KA-2

Located on Palmer Road, the site has an LTS unit and the flowline is equipped with two wellstream coolers.

2.3.3 Wellsite KA-3

This wellsite has been suspended and plugged.

2.3.4 Wellsite KA-4 and KA-14

Located just off Palmer Road, the site contains two wells, two LTS units, and a wellstream heater.

2.3.5 Wellsite KA-5 and KA-10

Located just off Skeet Road, this site contains one producing well (KA-5) and one observation well (KA-10), with a Desander unit for solids separation, and a PCV used on start-up.

2.3.6 Wellsite KA-6, KA-11 and KA-17

Located on Ahipaipa Road, this site contains two in service wells, and one suspended well (KA-11). KA-6 and KA-17 wellstream fluids are co-mingled, routed through a wellstream cooler and then to an LTS Unit.

2.3.7 Wellsite KA-8, KA-12, KA-15 and KA-18

Located just off Eltham Road, this site contains two (2) producing wells. KA-12 well is plugged and scheduled for abandonment and KA-15 well is shut-in and isolated [Ref. 4]. Two wellstream process skids and two wellhead compression units are fitted to the wells.

2.3.8 Wellsite KA-13

Located just off Skeet Road, this site contains one well, Desander, a flowline choke valve and a High Pressure Knock Out (HPKO) vessel. It connects into the KA-6/5 gathering lines.

2.3.9 Wellsite KA-9

Located on Lower Duthie Road, two wells were drilled on the site, KA-9 (referred to as KW-2) and KA-16. KA-16 is suspended and KW-2 is currently in service as a water injection well. There is very little equipment left on the wellsite, only the water injection line, a filter, and two pig receivers.

The wellsites flow schematic is presented in Figure 2-2.

