SUMMIT ENGINEERING SERVICES 400 Inverness Parkway, Suite 200 | Englewood, CO 80112 | 303.536.5526 | SUMMITENG.NET

February 4, 2020

Juliana Berry
City of Aurora Planning Department
15151 E. Alameda Parkway, Suite 5200
Aurora, Colorado 80012

RE: PHA/HAZOP Engineer of Record

Ms. Berry,

GMT Exploration Company LLC, Summit Engineering Services, Inc. and JCL Risk Services LLC conducted a PHA/HAZOP on the MCC 3-66-25-27 pad. The PHA/HAZOP occurred on 10/22/19-10/24/19. The engineer of record who is responsible for the evaluation of all applicable PHA/HAZOP recommendations into the design of the MCC 3-66-25-27 pad is:

- Gary Largesse, PE
    - PE 0044340

The PHA/HAZOP study followed industry standard guidelines for conducting PHA's using the Hazard and Operability (HAZOP) study technique. The PHA study was conducted in accordance with the OSHA PSM Standard and the EPA RMP Rule to meet compliance with certain requirements of the submittal documents for the oil and gas facility permitting by the City of Aurora, CO. The purpose of the PHA study was to analyze the process hazards associated with the future operation of the proposed design associated with the well production process for MCC 3-66-25-27.

Regards,

Gary Largesse, PE

Process Engineer

Lookup Detail View

Licensee Information

This serves as primary source verification of the license.*

**Primary source verification: License information provided by the Colorado Division of Professions and Occupations, established by 24-34-102 C.R.S.*

Name	Public Address
Gary Denis Largesse	Lakewood, CO 80228

Credential Information

License Number	License Method	License Type	License Status	Original Issue Date	Effective Date	Expiration Date
PE.0044340	Examination	Professional Engineer	Active	06/17/2010	11/01/2019	10/31/2021

Board/Program Actions

Discipline
There is no Discipline or Board Actions on file for this credential.

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Project Process Hazard Analysis (PHA) Study

New Well Production Process –
MCC 3-66 25-27 GMT in Adams County, CO

Final Report

December 2019

Prepared for:

GMT Exploration Company LLC

Prepared by:

JCL Risk Services LLC

*

Project Process Hazard Analysis (PHA) Study

New Well Production Process –
MCC 3-66 25-27 GMT in Adams County, CO

Prepared for:

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Prepared by:

JCL Risk Services LLC

BUSINESS CONFIDENTIAL

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Document History

Issue	Date	Description	Rev.
1	Nov 05, 2019	Draft Report Issued for Client Review	A
2	Dec 31, 2019	Final Report Issued for Client Review	0

Notice

This Report has been produced by JCL Risk Services LLC for GMT Exploration Company LLC for the specific purpose of documenting the delivery of independent professional risk management consulting services for a Project Process Hazard Analysis (PHA) Study ("Project PHA Study") and is only suitable for use in connection therewith. JCL Risk Services accepts no responsibility or liability for any unauthorized use or reliance upon any of the contents of this report.

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Executive Summary

GMT Exploration Company LLC ("GMT"), through Summit Engineering Services, Inc. ("Summit Engineering"), contracted JCL Risk Services LLC ("JCL Risk Services") to facilitate and record a Project Process Hazard Analysis (PHA) Study for a new Well Production Process – MCC 3-66 25-27 GMT in Adams County, CO, presently being designed by Summit Engineering.

The Project PHA Study followed industry standard guidelines for conducting PHAs using the Hazard and Operability (HAZOP) study technique. The Project PHA Study was conducted in accordance with the OSHA PSM Standard and EPA RMP Rule to meet compliance with certain requirements of the submittal documents (e.g. completed PHA/HAZOP) for oil and gas facility permitting by the City of Aurora, CO. The purpose of the Project PHA Study was to analyze the process hazards associated with the future operation of the proposed design associated with the Well Production Process for the Project.

The Project PHA Study was conducted during PHA Team sessions on October 22, 23 & 24, 2019 at the GMT Corporate offices in Denver, CO. The PHA Team included personnel representing production operations, project engineering, process engineering and electrical/instrumentation/controls (including at least one member who has experience and knowledge specific to the process) from GMT and Summit Engineering, plus personnel from JCL Risk Services with expertise in process safety and risk management and related OSHA PSM & EPA RMP regulations, with knowledge of the HAZOP methodology, and with training/proficiency in and facilitating/recording of PHA studies. These represent the minimum requirements by OSHA & EPA for PHA team composition.

The Project PHA Study addressed a greenfield design for process and utility equipment, piping and instrumentation for the following seven (7) HAZOP nodes:

1. Produced Fluid
2. Produced Gas
3. Flare Gas
4. Fuel Gas
5. Produced Oil
6. Produced Water
7. Condensate

The following systems were excluded from the Project PHA Study: Wellhead (by others), process equipment for future wells, Instrument Air System, and future Sales Gas Compressor.

The Project PHA Study results include:

(1) Findings documented in a set of PHA Worksheets that summarize the process hazard (and operability) scenarios analyzed by their causes and consequences, safeguards (designed or planned), and applicable risk rankings for evaluating potential impacts to safety and health of personnel and the community, and impacts to the environment; and

(2) Recommendations documented in the PHA Worksheets for those hazard scenarios where the PHA Team judged that further risk reduction measures may be warranted, or where follow-up action is needed for the Project (e.g. design verification).

The PHA Worksheets containing the detailed findings and recommendations for the Project PHA Study are provided in Appendix D. A summary of PHA recommendations distributed by risk is presented in Table 4.1. The PHA Team generated thirty-seven (37) PHA recommendations (see list in Table 4.2) intended to reduce the risk of potential hazard scenarios, to address GMT's practices for managing process safety, to meet compliance with regulatory requirements, or to improve the process design. GMT and Summit Engineering are responsible for resolving their respective recommendations from the Project PHA Study. The recommendations should be tracked for both resolution and closure by the responsible parties to be assigned. The status of these recommendations should be reviewed during an updated "Initial" PHA Study based on the "approved for construction" (or "as-built") drawings prior to startup of the production facility.

1. Introduction

1.1 Overview of the Design Project

GMT Exploration Company LLC ("GMT") is a Denver, Colorado based privately held independent oil and natural gas company currently engaged in the operation and development of oil and natural gas properties primarily located in Alaska and Wyoming. In addition to its current operations, the Company is actively pursuing new opportunities in Alberta, Canada, and in the Denver Julesberg Basin, Colorado.

GMT has contracted Summit Engineering Services, Inc. ("Summit Engineering") to design a new Well Production Process – MCC 3-66 25-27 GMT in Adams County, CO ("Project").

1.2 Overview of the Project PHA Study

GMT, through Summit Engineering, contracted JCL Risk Services LLC ("JCL Risk Services") to facilitate and record a Project Process Hazard Analysis (PHA) Study for a new Well Production Process – MCC 3-66 25-27 GMT in Adams County, CO, presently being designed by Summit Engineering. The Project PHA Study was conducted in accordance with the OSHA PSM Standard and EPA RMP Rule to meet compliance with certain requirements of the submittal documents (e.g. completed PHA/HAZOP) for oil and gas facility permitting by the City of Aurora, CO.

A Project PHA Study is typical for capital projects that involve the design and construction of new process facilities. At the time of the Project PHA, the design and associated reference drawings were estimated to be ~75% complete. Certain design data and vendor details were not available during the Project PHA Study. Nevertheless, assumptions based on previous design and operating experience of the PHA Team were made to enable the analysis to proceed, with a few PHA recommendations generated to capture the need for verifying design data when made available. This Project PHA Study should eventually be updated to serve as the "Initial" PHA Study for the process facility based on the "approved for construction" (or "as-built") drawings prior to its startup and operation.

JCL Risk Services has expended its best professional efforts in performing this consulting work. However, since this Project PHA Study was a joint effort between GMT, Summit Engineering and JCL Risk Services based on the information provided and discussions during the PHA Team sessions, JCL Risk Services can accept no liability for any use that GMT or anyone else may make of the documented results contained within this report or the accuracy of the information used or generated by the PHA Team.

1.3 Overview of the PHA Study Report

This report for the Project PHA Study documents the Purpose, Objectives & Scope (Section 2); the Technical Approach (Section 3); the Results (Section 4) summarizing the findings and recommendations; the Acronyms (Section 5) used with the report; and References (Section 6). This report also includes appendixes with the following supporting information:

Appendix A	Process Description – for the Well Production Process under review.
Appendix B	Risk Ranking Matrix – for risk ranking hazard scenarios.
Appendix C	PHA Team Sign-In Sheet – for recording attendance at the PHA Team sessions.
Appendix D	PHA Worksheets – for documenting details of scenarios and recommendations.
Appendix E	Reference Drawings – color-coded for referencing the scope of the analysis.

The PHA Study findings and recommendations (as well as the documented resolution of recommendations for PHAs and future updates or revalidations) should be retained for the life of the process.

2. Purpose, Objectives & Scope

2.1 Study Purpose

The purpose of the Project PHA Study was to analyze the process hazards associated with the future operation of the proposed design associated with the Well Production Process for the Project. Specifically, the Project PHA Study was conducted to:

- Identify process hazards and potential catastrophic events involving the release of highly hazardous chemicals.
- Examine ways to eliminate or reduce the risk of process hazards affecting employees and the community, and to minimize the likelihood of a release into and harming the environment.

As such, the Project PHA Study involved a systematic review of the proposed process design and an analysis of the process hazards for proposed operations. In addition, the development of hazard scenarios addressed previous incidents (as applicable), facility siting and human factors relevant to the design.

2.2 Study Objectives

Specific objectives of the Project PHA Study were to:

- Systematically identify and document the credible causes of deviations from the design intents for operation that could potentially result in the occurrence of hazard scenarios and/or significant operability scenarios.
- Determine and document for each hazard scenario the potential ultimate consequences (i.e. assuming existing safeguards or risk controls fail to function as designed) that could result in personnel injury, adverse effects to the community, or environmental impact.
- Determine and document for each hazard scenario existing (or planned) safeguards (i.e. engineering and administrative risk controls) as layers of protection for prevention and mitigation.
- Qualitatively estimate and document for each hazard scenario the severity of the ultimate consequences (i.e. with no credit for the identified safeguards), evaluating the potential impacts to safety and health of personnel and the community, the environment, and business reputation.
- Qualitatively estimate and document for each hazard scenario the likelihood of the cause being realized as a potential process safety incident with associated ultimate consequences (i.e. given credit for a reasonable level of effectiveness of the safeguards).
- Qualitatively assess the risk for each hazard scenario based on the estimated severity for the impacts and the estimated likelihood of the hazard scenario, using a standard risk ranking matrix.
- Evaluate the acceptability (or tolerability) of the assessed risk and the adequacy and effectiveness of identified safeguards for each hazard scenario, in order to determine whether recommendations are needed to further reduce the risk, to improve the current design or its documentation, or to improve operability.
- Document the results of the Project PHA Study in order to: (1) communicate understanding of the risks; (2) facilitate resolution of the recommendations; (3) provide input to or interface with other future safety studies or process safety activities, as applicable; (4) meet applicable regulatory requirements; and (5) provide a traceable audit trail for assurance that process hazards are being analyzed and addressed.

Project PHA Study for New Well Production Process – MCC 3-66 25-27 GMT in Adams County, CO The following were not objectives of the Project PHA Study:

- Evaluating or verifying the design basis or design philosophies for the Project.
- Developing or evolving the process design for the Project.
- Conducting a design review of any proposed changes for the Project, including designing, re-designing or problem-solving based on the PHA recommendations.
- Evaluating the merits or analysis of any new hazards associated with any future design changes based on the PHA recommendations.
- Resolving or tracking of PHA recommendations to closure which are the responsibility of the Client.

2.3 Study Scope

2.3.1 Design Life Cycle Phases

The Project PHA Study only addressed planned normal operations of the process facility after flowback operations based on the current process design under review. It did not address any hazards associated with fabrication, construction, installation, commissioning, start-up, shutdown, emergency response, non-routine, maintenance or other operating activities. It is expected that these operating modes and activities will be appropriately addressed in an updated "Initial" PHA Study after the design has been finalized.

2.3.2 Process Equipment and Utility Systems

A brief process description of the Well Production Process is provided in Appendix A. The current design of the new Well Production Process at the time of the Project PHA Study comprised the following major process equipment as represented on the reference drawings:

Burners/Heaters/Emission Control Devices:

- Burner Management System BMS-9010/20
- Burner Unit B-201
- Emission Control Device BR-9010/20
- Heater Unit H-201

Compressors:

- LP Gas Compressor C-2510
- VRU Gas Compressor C-3510

Headers/Manifolds:

- Blanket Gas Header
- C-2510 Suction Header
- Condensate Header
- Fuel Gas Header
- Maintenance Header
- Produced Gas Header
- Produced Oil Header
- Produced Water Header
- Sales Gas Header
- Sales Gas Meter Header
- Selection Manifold

Pumps:

- ECD Knockout Pump P-9050
- ECD Knockout Pump P-9055

Tanks:

- Oil Tank TK-5001/2/3/6/7/8
- Water Tank TK-4001/4

Vessels:

- 2-Phase Separator V-001
- C-2510 Suction Scrubber V-3510
- ECD Knockout Drum V-9050 (low pressure)
- ECD Knockout Drum V-9055 (high pressure)
- Fuel Gas Scrubber V-201
- Fuel Gas Scrubber V-3011
- Horizontal Separator V-1120
- Sales Gas Scrubber V-3450
- Sand Catcher V-0310
- Vapor Recovery Tower V-2000

Other:

- Instrument Air Skid SK-7000
- Produced Gas Meter Skid [unlabeled]
- Sales Gas Meter M-101/102
- Sump Tank SU-701
- Sump Tank SU-702
- Wellhead W-A (flow from)

The following systems and process equipment were excluded from the Project PHA Study:

- Wellhead W-A (by others, immediately upstream of the process being analyzed).
- Instrument Air System with Instrument Air Skid SK-7000 and Sump Tank SU-702 (does not apply to the OSHA PSM Standard since it does not involve a highly hazardous chemical (e.g. flammable gas) at or above the specified threshold quantity (e.g. 10,000 pounds). However, loss of instrument air was covered implicitly for safeguard malfunctions of control valves, ESD valves and instrumentation for the process.
- Sales Gas Compressor [unlabeled].
- Process equipment for future wells.

Reference drawings, including Site Layouts, Process Flow Diagrams (PFDs), Process & Instrument Diagrams (P&IDs) and Safety Data Sheets (SDS) for crude oil and produced water were used as the primary source of process safety information during the Project PHA Study (see Table 2.1). A Cause and Effects Matrix and Electrical Area Classification Drawings were not available for the design at this stage of the Project.

2.1 – Reference Drawings List

Number	Title	Revision	Date
8365-01-0100	GMT EXPLORATION COMPANY LLC MAJESTIC - 16 WELL PAD NORTH WELL AND FACILITY PAD INITIAL DEVELOPMENT SITE LAYOUT	N	10/09/19
8365-01-0101	GMT EXPLORATION COMPANY LLC MAJESTIC - 16 WELL PAD NORTH WELL AND FACILITY PAD RIG LAYOUT	C	10/09/19
8365-01-0102	GMT EXPLORATION COMPANY LLC MAJESTIC - 16 WELL PAD NORTH WELL AND FACILITY PAD FULL DEVELOPMENT SITE LAYOUT	E	10/09/19
8365-01-1000	GMT MAJESTIC - 16 WELL PAD PIPING & INSTRUMENTATION DIAGRAM COVER SHEET	C	12/03/19
8365-01-1200	GMT EXPLORATION COMPANY LLC MAJESTIC - 16 WELL PAD NORTH WELL AND FACILITY PAD PROCESS FLOW DIAGRAM	J	12/03/19
8365-01-1300	GMT MAJESTIC - 16 WELL PAD PIPING & INSTRUMENTATION DIAGRAM LEGEND SHEET 1	C	12/03/19
8365-01-1301	GMT MAJESTIC - 16 WELL PAD PIPING & INSTRUMENTATION DIAGRAM LEGEND SHEET 2	C	12/03/19
8365-01-1401	GMT MAJESTIC - 16 WELL PAD PIPING & INSTRUMENTATION DIAGRAM TYPICAL WELLHEAD W-A	C	12/03/19
8365-01-1402	GMT MAJESTIC - 16 WELL PAD PIPING & INSTRUMENTATION DIAGRAM SELECTION MANIFOLD	C	12/03/19
8365-01-1403	GMT MAJESTIC - 16 WELL PAD PIPING & INSTRUMENTATION DIAGRAM VHLP SEPARATOR V-1120	C	12/03/19
8365-01-1404	GMT MAJESTIC - 16 WELL PAD PIPING & INSTRUMENTATION DIAGRAM VHLP SEPARATOR V-1220	C	12/03/19
8365-01-1405	GMT MAJESTIC - 16 WELL PAD PIPING & INSTRUMENTATION DIAGRAM VHLP SEPARATOR V-1320 (FUTURE)	C	12/03/19

Number	Title	Revision	Date
8365-01-1406	GMT MAJESTIC - 16 WELL PAD PIPING & INSTRUMENTATION DIAGRAM HP BULK SEPARATOR #1 (FUTURE)	C	12/03/19
8365-01-1407	GMT MAJESTIC - 16 WELL PAD PIPING & INSTRUMENTATION DIAGRAM LP BULK OIL TREATER	B	12/03/19
8365-01-1408	GMT MAJESTIC - 16 WELL PAD PIPING & INSTRUMENTATION DIAGRAM VAPOR RECOVERY TOWERS	C	12/03/19
8365-01-1409	GMT MAJESTIC - 16 WELL PAD PIPING & INSTRUMENTATION DIAGRAM SALES GAS HEADER	C	12/03/19
8365-01-1410	GMT MAJESTIC - 16 WELL PAD PIPING & INSTRUMENTATION DIAGRAM WATER TANKS	C	12/03/19
8365-01-1411	GMT MAJESTIC - 16 WELL PAD PIPING & INSTRUMENTATION DIAGRAM WATER TANKS – (FUTURE)	C	12/03/19
8365-01-1412	GMT MAJESTIC - 16 WELL PAD PIPING & INSTRUMENTATION DIAGRAM FUEL GAS HEADER	C	12/03/19
8365-01-1413	GMT MAJESTIC - 16 WELL PAD PIPING & INSTRUMENTATION DIAGRAM LOW PRESSURE COMPRESSOR C-2510	C	12/03/19
8365-01-1414	GMT MAJESTIC - 16 WELL PAD PIPING & INSTRUMENTATION DIAGRAM FLARE KNOCKOUTS AND PUMPS	C	12/03/19
8365-01-1415	GMT MAJESTIC - 16 WELL PAD PIPING & INSTRUMENTATION DIAGRAM VRU GAS COMPRESSOR C-3510	C	12/03/19
8365-01-1416	GMT MAJESTIC - 16 WELL PAD PIPING & INSTRUMENTATION DIAGRAM BLANKET GAS HEADER	C	12/03/19
8365-01-1417	GMT MAJESTIC - 16 WELL PAD PIPING & INSTRUMENTATION DIAGRAM ECDS	C	12/03/19

Number	Title	Revision	Date
8365-01-1418	GMT MAJESTIC - 16 WELL PAD PIPING & INSTRUMENTATION DIAGRAM OIL TANKS – HOLDING	C	12/03/19
8365-01-1419	GMT MAJESTIC - 16 WELL PAD PIPING & INSTRUMENTATION DIAGRAM OIL TANKS – (FUTURE)	C	12/03/19
8365-01-1420	GMT MAJESTIC - 16 WELL PAD PIPING & INSTRUMENTATION DIAGRAM MAINTENANCE HEADER	C	12/03/19
8365-01-1421	GMT MAJESTIC - 16 WELL PAD PIPING & INSTRUMENTATION DIAGRAM CONDENSATE HEADER	C	12/03/19
8365-01-1422	GMT MAJESTIC - 16 WELL PAD PIPING & INSTRUMENTATION DIAGRAM INSTRUMENT AIR	C	12/03/19
8365-01-1423	GMT MAJESTIC - 16 WELL PAD PIPING & INSTRUMENTATION DIAGRAM LIQUID LOADOUT	A	12/03/19

2.3.3 Study Nodes

Manageable sections of the process design (referred to as HAZOP “nodes”) were reviewed during the Project PHA Study. The nodes typically included process equipment, piping and instrumentation for a specified design intent of the relevant process parameters.

A list of nodes and associated reference drawings addressed during the Project PHA Study is provided in Table 2.2. Reference drawings (e.g. P&IDs) color-coded for each of the analyzed nodes are provided in Appendix E. Note that a few minor corrections and minor design changes made during the Project PHA Study were annotated (redlined) on the drawings, but were not captured as recommendations. Instead, Summit Engineering is responsible for tracking changes to the drawings.

Note that for any identical trains or pieces of process equipment in parallel systems (e.g. separators) the Project PHA Study only addressed an analysis of one representative system. However, key interactions between the systems (e.g. redundancy in the supply of fuel gas) were analyzed during the Project PHA Study.

Table 2.2 – Node List

Node	Node Description	Design Conditions / Parameters	Drawings
1	**Produced Fluid** from: (1) Outlet of Wellhead W-A thru temporary Sand Catcher V-0310 (PF1A) thru Selection Manifold thru heated coil inside Horizontal Separator V-1120 to inlet of 2-Phase Separator V-001 via Selected Flow Line (PF2A); and (2) thru Maintenance Bypass (PF3A) and Maintenance Header to Oil Tank TK-5001 (PF4) **(pink)**	To transfer under wellhead pressure and controlled flow line pressure, produced fluid from the outlet of the wellhead via the flow line to the inlet of the 2-Phase Separator V-001; also to transfer produced fluid thru the maintenance bypass line to storage. Note: the initial design includes 2 new wells, with 14 future wells planned. Flow: 0 – 2,367 bbl/day (produced oil and produced water) Temperature: 65 - 103 F Pressure: 0 - 2,000 psig	8365-01-1401 8365-01-1402 8365-01-1403 8365-01-1418 8365-01-1420
2	**Produced Gas** from: (1) Gas outlet of Horizontal Separator V-1120 (PG4); (2) Gas outlet of Vapor Recovery Tower V-2000 (PG6) thru VRU Compressor C-3510 (PG7), comingled in C-2510 Suction Header thru C-2510 Suction Scrubber V-3510 thru LP Gas Compressor C-2510 (PG5), and (3) Gas outlet of 2-Phase Separator V-001 thru Produced Gas Meter Skid (PG1), comingled in Sales Gas Header thru Sales Gas Scrubber V-3450 thru Sales Gas Meter M-101/102 to Sales Gas Compressor (PGX); and (3) Gas outlet of Horizontal Separator V-1120 thru Blanket Gas Header (PG2) into Oil Tank TK-5006 as Blanket Gas (PG3) **(yellow)**	To separate produced gas from produced oil, to meter and monitor gas conditions, transfer under pressure control to Sales Gas Header, comingling with other gas sources; to scrub condensate from produced gas, to meter and monitor sales gas conditions, and transfer sales gas under pressure to Sales Gas Compressor (out of scope); and to provide a source of blanket gas for the Oil Tanks and Water Tanks. Also, to provide a path for flare gas (Node 3) and a source of fuel gas (Node 4). Flow: 0 - 1,813 Mscf/d Temperature: 60 - 80 F Pressure: 0 - 300 psig (to Sales)	8365-01-1403 8365-01-1408 8365-01-1409 8365-01-1413 8365-01-1415 8365-01-1416 8365-01-1418

Node	Node Description	Design Conditions / Parameters	Drawings
3	**Flare Gas** from: (1) Gas outlet of Sales Gas Scrubber V-3450 (FL1) thru ECD Knockout Drum V-9055 (FL2) thru Emission Control Device BR-9010/20 with Flame Arrestors and Burner Management System BMS-9010/20; (2) Oil Tank TK-5001/2/3/6/7/8 and Water Tank TK-4001/4 (FL3, FL4, FL5) thru ECD Knockout Drum V-9050 (FL6) thru Emission Control Device BR-9010/20 with Flame Arrestors; (3) Gas outlet of C-2510 Suction Scrubber V-3510 to inlet of ECD Knockout Drum V-9055 (FL7); Gas outlet of Vapor Recovery Tower V-2000 to inlet of ECD Knockout Drum V-9050 (FL8) **(pink)**	To meter and monitor flare gas conditions, transfer under pressure control and knock out condensates (as needed) for flaring. Flow: As needed Temperature: 60 - 80 F Pressure: 0 - 100 psig	8365-01-1409 8365-01-1410 8365-01-1413 8365-01-1414 8365-01-1415 8365-01-1417 8365-01-1418
4	**Fuel Gas** from: Gas outlet of Sales Gas Scrubber V-3450 (FG1) thru Fuel Gas Scrubber V-3011 to Fuel Gas Header with supplies to: (1) Fuel Gas Scrubber V-201 and Burner Unit B-201 for Heater Unit H-101 for Horizontal Separator V-1120 (FG2); (2) Engine for LP Gas Compressor C-2510 (FG3); and (3) Pilots for Emission Control Device BR-9010/20 with Burner Management System BMS-9010/20 (FG4) **(orange)**	To meter and monitor fuel gas conditions, transfer under pressure control and scrub condensates (as needed) for use as fuel gas in heater for Horizontal Separator V-1120 and flare pilots. Flow: 0 - TBD Mscf/d Temperature: 60 - 80 F Pressure: 0 - 100 psig	8365-01-1403 8365-01-1409 8365-01-1412 8365-01-1413 8365-01-1417

Node	Node Description	Design Conditions / Parameters	Drawings
5	**Produced Oil** from: Liquid outlet of 2-Phase Separator V-001 (PO1) into and thru Horizontal Separator V-1120 (PO2) thru Produced Oil Header thru liquid separation from Vapor Recovery Tower V-2000 (PO3) and thru Oil Tank TK-5001/2/3/6/7/8 to Truck Loadout **(green)**	To separate produced oil and produced water from produced gas and control the liquid level in the 2-Phase Separator V-001, drain into the Horizontal Separator V-1120; to control the liquid level in the Horizontal Separator V-1120 and transfer the produced oil under gravity to the Vapor Recovery Tower V-2000 to separate produced gas and produced water, and then send to Oil Tank TK-5001/2/3/6/7/8 for truck loadout. Note: the initial design includes 6 new tanks, with 4 future tanks planned. Flow: 0 - 1,259 bbl/day Temperature: 65 - 120 F Pressure: 0 - 100 psig	8365-01-1403 8365-01-1408 8365-01-1418
6	**Produced Water** from: Water outlet of Horizontal Separator V-1120 (PW1) to Produced Water Header and thru Water Tank TK-4001/4 to Truck Loadout **(rose)**	To separate produced water from produced oil and control liquid level in the Horizontal Separator V-1120, and transfer produced water under gravity to storage and truck loadout. Flow: 0 - 1,108 bbl/day Temperature: 65 - 120 F Pressure: 0 - 120 psig	8365-01-1403 8365-01-1410
7	**Condensate** from: Liquid outlet from: (1) Sales Gas Scrubber V-3450 (CO1); (2) Vapor Recovery Tower V-2000 (CO2); (3) Fuel Gas Scrubber V-3011 (CO3); (4) C-2510 Suction Scrubber V-3510 (CO4); (5) ECD Knockout Drum V-9050 via ECD Knockout Pump P-9050 and ECD Knockout Drum V-9055 via ECD Knockout Pump V-9055 (CO5); VRU Compressor C-3510 (CO6); all to Condensate Header (COX) and into Produced Water Header to Water Tank TK-4001/4. Condensate from Fuel Gas Scrubber V-201 and Sump Tank SU-702 via manual drain **(blue)**	To separate condensate from produced gas, sales gas, fuel gas and flare gas; and control liquid level and transfer condensate under gravity to storage and truck loadout. Condensate is manually drained from the Fuel Gas Scrubber V-201 and the Sump Tank SU-702. Flow: As needed Temperature: 65 - 120 F Pressure: 0 - 120 psig (from scrubbers, compressors and knockout drums)	8365-01-1403 8365-01-1408 8365-01-1409 8365-01-1410 8365-01-1412 8365-01-1413 8365-01-1414 8365-01-1415 8365-01-1421

2.3.4 Basis

The following represent the general basis for the Project PHA Study:

- Style of Recording – a "full recording" method of documenting the findings was used (i.e. "recording by exception" was not used).
- Hazard Scenarios – emphasis was placed on addressing those hazard scenarios which impacted the design of the new process and related systems.
- Causes – equipment malfunctions and human errors related to deviations from normal operations were analyzed, but a full procedural-style Project PHA Study was not carried for Startup and Shutdown operations, or truck loadout operations at this stage of the design. Hazard scenarios for every drain and vent valve with potential for minor loss of containment (i.e. local leaks) were not analyzed; instead, small leaks were covered in the Leak/Rupture deviation for each node.
- Consequences – the ultimate consequences for each hazard scenario were fully documented; whereas, documentation of operability issues were limited to those of major significance, and for noting "operability issue only" for causes with "no hazardous consequences". Operability issues included consequences that could result in equipment damage with no hazards, contaminated products, process inefficiencies, and undesired production reductions or shutdowns.
- Safeguards – engineering controls (e.g. basic process control systems, interlocks and shutdowns, pressure safety valves (PSVs), etc.) and administrative controls (e.g. operating procedures, training, inspection & testing programs, etc.) were fully documented. Engineering controls identified as safeguards were evaluated to determine whether they are credible, effective, and functional to ensure that they operate when required and as designed.
- Risk Assessment – all hazard scenarios were risk-ranked where information was available; operability scenarios were not risk-ranked.
- Recommendations – routine project tasks (e.g. minor P&ID corrections) were excluded from the recommendations in order to minimize the amount of formal action-tracking to closure. Instead, any P&IDs corrections were redlined and will be tracked by the Summit Engineering for future remedy.

3. Technical Approach

3.1 PHA Requirements & Guidelines

The Project PHA Study was performed in accordance with the OSHA Process Safety Management (PSM) Standard (29 CFR 1910.119, paragraph (e), "Process Hazard Analysis") and the EPA Risk Management Program (RMP) Rule (40 CFR Part 68.67, "Process Hazard Analysis"). The Project PHA Study followed industry standard guidelines for conducting PHAs, e.g. Center for Chemical Process Safety (CCPS) "Guidelines for Hazard Evaluation Procedures", specifically the Hazard and Operability (HAZOP) methodology.

3.2 PHA Team Sessions

The Project PHA Study was conducted during PHA Team sessions on October 22, 23 & 24, 2019 at the GMT Corporate offices in Denver, CO.

A brief orientation session was held during the morning of the first day of the Project PHA Study to present:

- PHA Team Expectations
- PHA Purpose, Scope, Objectives
- PHA Assumptions
- Process Safety Information
- PHA Terminology
- PHA Methodology

The Project PHA Study was conducted "real-time" during the PHA Team sessions by projecting the results interactively using a laptop computer and overhead projection equipment. The results were recorded directly into PHA Worksheets (see Appendix D) during these sessions using PHA-Pro®, Version 8, specialized software for recording PHAs. A list of the PHA Team Members who participated in the Project PHA Study is provided in Table 3.1. PHA Session Attendance for the PHA Team members is provided in Table 3.2. A PHA Team Sign-In Sheet is provided in Appendix C.

Table 3.1 – PHA Team Members

Name	Company	Title	Experience (yrs.) in current position	Experience (yrs.) in industry
Cox, B.J.	GMT	Production Superintendent	15	28
Hinds, Jaylen	Summit Engineering	Engineering Tech	1.5	1.5
Jones, David A.	JCL Risk Services LLC	Director – Process Safety Services	4	42
Kuskie, Jack	Summit Engineering	Project Manager/ Account Manager	2	15
Largesse, Gary	Summit Engineering	Process Engineer	2	20
Moore, Al	Summit Engineering	EI&C Manager	1.5	41

3.2 – PHA Session Attendance

Name	Oct 22nd	Oct 23rd	Oct 24th
Cox, B.J.	✓	✓	✓
Hinds, Jaylen	✓	✓	✓
Jones, David A.	✓	✓	✓
Kuskie, Jack	✓	✓	✓
Largesse, Gary	✓	✓	✓
Moore, Al	✓	A	A

Note: ✓ = Present; P = Part-time; A = Absent

The PHA Team included personnel representing production operations, project engineering, process engineering and electrical/instrumentation/controls (including at least one member who has experience and knowledge specific to the process) from GMT and Summit Engineering, plus personnel from JCL Risk Services with expertise in process safety and risk management and related OSHA PSM & EPA RMP regulations, with knowledge of the HAZOP methodology, and with training/proficiency in and facilitating/recording of PHA studies. These represent the minimum requirements by OSHA & EPA for PHA team composition.

The Project PHA Study was facilitated and recorded by David A. Jones from JCL Risk Services. He is a trained and experienced practitioner in PSM/RMP and health, safety, security and environment (HSSE) system development, implementation and auditing, including performing PHAs. He also has practical work experience in the oil and gas and chemical processing industries, including process engineering, construction, pre-startup safety reviews, operations, and PSM/RMP and HSSE management. A short biography is provided below.

Mr. David A. Jones

As Director, Process Safety Services for JCL Risk Services LLC, Mr. Jones is a process safety and quality, health, safety, security, environmental (QHSSE) professional with over 42 years of business and technical management experience (including process safety management, process safety engineering, process design, construction, and operations) serving the energy, petrochemical and chemical processing industries, including 10 years in Process Engineering & Operations and over 32 years in PSM and QHSSE Management.

Key positions have included:

- International PSM & HSSE Consulting (VP, Director, Manager)
- Corporate PSM & QHSSE Management (Global Director, Division Director)
- Process Safety Engineering (Lead Technical Safety Engineer)
- Process Engineering (Manager of Applied Technology, Lead Process Engineer, Sr. Process Engineer, Process Design Engineer.)
- Operations (Assistant Plant Manager, Production Supervisor, Process Supervisor, Process Operator as Co-Op Student)

Mr. Jones received a B.S. in Chemical Engineering from the University of South Florida and has completed all graduate studies towards his Master of Public Health (MPH), Occupational Health & Safety Management, from Tulane University (pending capstone).

He completed coursework for a Certificate in Safety Management (ASSE) and OSHA Certified Safety & Health Official (CSHO) for General Industry (29 CFR 1910) & Construction (29 CFR 1926) through the Texas A&M Engineering Extension Service (TEEX). Mr. Jones specializes in facilitating PHA/LOPA studies, and designing, developing, implementing, reviewing and auditing process safety and QHSSE management systems for design and operational risk, reliability and resilience performance, continuity and sustainability.

3.3 PHA Methodology

The Project PHA Study was conducted using a PHA methodology in accordance with industry standard guidelines for conducting PHAs, e.g. CCPS "Guidelines for Hazard Evaluation Procedures". Specifically, the PHA utilized the HAZOP methodology based on the complexity of the process design. HAZOP is recognized globally as one of the most rigorous risk assessments (i.e. risk identification, analysis and evaluation) techniques used for PHAs by process industries and is specified as an acceptable methodology by many process safety regulations, including the OSHA PSM Standard and EPA RMP Rule.

3.3.1 HAZOP Steps

The steps for applying the HAZOP methodology are shown in Figure 3.1.

3.3.2 Nodes, Design Intents, Process Parameters, Guidewords & Deviations

HAZOP Steps 1 – 4 (see Figure 3.1) addressed the following for process system identification:

- Nodes – the nodes were identified based on the selection of design intents and documented in the Node List with Node Descriptions (see Table 2.2) and noted on the color-coded reference drawings (e.g. P&IDs) (see Appendix E).
- Design Intents – the design intents and available process conditions for the systems and equipment for each node were reviewed by the PHA Team and documented in the Node List with Design Conditions/Parameters (see Table 2.2).
- Process Parameters – applicable process parameters (e.g. flow, pressure, level, temperature) were selected for specific process equipment within each node; and applicable general parameters (e.g. startup, maintenance) were also considered for each node (see Table 3.3). By convention, Misdirected Flow was used to analyze flow out of the node (e.g. PSV leaks through to atmosphere); and As Well As Flow was used to analyze flow into the node (e.g. chemical injection fluid leaks into the process).
- Guidewords & Deviations – deviations of process parameters from the design intents based on applicable HAZOP guidewords (see Table 3.3) were used to facilitate the identification of potential hazard scenarios for each node.

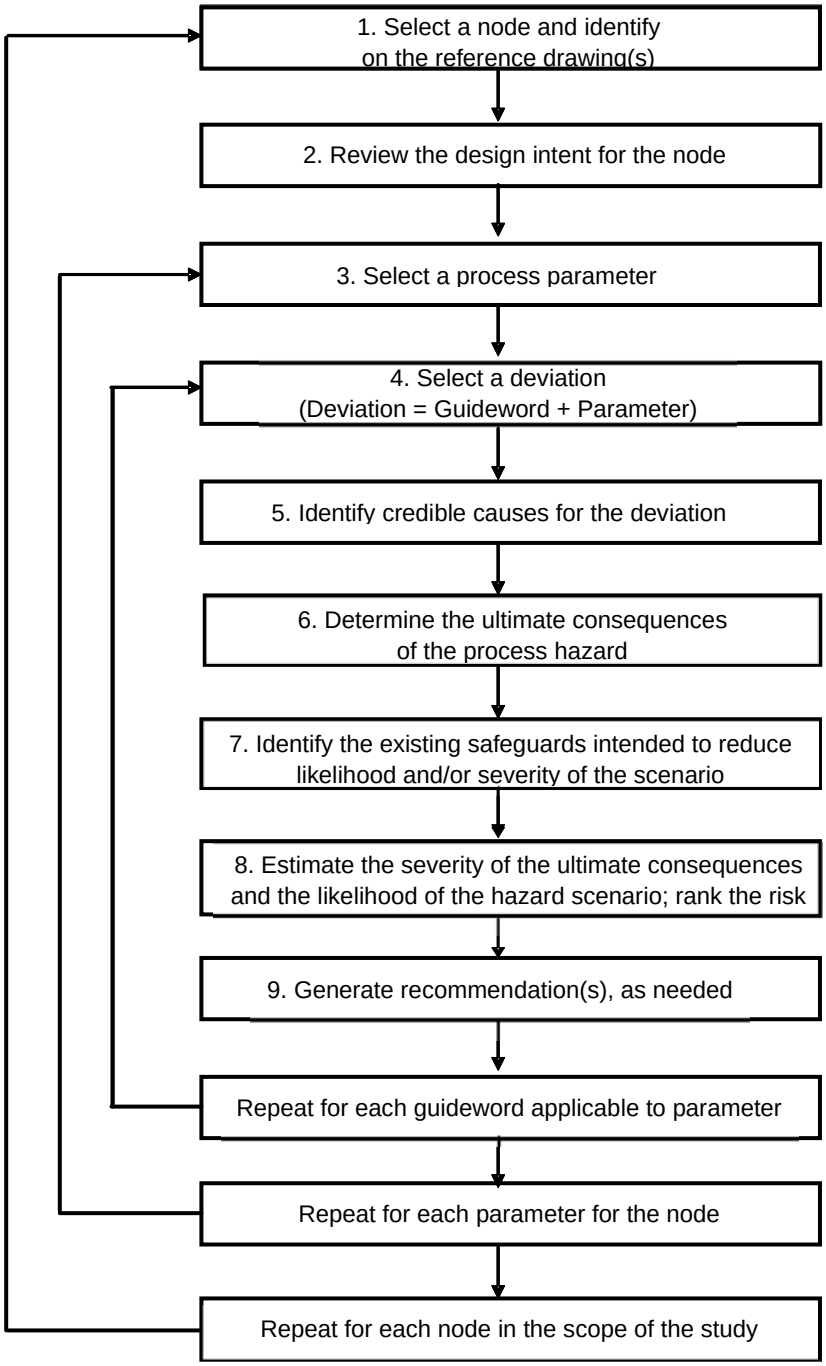

Figure 3.1 – HAZOP Steps

3.3 – Deviations

Process Parameters	HAZOP Guidewords					
	No	**Less**	**More**	**Reverse**	**Part Of**	**Other Than**
Flow	No Flow	Lower Flow	Higher Flow	Reverse Flow	As Well As Flow	Misdirected Flow
Pressure	No Pressure/ Vacuum	Lower Pressure	Higher Pressure	N/A	N/A	N/A
Level	No Level	Lower Level	Higher Level	N/A	N/A	N/A
Temperature	N/A	Lower Temperature	Higher Temperature	N/A	N/A	N/A
General	N/A	N/A	N/A	N/A	N/A	Composition Contamination Instrumentation Sampling Leak/Rupture Corrosion Erosion Loss of Utility Service Failure Startup Shutdown Maintenance Inspection Human Factors Facility Siting

3.3.3 Hazard Scenario Development

HAZOP Steps 5 – 7 (see Figure 3.1) addressed the following components for the hazard scenarios:

- Credible Causes – credible causes included the following categories:
    - *Equipment malfunctions* – e.g. control valve malfunctions closed.
    - *Human errors* – e.g. manual or automatic valve closed in error.
    - *External events* – e.g. contact of process equipment or piping by vehicles.
    - *Long-term processes* – e.g. corrosion, as applicable.

  Causes were limited to those within the node under review, except where the node occurred at a boundary condition for the process. Two independent causes occurring simultaneously (i.e. double jeopardy) were not considered credible, except where a common-mode failure was possible.

  Causes of equipment malfunctions for control loops were recorded as a loss of control function (e.g. control valve malfunctions closed or open; regardless of the "fail safe position" of the valve). Any component of the control loop is assumed to have caused the malfunction (e.g. controller malfunction, incorrect setpoint, loss of instrument air, etc.), and all components in the control loop were assumed to be adversely affected by the malfunction (e.g. credit was not taken for alarms associated with the control loop).

Causes involving human errors were recorded as an action performed "in error" without defining the type of error (e.g. act of omission, act of commission) or the reason for the error. For example, "manual valve closed in error" represents the state of the valve, regardless of whether it was inadvertently closed, it was the wrong valve intended to be closed, or was left closed.

- Ultimate Consequences – potential ultimate consequences (i.e. without any credit given for the documented existing (or planned) safeguards, where the risk controls fail) included a combination of the following categories:
    - *Precursor Events* – resulting from deviations from design intents or exceedance of design limits (e.g. overpressure).
    - *Intermediate Events* – resulting in process upsets or equipment failure (e.g. vessel rupture).
    - *Hazardous Events* – resulting in a process chemical release and subsequent impact (e.g. loss of containment, fire or explosion, personnel injury, environmental impact, etc.).

  The examination of potential consequences included those within the node under review, as well as those outside the node, including any upstream or downstream of the location of the cause.
- Safeguards – existing (or planned) safeguards included the following categories:
    - *Engineering Controls* – prevention, detection, control, mitigation (e.g. alarms, interlocks, shutdowns, check valves, Pressure Safety Valves (PSVs)).
    - *Administrative Controls* – prevention/preparation, detection, response (e.g. car sealing open/closed manual isolation valves, inspection and testing programs, response actions to alarms such as manual activation of an emergency shutdown (ESD)).

3.3.4 Risk Assessment

HAZOP Step 8 (see Figure 3.1) addressed the following qualitative assessment of risk (to personnel, the community, and the environment) for each hazard scenario, as documented in the PHA Worksheets (see Appendix D):

- Severity – based on the documented ultimate consequences for each credible hazard scenario (i.e. without any credit given for the documented existing safeguards), the impacts to the safety and health of personnel and the community and impacts to the environment were estimated by a consensus of the PHA Team from the severity rankings using a standard Risk Ranking Matrix (see Appendix B). A consequence category scale from '1' to '5' was used to indicate decreasing severity of the impacts for each hazard scenario.
- Likelihood – based on the cause being realized as a potential incident with the ultimate consequences and with credit given for a reasonable level of availability and effectiveness of the documented safeguards, the likelihood for each hazard scenario was estimated by a consensus of the PHA Team based on judgment, experience or historical evidence using the likelihood rankings using a standard Risk Ranking Matrix (see Appendix B). A likelihood category scale from '1' to '5' was used to indicate decreasing likelihood of each hazard scenario.
- Risk – using the highest estimated severity (i.e. for impacts to safety and health of personnel and the community and impacts to the environment) and the estimated likelihood for each hazard scenario, a maximum risk ranking was assigned to each hazard scenario using a standard Risk Ranking Matrix (see Appendix B), with values ranked to indicate a range of risks (from Negligible (N) to Extremely High (X)) with associated levels of risk tolerance/acceptance and priority for actions to reduce risks, where needed. Some scenarios were not risk ranked due to having no hazardous consequences, e.g. involving operability issues only.

3.3.5 Recommendations

HAZOP Step 9 (see Figure 3.1) addressed the generation of PHA recommendations during the Project PHA Study by the PHA Team based on available information and collective judgment to remedy a concern. Since the Project PHA Study was intended to identify problems related to process hazards and associated risks rather than to solve problems during the PHA Team sessions, further evaluation of the intent of each PHA recommendation should be carried out by the appropriate subject matter experts and/or those responsible for managing the design efforts within the Project as well as the future operation of the production facility.