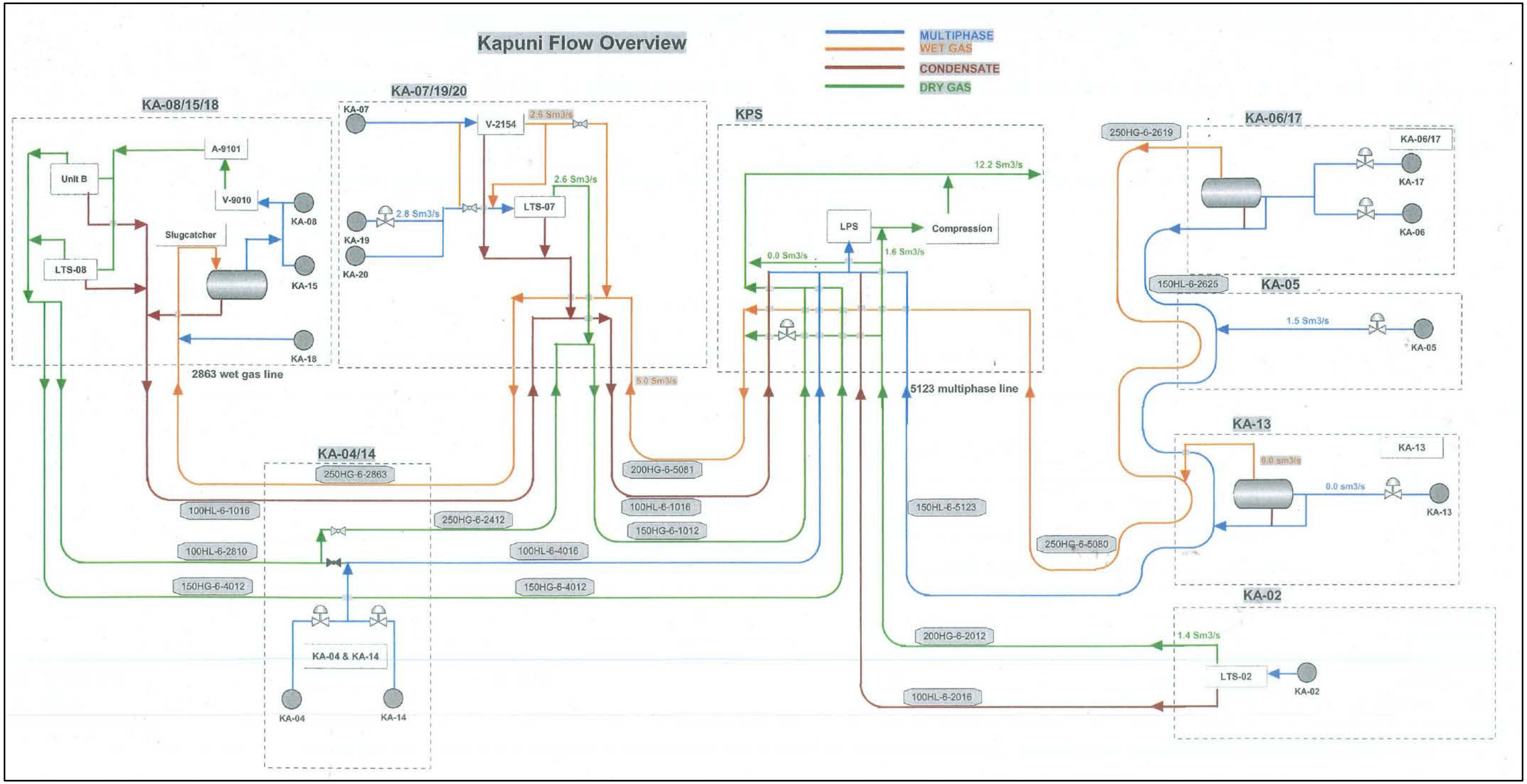


Figure 2-2: Kapuni Wellsites Flow Schematic

3. MODELLING INPUTS AND ASSUMPTIONS

This section outlines all modelling inputs and assumptions that will be used in the QRA. The assumptions and methodology will be consistent with those in the Todd Energy's Fire and Gas Analysis and Quantitative Risk Assessment Methodology Guideline [Ref. 5].

3.1 Assessment Tool

The risk assessment model will be set up using DNV GL Safeti version 8.22 [Ref. 6].

3.2 Definition of Parts Count Sections

3.2.1 Isolatable Inventory

Sectionalisation will be performed to segregate the facilities into a number of isolatable sections. 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. These sections will be split further where required, and the entire contained inventory was considered as available for release. Further segregations are based on:

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

The probability of successful detection and isolation is assumed to be 100%. 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.

Node sections will be highlighted in the Process Flow Diagrams (PFDs) and will be detailed in a Node Definition table in the QRA report which presents details of all the nodes including unique identification code, definition of boundaries, operating temperature and pressure, maximum pipe diameter, etc.

Following sectionalisation, a parts counts will be conducted to perform the frequency analysis for the QRA.

3.2.2 Components

The definition of components within the parts count will be aligned with failure rate data published in the International Association of Oil and Gas Producers (IOGP) Risk Assessment Data Directory (RADD) Process Release Frequency [Ref. 7]. The parts count will consider the following:

- Equipment items;
- Valves;
- Flanges;
- Instrumentation and small-bore fittings; and
- 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.

3.3 Failure Frequency Data and Hole Size Distributions

3.3.1 General Leak Frequency

The leak frequencies for process equipment and piping will be taken from the IOGP Process Release Frequency [Ref. 7]. The release frequencies of the main process equipment items from IOGP are based on the UK HSE (UK Health and Safety Executive) hydrocarbon release database (HCRD) which has been compiled by the UK HSE over a 20-year period. Two sets of data are presented in IOGP Process Release Frequency, which include the 1992 – 2015 data and 2006 – 2015 data.

The recommended values based on experience in the period 2006 – 2015 (inclusive) will be used. The IOGP release notes state that the number of incidents recorded per year in the database has been steadily decreasing, and it is considered appropriate to base the frequency on more recent data on the assumption that this is more representative of what will occur in the future.

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.

Atmospheric Storage Tank

The IOGP Release Frequency Data does not provide the frequencies for atmospheric storage tanks. Therefore, the following leak frequencies as shown in Table 3-1 from the TNO Purple Book [Ref. 23] will be used for methanol tanks.

Table 3-1: Release Frequencies for Atmospheric Storage Tank

Type of Release	Storage Tanks, Atmospheric
Instantaneous release of the complete inventory	5.0E-06 per year
Continuous release of the complete inventory in 10 minutes at a constant rate	5.0E-06 per year
Continuous release from a hole with an effective diameter of 10 mm	1.0E-04 per year

3.3.2 Pigging

Pig traps are located at the wellsites to clean, condition and/or monitor the pipelines. The pigging frequency will be used to calculate a modification factor for the leak frequency from the pig receivers.