All recommendations were assigned to a responsible party, with overall responsibility for resolution and closure assigned to GMT. The recommendations typically serve one of the following purposes:

- To eliminate or further reduce risks of process hazards adversely affecting personnel, the community or the environment by reducing the likelihood of an event and/or preventing or mitigating its consequences through additional or more effective safeguards (i.e. engineering controls or administrative controls);
- To verify the design basis or calculations (e.g. sizing of and setpoints for PSVs);
- To further study or analyze certain process conditions, design features or operational issues; and
- To correct or update the design basis or design documentation.

3.3.6 Other PHA Study Considerations

The Project PHA Study also addressed the following considerations based on the OSHA PSM Standard and EPA RMP Rule:

- Previous Incidents – since the process design represents a new well production facility and one which has yet to be built and operating, there was no history of reports or lessons learned available for review by the PHA Team for previous incidents that had a likely potential for catastrophic consequences in the workplace. Instead, the collective operational experience by PHA Team members was used to assess potential process safety hazards based on their knowledge of other incidents within the industry.
- Facility Siting – based on facility and equipment layout facility siting issues affecting adjacent process equipment and personnel based on discussions of the addressed in hazard scenarios within each node during the Project PHA Study and documented in the PHA Worksheets (see Appendix D), as follows:
    - *Causes* – proximity of adjacent simultaneous operations (SIMOPS) were considered and documented as possible causes for process deviations (e.g. vehicular traffic for product loadout contacting process equipment, etc.).
    - *Consequences* – proximity of process equipment and personnel to areas of vulnerability during releases, fires, and explosions were considered and documented as possible consequences (e.g. exposure to personnel and escalation of hazardous events).
    - *Safeguards* – designed locations of planned discharges (e.g. relief to atmospheres, vents, drains) were considered and documented as safeguards (e.g. PSV relief to a safe location at a specified distance above grade, provisions for secondary containment).

  A detailed facility siting study or equipment layout review in accordance with industry standards (e.g. API, CCPS) were beyond the scope of this Project PHA Study.

- Human Factors – human factors were addressed during the Project PHA Study and documented in the PHA Worksheets (see Appendix D), as follows:
    - *Causes* – human errors were considered and documented as possible causes for process deviations (e.g. manual or automatic valve closed in error).
    - *Consequences* – human exposures of personnel to hazardous chemicals (e.g. toxics) and/or hazardous energy sources (e.g. heat, pressure) were considered and documented as potential consequences from uncontrolled releases or other process safety or environmental events, including fire/explosion (e.g. with potential personnel injury).
    - *Safeguards* – human factors were considered and documented as existing (or planned) safeguards (e.g. alarms requiring timely operator response).
    - *Severity Rankings* – as part of the risk assessment for each hazard scenario, estimated potential impacts to personnel were considered and documented as severity rankings based on the documented consequences.

  A detailed ergonomics study or human reliability analysis were beyond the scope of this Project PHA Study. It is anticipated that a more detailed treatment of human factors for each hazard scenario will be addressed for the operational phase of the process during a future PHA Study, based on the anticipated availability of written operating procedures, safe work practices (e.g. permit systems and procedures), emergency response plans and procedures, and associated operator training following the final design phase of the Project.

4. Results

4.1 Study Findings

Findings from the Project PHA Study are documented in a set of PHA Worksheets (see Appendix D) that summarize the process hazard (and operability) scenarios analyzed by their causes and consequences, existing (or planned) safeguards, and applicable risk rankings for evaluated potential impacts to the safety and health of personnel and the community, and impacts to the environment.

4.2 Study Recommendations

Recommendations from the Project PHA Study are documented in the PHA Worksheets (see Appendix D) for those hazard scenarios where the PHA Team judged that further risk reduction measures were warranted, or where follow-up action (e.g. design verification) was needed for the Project.

The PHA Team generated thirty-seven (37) PHA recommendations (see Table 4.2) intended to reduce the risk of potential hazard scenarios, to address GMT's practices for managing process safety, to meet compliance with regulatory requirements, or to improve the design. A summary of PHA recommendations distributed by risk is presented in Table 4.1.

Table 4.1 – Distribution of Recommendations by Risk

Count	Risk Ranking	Comment
0	Extremely High (X)	Unacceptable risk – reduce by 3 orders of magnitude.
0	High (H)	Unacceptable risk – reduce by 2 orders of magnitude.
3	Medium High (MH)	Unacceptable risk – reduce by 1 order of magnitude.
25	Medium (M)	Tolerable risk – reduce further if practicable to do so.
6	Low (L)	Tolerable risk – reduce further if required or desired.
0	Negligible (N)	Negligible risk – no further risk reduction needed.
3	Not Risk Ranked (NRR)	Not risk ranked (e.g. design verification, operability issues, etc.).
37		**TOTAL**

GMT is responsible for resolving the recommendations from the Project PHA Study. The recommendations should be tracked for closure by the responsible parties assigned. The status of these recommendations should be reviewed during an updated "Initial" PHA Study based on the "approved for construction" (or "as-built") drawings prior to startup of the process facility.

In accordance with the OSHA PSM Standard, 29 CFR 1910.119(e)(5), OSHA states:

> "The employer shall establish a system to promptly address the team's findings and recommendations; assure that the recommendations are resolved in a timely manner and that the resolution is documented; document what actions are to be taken; complete actions as soon as possible; develop a written schedule of when these actions are to be completed; communicate the actions to operating, maintenance and other employees whose work assignments are in the process and who may be affected by the recommendations or actions."

In accordance with the OSHA Instruction CPL 2-2.45A CH-1 "29 CFR 1910.119, Process Safety Management of Highly Hazardous Chemicals-Compliance Guidelines and Enforcement Procedures" Sept 13, 1994:

> "OSHA considers an employer to have "resolved" the team's findings and recommendations when the employer either has adopted the recommendations, or has justifiably declined to do so. Where a recommendation is rejected, the employer must communicate this to the team, and expeditiously resolve any subsequent recommendations of the team. An employer can justifiably decline to adopt a recommendation where the employer can document, in writing and based upon adequate evidence, that one or more of the following conditions is true:
>
> 1. The analysis upon which the recommendation is based contains material factual errors;
> 2. The recommendation is not necessary to protect the health and safety of the employer's own employees, or the employees of contractors;
> 3. An alternative measure would provide a sufficient level of protection; or
> 4. The recommendation is infeasible. [note: OSHA has clarified that infeasible refers to technical feasibility, not economic feasibility].

Regarding "timeliness", OSHA has further clarified in the OSHA Instruction CPL 2-2.45A CH-1:

> "Employers must "promptly" address the problems identified in the PHA in a "timely manner," and complete actions "as soon as possible." What time frame did OSHA intend here?
>
> The standard's intent is for the employer to take corrective action as soon as possible. As soon as possible means that the employer shall proceed with all due speed, considering the complexity of the recommendation and the difficulty of implementation. OSHA expects employers to develop a schedule for completion of corrective actions, to document what actions are to be taken, and to document the completion of those actions as they occur."

Table 4.2 – Recommendations List

Recommendations	Responsible	Risk Ranking*	Place(s) Used**
1. Verify with the vendor that the LP Gas Compressor C-2510 is equipped with a pressure safety valve (PSV) on the fuel gas line to its engine.	Summit Engineering	**MH**	4.2.1.3, 4.5.1.2
2. Evaluate installing a Pressure Indicator Transmitter (PIT) in the fuel gas line downstream of the 2" Pressure Control Valve PCV-3012 downstream of the Fuel Gas Scrubber V-3011 with a high-high pressure interlock to activate an Emergency Shutdown (ESD).	Summit Engineering	**MH**	4.2.1.3, 4.2.1.4, 4.2.1.5, 4.5.1.2, 4.5.1.3, 4.5.1.4
3. Evaluate installing a pressure safety valve (PSV) in the fuel gas line downstream of the 2" Pressure Control Valve PCV-3012 downstream of Fuel Gas Scrubber V-3011 to protect against on overpressure of the fuel gas line.	Summit Engineering	**MH**	4.2.1.3, 4.2.1.4, 4.2.1.5, 4.5.1.2, 4.5.1.3, 4.5.1.4

Recommendations	Responsible	Risk Ranking*	Place(s) Used**
4. Develop written operating procedures, including a startup procedure (e.g. purging the entire process system with nitrogen to assure an oxygen free environment; proper alignment of process and isolation valves; proper isolation of master valves on the production tree prior to ESD reset); monitoring and inspection of process equipment and conditions to support daily checks by operators during normal operations; closing the master valves and flow line valve; entering setpoints for controllers and control valves; and manually activating an emergency shutdown (ESD), in order to provide assurance for safely conducting production activities.	GMT	**M**	1.2.1.2, 1.22.1.1, 3.8.1.1
5. Develop a written car seal procedure with a periodic auditing feature to assure the integrity of an open flow path for relief valves (e.g. pressure safety valves (PSVs)) for those with upstream manual isolation valves that are specified as car sealed open (CSO) or other process lines that are specified as CSO or car sealed closed (CSC) to assure the integrity of an open flow path (e.g. to atmosphere at a safe location or to the emission control devices) or a closed flow path (e.g. to prevent bypassing critical process equipment), to provide assurance for safely conducting production activities.	GMT	**M**	1.2.1.2
6. Develop and implement a training process, including training in operating procedures, specific safety and health hazards, emergency operations including shutdown, and safe work practices, to provide assurance for safely conducting production activities. The training should address initial training and periodic refresher training.	GMT	**M**	1.2.1.2
7. Develop and document a written Cause and Effects Matrix for safety critical controls, alarms and interlocks for the facility (e.g. emergency shutdown (ESD)) as part of the process safety information for the design package and as a supplement for operating procedures, to provide assurance for safely conducting production activities.	Summit Engineering	**M**	1.2.1.2
8. Develop written procedures for periodically inspecting and testing safety-critical equipment, including relief valves (e.g. Pressure Safety Valves (PSVs), Pressure Relief Valves (PRVs), Pressure Vacuum Relief Valves (PVRVs)); check valves, control valves, and Burner Management Systems (BMSs), to provide assurance for the integrity of these safety critical devices for safely conducting production activities.	GMT	**M**	1.2.1.2

Recommendations	Responsible	Risk Ranking*	Place(s) Used**
9. Develop a written Emergency Response Plan (ERP) for the facility, to provide assurance for safely conducting production activities during emergencies, including emergency operations, emergency response actions and equipment, and evacuation procedures.	GMT	**M**	1.2.1.2
10. Evaluate installing sand probes in piping at or downstream of the Wellhead W-A based on the concentration of sand experienced during flowback operations, to indicate the presence of sand from the Wellhead W-A into flow line and downstream equipment with the potential to erode piping, instrumentation and equipment.	Summit Engineering	**M**	1.19.1.1
11. Develop a written vehicular Traffic Safety Control Plan with prevention and mitigation measures around any vulnerable process equipment, to provide assurance that safe work practices for the control of hazards during production activities are in place.	GMT	**M**	1.27.1.1, 2.27.2.1, 3.27.1.1, 4.27.1.1, 5.27.1.1, 6.27.1.1, 7.27.1.1
12. Verify and document the sizing basis and set point for Pressure Safety Valve PSV-0103 on the Fuel Gas Scrubber V-201.	Summit Engineering	**M**	2.1.11.2, 2.1.12.2, 2.1.13.2, 4.2.1.5, 4.5.1.4
13. Verify and document the sizing basis and set point for Pressure Safety Valve PSV-3011 on the Fuel Gas Scrubber V-3011.	Summit Engineering	**M**	2.1.11.2, 2.1.12.2, 2.1.13.2, 4.1.2.2, 4.2.1.2
14. Verify and document the sizing basis and set point for Pressure Safety Valve PSV-3450 on the Sales Gas Scrubber V-3450.	Summit Engineering	**M**	2.1.11.2, 2.1.12.2, 2.1.13.2, 2.1.13.9

Recommendations	Responsible	Risk Ranking*	Place(s) Used**
15. Provide a supplemental source of blanket gas from the Fuel Gas System for the Oil Tanks TK-5001/2/3/6/7/8 and Water Tanks TK-4001/4.	Summit Engineering	**M**	2.1.2.2, 2.1.2.3, 2.1.4.2, 2.1.4.3, 2.1.17.4, 2.1.17.5, 2.1.18.4, 2.1.18.5, 2.1.19.4, 2.1.19.5, 2.2.1.2, 2.2.1.3
16. Evaluate adding a visual alarm at the truck loadout area to alert the truck driver(s) to a loss of blanket gas for the Oil Tanks TK-5001/2/3/6/7/8, to enable them to cease loadout operations to prevent creating a vacuum in and collapsing the tanks.	Summit Engineering	**M**	2.1.2.2, 2.1.2.3, 2.1.4.2, 2.1.4.3, 2.1.17.4, 2.1.17.5, 2.1.18.4, 2.1.18.5, 2.1.19.4, 2.1.19.5, 2.2.1.2, 2.2.1.3
17. Size the vapor lines from the Oil Tanks TK-5001/2/3/6/7/8 to the Emission Control Device (ECDs) BR-9010/20 for the maximum blanket gas flow rate and pressure, to prevent overpressuring and rupturing tanks from a malfunctioning 2"" Pressure Control Valve PCV-0102 downstream of the Horizontal Separator V-1120.	Summit Engineering	**M**	2.2.2.2
18. Verify and document the sizing basis and set point for Pressure Safety Valve PSV-2100 on the Vapor Recovery Tower V-2000.	Summit Engineering	**M**	2.24.1.1, 5.24.1.1
19. Evaluate providing a means of redundancy for the 4" Pressure Control Valve PCV-3107 downstream of the Sales Gas Scrubber V-3450 on the flare gas line, to provide assurance for an open path to the Emission Control Devices (ECDs) BR-9010/20 in case of a malfunction or during maintenance of PCV-3107.	Summit Engineering	**M**	3.1.3.1
20. Verify and document the design basis (e.g. sizing, metallurgy, height, etc.) for the Emission Control Devices (ECDs) BR-9010/20, to provide assurance for handling the worst case scenario of all sales gas flow being sent to the ECDs.	Summit Engineering	**M**	3.1.3.1

Recommendations	Responsible	Risk Ranking*	Place(s) Used**
21. Verify and document in the design basis the sizing of pressure safety valves (PSVs) for all pressure vessels to be able to accommodate the worst case of shutting in the sales gas pipeline with an inability to combust flare gas in the Emission Control Devices (i.e. cases for blocked flow to the ECDs).	Summit Engineering	**M**	3.1.3.1, 3.1.7.1, 3.1.8.1
22. Verify and document the sizing basis for Pressure Safety Valve PSV-9055 on the ECD Knockout Drum V-9055 to determine whether a blocked flow case is required in addition to the fire case.	Summit Engineering	**M**	3.1.8.3
23. Develop and implement a written procedure for Pre-Startup Safety Review (PSSR), to provide assurance that prior to the introduction of highly hazardous chemicals to the process: (1) Construction and equipment is in accordance with design specifications; (2) Safety, operating, maintenance, and emergency procedures are in place and are adequate; (3) For new facilities, a process hazard analysis has been performed and recommendations have been resolved or implemented before startup; and modified facilities meet the requirements contained in management of change (MOC) procedure; and (4) Training of each employee involved in operating the facility has been completed.	GMT	**M**	3.8.1.1
24. Verify the design intent of the 4" Pressure Control Valve PCV-3107 downstream of the Sales Gas Scrubber V-3450 on the flare gas line to the Emission Control Devices (ECDs) BR-9010/20.	Summit Engineering	**M**	4.1.2.2, 4.2.1.2
25. Verify with the vendor that the fuel gas pilot system for the Emission Control Devices (ECDs) BR-9010/20 is equipped with a pressure safety valve (PSV) on the fuel gas line to the ECDs.	Summit Engineering	**M**	4.2.1.4, 4.5.1.3
26. Analyze and document the hydraulics of the fuel gas flow through Pressure Control Valve PCV-0104 on the fuel gas from the Horizontal Separator V-1120 versus the flow of downstream fuel gas users to reduce the potential for an overpressure and rupture of the Fuel Gas Scrubber V-201 and/or its piping in case of PCV-0104 malfunctioning open.	Summit Engineering	**M**	4.2.3.1
27. Review the temperature control scheme (e.g. Temperature Control Valve TCV-0104) for the Horizontal Separator V-1120 based on the vendor package.	Summit Engineering	**M**	4.12.1.2

Recommendations	Responsible	Risk Ranking*	Place(s) Used**
28. Verify the sizing basis for Pressure Safety Valve PSV-0101 on the Horizontal Separator V-1120 for steam service, in case of Burner Management System BMS-201 malfunctioning high or an excess upstream fuel gas flow to the Heater H-201 causing a high temperature deviation with steam generation.	Summit Engineering	M	4.12.1.2
29. Develop a written safe work practice for sampling produced gas from identified sample points in the process system, including addressing the hazards of sampling (e.g. flash fire, thermal exposure), references to relevant safety data sheets (SDS), and requirements for personal protective equipment (PPE), to provide assurance for safely conducting production activities.	GMT	L	2.16.1.1
30. Verify with the vendor the effects on the Emission Control Devices (ECDs) BR-9010/20 for maximum flare gas flow rates from both the ECD Knockout Drum V-9050 (LP system) and ECD Knockout Drum V-9055 (HP system).	Summit Engineering	L	3.1.9.2, 3.1.18.2
31. Determine the required action(s) by the Burner Management System (BMS) BMS-9010/20 for the Emission Control Devices (ECDs) BR-9010/20 for a higher temperature in and/or higher flare gas flow through an ECD caused by an increased flow of flare gas to an ECD with an open path when the flare gas flow to the other ECD is blocked (e.g. 4" manual valve closed in error or Flame Arrestor is plugged).	Summit Engineering	L	3.1.9.2, 3.1.18.2
32. Determine and document the maximum supply flow rate of flare gas to the Emission Control Devices (ECDs) BR-9010/20 from both the ECD Knockout Drum V-9050 (LP system) and ECD Knockout Drum V-9055 (HP system).	Summit Engineering	L	3.1.9.2, 3.1.18.2
33. Evaluate activating an Emergency Shutdown (ESD) upon loss of fuel gas flow to the pilots for the Emission Control Devices (ECDs) BR-9010/20.	Summit Engineering	L	4.1.4.2
34. Determine the required action(s) by the Burner Management System (BMS) for the Burner B-201 in Heater H-201 for the Horizontal Separator V-1120 upon loss of pilot gas and flame to the Burner B-201 (e.g. 1/4" PCV-0108 malfunctions closed or set in error), to prevent sending unignited fuel gas through Heater H-201 into the atmosphere.	Summit Engineering	L	4.1.8.2
35. Verify with the vendor that the LP Gas Compressor C-2510 is equipped with a dedicated scrubber.	Summit Engineering	NRR	2.5.3.2, 7.10.4.1

Recommendations	Responsible	Risk Ranking*	Place(s) Used**
36. Review the maximum volume of blanket gas supply from the Oil Tanks TK-5001/2/3/6/7/8 and Water Tanks TK-4001/4 versus the maximum capacity of the 6" Pressure Control Valve PCV-5000 on the flare gas line to ECD Knockout Drum V-9050.	Summit Engineering	**NRR**	3.2.3.2
37. Verify that the location (height and orientation) of all relief lines to atmosphere from Pressure Safety Valves (PSVs), particularly PSV-0101 on the Horizontal Separator V-1120, are routed to a safe location away from personnel on walkways and elevated platforms.	Summit Engineering	**NRR**	2.27.1.1

NOTES:

* NRR = Not Risk Ranked

** The data in the “Place(s) Used” column are reference numbers for the Node, Deviation, Cause and Consequences for associated hazard and operability scenarios within the PHA Worksheets.

5. Acronyms

The acronyms listed in Table 5.1 were used within the Project PHA Study report and/or the PHA Worksheets (see Appendix D). Additional acronyms and abbreviations for equipment and instrumentation tags are provided in legend sheet drawings 8365-01-1300/1301 (see Table 2.1).

Table 5.1 – Acronyms List

Acronym	Definition
ACA	ANSI 150 [piping rating]
ANSI	American National Standards Institute
API	American Petroleum Institute
bbl/day	Barrels Per Day [flow]
B.S.	Bachelor of Science
BMS	Burner Management System
CCPS	Center for Chemical Process Safety
CFR	Code of Federal Regulations
CO	Condensate [stream numbering for HAZOP Node]
CSHO	Certified Safety & Health Official
CSC	Car Seal Closed [manual valve]
CSO	Car Seal Open [manual valve]
EI&C	Electrical, Instrumentation & Controls
ECD / ECDS	Emission Control Device / Emission Control Devices
EPA	Environmental Protection Agency [U.S.]
ERP	Emergency Response Plan
ESD	Emergency Shutdown
FCA	ANSI 1500 [piping rating]
FCV	Flow Control Valve
FG	Fuel Gas [stream numbering for HAZOP Node]
FL	Flare Gas [stream numbering for HAZOP Node]
GMT	GMT Exploration Company LLC
H2S	Hydrogen Sulfide
HAZOP	Hazard and Operability [PHA study methodology]
HP	High Pressure
HSSE	Heath, Safety, Security & Environment
JT	Joule-Thompson [cooling effect across pressure drop]

Acronym	Definition
LCV	Level Control Valve
LDAR	Leak Detection and Repair
LIT	Level Indicator Transmitter
LLC	Limited Liability Company
LOPA	Level of Protection Analysis
LP	Low Pressure
MAWP	Maximum Allowable Working Pressure
MMSCFD	Million Standard Cubic Feet Per Day [flow]
MOC	Management of Change
MPH	Master of Public Health
MSCFD	Thousand Standard Cubic Feet Per Day [flow]
N/A	Not Applicable
NC	Normally Closed [manual valve]
NRR	Not Risk Ranked
OSHA	Occupational Safety & Health Administration [U.S.]
P&ID	Piping and Instrumentation Diagram
PCV	Pressure Control Valve
PF	Produced Fluid [stream numbering for HAZOP Node]
PFD	Process Flow Diagram
PG	Produced Gas [stream numbering for HAZOP Node]
PHA	Process Hazard Analysis
PIT	Pressure Indicator Transmitter
PO	Produced Oil [stream numbering for HAZOP Node]
PPE	Personal Protective Equipment
PRV	Pressure Relief Valve [for tank]
psig	Pounds per Square Inch Gauge [pressure]
PSM	Process Safety Management
PSSR	Pre-Startup Safety Review
PSV	Pressure Safety Valve [for vessel]
PVRV	Pressure Vacuum Relief Valve [for tank]
PW	Produced Water [stream numbering for HAZOP Node]
QHSSE	Quality, Health, Safety, Security & Environment

Acronym	Definition
RMP	Risk Management Program
SDS	Safety Data Sheet
SDV	Shutdown Valve
SIMOPS	Simultaneous Operations
TCV	Temperature Control Valve
TEEX	Texas Engineering Extension System
VHLP	Vertical/Horizontal Low Pressure [separators]
VRT	Vapor Recovery Tower
VRU	Vapor Recovery Unit

6. References

The following references apply to this Project PHA Study:

1. CCPS. *Guidelines for Hazard Evaluation Procedures*, 3rd Edition, ISBN: 13: 978-0-471-97815-2, Center for Chemical Process Safety (CCPS) of the American Institute of Chemical Engineers (AIChE) and John Wiley & Sons, New York, New York, 2008.
2. City of Aurora, Colorado. Oil and Gas Drilling:

   https://www.auroragov.org/cms/one.aspx?portalId=1881221&pageId=2034568
3. EPA. Risk Management Program (RMP) Rule (40 CFR Part 68.67, “Process Hazard Analysis”).
4. OSHA. Instruction CPL 2-2.45A CH-1 "29 CFR 1910.119, Process Safety Management of Highly Hazardous Chemicals-Compliance Guidelines and Enforcement Procedures" Sept 13, 1994.
5. OSHA. Process Safety Management (PSM) Standard (29 CFR 1910.119, (e), Process Hazard Analysis”).

Appendix A – Process Description

GMT Exploration Company LLC

MAJESTIC PAD (16 WELL)

CITY OF AURORA, COLORADO

PROCESS DESCRIPTION

DOCUMENT# 8365-PD-1510

A	11/18/19	Issued for Review	GDL	KA	JK	
REV.	**DATE**	**DESCRIPTION**	**ORIG**	**CHK**	**APPR**	**CLIENT**

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1.0 GENERAL

1.1 Project Purpose

The purpose of this project is to install a well pad facility with up to 16 producing wells in staged development. Two wells will be drilled in Phase 1 of the pad development. The facility will include wellheads, separation equipment, storage tanks, gas compression, oil and water truck loadout, emission control devices, metering, and associated piping and utilities. The location will be serviced by electricity. Electric driven compression will be utilized where feasible.

1.2 Site Description

GMT's Majestic pad is located in Aurora, Colorado (approximate elevation of 5,700 ft ASL).

2.0 PROCESS DESIGN

2.1 Process Equipment

The following equipment will be installed in Phase 1 of the well pad development. Additional equipment will be required once additional wells are drilled and brought into production.

2.1.1 Wellheads:

GMT's current plan is to build a facility for two (2) wells for operation and start up in Phase 1 of development. The addition of equipment to serve the increased production with future drilling will be determined in the future to align with GMT's drilling schedule.

2.1.2 Flowlines and Selection Manifolds:

In phase one, single wellhead flowlines will be routed to a dedicated separator. Provisions will be made to divert the flowlines to a header system for future development.

2.1.3 Separation Units:

- Two vertical/horizontal liquid production (VHLP) separation units
- One Vapor recovery tower (VRT)
- Two Vapor knockout drums to prevent liquid carryover into emission control devices and compression

2.1.4 Storage Tanks:

For phase one of this project, storage tanks will be installed to serve the production from two well heads. Six (6) 500 BBL API 12F tanks are adequate for oil storage for this phase and two (2) 500 BBL API 12F tanks are adequate for water storage. Both oil and water storage tanks will operate at 80% level.

2.1.5 Gas Compression:

The multi-well pad facility will utilize compression in the following ways:

1. Flash Gas Compression – To reduce emissions and maximize gas sales, vapor flashing off the VRT is compressed in a Vapor Recovery Unit (VRU) and delivered into the LP suction header.

2. LP Compression – The LP suction header combines gas from the VRU and from the horizontal separators. This gas is boosted in the LP Compressor to the same pressure as the gas coming from the horizontal separators.

3. Sales Gas Compression – If the pad is delivering to a high-pressure gathering line, sales gas compression would be necessary to compress the gas into the gathering system.

2.1.6 Emission Control Devices (ECDs):

Non-recoverable vapors discharged from the tank battery, truck loadouts, or during process interruption (e.g. flash gas compression is down) will flow to a vapor knockout drum prior to being combusted. Emission control is essential to keeping a facility within its air permit parameters.

2.1.7 Oil Truck Loadout:

Trucking will be used to move oil off-site to sales until an oil sales pipeline is available at the pad.

2.1.8 Water Truck Loadout:

Trucking will be used to move water off-site to disposal until a water disposal pipeline is available.

2.1.9 Metering:

Flow meters will be installed on the HP/LP vapor, oil, and water outlets on each test VHLP. Trucking tickets will be used for oil sales while the test meters will be used for well allocation and production performance data. A station discharge meter will be installed by a midstream company that acquires the gas from this facility (company TBD).

2.2 Process Description

Wellheads:
There will be space for 16 wellheads on the Majestic pad in the full build out. Sand separators will be installed downstream of each wellhead for the first few months of production.

Initial Separation:
Well fluids flow from each well head to a dedicated production separator in a single flowline. Provisions are made to divert fluids to a selection manifold that aligns the flow to either future bulk separators or the VHLP separators in Test service. The selection manifold allows any well to be aligned to the various future test separators or future bulk separators.

In the phase 1 arrangement, the VHLP unit will be utilized as the production separation unit. This unit employs a vertical separation section to measure HP Gas via meter run and a heated horizontal section to measure LP Gas, Oil and Water.

Oil Towers and Storage:
The oil discharging from the production separation units will share a common bulk oil header that flows to the VRT. The VRT operates at reduced pressure (5 - 10 psig), generating flash gas. Oil in the VRT is siphoned from the bottom of the vessel and flows to the oil tank battery. These tanks normally operate at approximately 4 oz/in^2 (0.25 psig) as a result some additional vapor flashes from the oil. The tank flash vapor flows to a vapor knockout drum for combustion by the ECDs. The ECDs combust heavy hydrocarbons so they are not released to the atmosphere.

VRT, Tank Gas and LP Compression:
The overhead vapor from the VRTs flows to the VRT Gas Compressor which boosts the pressure to approximately 50 psig, LP Suction Header pressure. The compressor discharge combines with the LP Gas from the separation units. The gas flows to the LP Suction Scrubber to knock out liquid condensate prior to compression. The LP Compressors boost the gas pressure to approximately 150 psig. Additional compression into a sales gas line may be required depending on final takeaway conditions. Condensate drains from these separators and compressor skids are routed to the condensate header discharging into the site inlet via pumps.

2.3 Flow Rates

The expected initial flow rates per well are:

Oil: 1260 BBL/day

Water: 1100 BBL/day

Gas: 1810 MSCFD

Appendix B – Risk Ranking Matrix

Risk Ranking Matrix Process Hazard Analysis (PHA) Study GMT Exploration Company LLC				Likelihood				
				1 / 10 Years	1 / 100 Years	1 / 1,000 Years	1 / 10,000 Years	1 / 100,000 Years
Severity	**People**	**Environment**	**Reputation**	**1**	**2**	**3**	**4**	**5**
1	Multiple Fatalities	Significant Event – with serious offsite impact with long-term effects	National Concern	**Extremely High (X)** Unacceptable risk – reduce by 3 orders of magnitude	**Extremely High (X)** Unacceptable risk – reduce by 3 orders of magnitude	**High (H)** Unacceptable risk – reduce by 2 orders of magnitude	**Medium High (MH)** Unacceptable risk – reduce by 1 order of magnitude	**Medium (M)** Tolerable risk – reduce further if practicable to do so
2	Single Fatality	Significant Event – with serious offsite impact with no long-term effects	Regional Concern	**Extremely High (X)** Unacceptable risk – reduce by 3 orders of magnitude	**High (H)** Unacceptable risk – reduce by 2 orders of magnitude	**Medium High (MH)** Unacceptable risk – reduce by 1 order of magnitude	**Medium (M)** Tolerable risk – reduce further if practicable to do so	**Low (L)** Tolerable risk – reduce further if required or desired
3	Days Away From Work	Significant Event – with minor offsite impact	Local Concern	**High (H)** Unacceptable risk – reduce by 2 orders of magnitude	**Medium High (MH)** Unacceptable risk – reduce by 1 order of magnitude	**Medium (M)** Tolerable risk – reduce further if practicable to do so	**Low (L)** Tolerable risk – reduce further if required or desired	**Negligible (N)** Negligible risk – no further risk reduction needed
4	Medical Treatment	Recordable Event – with agency notification or permit violation	Minimal Concern	**Medium High (MH)** Unacceptable risk – reduce by 1 order of magnitude	**Medium (M)** Tolerable risk – reduce further if practicable to do so	**Low (L)** Tolerable risk – reduce further if required or desired	**Negligible (N)** Negligible risk – no further risk reduction needed	**Negligible (N)** Negligible risk – no further risk reduction needed
5	First Aid Treatment	Recordable Event – with no agency notification or permit violation	No Concern	**Medium (M)** Tolerable risk – reduce further if practicable to do so	**Low (L)** Tolerable risk – reduce further if required or desired	**Negligible (N)** Negligible risk – no further risk reduction needed	**Negligible (N)** Negligible risk – no further risk reduction needed	**Negligible (N)** Negligible risk – no further risk reduction needed

Appendix C – PHA Team Sign-In Sheet

JCL RISK SERVICES LLC
COMMITTED TO SUCCESS

GMT Exploration Company LLC

Sign-In Sheet for Process Hazard Analysis (PHA)

Location: GMT Exploration – Denver, CO **Process Unit:** Majestic 16 Well Pad Facility, Adams Co., CO **Project No:** 5328T

Name (please print)	Company	Title	Email Address	Years of Experience		2019 Sessions – Month/Day				
				Current Position	In Industry	Oct 22	Oct 23	Apr 24		
David A. Jones	JCL Risk Services LLC	Director – Process Safety Services (PHA Facilitator)	djones@jclsc.com	4	42	✓	✓	✓		
AL MOORE	SUMMIT ENGINEERING	EI&C MANAGER	ALLENMOORE@SUMMITENG.NET	1.5	41	✓	X	X		
Gary Largesse	Summit Engineering	Process Eng.neer	GaryLargesse@Summiteng.net	2	20	✓	✓	✓		
JAYLEN HINDS	SUMMIT ENGINEERING	ENGINEERING TECH	JAYLENHINDS@SUMMITENG.NET	1.5	1.5	✓	✓	✓		
Jack Kuskie	Summit Engineering	Project Manager	Jackkuskie@summiteng.net	2	15	✓	✓	✓		
B.J. Cox	GMT	PROD. SUP.	BJCOX@GMTEXPLORATION.COM	15	28	✓	✓	✓		

Appendix D – PHA Worksheets

Node: 1. **Produced Fluid** from: (1) Outlet of Wellhead W-A thru temporary Sand Catcher V-0310 (PF1A) thru Selection Manifold thru heated coil inside Horizontal Separator V-1120 to inlet of 2-Phase Separator V-001 via Selected Flow Line (PF2A); and (2) thru Maintenance Bypass (PF3A) and Maintenance Header to Oil Tank TK-5001 (PF4) **(pink)**

Drawings / References: 8365-01-1401; 8365-01-1402; 8365-01-1403; 8365-01-1418; 8365-01-1420

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
1. No/Less Flow	1.1. Loss of well fluid from wellhead for any reason or high paraffin content fluid or hydrates or either 2-1/16" (5K) manual valves closed in error or 2" Shut Down Valve SDV-0015 malfunctions closed or closed in error or ESD activated or any of nine 2" manual valves closed in error or 2" Flow Control Valve (choke valve) FCV-1011 malfunctions closed or set in error or 2" Shut Down Valve SDV-0101 malfunctions closed or closed in error 2" Flow Control Valve (choke valve) FCV-0114 upstream of 2-Phase Separator V-001 malfunctions closed or set in error	1.1.1. Potential to decrease and lose flow of produced fluid from Wellhead W-A. Potential to increase pressure in flow line upstream of closed valve but insufficient to overpressure flow line or wellhead. Potential to decrease or lose production from well. No hazardous consequences. Operability issue only. (upstream)	1. Operating procedures address proper manual valve alignment 2. Periodic inspection and testing of control valves 3. Daily checks of equipment and operating conditions by Operator 4. Low Pressure Alarm on Pressure Indicator PI-0016 on Flow Line 2"-PF-0010-FCA from Wellhead W-A (valid for loss of well fluid or either 2-1/16" (5K) manual valves closed) 5. High Pressure Alarm on Pressure Indicator PI-0016 on Flow Line 2"-PF-0010-FCA from Wellhead W-A 6. High-High Pressure Alarm on Pressure Indicator PI-0016 on Flow Line 2"-PF-0010-FCA from Wellhead W-A 7. High-High Pressure Indicator Transmitter PIT-0016 on Flow Line 2"-PF-0010-FCA from Wellhead W-A opens solenoid and closes Shutdown Valve SDV-0015 to activate an ESD 8. Ability to manually activate an Emergency Shutdown (ESD) 9. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead 10. High Pressure Alarm on Pressure Indicator PI-0103 on gas outlet of 2-Phase Separator V-001 11. High-High Pressure Alarm on Pressure Indicator PI-0103 on gas outlet of 2-Phase Separator V-001 12. High-High Pressure Alarm on Pressure Indicator PI-0103 on gas outlet of 2-Phase Separator V-001 opens solenoid and closes Shut Down Valve SDV-0101						Flow line is rated for 5K upstream of Shut Down Valve SDV-0015 and FCA ANSI 1500 schedule 160 downstream of Shut Down Valve SDV-0015.
		1.1.2. Potential to decrease and lose flow of produced fluid from Wellhead W-A. Potential to maintain pressure in flow line downstream of closed valve and in 2-Phase Separator V-001. Potential to decrease or lose production from well. No hazardous consequences. Operability issue only. (downstream)	1. Operating procedures address proper manual valve alignment 2. Periodic inspection and testing of control valves 3. Daily checks of equipment and operating conditions by Operator 4. High Pressure Alarm on Pressure Indicator PI-0016 on Flow Line 2"-PF-0010-FCA from Wellhead W-A 5. High-High Pressure Alarm on Pressure Indicator PI-0016 on Flow Line 2"-PF-0010-FCA from Wellhead W-A 6. High-High Pressure Indicator Transmitter PIT-0016 on Flow Line 2"-PF-0010-FCA from Wellhead W-A opens solenoid and closes Shutdown Valve SDV-0015 to activate an ESD 7. Ability to manually activate an Emergency Shutdown (ESD) 8. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead 9. High Pressure Alarm on Pressure Indicator PI-0103 on gas outlet of 2-Phase Separator V-001 10. High-High Pressure Alarm on Pressure Indicator PI-0103 on gas outlet of 2-Phase						Flow line is rated for 5K upstream of Shut Down Valve SDV-0015 and FCA ANSI 1500 schedule 160 downstream of Shut Down Valve SDV-0015.

Node: 1. **Produced Fluid** from: (1) Outlet of Wellhead W-A thru temporary Sand Catcher V-0310 (PF1A) thru Selection Manifold thru heated coil inside Horizontal Separator V-1120 to inlet of 2-Phase Separator V-001 via Selected Flow Line (PF2A); and (2) thru Maintenance Bypass (PF3A) and Maintenance Header to Oil Tank TK-5001 (PF4) **(pink)**

Drawings / References: 8365-01-1401; 8365-01-1402; 8365-01-1403; 8365-01-1418; 8365-01-1420

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
			Separator V-001 11. High-High Pressure Alarm on Pressure Indicator PI-0103 on gas outlet of 2-Phase Separator V-001 opens solenoid and closes Shutdown Valve SDV-0101						
2. Higher Flow	2.1. Either 2" Flow Control Valve (choke valve) FCV-1011/0114 malfunctions open (e.g. choke washout) or set in error	2.1.1. Potential to increase flow of well fluid from well. Potential to damage reservoir with consequences outside of scope of PHA. (upstream)	1. Upstream safeguards in well and reservoir						
		2.1.2. Potential to increase flow of produced fluid from Wellhead W-A. Potential to increase pressure in flow line downstream of 2" Flow Control Valve (choke valve) FCV-1011. Potential to increase level in and overfill 2-Phase Separator V-001. Potential to increase pressure and overpressure and rupture flow line downstream of FCV-0114 and/or 2-Phase Separator V-001 and/or Horizontal Separator V-1120. Potential to release produced fluids into atmosphere and onto ground. Potential fire/explosion. Potential personnel injury. Potential environmental impact. (downstream)	1. Flowback safeguards (including correct sizing and setting for choke valve)	1	5	M	7. Develop and document a written Cause and Effects Matrix for safety critical controls, alarms and interlocks for the facility (e.g. emergency shutdown (ESD)) as part of the process safety information for the design package and as a supplement for operating procedures, to provide assurance for safely conducting production activities.	Summit Engineering	Flow line is rated for 5K upstream of choke valve and schedule 160 downstream of choke valve.
			2. Daily checks of equipment and operating conditions by Operator				4. Develop written operating procedures, including a startup procedure (e.g. purging the entire process system with nitrogen to assure an oxygen free environment; proper alignment of process and isolation valves; proper isolation of master valves on the production tree prior to ESD reset); monitoring and inspection of process equipment and conditions to support daily checks by operators during normal operations; closing the master valves and flow line valve; entering setpoints for controllers and control valves; and manually activating an emergency shutdown (ESD), in order to provide assurance for safely conducting production activities.	GMT	Trucks could be in the area of the event when this hazard scenario event occurs.
			3. 2" Flow Control Valve (choke valve) FCV-1011/0114 (not affected by the cause) restricts flow				5. Develop a written car seal procedure with a periodic auditing feature to assure the integrity of an open flow path for relief valves (e.g. pressure safety valves (PSVs)) for those with upstream manual isolation valves that are specified as car sealed open (CSO) or other process lines that are specified as CSO or car sealed closed (CSC) to assure the integrity of an open flow path (e.g. to atmosphere at a safe location or to the emission control devices) or a closed flow path (e.g. to prevent bypassing critical process equipment), to provide assurance for safely conducting production activities.	GMT	
			4. High Pressure Alarm on Pressure Indicator PI-0103 on gas outlet of 2-Phase Separator V-001				6. Develop and implement a training process, including training in operating procedures, specific safety and health hazards, emergency operations including shutdown, and safe work practices, to provide assurance for safely conducting production activities. The training should address initial training and periodic refresher training.	GMT	
			5. High-High Pressure Alarm on Pressure Indicator PI-0103 on gas outlet of 2-Phase Separator V-001				8. Develop written procedures for periodically inspecting and testing safety-critical equipment, including relief valves (e.g. Pressure Safety Valves (PSVs), Pressure Relief Valves (PRVs), Pressure Vacuum Relief Valves (PVRVs)); check valves, control valves, and Burner Management Systems (BMSs), to provide assurance for the integrity of these safety critical devices for safely conducting production activities.	GMT	

Node: 1. **Produced Fluid** from: (1) Outlet of Wellhead W-A thru temporary Sand Catcher V-0310 (PF1A) thru Selection Manifold thru heated coil inside Horizontal Separator V-1120 to inlet of 2-Phase Separator V-001 via Selected Flow Line (PF2A); and (2) thru Maintenance Bypass (PF3A) and Maintenance Header to Oil Tank TK-5001 (PF4) **(pink)**

Drawings / References: 8365-01-1401; 8365-01-1402; 8365-01-1403; 8365-01-1418; 8365-01-1420

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
			6. High-High Pressure Alarm on Pressure Indicator PI-0103 on gas outlet of 2-Phase Separator V-001 activates an ESD 7. Ability to manually activate an Emergency Shutdown (ESD) 8. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead 9. High-High Level Alarm LAHH-0104 on 2-Phase Separator V-001 10. Level Switch High-High LSHH-0104 on 2-Phase Separator V-001 activates an ESD 11. Level Control Valve LCV-0103 on 2-Phase Separator V-001 designed to open to maintain level and may relieve some pressure until high-high level trips the SDV 12. Level Control Valve LCV-0101 on Horizontal Separator V-1120 designed to open to maintain level and may relieve some pressure 13. Level Switch High-High LSHH-0101 on Horizontal Separator V-1120 closes Shutdown Valve SDV-0101 14. Pressure Safety Valve PSV-0102 on 2-Phase Separator V-001 set at 740 psig relieves to atmosphere at a safe location (10-15 feet above grade) 15. Pressure Safety Valve PSV-0101 on Horizontal Separator V-1120 set at 125 psig relieves to atmosphere at a safe location (10-15 feet above grade) 16. Periodic inspection and testing of PSVs, PRVs, and PVRVs 17. Manual isolation valve upstream of PSV is car sealed open (CSO) 18. 2" check valve on liquid outlet of 2-Phase Separator V-001 in produced oil line to Horizontal Separator V-1120 is designed to prevent backflow from Horizontal Separator V-1120 to leak point 19. Emergency Response Plan (ERP)				9. Develop a written Emergency Response Plan (ERP) for the facility, to provide assurance for safely conducting production activities during emergencies, including emergency operations, emergency response actions and equipment, and evacuation procedures.	GMT	
		2.1.3. Potential to send (reverse flow) produced gas from other sources from Produced Gas Header to increase release amount and escalate fire/explosion. Potential personnel injury. Potential environmental impact. (downstream)	1. Flowback safeguards (including correct sizing and setting for choke valve) 2. Daily checks of equipment and operating conditions by Operator 3. 2" Flow Control Valve (choke valve) FCV-1011/0114 (not affected by the cause) restricts flow 4. High Pressure Alarm on Pressure Indicator PI-0103 on gas outlet of 2-Phase Separator V-001 5. High-High Pressure Alarm on Pressure Indicator PI-0103 on gas outlet of 2-Phase Separator V-001 6. High-High Pressure Alarm on Pressure Indicator PI-0103 on gas outlet of 2-Phase Separator V-001 activates an ESD 7. Ability to manually activate an Emergency	1	5	M			PHA team deemed existing safeguards were adequate (sufficient and effective) for this hazard scenario Trucks could be in the area of the event when this hazard scenario event occurs.