Table 3-2: Pigging Frequencies and Modification Factor [Ref. 19]

Tag	Description	To		Pigging Frequency (per year)	Average pigging duration (hours)	Modification Factor
KA-06/17						
A-2613	Hydrocarbon gas to gathering line	A-5001	KPS	4	1.5	0.001
A-2614	Hydrocarbon liquid to gathering line	A-5003	KPS	4	1.5	0.001
KA-02						
A-0101B	Hydrocarbon liquid to A-0501A (KPS)	A-0501A	KPS	2	8	0.002
A-0103	Hydrocarbon gas to A-0503 (KPS)	A-0503	KPS	4	1.5	0.001
KA-08/18						
A-2863	Wet gas from KA-4/14	A-2165	KA-19	4	1.5	0.001
A-2813	Dry gas to KA-4	A-0502D	KPS	2	1	0.0002
A-2814	Dry gas to KA-4	A-2440	KA-4/14	4	1.5	0.001
A-2864	Condensate to KA-1&7	A-0501B	KPS	4	7	0.003
KA-4/14						
A-2440	Dry gas to KA-7	A-2167	KA-19	1	1	0.0001
KA-19						
A-2165	Wet gas to KA-8/18 via KA-4/14	A-2863	KA-8/18	4	1	0.0005
A-2167	Dry gas from KA-4/14 wellsites	A-2440	KA-4/14	1	1	0.0001
A-2163	Wet gas from A-5002	A-5002	KPS	4	0.5	0.0002
A-2166	Dry gas to KPS A-502A	A-0502A	KPS	1	0.5	0.0001
A-2164	Vector Treated Gas from KPS A-5004	A-5004	KPS	1	0.5	0.0001
A-2169	(Hydrocarbon gas) To Kiwi Dairy Co. & Taranaki Byproducts Co.	N/A	Other	1	6	0.001

Note: No pig traps at KA-05 and KA-13.

3.3.3 Release Hole Sizes

For every component failure, there is a range of credible hole sizes ranging from pinhole leak to full bore rupture (FBR). The representative hole sizes to be used for process sites are as shown in Table 3-3.

The geometric mean for hole diameter will be used to represent a range in hole sizes as this approach has a mathematical basis that aligns with numbers that are exponential in nature, such as is the case for hole sizes where 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. The use of geometric mean is also aligned with the recommendation in the latest IOGP Process Release Frequency [Ref. 7].

Table 3-3: Hole Size Distribution

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

22 mm will be used as the maximum hole size for small bore fittings as per the Todd Energy's Methodology Guideline [Ref. 5].

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 consistent with the approach used for other release size categories and may be appropriate given the limited FBR base data that is used by the algorithm to calculate frequency.

It is noted for methanol tanks that will reference to TNO Purple Book [Ref. 23] failure data, actual hole sizes following the failure data will be used as there are no sufficient leak size distribution data in Purple Book to calculate the geometric mean.

3.3.4 Leak Frequency Modification Factor

Several leak frequency modification factors will be applied to the release frequency database as per the Todd Energy's Methodology Guideline [Ref. 5]. These are listed below:

- 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: steel process pipes of IOGP Process Release Frequencies [Ref. 7].
  - For interskid piping, the modification factor for "inter-unit piping" (section 3.3.3 of IOGP Process Release Frequencies) which is 0.9 will be applied, i.e. there will be a 90% reduction in frequencies.
- 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 in comparison with Todd Energy facilities. For wellsites, 22 of the incidents can be discounted on the basis that the release scenarios cannot occur on an onshore wellsite. The frequency for rupture release will be reduced by 65%.

The maximum flange release hole size will also be limited to 22 mm as a release from a flange is normally limited to a segment of a gasket between bolts [Ref. 5].

3.4 Blowout Events

For normal operations, it is assumed that a blowout may occur during either production, well workover or well wireline activities. The categories applied for classifying the incidents [Ref. 11 and 12] are shown in Table 3-4.

Table 3-4: Categories of Blowout Incidents

Main	Category	Description
Blowout and well release	Blowout (surface flow)	• Uncontrolled incidents with surface flow, including subsea releases, e.g., from topside or subsea wellhead, drill floor or Christmas tree. • Considered as 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 to avoid over-estimating the release rate and creating unrealistic results.
	Blowout (underground flow)	• Underground flow only or with limited surface flow where minor flow occurred and typically the Blowout Preventer (BOP) has been activated. • Considered to have no consequences on the surface and will therefore not considered in this study.
	Diverted well release	• An incident where the diverter system functioned as intended. • 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 included as the event frequency as given in Table 3-4 is equal to zero.
	Well release	• An incident where hydrocarbons (oil or gas) flow from the well at some point where flow was not intended, and the flow was stopped by use of the barrier system that was available on the well at the time the incident started. • Assumed to be release from the wellhead and Christmas trees. It will be modelled as a horizontal well fluid release at well pressures. Release sizes will be based on the same hole size distribution used for other release cases.

The blowout likelihood from the IOGP Blowout Frequencies [Ref. 11] will be used, specifically data for offshore operations in areas not operating according to North Sea Standard (Table 2-3 in the IOGP). It is noted that the Kapuni wellsites are located onshore, however, IOGP recommends the use of offshore data presented in Section 2 in the IOGP but noted that there will be a greater degree of uncertainty. The frequency for well wirelining considered in the KA-4/14 and KA-13 QRA [Ref. 1] is once per well per year, and no workover will be performed in the wells' life time. These assumptions will be used in this QRA as well.

Table 3-5: Blowout and Well Release Frequencies for Production Operation

Operation	Category	Frequency	
Production (Excluding external causes Note 1)	Blowout (surface flow)	3.3E-05	per well year
	Diverted well release	0	per well year
	Well release	2.9E-05	per well year
Wireline	Blowout (surface flow)	9.0E-06	per well year
	Diverted well release	0	per well year
	Well release	2.6E-05	per well year

Note 1: External causes are external loads such as storms or fire leading to blowout or well release.

3.5 Ignition Probabilities

The probability of ignition of a release is a function of the release rate, the nature of the material being released and the conditions of the surrounding plant. For this QRA, The Energy Institute (EI) ignition probability model referenced in IOGP Ignition Probabilities [Ref. 8] will be used for the estimation of overall ignition probability of loss of containment scenarios.

For wellsite, ignition probabilities should be taken from Scenarios 5 and 6 and they are assumed to particularly apply to a 'plant' where processing takes place. This is considered conservative for use at wellsites as not much processing takes place.

The scenarios are described as:

- Scenario 5 – Small Plant Gas LPG (Gas or LPG release from small onshore plant) - Releases of flammable gases, vapour or liquids significantly above their normal boiling point from small onshore plants (plant area up to 1200 m^2, site area up to 35,000 m^2).
- Scenario 6 - Small Plant Liquid (Liquid release from small onshore plant) - 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 m^2, site area up to 35,000 m^2) and which are not bunded or otherwise contained.

The graphs of ignition probabilities as a function of mass release rate are shown in Figure 3-1.

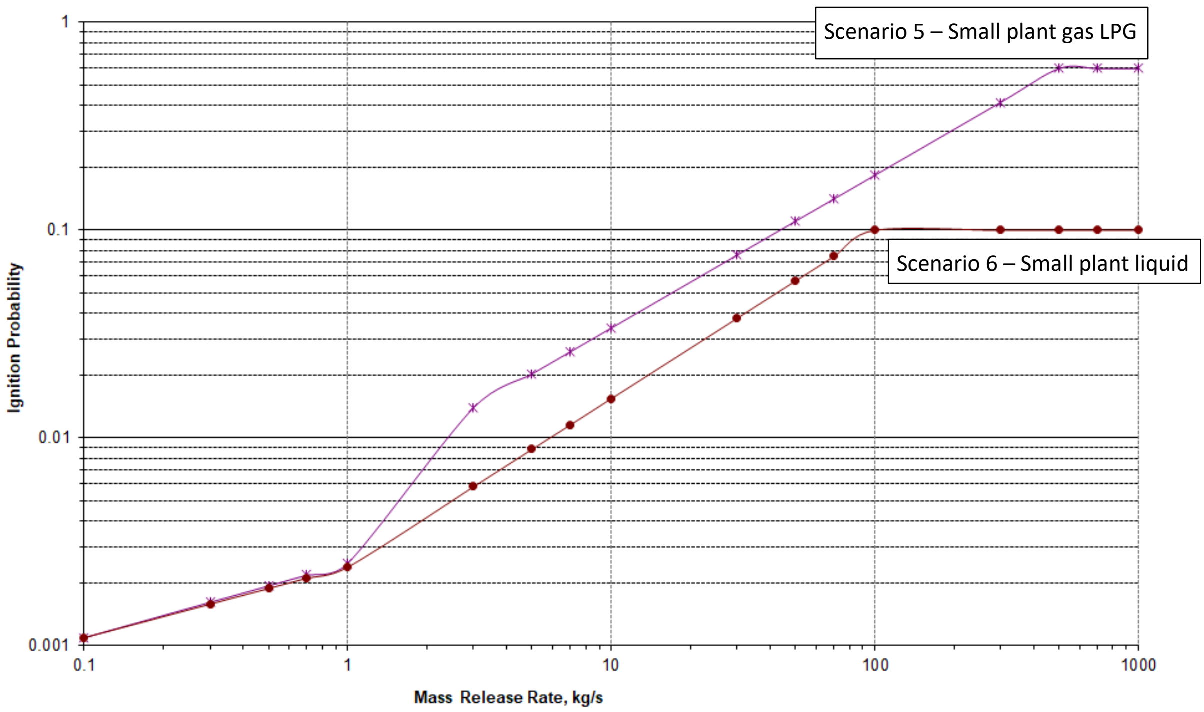


Figure 3-1: Ignition Probability

Early and Delayed 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 early to delayed ignition probability will be used. Given the maturity of the hazardous area for all wellsites, it can be assumed that probability of early ignition would be low.