Node: 1. **Produced Fluid** from: (1) Outlet of Wellhead W-A thru temporary Sand Catcher V-0310 (PF1A) thru Selection Manifold thru heated coil inside Horizontal Separator V-1120 to inlet of 2-Phase Separator V-001 via Selected Flow Line (PF2A); and (2) thru Maintenance Bypass (PF3A) and Maintenance Header to Oil Tank TK-5001 (PF4) **(pink)**

Drawings / References: 8365-01-1401; 8365-01-1402; 8365-01-1403; 8365-01-1418; 8365-01-1420

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
			Shutdown (ESD)						
			8. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead						
			9. High-High Level Alarm LAHH-0104 on 2-Phase Separator V-001						
			10. Level Switch High-High LSHH-0104 on 2-Phase Separator V-001 activates an ESD						
			11. Level Control Valve LCV-0103 on 2-Phase Separator V-001 designed to open to maintain level and may relieve some pressure until high-high level trips the SDV						
			12. Level Control Valve LCV-0101 on Horizontal Separator V-1120 designed to open to maintain level and may relieve some pressure						
			13. Level Switch High-High LSHH-0101 on Horizontal Separator V-1120 closes Shutdown Valve SDV-0101						
			14. Pressure Safety Valve PSV-0102 on 2-Phase Separator V-001 set at 740 psig relieves to atmosphere at a safe location (10-15 feet above grade)						
			15. Pressure Safety Valve PSV-0101 on Horizontal Separator V-1120 set at 125 psig relieves to atmosphere at a safe location (10-15 feet above grade)						
			16. Periodic inspection and testing of PSVs, PRVs, and PVRVs						
			17. Manual isolation valve upstream of PSV is car sealed open (CSO)						
			18. 2" check valve on liquid outlet of 2-Phase Separator V-001 in produced oil line to Horizontal Separator V-1120 is designed to prevent backflow from Horizontal Separator V-1120 to leak point						
			19. 3" check valve at Produced Gas Meter Skid is designed to prevent backflow from Sales Gas Header to leak point						
			20. 6" check valve at Produced Gas Meter Skid is designed to prevent backflow from Sales Gas Header to leak point						
			21. Emergency Response Plan (ERP)						
		2.1.4. Potential to send (reverse flow) produced oil from other sources from Produced Oil Header to increase release amount and escalate fire/explosion. Potential personnel injury. Potential environmental impact. (downstream)	1. Flowback safeguards (including correct sizing and setting for choke valve)	1	5	M			PHA team deemed existing safeguards were adequate (sufficient and effective) for this hazard scenario
			2. Daily checks of equipment and operating conditions by Operator						Trucks could be in the area of the event when this hazard scenario event occurs.
			3. 2" Flow Control Valve (choke valve) FCV-1011/0114 (not affected by the cause) restricts flow						
			4. High Pressure Alarm on Pressure Indicator PI-0103 on gas outlet of 2-Phase Separator V-001						
			5. High-High Pressure Alarm on Pressure Indicator PI-0103 on gas outlet of 2-Phase Separator V-001						
			6. High-High Pressure Alarm on Pressure Indicator PI-0103 on gas outlet of 2-Phase Separator V-001 activates an ESD						

Node: 1. **Produced Fluid** from: (1) Outlet of Wellhead W-A thru temporary Sand Catcher V-0310 (PF1A) thru Selection Manifold thru heated coil inside Horizontal Separator V-1120 to inlet of 2-Phase Separator V-001 via Selected Flow Line (PF2A); and (2) thru Maintenance Bypass (PF3A) and Maintenance Header to Oil Tank TK-5001 (PF4) **(pink)**

Drawings / References: 8365-01-1401; 8365-01-1402; 8365-01-1403; 8365-01-1418; 8365-01-1420

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
			7. Ability to manually activate an Emergency Shutdown (ESD) 8. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead 9. High-High Level Alarm LAHH-0104 on 2-Phase Separator V-001 10. Level Switch High-High LSHH-0104 on 2-Phase Separator V-001 activates an ESD 11. Level Control Valve LCV-0103 on 2-Phase Separator V-001 designed to open to maintain level and may relieve some pressure until high-high level trips the SDV 12. Level Control Valve LCV-0101 on Horizontal Separator V-1120 designed to open to maintain level and may relieve some pressure 13. Level Switch High-High LSHH-0101 on Horizontal Separator V-1120 closes Shutdown Valve SDV-0101 14. Pressure Safety Valve PSV-0102 on 2-Phase Separator V-001 set at 740 psig relieves to atmosphere at a safe location (10-15 feet above grade) 15. Pressure Safety Valve PSV-0101 on Horizontal Separator V-1120 set at 125 psig relieves to atmosphere at a safe location (10-15 feet above grade) 16. Periodic inspection and testing of PSVs, PRVs, and PVRVs 17. Manual isolation valve upstream of PSV is car sealed open (CSO) 18. 2" check valve on liquid outlet of 2-Phase Separator V-001 in produced oil line to Horizontal Separator V-1120 is designed to prevent backflow from Horizontal Separator V-1120 to leak point 19. 2" check valve on produced oil line from outlet of Horizontal Separator V-1120 is designed to prevent backflow from Produced Oil Header to leak point 20. Emergency Response Plan (ERP)						
3. Reverse Flow	3.1. No new causes, refer to Higher Flow deviations in this node								
4. As Well As Flow	4.1. 2" manual valve for isolating casing line open in error or leaks through	4.1.1. Similar hazard scenario for Higher Flow in this node	1. Same safeguards for Higher Flow in this Node, except that both choke valves are available, plus 2. Operating procedures address proper manual valve alignment	1	5	M			PHA team deemed existing safeguards were adequate (sufficient and effective) for this hazard scenario Trucks could be in the area of the event when this hazard scenario event occurs.
5. Misdirected Flow	5.1. 2" normally closed (NC) manual valve on maintenance bypass line open in error or leaks through	5.1.1. Potential to increase flow of produced fluid from Wellhead W-A through maintenance bypass line. Potential to decrease flow and pressure to 2-Phase Separator V-001. Potential to decrease production from well. No hazardous consequences. Operability issue only. (upstream)							
		5.1.2. Potential to increase flow of produced fluid from Wellhead W-A through maintenance bypass line. Potential to increase pressure in and overpressure	1. Operating procedures address proper manual valve alignment	1	5	M			PHA team deemed existing safeguards were adequate (sufficient and effective) for

Node: 1. **Produced Fluid** from: (1) Outlet of Wellhead W-A thru temporary Sand Catcher V-0310 (PF1A) thru Selection Manifold thru heated coil inside Horizontal Separator V-1120 to inlet of 2-Phase Separator V-001 via Selected Flow Line (PF2A); and (2) thru Maintenance Bypass (PF3A) and Maintenance Header to Oil Tank TK-5001 (PF4) **(pink)**

Drawings / References: 8365-01-1401; 8365-01-1402; 8365-01-1403; 8365-01-1418; 8365-01-1420

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
		and rupture piping and/or Oil Tank TK-5001. Potential to release produced fluids into atmosphere and onto ground. Potential fire/explosion. Potential personnel injury. Potential environmental impact. (downstream)							this hazard scenario
			2. 2" manual valve in maintenance line on skid is car sealed open (CSO) to prevent overpressuring skid piping rated for ACA ANSI 150						Trucks could be in the area of the event when this hazard scenario event occurs.
			3. 2" manual valve on inlet of Oil Tank TK-5001 is car sealed open (CSO) to prevent overpressuring Maintenance Header piping rated for ACA ANSI 150						
			4. Maintenance bypass line is heat traced and insulated to prevent pluggage due to water freezing in cold weather						
			5. Daily checks of equipment and operating conditions by Operator						
			6. Restricted Orifice RO-0103 in maintenance bypass line restricts flow						
			7. High-High Pressure Alarm PAHH-0104 on maintenance bypass line						
			8. Pressure Switch High-High PSHH-0104 on maintenance bypass line set at 2 psig activates an ESD						
			9. Ability to manually activate an Emergency Shutdown (ESD)						
			10. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead						
			11. Pressure Relief Valve PRV-5110 on Flare Gas line on Oil Tank TK-5001 set at 14 oz/in2 relieves to atmosphere at a safe location (above top of tank)						
			12. Pressure Vacuum Relief Valve PVRV-5101 on Oil Tank TK-5001 set at 16 oz/in2 designed to relieve into atmosphere at a safe location						
			13. Periodic inspection and testing of PSVs, PRVs, and PVRVs						
			14. Emergency Response Plan (ERP)						
	5.2. Leak in coil inside Horizontal Separator V-1120 (e.g. corrosion, erosion from sand)	5.2.1. Potential to send well fluid into Horizontal Separator V-1120. Potential to increase pressure in and overpressure and rupture Horizontal Separator V-1120. Potential to release produced fluids into atmosphere and onto ground. Potential fire/explosion. Potential personnel injury. Potential environmental impact. (downstream)	1. Sand Catcher V-0310 (temporary) installed in flow line upstream of 2-Phase Separator V-001 is designed to catch and remove sand to minimize erosion of downstream piping and equipment	1	5	M			PHA team deemed existing safeguards were adequate (sufficient and effective) for this hazard scenario
			2. Daily checks of equipment and operating conditions by Operator						Trucks could be in the area of the event when this hazard scenario event occurs.
			3. High Pressure Alarm on Pressure Indicator PI-0102 on gas outlet of Horizontal Separator V-1120						
			4. High-High Pressure Alarm on Pressure Indicator PI-0102 on gas outlet of Horizontal Separator V-1120						
			5. High-High Pressure on Pressure Indicator Transmitter PIT-0103 on gas outlet of Horizontal Separator V-1120 activates an ESD						
			6. Ability to manually activate an Emergency Shutdown (ESD)						
			7. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead						
			8. Pressure Safety Valve PSV-0101 on Horizontal Separator V-1120 set at 125 psig relieves to						

Node: 1. **Produced Fluid** from: (1) Outlet of Wellhead W-A thru temporary Sand Catcher V-0310 (PF1A) thru Selection Manifold thru heated coil inside Horizontal Separator V-1120 to inlet of 2-Phase Separator V-001 via Selected Flow Line (PF2A); and (2) thru Maintenance Bypass (PF3A) and Maintenance Header to Oil Tank TK-5001 (PF4) **(pink)**

Drawings / References: 8365-01-1401; 8365-01-1402; 8365-01-1403; 8365-01-1418; 8365-01-1420

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
			atmosphere at a safe location (10-15 feet above grade) 9. Periodic inspection and testing of PSVs, PRVs, and PVRVs 10. Manual isolation valve upstream of PSV is car sealed open (CSO) 11. Emergency Response Plan (ERP)						
6. No Pressure (Vacuum)	6.1. No credible causes identified by PHA Team								
7. Lower Pressure	7.1. No new causes, refer to No/Less Flow deviation in this node								
8. Higher Pressure	8.1. No new causes, refer to No/Less Flow and Higher Flow deviations in this node								
9. No/Lower Level	9.1. No credible causes identified by PHA Team								
10. Higher Level	10.1. No new causes, refer to Higher Flow deviations in this node								
11. Lower Temperature	11.1. 2" Flow Control Valve (choke valve) FCV-0114 malfunctions closed or set in error	11.1.1. Potential to decrease flow and temperature of well fluid due to Joule-Thompson (JT) effect. Potential to plug flow in coil in Horizontal Separator V-1120. Potential to decrease temperature and plug fuel gas line to users. Potential to decrease and lose flow of fuel gas to LP Gas Compressor C-2510. Refer to hazard scenario for LP Gas Compressor C-2510 not running for any reason (e.g. loss of fuel gas) in No/Less Flow deviation in Node 2 Produced Gas. (downstream)	1. Flowback safeguards (including correct sizing and setting for choke valve) 2. Operating procedures address proper manual valve alignment 3. Daily checks of equipment and operating conditions by Operator 4. Burner Management System BMS-unlabeled for Burner B-201 in Heater H-201 for Horizontal Separator V-1120 indicates and alarms for intermittent loss of fuel gas to pilot 5. Fuel gas supply from Horizontal Separator V-1120/1220 is a sufficient supplement (with 2" manual valve on Fuel Gas Scrubber V-201/202)						
		11.1.2. Potential to decrease flow and temperature of well fluid due to Joule-Thompson (JT) effect. Potential to plug flow in coil in Horizontal Separator V-1120. Potential to decrease temperature and plug fuel gas line to users. Potential to decrease and lose flow of fuel gas pilot for Emission Control Device BR-9010/20. Potential to lose ability to control emissions. Potential to emit uncombusted fuel gas (natural gas) into atmosphere. Potential environmental impact only. (downstream)	1. Flowback safeguards (including correct sizing and setting for choke valve) 2. Operating procedures address proper manual valve alignment 3. Daily checks of equipment and operating conditions by Operator 4. Burner Management System BMS-9010/20 for Emission Control Device BR-9010/20 indicates and alarms for intermittent loss of fuel gas to pilot 5. Fuel gas supply from Horizontal Separator V-1120/1220 is a sufficient supplement (with 2" manual valve on Fuel Gas Scrubber V-201/202) 6. Air Quality Monitoring System to continuously monitor emissions	3	4	L			
12. Higher Temperature	12.1. No credible causes identified by PHA Team								
13. Composition	13.1. No credible causes identified by PHA Team								
14. Contamination	14.1. No credible causes identified by PHA Team								
15. Instrumentation	15.1. No credible causes identified by PHA Team								
16. Sampling	16.1. No credible causes identified by PHA Team								
17. Leak/Rupture	17.1. Flange / gasket / tubing / valve	17.1.1. Potential to leak hydrocarbons into atmosphere or onto ground. Potential fire/explosion. Potential thermal exposure and personnel injury. Potential	1. Gasket replacement program as part of maintenance activity 2. Daily checks of equipment and operating	3	4	L			

Node: 1. **Produced Fluid** from: (1) Outlet of Wellhead W-A thru temporary Sand Catcher V-0310 (PF1A) thru Selection Manifold thru heated coil inside Horizontal Separator V-1120 to inlet of 2-Phase Separator V-001 via Selected Flow Line (PF2A); and (2) thru Maintenance Bypass (PF3A) and Maintenance Header to Oil Tank TK-5001 (PF4) **(pink)**

Drawings / References: 8365-01-1401; 8365-01-1402; 8365-01-1403; 8365-01-1418; 8365-01-1420

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
		environmental impact.	conditions by Operator 3. Leak detection and repair (LDAR) program to periodically monitor emissions 4. Air Quality Monitoring System to continuously monitor emissions 5. Emergency Response Plan (ERP)						
	17.2. Piping or equipment rupture in flowline (not identified in any hazard scenario above)	17.2.1. Potential to send (reverse flow) produced fluid from 2-Phase Separator V-001 and/or Horizontal Separator V-1120 to increase release amount and escalate fire/explosion. Potential personnel injury. Potential environmental impact. (upstream)	1. Daily checks of equipment and operating conditions by Operator 2. Leak detection and repair (LDAR) program to periodically monitor emissions 3. Air Quality Monitoring System to continuously monitor emissions 4. Ability to manually activate an Emergency Shutdown (ESD) 5. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead 6. 2" check valve in flowline upstream of 2-Phase Separator V-001 7. Emergency Response Plan (ERP)	1	5	M			PHA team deemed existing safeguards were adequate (sufficient and effective) for this hazard scenario
		17.2.2. Potential to release produced fluids into atmosphere and onto ground. Potential fire/explosion. Potential personnel injury. Potential environmental impact. (downstream)	1. Daily checks of equipment and operating conditions by Operator 2. Leak detection and repair (LDAR) program to periodically monitor emissions 3. Air Quality Monitoring System to continuously monitor emissions 4. Ability to manually activate an Emergency Shutdown (ESD) 5. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead 6. Emergency Response Plan (ERP)	1	5	M			PHA team deemed existing safeguards were adequate (sufficient and effective) for this hazard scenario
18. Corrosion	18.1. No new causes, refer to Misdirected Flow deviation in this node								
19. Erosion	19.1. Presence of sand from reservoir flowing through Wellhead W-A	19.1.1. Potential to send sand from Wellhead W-A into flow line and downstream equipment. Potential to erode piping, instrumentation and equipment. Potential to experience long-term wear. Potential to leak hydrocarbons into atmosphere or onto ground. Potential fire/explosion. Potential personnel injury. Potential environmental impact.	1. Flowback safeguards (including correct sizing and setting for choke valve) 2. Sand Catcher V-0310 (temporary) installed in flow line upstream of 2-Phase Separator V-001 designed to catch and removed sand to minimize erosion of downstream piping and equipment 3. Daily checks of equipment and operating conditions by Operator 4. Leak detection and repair (LDAR) program to periodically monitor emissions 5. Emergency Response Plan (ERP)	3	3	M	10. Evaluate installing sand probes in piping at or downstream of the Wellhead W-A based on the concentration of sand experienced during flowback operations, to indicate the presence of sand from the Wellhead W-A into flow line and downstream equipment with the potential to erode piping, instrumentation and equipment.	Summit Engineering	
20. Loss of Utility	20.1. No credible causes identified by PHA Team								
21. Service Failure	21.1. No credible causes identified by PHA Team								
22. Startup	22.1. Inadequate isolation of master valve on production tree prior to Emergency Shutdown (ESD) reset	22.1.1. Potential to rapidly increase flow of well fluid. Potential for hydraulic shock to piping and equipment. Refer to hazard scenario for choke washout in Higher Flow in this node.	1. Refer to safeguards for hazard scenario for choke washout in Higher Flow in this node.	1	5	M	4. Develop written operating procedures, including a startup procedure (e.g. purging the entire process system with nitrogen to assure an oxygen free environment; proper alignment of process and isolation valves; proper isolation of master valves on the production tree prior to ESD reset); monitoring and inspection of process	GMT	

Node: 1. **Produced Fluid** from: (1) Outlet of Wellhead W-A thru temporary Sand Catcher V-0310 (PF1A) thru Selection Manifold thru heated coil inside Horizontal Separator V-1120 to inlet of 2-Phase Separator V-001 via Selected Flow Line (PF2A); and (2) thru Maintenance Bypass (PF3A) and Maintenance Header to Oil Tank TK-5001 (PF4) **(pink)**

Drawings / References: 8365-01-1401; 8365-01-1402; 8365-01-1403; 8365-01-1418; 8365-01-1420

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
							equipment and conditions to support daily checks by operators during normal operations; closing the master valves and flow line valve; entering setpoints for controllers and control valves; and manually activating an emergency shutdown (ESD), in order to provide assurance for safely conducting production activities.		
23. Shutdown	23.1. No credible causes identified by PHA Team								
24. Maintenance	24.1. No new causes, refer to Misdirected Flow deviation in this node								
25. Inspection	25.1. No credible causes identified by PHA Team								
26. Human Factors	26.1. No credible causes identified by PHA Team								
27. Facility Siting	27.1. Vehicular traffic operating in close proximity to process equipment	27.1.1. Potential for vehicles to collide with or otherwise contact process equipment, piping or instrumentation containing produced fluids. Potential to release produced fluids into atmosphere and onto ground. Potential fire/explosion. Potential personnel injury. Potential environmental impact.	1. Daily checks of equipment and operating conditions by Operator 2. Physical barriers designed to protect process equipment and piping 3. Emergency Response Plan (ERP)	3	3	M	11. Develop a written vehicular Traffic Safety Control Plan with prevention and mitigation measures around any vulnerable process equipment, to provide assurance that safe work practices for the control of hazards during production activities are in place.	GMT	

Node: 2. **Produced Gas** from: (1) Gas outlet of Horizontal Separator V-1120 (PG4); (2) Gas outlet of Vapor Recovery Tower V-2000 (PG6) thru VRU Gas Compressor C-3510 (PG7), commingled in C-2510 Suction Header thru C-2510 Suction Scrubber V-3510 thru LP Gas Compressor C-2510 (PG5), and (3) Gas outlet of 2-Phase Separator V-001 thru Produced Gas Meter Skid (PG1), commingled in Sales Gas Header thru Sales Gas Scrubber V-3450 thru Sales Gas Meter M-101/102 to Sales Gas Compressor (PGX); and (3) Gas outlet of Horizontal Separator V-1120 thru Blanket Gas Header (PG2) into Oil Tank TK-5006 as Blanket Gas (PG3) **(yellow)**

Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1409; 8365-01-1413; 8365-01-1415; 8365-01-1416; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
1. No/Less Flow	1.1. Stream PG2 and PG3								
	1.2. 2" manual valve from gas outlet of Horizontal Separator V-1120 closed in error or 2" Pressure Control Valve PCV-102 malfunctions closed or set in error or either 2" manual isolation valve around PCV-102 closed in error or either 2" manual valve on blanket gas inlet of Oil Tank TK-5001/5006 closed in error	1.2.1. Potential to decrease and lose produced gas from Horizontal Separator V-1120. Potential to increase pressure in and overpressure and rupture Horizontal Separator V-1120. Potential to release produced fluids into atmosphere and onto ground. Potential fire/explosion. Potential personnel injury. Potential environmental impact. (downstream)	1. Operating procedures address proper manual valve alignment 2. Daily checks of equipment and operating conditions by Operator 3. High Pressure Alarm on Pressure Indicator PI-0102 on gas outlet of Horizontal Separator V-1120 4. High-High Pressure Alarm on Pressure Indicator PI-0102 on gas outlet of Horizontal Separator V-1120 5. High-High Pressure on Pressure Indicator Transmitter PIT-0102 on gas outlet of Horizontal Separator V-1120 activates an ESD 6. Ability to manually activate an Emergency Shutdown (ESD) 7. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead 8. Pressure Safety Valve PSV-0101 on Horizontal Separator V-1120 set at 125 psig relieves to atmosphere at a safe location (10-15 feet above grade) 9. Periodic inspection and testing of PSVs, PRVs, and PVRVs 10. Manual isolation valve upstream of PSV is car sealed open (CSO) 11. Emergency Response Plan (ERP)	1	5	M			PHA team deemed existing safeguards were adequate (sufficient and effective) for this hazard scenario Trucks could be in the area of the event when this hazard scenario event occurs. Produced oil backflow is not credible since LCV-0101 is closed.
		1.2.2. Potential to decrease and lose produced gas from Horizontal Separator V-1120. Potential to decrease flow of produced gas to Blanket Gas Header. Potential to decrease and lose blanket gas for Oil Tank TK-5001/2/3/6/7/8 and Water Tank TK-4001/4. Potential to create vacuum in and collapse Oil Tank TK-5001/2/3/6/7/8 and/or Water Tank TK-4001/4 during truck loadout. Potential to release produced oil and/or produced water. Potential fire. Potential personnel injury. Potential environmental impact. (upstream)	1. Operating procedures address proper manual valve alignment 2. Daily checks of equipment and operating conditions by Operator 3. High Pressure Alarm on Pressure Indicator PI-0102 on gas outlet of Horizontal Separator V-1120 4. High-High Pressure Alarm on Pressure Indicator PI-0102 on gas outlet of Horizontal Separator V-1120 5. High-High Pressure on Pressure Indicator Transmitter PIT-0102 on gas outlet of Horizontal Separator V-1120 activates an ESD 6. Ability to manually activate an Emergency Shutdown (ESD) 7. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead 8. Other well(s) provides supplemental blanket gas (assuming ESD has not shut down all production trains) 9. Pressure Vacuum Relief Valve PVRV-	3	4	L	15. Provide a supplemental source of blanket gas from the Fuel Gas System for the Oil Tanks TK-5001/2/3/6/7/8 and Water Tanks TK-4001/4. 16. Evaluate adding a visual alarm at the truck loadout area to alert the truck driver(s) to a loss of blanket gas for the Oil Tanks TK-5001/2/3/6/7/8, to enable them to cease loadout operations to prevent creating a vacuum in and collapsing the tanks.	Summit Engineering Summit Engineering	