3.6 Material Composition

The Heat and Material Balances (HMBs) will be provided by Todd Energy's process engineer [Ref. 9]. The wellstream fluid from each well have different flowrates, material compositions and operating conditions. Any stream that has unique consequences will be represented by dedicated sections. For sections with similar operating conditions or fluid composition that have similar consequence results, the worst-case scenario will be selected as representative, to rationalise the number of scenarios performed. This is to avoid the averaging out of inputs of different wellstreams, as it may create a stream with 'brand new' operating conditions, material compositions and flowrates which does not represent the actual release conditions.

As far as is reasonable, the compositions in each stream are simplified, i.e. isomers are summed together and the C6+ hypothetical materials (KP01, up to KP30) are represented by different heavy alkanes. The following alkanes are selected to represent different ranges of hypothetical materials found in the streams based on their properties:

- KP01 to KP10 are assumed to be C7;
- KP11 to KP20 are assumed to be C10; and
- KP21 to KP30 are assumed to be C20.

Note that the hypothetical materials in the Todd Energy's Methodology Guideline are represented in ST01 to ST30; whereas the hypothetical materials in the HMB provided by the process engineer are represented in KP01 to KP30. The hypotheticals STXX are the same as KPXX [Ref. 19].

The important characteristic of molecular weight is kept close to the actual value to ensure the release rate is representative.

The effects of water cut of the hydrocarbon on fire hazards will be considered to identify the streams that are considered not flammable due to high water content. According to Oil and Gas UK Fire and Explosion Guidance [Ref. 10], for water cuts under 50%, no significant reduction in heat fluxes to engulfed objects can be expected (<10%). However, for water cuts over 50%, the flames are significantly less radiative, and the overall heat flux to an obstacle can be reduced by 40% or more. To be in line with Oil and Gas UK Fire and Explosion Guidance, it is assumed that a mixture remains flammable if it has a water cut of up to 125% (defined as mass of water/ mass of fuel x 100%), although not necessarily capable of supporting a stable flame in the absence of some other supporting mechanisms.

Similarly, increasing concentrations of CO_2 were found to reduce the likelihood of ignition of a methane jet release. At CO_2 concentrations of 22–40% (v/v) it was possible for a self-sustaining flame to exist, but beyond these concentrations a pilot flame was required to aid combustion. Beyond 60% CO_2 the pilot flame had no effect and the mixture was completely inert [Ref. 22].

The average flammability of the mixtures will be calculated by Safeti software, considering the effects of the inert components (e.g., CO_2, N_2 and H_2O).

3.7 Release Scenarios

Release rates will be calculated based on the release hole size and operating pressure. All releases will be modelled at initial process conditions until the entire isolatable inventory has been depleted and will not take account of the depressurisation that occurs over time.

All wellsites have automated ESD on fire detection, and KA-8/18 has automatic ESD on gas detection as well. Hydrocarbon leaks at the wellsites or along the pipelines (other than minor leaks) will lead to pressure and/or liquid level drop at KPS, which will alert the operators to perform a check at the wellsite(s).

Given the proximity to the KPS, operators can generally arrive at the wellsites within 15 minutes. As such, 15 minutes delayed detection will be assumed, and 15 minutes of released inventory will be added. Full bore rupture cases are only considered credible when there is major work on site, and the wellsite would be manned to detect the leak immediately. Hence undetected full bore rupture is not considered credible.

The inventory for well blowout and well release events will be considered as unlimited because they can be supplied from the downhole reservoirs.

The wellsites bunding and drainage systems are designed to contain hazardous materials within the boundaries of the wellsite. Therefore, condensate pools are assumed to remain confined within the site.

Other assumptions to be applied in the QRA include:

- The height of release from all scenarios will be assumed to be at 1 m above ground, although some equipment may be located at the elevation higher than the ground level.
- For wellsite releases, 70% of the releases should be modelled as horizontal releases and 30% of the releases as vertical releases. Well blowout will be modelled as 100% vertical release.
- All outdoor releases are modelled as non-impinged (free) releases and are monitored at the downwind direction.
- A free-field condition is assumed although in real facility situations, multiple obstructions beyond the leak source could shield or deflect the jet fire. Obstructions in the path of the vapour cloud could also alter the concentration of gas in the cloud
- Fire durations are estimated based on the assumption that isolation and shutdown are immediate.
- In estimating piping length, a safety factor of 1.25 will be applied to all lengths measured from the map to account for bends and elevations which could not be determined from the 2D map.
- For liquid releases from pressurised sources, if the rainout is significant then a pool fire will result. If not, a spray fire (equivalent to a jet fire) will result. It is suggested in the Oil and Gas UK Fire and Explosion Guidance [Ref. 10] that for ignited two-phase releases:
  - If the Gas Oil Ratio (GOR) is low, at drive pressures above 10 bar(abs) a spray fire will result;
  - If the GOR is high, at drive pressures above 5 bar(abs) a spray fire will result.

Note: Gas oil ratio is the ratio of gas to oil within the hydrocarbon fluid. A high GOR indicates a high gas content which has implications for the potential for gas fires from a depressurisation and release [Ref. 10].

3.8 Congested Area

A flammable vapour cloud accumulation at congested area(s) is the prerequisite to a vapour cloud explosion (VCE). There is limited equipment at the wellsites, and these areas are generally open with good ventilation expected throughout the year. The possibility of flammable vapour accumulating and developing into subsequent vapour cloud explosions, are considered not credible. Hence, VCE modelling will not be carried out.

3.9 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).

3.9.1 Wind Speed and Direction

Wind speed and direction data are taken from NIWA's CliFlo database [Ref. 16] for the Hawera Automatic Weather Station (AWS) to represent the atmospheric conditions at Kapuni. Data for 5-year period from January 2008 to December 2012 are taken, with wind speed and direction measurements taken every hour. The wind rose is shown in Figure 3-2.

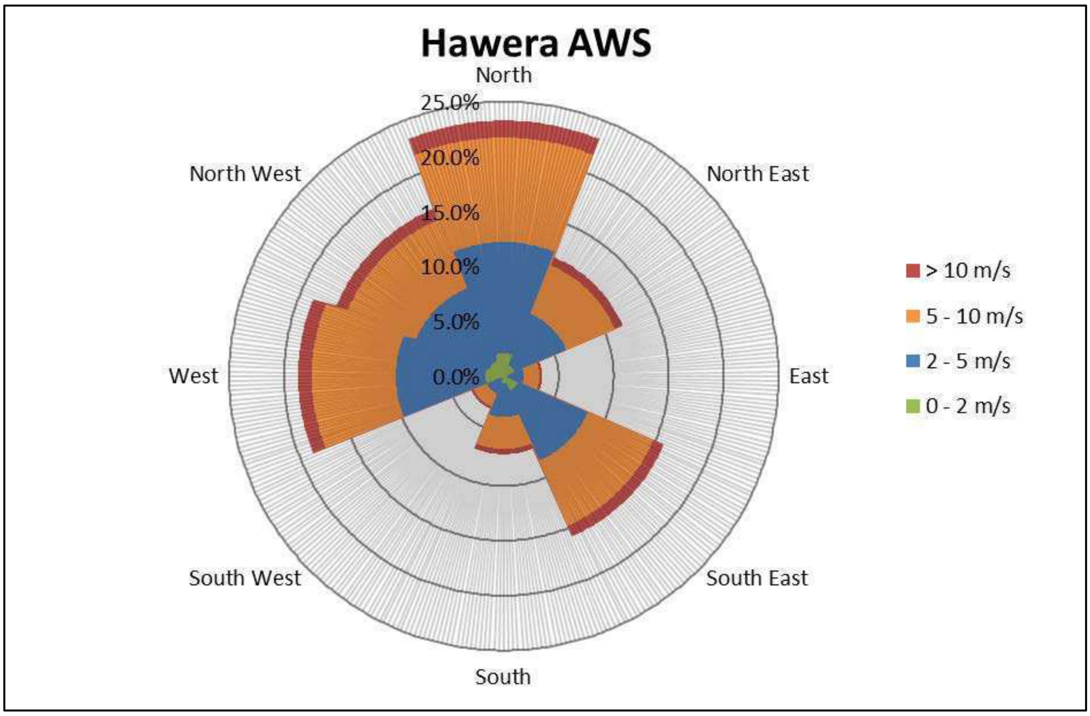


Figure 3-2: Hawera AWS Windrose

The following combinations of wind speed and atmospheric stability will be considered in the QRA that represents the typical wind speed conditions around the wellsites:

- 2/F – wind speed of 2 m/s with Pasquill Stability class F – stable, night with moderate clouds and light/moderate wind
- 5/D – wind speed of 5 m/s with Pasquill Stability class D – neutral, little sun and high wind or overcast/windy night
- 10/D – wind speed of 10 m/s with Pasquill Stability class D

For the modelling, 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 power-law profile.

By consideration of the Pasquill Stability class relationship with day and night and wind speeds, the wind data for use in the QRA model is calculated as shown in Table 3-6.

Table 3-6: Hawera AWS Wind Data

Wind Speed / Pasquill 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%

Wind Speed / Pasquill Stability	North	North East	East	South East	South	South West	West	North West	Total
2 - 5 m/s / D	10.1%	5.1%	1.5%	6.9%	3.1%	1.4%	8.2%	7.2%	43.5%
> 5 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%

3.9.2 Ambient Temperature and Relative Humidity

The following ambient temperature and relative humidity as consistent with those used in the KPS QRA [Ref. 18] will be used in the QRA:

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

3.9.3 Solar Radiation

The allowance for solar radiation will not be included in the thermal radiation effects consideration.

3.9.4 Surface Roughness

Safeti 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 generally represents an area of “open flat terrain; grass, few isolated objects” to represent the open area of the wellsites.

3.10 Fatality Criteria

The physical effects from these consequences can have different impacts on humans. The variation of harm from different effects is reflected in a parameter known as the harm probability. In this study, human harm relates to high potential for fatality.

3.10.1 Heat Radiation

The method of calculating the probability of fatality for an individual, given known exposure duration and thermal heat radiation levels, is undertaken 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. 17]. 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

Safeti calculates the Probit values during the analysis.

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

3.10.2 Flash Fire

If personnel are within the 100% lower flammable limit (LFL) of the gas plume, 100% fatality is assumed. LFL is the lower end of the concentration range over which the flammable mixture of vapour in air can be ignited.

A flash fire occurs when a dispersed cloud of flammable vapour and air mixture is ignited within its flammable regions, causing a wall of flame to spread throughout the flammable region and back to the release point. The flame propagates through the cloud in a manner such that negligible or no damaging overpressure is generated. This flash is almost instantaneous as the flame propagates at high speed through the cloud and back to the source.

An assumption of 100% fatality rate within the footprint of the cloud is conservative and does not allow for potential risk reducing considerations such as:

- uneven mixing of flammable vapour and air in the cloud resulting in uneven propagation of the flame,
- topography,
- sparsely populated rural land use adjoining the site,
- availability of shelter,
- opportunity for escape, and
- clothing worn by persons exposed to the flash fire.

Thermal radiation outside of the flash fire footprint, reduces rapidly and is not sustained due to the instantaneous nature of the event. The potential for fatality outside the flash fire footprint is not considered credible.

3.10.3 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 light 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 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. Passive Fire Protection (PFP) can be provided on pressurised vessels to minimise the probability of BLEVE. 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 at the wellsites are shown in Table 3-7.

Table 3-7: Kapuni Wellsites Vessels Liquid Volume Estimation

Tag	Description	Diameter (m)	Length / Height (m)	Volume (m^3)	Liquid Level (mm)	Liquid Volume (m^3)
KA-02						
V-201A	HP Knockout	0.686	4.572	1.69	343	0.84
V-204A	Secondary Knockout	0.914	3.048	2.00	457	1.00
V-0202A	LT Separator	1.219	3.810	4.45	1905	2.22
KA-05						
V-0516	KA-5 Desander	0.406	4.572	0.59	406	0.59

Tag	Description	Diameter (m)	Length / Height (m)	Volume (m^3)	Liquid Level (mm)	Liquid Volume (m^3)
KA-19						
V-2154	Wellhead Knockout	1.068	4.572	4.10	534	2.05
KA-8/18						
V-2803	HP Knockout Drum	0.685	4.570	1.68	342.5	0.84
V-9010	Wellstream Separator (2 phase)	1.600	4.500	9.05	800	**4.52**
V-9020	Wellstream Separator (2 phase)	1.600	4.500	9.05	800	**4.52**
V-2808	LT Separator	1.830	5.640	14.83	915	**7.42**
V-2804	Low Temperature Separator	1.220	3.810	4.45	1905	2.23
V-2805	Secondary Knockout	915	3.050	2.01	457.5	1.00

Based on the table, the liquid volume for the KA-8/18 Wellstream Separators (V-9010 & V-9020) and LT Separator (V-2808) might be greater than 4 m^3. However, based on the Heat and Material Balance, the composition of the liquid sections from the Wellstream Separators is mainly water (approx. 88 vol%), and the liquid from the LT Separator is mostly heavy hydrocarbons with volatile hydrocarbons making up only 15 vol% of the total composition. Therefore, it is considered that all vessels in Kapuni Wellsite do not have BLEVE potential.

3.10.4 Toxic Effects

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

Toxic effect from methanol will be considered in the QRA. 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

3.11 Risk Criteria

Risk is the combination of the likelihood and consequence of such accidents. It is defined as the probability of a specific adverse event occurring in a specific period or in specified circumstances. The likelihood may be expressed either as a frequency (i.e. the rate of events per unit time) or a probability (i.e. the chance of the event occurring in specified circumstances). The consequence is the degree of harm caused by the event.

Escape and evacuation fatalities are generally not considered for an onshore plant due to the open site layout and personnel's ready accessibility to the muster area. Hence, only immediate fatalities will be taken into account when performing the risk analysis to onsite workers.

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. In real situation, people do not constantly remain in one location, so this risk value does not provide a realistic representation of the true level of risk.

However, this value allows different areas to be compared on the same basis and is a useful measure for establishing the most hazardous areas of the plant, or for the comparison of facility risk profiles against standard criteria. The LSIR can be expressed as follows:

$$LSIR = \Sigma F \times P$$

Where:

F = Frequency of an event outcome per year

P = Probability of death due to the event at the location

∑ = Sum over all modelled events

LSIR is usually presented as risk contours or by defining risks at selected locations (e.g. site boundary).

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 3-8.

Table 3-8: 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

NSW HIPAP 4 states that where these criteria are initially exceeded, commercial and industrial land development may be appropriate where mitigating measures can be implemented to reduce risk exposure to less than the target individual fatality risk level.

4. REFERENCES

1. QRA Results – KA-4/14 & KA-13 Wellsites Memorandum, 620053-MMO-R0001, dated 17 July 2019.
2. Safety Case – Kapuni Production Station, Doc. No. NPL649981, Rev. 1, January 2018.
3. Email correspondence with Roisin Johnson, Mike Brophy and Rafeal Moreno (Todd Energy) and Y'vette Lee (Worley New Zealand), Sub.: RE: 610114 Kapuni Wellsites QRA Clarification - KA-7 dated 6 May 2020.
4. Email correspondence with Roisin Johnson, Mike Brophy and Rafeal Moreno (Todd Energy) and Y'vette Lee (Worley New Zealand), Sub.: RE: KA-15 well flow check dated 18 May 2020.
5. Todd Energy Fire and Gas Analysis and Quantitative Risk Assessment Methodology Guideline, NZ-1005-TECD721654, Rev. 0.
6. DNV GL Safeti software package version 8.22.
7. IOGP Risk Assessment Data Directory, Process Release Frequencies (OGP 434-1), September 2019.
8. IOGP Risk Assessment Data Directory, Ignition Probabilities (OGP 434-6), September 2019.
9. Email correspondence with Rebekah Heperi (Todd Energy) and Y'vette Lee (Worley), Sub.: 610114 Wellsites QRA information request - heat and material balance dated 27 May 2020.
10. Oil and Gas UK, Fire and Explosion Guidance, Issue 1 May 2007.
11. IOGP Risk Assessment Data Directory, Blowout Frequencies, September 2019.
12. SINTEF Offshore Blowout Database website, https://www.sintef.no/en/projects/sintef-offshore-blowout-database/
13. New South Wales Hazardous Industry Planning Advisory Paper No. 4 (HIPAP4), Risk Criteria for Land Use Safety Planning, January 2011.
14. Australian Standard, The Storage and Handling of Flammable and Combustible Liquids, AS 1940:2017.
15. Pressure-relieving and Depressuring Systems, API Standard 521, 6th Edition, January 2014.
16. New Zealand National Climate Database (http://cliflo.niwa.co.nz/).
17. Methods for the Determination of Possible Damage to People and Objects Resulting from Release of Hazardous Materials ('TNO Green Book').
18. Kapuni Production Station, Quantitative Risk Assessment Report, 610052-RPT-R0002, Rev. 1, April 2020.
19. Email correspondence between Mike Brophy (Todd Energy) and Y'vette Lee (Worley New Zealand), Sub.: RE: KA-18 Questions dated 13 July 2020.
20. Email correspondence between Mike Brophy (Todd Energy) and Y'vette Lee (Worley New Zealand), Sub.: RE: 610114 Wellsites QRA information request - heat and material balance dated 13 July 2020.
21. Discussion between Mike Brophy and Y'vette Lee on 31 July 2020.
22. Flammability of Hydrocarbon / CO2 mixtures: Part 1, Ignition and Explosion Characteristic, Symposium Series No. 156, 2011.
23. TNO Purple Book, Guidelines for Quantitative Risk Assessment, December 2005.