Node: 2. **Produced Gas** from: (1) Gas outlet of Horizontal Separator V-1120 (PG4); (2) Gas outlet of Vapor Recovery Tower V-2000 (PG6) thru VRU Gas Compressor C-3510 (PG7), commingled in C-2510 Suction Header thru C-2510 Suction Scrubber V-3510 thru LP Gas Compressor C-2510 (PG5), and (3) Gas outlet of 2-Phase Separator V-001 thru Produced Gas Meter Skid (PG1), commingled in Sales Gas Header thru Sales Gas Scrubber V-3450 thru Sales Gas Meter M-101/102 to Sales Gas Compressor (PGX); and (3) Gas outlet of Horizontal Separator V-1120 thru Blanket Gas Header (PG2) into Oil Tank TK-5006 as Blanket Gas (PG3) **(yellow)**

Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1409; 8365-01-1413; 8365-01-1415; 8365-01-1416; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
			5101/2/3/6/7/8 on Oil Tank TK-5001/2/3/6/7/8 set at -4 oz/in2 designed to break vacuum and prevent tank collapse						
			10. Pressure Vacuum Relief Valve PVRV-4001/4 on Water Tank TK-4001/4 set at -4 oz/in2 designed to break vacuum and prevent tank collapse						
			11. Periodic inspection and testing of PSVs, PRVs, and PVRVs						
			12. Secondary and tertiary containment for Oil Tank TK-5001/2/3/6/7/8						
			13. Secondary and tertiary containment for Water Tank TK-4001/4						
			14. Emergency Response Plan (ERP)						
		1.2.3. **IF PVRV SAFEGUARDS WORK AS DESIGNED:** Potential to decrease and lose produced gas from Horizontal Separator V-1120. Potential to decrease and lose produced gas from Horizontal Separator V-1120. Potential to decrease and lose blanket gas for Oil Tank TK-5001/2/3/6/7/8 and Water Tank TK-4001/4. Potential to create vacuum and for air ingress into Oil Tank TK-5001/2/3/6/7/8 and Water Tank TK-4001/4 during truck loadout. Potential to create explosive mixture in Oil Tank TK-5001/2/3/6/7/8. Potential fire/explosion. Potential to release produced oil and produced gas (blanket gas). Potential fire/explosion. Potential personnel injury. Potential environmental impact. (downstream)	1. Operating procedures address proper manual valve alignment	1	5	M	15. Provide a supplemental source of blanket gas from the Fuel Gas System for the Oil Tanks TK-5001/2/3/6/7/8 and Water Tanks TK-4001/4.	Summit Engineering	Trucks could be in the area of the event when this hazard scenario event occurs.
			2. Daily checks of equipment and operating conditions by Operator				16. Evaluate adding a visual alarm at the truck loadout area to alert the truck driver(s) to a loss of blanket gas for the Oil Tanks TK-5001/2/3/6/7/8, to enable them to cease loadout operations to prevent creating a vacuum in and collapsing the tanks.	Summit Engineering	Produced oil backflow is not credible since LCV-0101 is closed.
			3. High Pressure Alarm on Pressure Indicator PI-0102 on gas outlet of Horizontal Separator V-1120						
			4. High-High Pressure Alarm on Pressure Indicator PI-0102 on gas outlet of Horizontal Separator V-1120						
			5. High-High Pressure on Pressure Indicator Transmitter PIT-0102 on gas outlet of Horizontal Separator V-1120 activates an ESD						
			6. Ability to manually activate an Emergency Shutdown (ESD)						
			7. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead						
			8. Other well(s) provides supplemental blanket gas (assuming ESD has not shut down all production trains)						
			9. Emergency Response Plan (ERP)						
	1.3. Stream PG4								
	1.4. 2" manual valve from gas outlet of Horizontal Separator V-1120 closed in error or 2" Pressure Control Valve PCV-0101 malfunctions closed or set in error or either 2" manual isolation valve around PCV-0101 closed in error	1.4.1. Potential to decrease and lose produced gas from Horizontal Separator V-1120. Potential to increase pressure in and overpressure and rupture Horizontal Separator V-1120. Potential to release produced fluids into atmosphere and onto ground. Potential fire/explosion. Potential personnel injury. Potential environmental impact. (upstream)	1. Operating procedures address proper manual valve alignment	1	5	M			PHA team deemed existing safeguards were adequate (sufficient and effective) for this hazard scenario
			2. Daily checks of equipment and operating conditions by Operator						Trucks could be in the area of the event when this hazard scenario event occurs.
			3. High Pressure Alarm on Pressure Indicator PI-0102 on gas outlet of Horizontal Separator V-1120						Produced oil backflow is not credible since LCV-0101 is closed.
			4. High-High Pressure Alarm on Pressure Indicator PI-0102 on gas outlet of Horizontal Separator V-1120						
			5. High-High Pressure on Pressure Indicator Transmitter PIT-0102 on gas outlet of Horizontal Separator V-1120 activates an ESD						
			6. Ability to manually activate an Emergency						

Node: 2. **Produced Gas** from: (1) Gas outlet of Horizontal Separator V-1120 (PG4); (2) Gas outlet of Vapor Recovery Tower V-2000 (PG6) thru VRU Gas Compressor C-3510 (PG7), commingled in C-2510 Suction Header thru C-2510 Suction Scrubber V-3510 thru LP Gas Compressor C-2510 (PG5), and (3) Gas outlet of 2-Phase Separator V-001 thru Produced Gas Meter Skid (PG1), commingled in Sales Gas Header thru Sales Gas Scrubber V-3450 thru Sales Gas Meter M-101/102 to Sales Gas Compressor (PGX); and (3) Gas outlet of Horizontal Separator V-1120 thru Blanket Gas Header (PG2) into Oil Tank TK-5006 as Blanket Gas (PG3) **(yellow)**

Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1409; 8365-01-1413; 8365-01-1415; 8365-01-1416; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
			Shutdown (ESD) 7. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead 8. Pressure Safety Valve PSV-0101 on Horizontal Separator V-1120 set at 125 psig relieves to atmosphere at a safe location (10-15 feet above grade) 9. Periodic inspection and testing of PSVs, PRVs, and PVRVs 10. Manual isolation valve upstream of PSV is car sealed open (CSO) 11. Emergency Response Plan (ERP)						
		1.4.2. Potential to decrease and lose flow of produced gas to C-2510 Suction Scrubber V-3510. Potential to decrease flow of produced gas to LP Gas Compressor C-2510. Potential to starve compressor. Potential to damage compressor with no external release. No hazardous consequences. Operability issue only. (downstream)	1. Operating procedures address proper manual valve alignment 2. Daily checks of equipment and operating conditions by Operator 3. High Pressure Alarm on Pressure Indicator PI-0102 on gas outlet of Horizontal Separator V-1120 4. High-High Pressure Alarm on Pressure Indicator PI-0102 on gas outlet of Horizontal Separator V-1120 5. High-High Pressure on Pressure Indicator Transmitter PIT-0102 on gas outlet of Horizontal Separator V-1120 activates an ESD 6. Ability to manually activate an Emergency Shutdown (ESD) 7. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead						
		1.4.3. Potential to decrease and lose produced gas from Horizontal Separator V-1120. Potential to decrease and lose produced gas to Sales. No hazardous consequences. Operability issue only. (downstream)	1. Operating procedures address proper manual valve alignment 2. Daily checks of equipment and operating conditions by Operator 3. High Pressure Alarm on Pressure Indicator PI-0102 on gas outlet of Horizontal Separator V-1120 4. High-High Pressure Alarm on Pressure Indicator PI-0102 on gas outlet of Horizontal Separator V-1120 5. High-High Pressure on Pressure Indicator Transmitter PIT-0102 on gas outlet of Horizontal Separator V-1120 activates an ESD 6. Ability to manually activate an Emergency Shutdown (ESD) 7. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead						
	1.5. Stream PG6 & PG7								
	1.6. 4" manual valve on gas outlet of Vapor Recovery Tower V-2000 closed in error	1.6.1. Potential to decrease and lose flow of produced gas from Vapor Recovery Tower V-2000. Potential to send produced gas into Oil Tank TK-5001/2/3/6/7/8. Potential to increase flow of produced gas from Oil Tank TK-5001/2/3/6/7/8 to Emission Control Device BR-9010/20. No hazardous consequence. Operability issue only. (upstream)							

Node: 2. **Produced Gas** from: (1) Gas outlet of Horizontal Separator V-1120 (PG4); (2) Gas outlet of Vapor Recovery Tower V-2000 (PG6) thru VRU Gas Compressor C-3510 (PG7), commingled in C-2510 Suction Header thru C-2510 Suction Scrubber V-3510 thru LP Gas Compressor C-2510 (PG5), and (3) Gas outlet of 2-Phase Separator V-001 thru Produced Gas Meter Skid (PG1), commingled in Sales Gas Header thru Sales Gas Scrubber V-3450 thru Sales Gas Meter M-101/102 to Sales Gas Compressor (PGX); and (3) Gas outlet of Horizontal Separator V-1120 thru Blanket Gas Header (PG2) into Oil Tank TK-5006 as Blanket Gas (PG3) **(yellow)**

Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1409; 8365-01-1413; 8365-01-1415; 8365-01-1416; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
		1.6.2. Potential to decrease and lose flow of produced gas from Vapor Recovery Tower V-2000. Potential to decrease and lose flow of produced to VRU Gas Compressor C-3510. Potential to starve compressor. Potential to damage compressor, but with no external release of gas. Potential to decrease flow of produced gas to Sales Gas. No hazardous consequences. Operability issue only. (downstream)							
	1.7. VRU Gas Compressor C-3510 not running for any reason	1.7.1. Potential to decrease and lose flow of produced gas from Vapor Recovery Tower V-2000. Potential to send (reverse flow) produced gas from Sales Gas Header through VRU Gas Compressor C-3510. Potential to damage compressor, but with no external release of gas. No hazardous consequences. Operability issue only. (upstream)	1. Preventive maintenance program for compressors and pumps 2. 3" check valve downstream of VRU Gas Compressor C-3510 is designed to prevent backflow from Sales Gas Header						
		1.7.2. Potential to decrease and lose flow of produced gas from Vapor Recovery Tower V-2000. Potential to send produced gas into Oil Tank TK-5001/2/3/6/7/8. Potential to increase flow of produced gas from Oil Tank TK-5001/2/3/6/7/8 to Emission Control Device BR-9010/20. No hazardous consequence. Operability issue only. (upstream)	1. Preventive maintenance program for compressors and pumps 2. Pressure Control Valve PCV-2301 on flare gas line to Emission Control Device BR-9010/20 relieves some of the pressure 3. Manual isolation valves upstream and downstream of Pressure Control Valve PCV-2301 on flare gas line to Emission Control Device BR-9010/20 are car sealed open (CSO)						
		1.7.3. Potential to decrease and lose flow of produced gas from Vapor Recovery Tower V-2000. Potential to decrease and lose flow of produced to VRU Gas Compressor C-3510. Potential to decrease flow of produced gas to Sales Gas. No hazardous consequences. Operability issue only. (downstream)	1. Preventive maintenance program for compressors and pumps 2. Pressure Control Valve PCV-2301 on flare gas line to Emission Control Device BR-9010/20 relieves some of the pressure 3. Manual isolation valves upstream and downstream of Pressure Control Valve PCV-2301 on flare gas line to Emission Control Device BR-9010/20 are car sealed open (CSO)						
	1.8. Stream PG5								
	1.9. Any one of three 3" manual valves on outlet of LP Gas Compressor C-2510 closed in error	1.9.1. Potential to decrease and lose flow of produced gas from LP Gas Compressor C-2510. Potential to deadhead compressor. Potential to damage compressor, but with no external release of gas. No hazardous consequences. Operability issue only. (upstream)							
		1.9.2. Potential to decrease and lose flow of produced gas from LP Gas Compressor C-2510. Potential to decrease flow of produced gas to Sales Gas. No hazardous consequences. Operability issue only. (downstream)							
	1.10. Stream PG1								
	1.11. Either 3" manual valve from gas outlet of 2-Phase Separator V-001 closed in error or 6" manual valve on Sales Gas Header closed in error	1.11.1. Potential to decrease flow of produced gas to Sales Gas Header. Potential to increase pressure in and overpressure and rupture 2-Phase Separator V-001 and Fuel Gas System. Potential to release produced fluids into atmosphere and onto ground. Potential fire/explosion. Potential personnel injury. Potential environmental impact. (upstream)	1. Operating procedures address proper manual valve alignment 2. Daily checks of equipment and operating conditions by Operator 3. High Pressure Alarm on Pressure Indicator PI-0103 on gas outlet of 2-Phase Separator V-001 4. High-High Pressure Alarm on Pressure	1	5	M			PHA team deemed existing safeguards were adequate (sufficient and effective) for this hazard scenario Overpressure of Horizontal Separator V-1120 is not credible since liquid dump valve is closed. Produced oil backflow is not credible since LCV-0101 is closed.

Node: 2. **Produced Gas** from: (1) Gas outlet of Horizontal Separator V-1120 (PG4); (2) Gas outlet of Vapor Recovery Tower V-2000 (PG6) thru VRU Gas Compressor C-3510 (PG7), commingled in C-2510 Suction Header thru C-2510 Suction Scrubber V-3510 thru LP Gas Compressor C-2510 (PG5), and (3) Gas outlet of 2-Phase Separator V-001 thru Produced Gas Meter Skid (PG1), commingled in Sales Gas Header thru Sales Gas Scrubber V-3450 thru Sales Gas Meter M-101/102 to Sales Gas Compressor (PGX); and (3) Gas outlet of Horizontal Separator V-1120 thru Blanket Gas Header (PG2) into Oil Tank TK-5006 as Blanket Gas (PG3) **(yellow)**

Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1409; 8365-01-1413; 8365-01-1415; 8365-01-1416; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
			Indicator PI-0103 on gas outlet of 2-Phase Separator V-001						
			5. High-High Pressure Indicator Transmitter PIT-0103 on gas outlet of 2-Phase Separator V-001 activates an ESD						
			6. Ability to manually activate an Emergency Shutdown (ESD)						
			7. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead						
			8. Pressure Safety Valve PSV-0102 on 2-Phase Separator V-001 set at 740 psig relieves to atmosphere at a safe location (10-15 feet above grade)						
			9. Periodic inspection and testing of PSVs, PRVs, and PVRVs						
			10. Manual isolation valve upstream of PSV is car sealed open (CSO)						
			11. Emergency Response Plan (ERP)						
		1.11.2. Potential to decrease flow of produced gas to Sales Gas Header. Potential to increase pressure in and overpressure and rupture Fuel Gas Scrubber V-201, Fuel Gas Scrubber V-3011, Sales Gas Scrubber V-3450 and Fuel Gas Header (including piping to LP Gas Compressor C-2510, Pilot Fuel Pots for Emission Control Device BR-9010/9020). Potential to release fuel gas into atmosphere and onto ground. Potential fire/explosion. Potential personnel injury. Potential environmental impact. (upstream)	1. Operating procedures address proper manual valve alignment	1	5	M	12. Verify and document the sizing basis and set point for Pressure Safety Valve PSV-0103 on the Fuel Gas Scrubber V-201.	Summit Engineering	Trucks could be in the area of the event when this hazard scenario event occurs.
			2. Daily checks of equipment and operating conditions by Operator				13. Verify and document the sizing basis and set point for Pressure Safety Valve PSV-3011 on the Fuel Gas Scrubber V-3011.	Summit Engineering	
			3. High Pressure Alarm on Pressure Indicator PI-0103 on gas outlet of 2-Phase Separator V-001				14. Verify and document the sizing basis and set point for Pressure Safety Valve PSV-3450 on the Sales Gas Scrubber V-3450.	Summit Engineering	
			4. High-High Pressure Alarm on Pressure Indicator PI-0103 on gas outlet of 2-Phase Separator V-001						
			5. High-High Pressure Indicator Transmitter PIT-0103 on gas outlet of 2-Phase Separator V-001 activates an ESD						
			6. Ability to manually activate an Emergency Shutdown (ESD)						
			7. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead						
			8. Pressure Control Valve PCV-0104 upstream of Fuel Gas Scrubber V-201 closes to protect Fuel Gas Scrubber V-201						
			9. Pressure Control Valve PCV-3011 upstream of Fuel Gas Scrubber V-3011 closes to protect Fuel Gas Scrubber V-3011						
			10. Pressure Safety Valve PSV-0103 on Fuel Gas Scrubber V-201 set at ??? psig relieves to atmosphere at a safe location (outside of building)						
			11. Pressure Safety Valve PSV-3011 on Fuel Gas Scrubber V-3011 set at ??? psig relieves to atmosphere at a safe location (above top of vessel)						
			12. Pressure Safety Valve PSV-3450 on Sales Gas Scrubber V-3450 set at ??? psig relieves to atmosphere at a safe location (above top of vessel)						
			13. Periodic inspection and testing of PSVs, PRVs, and PVRVs						

Node: 2. **Produced Gas** from: (1) Gas outlet of Horizontal Separator V-1120 (PG4); (2) Gas outlet of Vapor Recovery Tower V-2000 (PG6) thru VRU Gas Compressor C-3510 (PG7), commingled in C-2510 Suction Header thru C-2510 Suction Scrubber V-3510 thru LP Gas Compressor C-2510 (PG5), and (3) Gas outlet of 2-Phase Separator V-001 thru Produced Gas Meter Skid (PG1), commingled in Sales Gas Header thru Sales Gas Scrubber V-3450 thru Sales Gas Meter M-101/102 to Sales Gas Compressor (PGX); and (3) Gas outlet of Horizontal Separator V-1120 thru Blanket Gas Header (PG2) into Oil Tank TK-5006 as Blanket Gas (PG3) **(yellow)**

Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1409; 8365-01-1413; 8365-01-1415; 8365-01-1416; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
			14. Manual isolation valve upstream of PSV is car sealed open (CSO)						
			15. Emergency Response Plan (ERP)						
		1.11.3. Potential to send (reverse flow) produced gas from other sources from C-2510 Suction Header and Blanket Gas Header to increase release amount and escalate fire/explosion. Potential personnel injury. Potential environmental impact. **Refer to above hazard scenario with same cause for No/Less Flow deviation in this node** (downstream)	1. Refer to safeguards in above hazard scenario with same cause for No/Less Flow deviation in this node, plus:	1	5	M			PHA team deemed existing safeguards were adequate (sufficient and effective) for this hazard scenario
			2. 2" check valve on produced gas outlet of Horizontal Separator V-1120 downstream of Pressure Control Valve PCV-0101 is designed to prevent backflow from C-2510 Suction Header to leak point						Trucks could be in the area of the event when this hazard scenario event occurs.
			3. 2" check valve on produced gas outlet of Horizontal Separator V-1120 downstream of Pressure Control Valve PCV-0102 is designed to prevent backflow from Blanket Gas Header to leak point						
			4. 6" check valve at Produced Gas Meter Skid is designed to prevent backflow from Sales Gas Header to leak point						
		1.11.4. Potential to decrease and lose flow of produced gas to Sales Gas Header. Potential to decrease and lose production of Sales Gas. No hazardous consequences. Operability issue only. (downstream)							
	1.12. 6" manual valve from Sales Gas Header to inlet of Sales Gas Scrubber V-3450 closed in error	1.12.1. Potential to decrease and lose flow of produced gas to Sales Gas Scrubber V-3450. Potential to decrease flow of produced gas to Sales Gas Header. Potential to increase pressure in and overpressure and rupture 2-Phase Separator V-001 and Fuel Gas System. Potential to release produced fluids into atmosphere and onto ground. Potential fire/explosion. Potential personnel injury. Potential environmental impact. (upstream)	1. Operating procedures address proper manual valve alignment	1	5	M			PHA team deemed existing safeguards were adequate (sufficient and effective) for this hazard scenario
			2. Daily checks of equipment and operating conditions by Operator						Overpressure of HS is not credible since dump valve is closed.
			3. High Pressure Alarm on Pressure Indicator PI-0103 on gas outlet of 2-Phase Separator V-001						Produced oil backflow is not credible since LCV-0101 is closed.
			4. High-High Pressure Alarm on Pressure Indicator PI-0103 on gas outlet of 2-Phase Separator V-001						
			5. High-High Pressure Indicator Transmitter PIT-0103 on gas outlet of 2-Phase Separator V-001 activates an ESD						
			6. Ability to manually activate an Emergency Shutdown (ESD)						
			7. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead						
			8. Pressure Safety Valve PSV-0102 on 2-Phase Separator V-001 set at 740 psig relieves to atmosphere at a safe location (10-15 feet above grade)						
			9. Periodic inspection and testing of PSVs, PRVs, and PVRVs						
			10. Manual isolation valve upstream of PSV is car sealed open (CSO)						
			11. Emergency Response Plan (ERP)						
		1.12.2. Potential to decrease and lose flow of produced gas to Sales Gas Scrubber V-3450. Potential to decrease flow of produced gas to Sales Gas Header. Potential to increase pressure in and overpressure and rupture Fuel Gas Scrubber V-201, Fuel Gas Scrubber V-	1. Operating procedures address proper manual valve alignment	1	5	M	12. Verify and document the sizing basis and set point for Pressure Safety Valve PSV-0103 on the Fuel Gas Scrubber V-201.	Summit Engineering	Trucks could be in the area of the event when this hazard scenario event occurs.
			2. Daily checks of equipment and operating conditions by Operator				13. Verify and document the sizing basis and set point for Pressure Safety Valve PSV-	Summit Engineering	

Node: 2. **Produced Gas** from: (1) Gas outlet of Horizontal Separator V-1120 (PG4); (2) Gas outlet of Vapor Recovery Tower V-2000 (PG6) thru VRU Gas Compressor C-3510 (PG7), commingled in C-2510 Suction Header thru C-2510 Suction Scrubber V-3510 thru LP Gas Compressor C-2510 (PG5), and (3) Gas outlet of 2-Phase Separator V-001 thru Produced Gas Meter Skid (PG1), commingled in Sales Gas Header thru Sales Gas Scrubber V-3450 thru Sales Gas Meter M-101/102 to Sales Gas Compressor (PGX); and (3) Gas outlet of Horizontal Separator V-1120 thru Blanket Gas Header (PG2) into Oil Tank TK-5006 as Blanket Gas (PG3) **(yellow)**

Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1409; 8365-01-1413; 8365-01-1415; 8365-01-1416; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
		3011, Sales Gas Scrubber V-3450 and Fuel Gas Header (including piping to LP Gas Compressor C-2510, Pilot Fuel Pots for Emission Control Device BR-9010/9020). Potential to release fuel gas into atmosphere and onto ground. Potential fire/explosion. Potential personnel injury. Potential environmental impact. (upstream)					3011 on the Fuel Gas Scrubber V-3011.		
			3. High Pressure Alarm on Pressure Indicator PI-0103 on gas outlet of 2-Phase Separator V-001				14. Verify and document the sizing basis and set point for Pressure Safety Valve PSV-3450 on the Sales Gas Scrubber V-3450.	Summit Engineering	
			4. High-High Pressure Alarm on Pressure Indicator PI-0103 on gas outlet of 2-Phase Separator V-001						
			5. High-High Pressure Indicator Transmitter PIT-0103 on gas outlet of 2-Phase Separator V-001 activates an ESD						
			6. Ability to manually activate an Emergency Shutdown (ESD)						
			7. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead						
			8. Pressure Control Valve PCV-0104 upstream of Fuel Gas Scrubber V-201 closes to protect Fuel Gas Scrubber V-201						
			9. Pressure Control Valve PCV-3011 upstream of Fuel Gas Scrubber V-3011 closes to protect Fuel Gas Scrubber V-3011						
			10. Pressure Safety Valve PSV-0103 on Fuel Gas Scrubber V-201 set at ??? psig relieves to atmosphere at a safe location (outside of building)						
			11. Pressure Safety Valve PSV-3011 on Fuel Gas Scrubber V-3011 set at ??? psig relieves to atmosphere at a safe location (above top of vessel)						
			12. Pressure Safety Valve PSV-3450 on Sales Gas Scrubber V-3450 set at ??? psig relieves to atmosphere at a safe location (above top of vessel)						
			13. Periodic inspection and testing of PSVs, PRVs, and PVRVs						
			14. Manual isolation valve upstream of PSV is car sealed open (CSO)						
			15. Emergency Response Plan (ERP)						
		1.12.3. Potential to decrease and lose flow of produced gas to Sales Gas Scrubber V-3450. Potential to send (reverse flow) produced gas from other sources from C-2510 Suction Header and Blanket Gas Header to increase release amount and escalate fire/explosion. Potential personnel injury. Potential environmental impact. **Refer to above hazard scenario with same cause for No/Less Flow deviation in this node** (downstream)	1. Refer to safeguards in above hazard scenario with same cause for No/Less Flow deviation in this node, plus:	1	5	M			PHA team deemed existing safeguards were adequate (sufficient and effective) for this hazard scenario
			2. 2" check valve on produced gas outlet of Horizontal Separator V-1120 downstream of Pressure Control Valve PCV-0101 is designed to prevent backflow from C-2510 Suction Header to leak point						Trucks could be in the area of the event when this hazard scenario event occurs.
			3. 2" check valve on produced gas outlet of Horizontal Separator V-1120 downstream of Pressure Control Valve PCV-0102 is designed to prevent backflow from Blanket Gas Header to leak point						
			4. 6" check valve at Produced Gas Meter Skid is designed to prevent backflow from Sales Gas Header to leak point						
		1.12.4. Potential to decrease and lose flow of produced gas to Sales Gas Scrubber V-3450. Potential to decrease and lose flow of produced gas to Sales Gas Header. Potential to decrease and lose production of Sales							

Node: 2. **Produced Gas** from: (1) Gas outlet of Horizontal Separator V-1120 (PG4); (2) Gas outlet of Vapor Recovery Tower V-2000 (PG6) thru VRU Gas Compressor C-3510 (PG7), commingled in C-2510 Suction Header thru C-2510 Suction Scrubber V-3510 thru LP Gas Compressor C-2510 (PG5), and (3) Gas outlet of 2-Phase Separator V-001 thru Produced Gas Meter Skid (PG1), commingled in Sales Gas Header thru Sales Gas Scrubber V-3450 thru Sales Gas Meter M-101/102 to Sales Gas Compressor (PGX); and (3) Gas outlet of Horizontal Separator V-1120 thru Blanket Gas Header (PG2) into Oil Tank TK-5006 as Blanket Gas (PG3) **(yellow)**

Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1409; 8365-01-1413; 8365-01-1415; 8365-01-1416; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
		Gas. No hazardous consequences. Operability issue only. (downstream)							
		1.12.5. Potential to decrease and lose flow of produced gas to Sales Gas Scrubber V-3450. Potential to decrease and lose flow of produced gas from LP Gas Compressor C-2510. Potential to deadhead compressor. Potential to damage compressor, but with no external release of gas. No hazardous consequences. Operability issue only. (upstream)							
		1.12.6. Potential to decrease and lose flow of produced gas to Sales Gas Scrubber V-3450. Potential to decrease and lose flow of produced gas from LP Gas Compressor C-2510. Potential to decrease flow of produced gas to Sales Gas. No hazardous consequences. Operability issue only. (downstream)							
		1.12.7. Potential to decrease and lose flow of produced gas to Sales Gas Scrubber V-3450. Potential to decrease and lose flow of produced gas to Sales Gas Scrubber V-3450. Potential to decrease production of Sales Gas. No hazardous consequence. Operability issue only. (downstream)							
		1.12.8. Potential to decrease and lose flow of produced gas to Sales Gas Scrubber V-3450. Potential to decrease and lose flow of produced gas to Sales Gas Scrubber V-3450. Potential to decrease supply of fuel gas to Fuel Gas Header. **Refer to scenarios for No/Less Flow deviation in Node 4 Fuel Gas.** (downstream)							
	1.13. Either 6" manual valve from gas outlet of Sales Gas Scrubber V-3450 closed in error or 6" common manual valve in Sales Gas Meter Header closed in error or 3" Pressure Control Valve PCV-101/102 (pipeline pressure protection valve) to either Sales Gas Meter M-101/102 malfunctions closed or closes (as designed) upon high pipeline pressure or either 3" manual isolation valve around or Pressure Control Valve PCV-101/102 closed in error	1.13.1. Potential to decrease and lose flow of produced gas from Sales Gas Scrubber V-3450 to Sales Gas Meter M-101/102. Potential to decrease and lose flow of produced gas to Sales Gas Scrubber V-3450. Potential to decrease flow of produced gas to Sales Gas Header. Potential to increase pressure in and overpressure and rupture 2-Phase Separator V-001 and Fuel Gas System. Potential to release produced fluids into atmosphere and onto ground. Potential fire/explosion. Potential personnel injury. Potential environmental impact. (upstream)	1. Operating procedures address proper manual valve alignment 2. Daily checks of equipment and operating conditions by Operator 3. High Pressure Alarm on Pressure Indicator PI-0103 on gas outlet of 2-Phase Separator V-001 4. High-High Pressure Alarm on Pressure Indicator PI-0103 on gas outlet of 2-Phase Separator V-001 5. High-High Pressure Indicator Transmitter PIT-0103 on gas outlet of 2-Phase Separator V-001 activates an ESD 6. Ability to manually activate an Emergency Shutdown (ESD) 7. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead 8. Pressure Safety Valve PSV-0102 on 2-Phase Separator V-001 set at 740 psig relieves to atmosphere at a safe location (10-15 feet above grade) 9. Periodic inspection and testing of PSVs, PRVs, and PVRVs 10. Manual isolation valve upstream of PSV is car sealed open (CSO) 11. Emergency Response Plan (ERP)	1	5	M			PHA team deemed existing safeguards were adequate (sufficient and effective) for this hazard scenario Overpressure of HS is not credible since dump valve is closed. Produced oil backflow is not credible since LCV-0101 is closed.
		1.13.2. Potential to decrease and lose flow of produced gas from Sales Gas Scrubber V-3450 to Sales Gas Meter M-101/102. Potential to decrease and lose flow of	1. Operating procedures address proper manual valve alignment	1	5	M	12. Verify and document the sizing basis and set point for Pressure Safety Valve PSV-0103 on the Fuel Gas Scrubber V-201.	Summit Engineering	Trucks could be in the area of the event when this hazard scenario event

Node: 2. **Produced Gas** from: (1) Gas outlet of Horizontal Separator V-1120 (PG4); (2) Gas outlet of Vapor Recovery Tower V-2000 (PG6) thru VRU Gas Compressor C-3510 (PG7), commingled in C-2510 Suction Header thru C-2510 Suction Scrubber V-3510 thru LP Gas Compressor C-2510 (PG5), and (3) Gas outlet of 2-Phase Separator V-001 thru Produced Gas Meter Skid (PG1), commingled in Sales Gas Header thru Sales Gas Scrubber V-3450 thru Sales Gas Meter M-101/102 to Sales Gas Compressor (PGX); and (3) Gas outlet of Horizontal Separator V-1120 thru Blanket Gas Header (PG2) into Oil Tank TK-5006 as Blanket Gas (PG3) **(yellow)**

Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1409; 8365-01-1413; 8365-01-1415; 8365-01-1416; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
		produced gas to Sales Gas Scrubber V-3450. Potential to decrease flow of produced gas to Sales Gas Header. Potential to increase pressure in and overpressure and rupture Fuel Gas Scrubber V-201, Fuel Gas Scrubber V-3011, Sales Gas Scrubber V-3450 and Fuel Gas Header (including piping to LP Gas Compressor C-2510, Pilot Fuel Pots for Emission Control Device BR-9010/9020). Potential to release fuel gas into atmosphere and onto ground. Potential fire/explosion. Potential personnel injury. Potential environmental impact. (upstream)	2. Daily checks of equipment and operating conditions by Operator				13. Verify and document the sizing basis and set point for Pressure Safety Valve PSV-3011 on the Fuel Gas Scrubber V-3011.	Summit Engineering	occurs.
			3. High Pressure Alarm on Pressure Indicator PI-0103 on gas outlet of 2-Phase Separator V-001				14. Verify and document the sizing basis and set point for Pressure Safety Valve PSV-3450 on the Sales Gas Scrubber V-3450.	Summit Engineering	
			4. High-High Pressure Alarm on Pressure Indicator PI-0103 on gas outlet of 2-Phase Separator V-001						
			5. High-High Pressure Indicator Transmitter PIT-0103 on gas outlet of 2-Phase Separator V-001 activates an ESD						
			6. Ability to manually activate an Emergency Shutdown (ESD)						
			7. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead						
			8. Pressure Control Valve PCV-0104 upstream of Fuel Gas Scrubber V-201 closes to protect Fuel Gas Scrubber V-201						
			9. Pressure Control Valve PCV-3011 upstream of Fuel Gas Scrubber V-3011 closes to protect Fuel Gas Scrubber V-3011						
			10. Pressure Safety Valve PSV-0103 on Fuel Gas Scrubber V-201 set at ??? psig relieves to atmosphere at a safe location (outside of building)						
			11. Pressure Safety Valve PSV-3011 on Fuel Gas Scrubber V-3011 set at ??? psig relieves to atmosphere at a safe location (above top of vessel)						
			12. Pressure Safety Valve PSV-3450 on Sales Gas Scrubber V-3450 set at ??? psig relieves to atmosphere at a safe location (above top of vessel)						
			13. Periodic inspection and testing of PSVs, PRVs, and PVRVs						
			14. Manual isolation valve upstream of PSV is car sealed open (CSO)						
			15. Emergency Response Plan (ERP)						
		1.13.3. Potential to decrease and lose flow of produced gas from Sales Gas Scrubber V-3450 to Sales Gas Meter M-101/102. Potential to decrease and lose flow of produced gas to Sales Gas Scrubber V-3450. Potential to send (reverse flow) produced gas from other sources from C-2510 Suction Header and Blanket Gas Header to increase release amount and escalate fire/explosion. Potential personnel injury. Potential environmental impact. **Refer to above hazard scenario with same cause for No/Less Flow deviation in this node** (downstream)	1. Refer to safeguards in above hazard scenario with same cause for No/Less Flow deviation in this node, plus:	1	5	M			PHA team deemed existing safeguards were adequate (sufficient and effective) for this hazard scenario
			2. 2" check valve on produced gas outlet of Horizontal Separator V-1120 downstream of Pressure Control Valve PCV-0101 is designed to prevent backflow from C-2510 Suction Header to leak point						Trucks could be in the area of the event when this hazard scenario event occurs.
			3. 2" check valve on produced gas outlet of Horizontal Separator V-1120 downstream of Pressure Control Valve PCV-0102 is designed to prevent backflow from Blanket Gas Header to leak point						
			4. 6" check valve at Produced Gas Meter Skid is designed to prevent backflow from Sales Gas Header to leak point						
		1.13.4. Potential to decrease and lose flow of produced gas from Sales Gas Scrubber V-3450 to Sales Gas Meter							

Node: 2. **Produced Gas** from: (1) Gas outlet of Horizontal Separator V-1120 (PG4); (2) Gas outlet of Vapor Recovery Tower V-2000 (PG6) thru VRU Gas Compressor C-3510 (PG7), commingled in C-2510 Suction Header thru C-2510 Suction Scrubber V-3510 thru LP Gas Compressor C-2510 (PG5), and (3) Gas outlet of 2-Phase Separator V-001 thru Produced Gas Meter Skid (PG1), commingled in Sales Gas Header thru Sales Gas Scrubber V-3450 thru Sales Gas Meter M-101/102 to Sales Gas Compressor (PGX); and (3) Gas outlet of Horizontal Separator V-1120 thru Blanket Gas Header (PG2) into Oil Tank TK-5006 as Blanket Gas (PG3) **(yellow)**

Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1409; 8365-01-1413; 8365-01-1415; 8365-01-1416; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
		M-101/102. Potential to decrease and lose flow of produced gas to Sales Gas Scrubber V-3450. Potential to decrease and lose flow of produced gas to Sales Gas Header. Potential to decrease and lose production of Sales Gas. No hazardous consequences. Operability issue only. (downstream)							
		1.13.5. Potential to decrease and lose flow of produced gas from Sales Gas Scrubber V-3450 to Sales Gas Meter M-101/102. Potential to decrease and lose flow of produced gas to Sales Gas Scrubber V-3450. Potential to decrease and lose flow of produced gas from LP Gas Compressor C-2510. Potential to deadhead compressor. Potential to damage compressor, but with no external release of gas. No hazardous consequences. Operability issue only. (upstream)							
		1.13.6. Potential to decrease and lose flow of produced gas from Sales Gas Scrubber V-3450 to Sales Gas Meter M-101/102. Potential to decrease and lose flow of produced gas to Sales Gas Scrubber V-3450. Potential to decrease and lose flow of produced gas from LP Gas Compressor C-2510. Potential to decrease flow of produced gas to Sales Gas. No hazardous consequences. Operability issue only. (downstream)							
		1.13.7. Potential to decrease and lose flow of produced gas from Sales Gas Scrubber V-3450 to Sales Gas Meter M-101/102. Potential to decrease and lose flow of produced gas to Sales Gas Scrubber V-3450. Potential to decrease and lose flow of produced gas to Sales Gas Scrubber V-3450. Potential to decrease production of Sales Gas. No hazardous consequence. Operability issue only. (downstream)							
		1.13.8. Potential to decrease and lose flow of produced gas from Sales Gas Scrubber V-3450 to Sales Gas Meter M-101/102. Potential to decrease and lose flow of produced gas to Sales Gas Scrubber V-3450. Potential to decrease and lose flow of produced gas to Sales Gas Scrubber V-3450. Potential to decrease supply of fuel gas to Fuel Gas Header. **Refer to scenarios for No/Less Flow deviation in Node 4 Fuel Gas.** (downstream)							
		1.13.9. Potential to decrease and lose flow of produced gas from Sales Gas Scrubber V-3450 to Sales Gas. Potential to increase pressure in and overpressure and rupture Sales Gas Scrubber V-3450. Potential to release produced gas and produced water (condensate) into atmosphere and onto ground. Potential fire/explosion. Potential personnel injury. Potential environmental impact. (upstream)	1. Refer to safeguards in previous hazard scenario for produced gas from 2-Phase Separator V-001 for No/Less Flow deviation in this node, plus: 2. Operating procedures address proper manual valve alignment 3. Daily checks of equipment and operating conditions by Operator 4. Pressure Safety Valve PSV-3450 on Sales Gas Scrubber V-3450 set at ??? psig relieves to atmosphere at a safe location (above top of vessel) 5. Periodic inspection and testing of PSVs, PRVs, and PVRVs 6. Manual isolation valve upstream of PSV is car sealed open (CSO) 7. Emergency Response Plan (ERP)	2	5	L	14. Verify and document the sizing basis and set point for Pressure Safety Valve PSV-3450 on the Sales Gas Scrubber V-3450.	Summit Engineering	Note: VRU Gas Compressor C-3510 and associated equipment and instrumentation has not yet been designed.
		1.13.10. Potential to decrease and lose flow of produced gas from Sales Gas Scrubber V-3450 to Sales Gas.							

Node: 2. **Produced Gas** from: (1) Gas outlet of Horizontal Separator V-1120 (PG4); (2) Gas outlet of Vapor Recovery Tower V-2000 (PG6) thru VRU Gas Compressor C-3510 (PG7), commingled in C-2510 Suction Header thru C-2510 Suction Scrubber V-3510 thru LP Gas Compressor C-2510 (PG5), and (3) Gas outlet of 2-Phase Separator V-001 thru Produced Gas Meter Skid (PG1), commingled in Sales Gas Header thru Sales Gas Scrubber V-3450 thru Sales Gas Meter M-101/102 to Sales Gas Compressor (PGX); and (3) Gas outlet of Horizontal Separator V-1120 thru Blanket Gas Header (PG2) into Oil Tank TK-5006 as Blanket Gas (PG3) **(yellow)**

Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1409; 8365-01-1413; 8365-01-1415; 8365-01-1416; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
		Potential to decrease and lose production of Sales Gas. No hazardous consequences. Operability issue only. (downstream)							
	1.14. Stream PG7								
	1.15. 3" manual valve on outlet of VRU Gas Compressor C-3510 closed in error	1.15.1. Potential to decrease and lose flow of produced gas from VRU Gas Compressor C-3510. Potential to decrease and lose flow of produced gas from Vapor Recovery Tower V-2000. Potential to send entrained produced gas into Oil Tank TK-5001/2/3/6/7/8. Potential to increase flow of produced gas from Oil Tank TK-5001/2/3/6/7/8 to Emission Control Device BR-9010/20. No hazardous consequence. Operability issue only. (upstream)	1. Operating procedures address proper manual valve alignment 2. Daily checks of equipment and operating conditions by Operator 3. Pressure Control Valve PCV-2301 on flare gas line to Emission Control Device BR-9010/20 relieves some of the pressure 4. Manual isolation valves upstream and downstream of Pressure Control Valve PCV-2301 on flare gas line to Emission Control Device BR-9010/20 are car sealed open (CSO)						
		1.15.2. Potential to decrease and lose flow of produced gas from VRU Gas Compressor C-3510. Potential to deadhead compressor. Potential to damage compressor with no external release. No hazardous consequences. Operability issue only. (downstream)	1. Operating procedures address proper manual valve alignment 2. Daily checks of equipment and operating conditions by Operator 3. Pressure Control Valve PCV-2301 on flare gas line to Emission Control Device BR-9010/20 relieves some of the pressure 4. Manual isolation valves upstream and downstream of Pressure Control Valve PCV-2301 on flare gas line to Emission Control Device BR-9010/20 are car sealed open (CSO)						
	1.16. Stream PG7 & PG4								
	1.17. 4" manual valve on **inlet** of C-2510 Suction Scrubber V-3510 closed in error	1.17.1. Potential to decrease and lose flow of produced gas to C-2510 Suction Scrubber V-3510. Potential to decrease and lose flow of produced gas from VRU Gas Compressor C-3510. Potential to decrease and lose flow of produced gas from Vapor Recovery Tower V-2000. Potential to send entrained produced gas into Oil Tank TK-5001/2/3/6/7/8. Potential to increase flow of produced gas from Oil Tank TK-5001/2/3/6/7/8 to Emission Control Device BR-9010/20. No hazardous consequence. Operability issue only. (upstream)	1. Operating procedures address proper manual valve alignment 2. Daily checks of equipment and operating conditions by Operator 3. Manual valve on inlet of C-2510 Suction Scrubber V-3510 is car sealed open (CSO) 4. Pressure Control Valve PCV-2301 on flare gas line to Emission Control Device BR-9010/20 relieves some of the pressure 5. Manual isolation valves upstream and downstream of Pressure Control Valve PCV-2301 on flare gas line to Emission Control Device BR-9010/20 are car sealed open (CSO)						
		1.17.2. Potential to decrease and lose flow of produced gas to C-2510 Suction Scrubber V-3510. Potential to decrease and lose flow of produced gas from VRU Gas Compressor C-3510. Potential to deadhead compressor. Potential to damage compressor with no external release. No hazardous consequences. Operability issue only. (downstream)	1. Operating procedures address proper manual valve alignment 2. Daily checks of equipment and operating conditions by Operator 3. Manual valve on inlet of C-2510 Suction Scrubber V-3510 is car sealed open (CSO) 4. Pressure Control Valve PCV-2301 on flare gas line to Emission Control Device BR-9010/20 relieves some of the pressure 5. Manual isolation valves upstream and downstream of Pressure Control Valve PCV-2301 on flare gas line to Emission Control Device BR-9010/20 are car sealed open (CSO)						
		1.17.3. Potential to decrease and lose flow of produced gas to C-2510 Suction Scrubber V-3510. Potential to decrease and lose produced gas from Horizontal Separator V-1120. Potential to increase pressure in	1. Operating procedures address proper manual valve alignment	1	5	M			PHA team deemed existing safeguards were adequate (sufficient and effective) for this hazard scenario

Node: 2. **Produced Gas** from: (1) Gas outlet of Horizontal Separator V-1120 (PG4); (2) Gas outlet of Vapor Recovery Tower V-2000 (PG6) thru VRU Gas Compressor C-3510 (PG7), commingled in C-2510 Suction Header thru C-2510 Suction Scrubber V-3510 thru LP Gas Compressor C-2510 (PG5), and (3) Gas outlet of 2-Phase Separator V-001 thru Produced Gas Meter Skid (PG1), commingled in Sales Gas Header thru Sales Gas Scrubber V-3450 thru Sales Gas Meter M-101/102 to Sales Gas Compressor (PGX); and (3) Gas outlet of Horizontal Separator V-1120 thru Blanket Gas Header (PG2) into Oil Tank TK-5006 as Blanket Gas (PG3) **(yellow)**

Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1409; 8365-01-1413; 8365-01-1415; 8365-01-1416; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
		and overpressure and rupture Horizontal Separator V-1120. Potential to release produced fluids into atmosphere and onto ground. Potential fire/explosion. Potential personnel injury. Potential environmental impact. (downstream)	2. Daily checks of equipment and operating conditions by Operator						Trucks could be in the area of the event when this hazard scenario event occurs.
			3. Manual valve on inlet of C-2510 Suction Scrubber V-3510 is car sealed open (CSO)						Produced oil backflow is not credible since LCV-0101 is closed.
			4. High Pressure Alarm on Pressure Indicator PI-0102 on gas outlet of Horizontal Separator V-1120						
			5. High-High Pressure Alarm on Pressure Indicator PI-0102 on gas outlet of Horizontal Separator V-1120						
			6. High-High Pressure on Pressure Indicator Transmitter PIT-0102 on gas outlet of Horizontal Separator V-1120 activates an ESD						
			7. Ability to manually activate an Emergency Shutdown (ESD)						
			8. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead						
			9. Pressure Safety Valve PSV-0101 on Horizontal Separator V-1120 set at 125 psig relieves to atmosphere at a safe location (10-15 feet above grade)						
			10. Periodic inspection and testing of PSVs, PRVs, and PVRVs						
			11. Manual isolation valve upstream of PSV is car sealed open (CSO)						
			12. Emergency Response Plan (ERP)						
		1.17.4. Potential to decrease and lose flow of produced gas to C-2510 Suction Scrubber V-3510. Potential to decrease flow of produced gas to LP Gas Compressor C-2510. Potential to starve compressor. Potential to damage compressor with no external release. No hazardous consequences. Operability issue only. (downstream)	1. Operating procedures address proper manual valve alignment						
			2. Daily checks of equipment and operating conditions by Operator						
			3. Manual valve on inlet of C-2510 Suction Scrubber V-3510 is car sealed open (CSO)						
			4. High Pressure Alarm on Pressure Indicator PI-0102 on gas outlet of Horizontal Separator V-1120						
			5. High-High Pressure Alarm on Pressure Indicator PI-0102 on gas outlet of Horizontal Separator V-1120						
			6. High-High Pressure on Pressure Indicator Transmitter PIT-0102 on gas outlet of Horizontal Separator V-1120 activates an ESD						
			7. Ability to manually activate an Emergency Shutdown (ESD)						
			8. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead						
		1.17.5. Potential to decrease and lose produced gas from Horizontal Separator V-1120. Potential to decrease and lose produced gas to Sales. No hazardous consequences. Operability issue only. (downstream)	1. Operating procedures address proper manual valve alignment						
			2. Daily checks of equipment and operating conditions by Operator						
			3. Manual valve on inlet of C-2510 Suction Scrubber V-3510 is car sealed open (CSO)						
			4. High Pressure Alarm on Pressure Indicator PI-0102 on gas outlet of Horizontal Separator V-1120						

Node: 2. **Produced Gas** from: (1) Gas outlet of Horizontal Separator V-1120 (PG4); (2) Gas outlet of Vapor Recovery Tower V-2000 (PG6) thru VRU Gas Compressor C-3510 (PG7), commingled in C-2510 Suction Header thru C-2510 Suction Scrubber V-3510 thru LP Gas Compressor C-2510 (PG5), and (3) Gas outlet of 2-Phase Separator V-001 thru Produced Gas Meter Skid (PG1), commingled in Sales Gas Header thru Sales Gas Scrubber V-3450 thru Sales Gas Meter M-101/102 to Sales Gas Compressor (PGX); and (3) Gas outlet of Horizontal Separator V-1120 thru Blanket Gas Header (PG2) into Oil Tank TK-5006 as Blanket Gas (PG3) **(yellow)**

Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1409; 8365-01-1413; 8365-01-1415; 8365-01-1416; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
			5. High-High Pressure Alarm on Pressure Indicator PI-0102 on gas outlet of Horizontal Separator V-1120						
			6. High-High Pressure on Pressure Indicator Transmitter PIT-0102 on gas outlet of Horizontal Separator V-1120 activates an ESD						
			7. Ability to manually activate an Emergency Shutdown (ESD)						
			8. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead						
	1.18. 4" manual valve on **outlet** of C-2510 Suction Scrubber V-3510 closed in error or 2" Pressure Control Valve PCV-2200 malfunctions closed or set in error or 3" manual valve downstream of PCV-2200 closed in error	1.18.1. Potential to decrease and lose flow of produced gas from C-2510 Suction Scrubber V-3510. Potential to increase pressure but insufficient to overpressure C-2510 Suction Scrubber V-3510. No hazardous consequences. Operability issue only. (upstream)	1. Operating procedures address proper manual valve alignment						Pressure Safety Valve PSV-3510 on C-2510 Suction Scrubber V-3510 is sized for fire case, not blocked flow.
			2. Daily checks of equipment and operating conditions by Operator						
			3. Pressure Control Valve PCV-2202 on flare gas line to Emission Control Device BR-9010/20 relieves some of the pressure						
			4. Manual isolation valves upstream and downstream of Pressure Control Valve PCV-2202 on flare gas line to Emission Control Device BR-9010/20 are car sealed open (CSO)						
		1.18.2. Potential to decrease and lose flow of produced gas from C-2510 Suction Scrubber V-3510. Potential to decrease and lose flow of produced gas from VRU Gas Compressor C-3510. Potential to decrease and lose flow of produced gas from Vapor Recovery Tower V-2000. Potential to send entrained produced gas into Oil Tank TK-5001/2/3/6/7/8. Potential to increase flow of produced gas from Oil Tank TK-5001/2/3/6/7/8 to Emission Control Device BR-9010/20. No hazardous consequence. Operability issue only. (upstream)	1. Operating procedures address proper manual valve alignment						
			2. Daily checks of equipment and operating conditions by Operator						
			3. Manual valve on outlet of C-2510 Suction Scrubber V-3510 is car sealed open (CSO)						
			4. Pressure Control Valve PCV-2202 on flare gas line to Emission Control Device BR-9010/20 relieves some of the pressure						
			5. Manual isolation valves upstream and downstream of Pressure Control Valve PCV-2202 on flare gas line to Emission Control Device BR-9010/20 are car sealed open (CSO)						
		1.18.3. Potential to decrease and lose flow of produced gas from C-2510 Suction Scrubber V-3510. Potential to decrease and lose flow of produced gas from VRU Gas Compressor C-3510. Potential to deadhead compressor. Potential to damage compressor with no external release. No hazardous consequences. Operability issue only. (downstream)	1. Operating procedures address proper manual valve alignment						
			2. Daily checks of equipment and operating conditions by Operator						
			3. Manual valve on outlet of C-2510 Suction Scrubber V-3510 is car sealed open (CSO)						
			4. Pressure Control Valve PCV-2202 on flare gas line to Emission Control Device BR-9010/20 relieves some of the pressure						
			5. Manual isolation valves upstream and downstream of Pressure Control Valve PCV-2202 on flare gas line to Emission Control Device BR-9010/20 are car sealed open (CSO)						
		1.18.4. Potential to decrease and lose flow of produced gas from C-2510 Suction Scrubber V-3510. Potential to decrease and lose produced gas from Horizontal Separator V-1120. Potential to increase pressure in and overpressure and rupture Horizontal Separator V-1120. Potential to release produced fluids into atmosphere and onto ground. Potential fire/explosion. Potential personnel injury. Potential environmental impact. (downstream)	1. Operating procedures address proper manual valve alignment	1	5	M			PHA team deemed existing safeguards were adequate (sufficient and effective) for this hazard scenario
			2. Daily checks of equipment and operating conditions by Operator						Trucks could be in the area of the event when this hazard scenario event occurs.
			3. Manual valve on outlet of C-2510 Suction Scrubber V-3510 is car sealed open (CSO)						Produced oil backflow is not credible since LCV-0101 is

Node: 2. **Produced Gas** from: (1) Gas outlet of Horizontal Separator V-1120 (PG4); (2) Gas outlet of Vapor Recovery Tower V-2000 (PG6) thru VRU Gas Compressor C-3510 (PG7), commingled in C-2510 Suction Header thru C-2510 Suction Scrubber V-3510 thru LP Gas Compressor C-2510 (PG5), and (3) Gas outlet of 2-Phase Separator V-001 thru Produced Gas Meter Skid (PG1), commingled in Sales Gas Header thru Sales Gas Scrubber V-3450 thru Sales Gas Meter M-101/102 to Sales Gas Compressor (PGX); and (3) Gas outlet of Horizontal Separator V-1120 thru Blanket Gas Header (PG2) into Oil Tank TK-5006 as Blanket Gas (PG3) **(yellow)**

Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1409; 8365-01-1413; 8365-01-1415; 8365-01-1416; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
			4. Pressure Control Valve PCV-2202 on flare gas line to Emission Control Device BR-9010/20 relieves some of the pressure						closed.
			5. Manual isolation valves upstream and downstream of Pressure Control Valve PCV-2202 on flare gas line to Emission Control Device BR-9010/20 are car sealed open (CSO)						
			6. High Pressure Alarm on Pressure Indicator PI-0102 on gas outlet of Horizontal Separator V-1120						
			7. High-High Pressure Alarm on Pressure Indicator PI-0102 on gas outlet of Horizontal Separator V-1120						
			8. High-High Pressure on Pressure Indicator Transmitter PIT-0102 on gas outlet of Horizontal Separator V-1120 activates an ESD						
			9. Ability to manually activate an Emergency Shutdown (ESD)						
			10. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead						
			11. Pressure Safety Valve PSV-0101 on Horizontal Separator V-1120 set at 125 psig relieves to atmosphere at a safe location (10-15 feet above grade)						
			12. Periodic inspection and testing of PSVs, PRVs, and PVRVs						
			13. Manual isolation valve upstream of PSV is car sealed open (CSO)						
			14. Emergency Response Plan (ERP)						
		1.18.5. Potential to decrease and lose flow of produced gas from C-2510 Suction Scrubber V-3510. Potential to decrease flow of produced gas to LP Gas Compressor C-2510. Potential to starve compressor. Potential to damage compressor with no external release. No hazardous consequences. Operability issue only. (downstream)	1. Operating procedures address proper manual valve alignment						
			2. Daily checks of equipment and operating conditions by Operator						
			3. Manual valve on outlet of C-2510 Suction Scrubber V-3510 is car sealed open (CSO)						
			4. Pressure Control Valve PCV-2202 on flare gas line to Emission Control Device BR-9010/20 relieves some of the pressure						
			5. Manual isolation valves upstream and downstream of Pressure Control Valve PCV-2202 on flare gas line to Emission Control Device BR-9010/20 are car sealed open (CSO)						
			6. High Pressure Alarm on Pressure Indicator PI-0102 on gas outlet of Horizontal Separator V-1120						
			7. High-High Pressure Alarm on Pressure Indicator PI-0102 on gas outlet of Horizontal Separator V-1120						
			8. High-High Pressure on Pressure Indicator Transmitter PIT-0102 on gas outlet of Horizontal Separator V-1120 activates an ESD						
			9. Ability to manually activate an Emergency Shutdown (ESD)						
			10. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead						
		1.18.6. Potential to decrease and lose flow of produced gas	1. Operating procedures address proper manual						

Node: 2. **Produced Gas** from: (1) Gas outlet of Horizontal Separator V-1120 (PG4); (2) Gas outlet of Vapor Recovery Tower V-2000 (PG6) thru VRU Gas Compressor C-3510 (PG7), commingled in C-2510 Suction Header thru C-2510 Suction Scrubber V-3510 thru LP Gas Compressor C-2510 (PG5), and (3) Gas outlet of 2-Phase Separator V-001 thru Produced Gas Meter Skid (PG1), commingled in Sales Gas Header thru Sales Gas Scrubber V-3450 thru Sales Gas Meter M-101/102 to Sales Gas Compressor (PGX); and (3) Gas outlet of Horizontal Separator V-1120 thru Blanket Gas Header (PG2) into Oil Tank TK-5006 as Blanket Gas (PG3) **(yellow)**

Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1409; 8365-01-1413; 8365-01-1415; 8365-01-1416; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
		from C-2510 Suction Scrubber V-3510. Potential to decrease and lose produced gas from Horizontal Separator V-1120. Potential to decrease and lose produced gas to Sales. No hazardous consequences. Operability issue only. (downstream)	valve alignment 2. Daily checks of equipment and operating conditions by Operator 3. Manual valve on outlet of C-2510 Suction Scrubber V-3510 is car sealed open (CSO) 4. Pressure Control Valve PCV-2202 on flare gas line to Emission Control Device BR-9010/20 relieves some of the pressure 5. Manual isolation valves upstream and downstream of Pressure Control Valve PCV-2202 on flare gas line to Emission Control Device BR-9010/20 are car sealed open (CSO) 6. High Pressure Alarm on Pressure Indicator PI-0102 on gas outlet of Horizontal Separator V-1120 7. High-High Pressure Alarm on Pressure Indicator PI-0102 on gas outlet of Horizontal Separator V-1120 8. High-High Pressure on Pressure Indicator Transmitter PIT-0102 on gas outlet of Horizontal Separator V-1120 activates an ESD 9. Ability to manually activate an Emergency Shutdown (ESD) 10. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead						
	1.19. LP Gas Compressor C-2510 not running for any reason (e.g. loss of fuel gas)	1.19.1. Potential to decrease and lose flow of produced gas from C-2510 Suction Scrubber V-3510. Potential to decrease and lose flow of produced gas from VRU Gas Compressor C-3510. Potential to decrease and lose flow of produced gas from Vapor Recovery Tower V-2000. Potential to send entrained produced gas into Oil Tank TK-5001/2/3/6/7/8. Potential to increase flow of produced gas from Oil Tank TK-5001/2/3/6/7/8 to Emission Control Device BR-9010/20. No hazardous consequence. Operability issue only. (upstream)	1. Operating procedures address proper manual valve alignment 2. Daily checks of equipment and operating conditions by Operator 3. Preventive maintenance program for compressors and pumps 4. Pressure Control Valve PCV-2301 on flare gas line to Emission Control Device BR-9010/20 relieves some of the pressure 5. Manual isolation valves upstream and downstream of Pressure Control Valve PCV-2301 on flare gas line to Emission Control Device BR-9010/20 are car sealed open (CSO) 6. Pressure Control Valve PCV-2202 on flare gas line to Emission Control Device BR-9010/20 relieves some of the pressure 7. Manual isolation valves upstream and downstream of Pressure Control Valve PCV-2202 on flare gas line to Emission Control Device BR-9010/20 are car sealed open (CSO)						
		1.19.2. Potential to decrease and lose flow of produced gas from C-2510 Suction Scrubber V-3510. Potential to decrease and lose flow of produced gas from VRU Gas Compressor C-3510. Potential to deadhead compressor. Potential to damage compressor with no external release. No hazardous consequences. Operability issue only. (downstream)	1. Operating procedures address proper manual valve alignment 2. Daily checks of equipment and operating conditions by Operator 3. Pressure Control Valve PCV-2301 on flare gas line to Emission Control Device BR-9010/20 relieves some of the pressure 4. Manual isolation valves upstream and downstream of Pressure Control Valve PCV-2301 on flare gas line to Emission Control Device BR-9010/20 are car sealed open (CSO) 5. Pressure Control Valve PCV-2202 on flare gas						

Node: 2. **Produced Gas** from: (1) Gas outlet of Horizontal Separator V-1120 (PG4); (2) Gas outlet of Vapor Recovery Tower V-2000 (PG6) thru VRU Gas Compressor C-3510 (PG7), commingled in C-2510 Suction Header thru C-2510 Suction Scrubber V-3510 thru LP Gas Compressor C-2510 (PG5), and (3) Gas outlet of 2-Phase Separator V-001 thru Produced Gas Meter Skid (PG1), commingled in Sales Gas Header thru Sales Gas Scrubber V-3450 thru Sales Gas Meter M-101/102 to Sales Gas Compressor (PGX); and (3) Gas outlet of Horizontal Separator V-1120 thru Blanket Gas Header (PG2) into Oil Tank TK-5006 as Blanket Gas (PG3) **(yellow)**

Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1409; 8365-01-1413; 8365-01-1415; 8365-01-1416; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
			line to Emission Control Device BR-9010/20 relieves some of the pressure						
			6. Manual isolation valves upstream and downstream of Pressure Control Valve PCV-2202 on flare gas line to Emission Control Device BR-9010/20 are car sealed open (CSO)						
		1.19.3. Potential to decrease and lose flow of produced gas from C-2510 Suction Scrubber V-3510. Potential to decrease and lose produced gas from Horizontal Separator V-1120. Potential to increase pressure in and overpressure and rupture Horizontal Separator V-1120. Potential to release produced fluids into atmosphere and onto ground. Potential fire/explosion. Potential personnel injury. Potential environmental impact. (downstream)	1. Operating procedures address proper manual valve alignment	1	5	M			PHA team deemed existing safeguards were adequate (sufficient and effective) for this hazard scenario
			2. Daily checks of equipment and operating conditions by Operator						Trucks could be in the area of the event when this hazard scenario event occurs.
			3. Pressure Control Valve PCV-2202 on flare gas line to Emission Control Device BR-9010/20 relieves some of the pressure						Produced oil backflow is not credible since LCV-0101 is closed.
			4. Manual isolation valves upstream and downstream of Pressure Control Valve PCV-2202 on flare gas line to Emission Control Device BR-9010/20 are car sealed open (CSO)						
			5. High Pressure Alarm on Pressure Indicator PI-0102 on gas outlet of Horizontal Separator V-1120						
			6. High-High Pressure Alarm on Pressure Indicator PI-0102 on gas outlet of Horizontal Separator V-1120						
			7. High-High Pressure on Pressure Indicator Transmitter PIT-0102 on gas outlet of Horizontal Separator V-1120 activates an ESD						
			8. Ability to manually activate an Emergency Shutdown (ESD)						
			9. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead						
			10. Pressure Safety Valve PSV-0101 on Horizontal Separator V-1120 set at 125 psig relieves to atmosphere at a safe location (10-15 feet above grade)						
			11. Periodic inspection and testing of PSVs, PRVs, and PVRVs						
			12. Manual isolation valve upstream of PSV is car sealed open (CSO)						
			13. Emergency Response Plan (ERP)						
		1.19.4. Potential to decrease and lose flow of produced gas from C-2510 Suction Scrubber V-3510. Potential to decrease and lose produced gas from Horizontal Separator V-1120. Potential to decrease and lose produced gas to Sales. No hazardous consequences. Operability issue only. (downstream)	1. Operating procedures address proper manual valve alignment						
			2. Daily checks of equipment and operating conditions by Operator						
			3. Pressure Control Valve PCV-2202 on flare gas line to Emission Control Device BR-9010/20 relieves some of the pressure						
			4. Manual isolation valves upstream and downstream of Pressure Control Valve PCV-2202 on flare gas line to Emission Control Device BR-9010/20 are car sealed open (CSO)						
			5. High Pressure Alarm on Pressure Indicator PI-0102 on gas outlet of Horizontal Separator V-1120						
			6. High-High Pressure Alarm on Pressure						

Node: 2. **Produced Gas** from: (1) Gas outlet of Horizontal Separator V-1120 (PG4); (2) Gas outlet of Vapor Recovery Tower V-2000 (PG6) thru VRU Gas Compressor C-3510 (PG7), commingled in C-2510 Suction Header thru C-2510 Suction Scrubber V-3510 thru LP Gas Compressor C-2510 (PG5), and (3) Gas outlet of 2-Phase Separator V-001 thru Produced Gas Meter Skid (PG1), commingled in Sales Gas Header thru Sales Gas Scrubber V-3450 thru Sales Gas Meter M-101/102 to Sales Gas Compressor (PGX); and (3) Gas outlet of Horizontal Separator V-1120 thru Blanket Gas Header (PG2) into Oil Tank TK-5006 as Blanket Gas (PG3) **(yellow)**

Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1409; 8365-01-1413; 8365-01-1415; 8365-01-1416; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
			Indicator PI-0102 on gas outlet of Horizontal Separator V-1120						
			7. High-High Pressure on Pressure Indicator Transmitter PIT-0102 on gas outlet of Horizontal Separator V-1120 activates an ESD						
			8. Ability to manually activate an Emergency Shutdown (ESD)						
			9. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead						
		1.19.5. Potential to decrease and lose flow of produced gas from C-2510 Suction Scrubber V-3510. Potential to increase pressure but insufficient to overpressure C-2510 Suction Scrubber V-3510. No hazardous consequences. Operability issue only. (upstream)	1. Operating procedures address proper manual valve alignment						Pressure Safety Valve PSV-3510 on C-2510 Suction Scrubber V-3510 is sized for fire case, not blocked flow.
			2. Daily checks of equipment and operating conditions by Operator						
			3. Pressure Control Valve PCV-2202 on flare gas line to Emission Control Device BR-9010/20 relieves some of the pressure						
			4. Manual isolation valves upstream and downstream of Pressure Control Valve PCV-2202 on flare gas line to Emission Control Device BR-9010/20 are car sealed open (CSO)						
2. Higher Flow	2.1. 2" Pressure Control Valve PCV-0101 downstream of Horizontal Separator V-1120 malfunctions open or set in error	2.1.1. Potential to increase flow of produced gas and increase pressure in LP Gas Compressor C-2510. Potential to increase suction pressure to compressor. No hazardous consequences. Operability issue only. (downstream)							
		2.1.2. Potential to increase flow of produced gas and decrease pressure in LP Gas Compressor C-2510. Potential to decrease flow of produced gas to Blanket Gas Header. Potential to decrease and lose blanket gas for Oil Tank TK-5001/2/3/6/7/8 and Water Tank TK-4001/4. Potential to create vacuum in and collapse Oil Tank TK-5001/2/3/6/7/8 and/or Water Tank TK-4001/4 during truck loadout. Potential to release produced oil and/or produced water. Potential fire. Potential personnel injury. Potential environmental impact. (upstream)	1. Operating procedures address proper manual valve alignment	3	4	L	15. Provide a supplemental source of blanket gas from the Fuel Gas System for the Oil Tanks TK-5001/2/3/6/7/8 and Water Tanks TK-4001/4.	Summit Engineering	
			2. Daily checks of equipment and operating conditions by Operator				16. Evaluate adding a visual alarm at the truck loadout area to alert the truck driver(s) to a loss of blanket gas for the Oil Tanks TK-5001/2/3/6/7/8, to enable them to cease loadout operations to prevent creating a vacuum in and collapsing the tanks.	Summit Engineering	
			3. Other well(s) provides supplemental blanket gas (assuming ESD has not shut down all production trains)						
			4. Pressure Vacuum Relief Valve PVRV-5101/2/3/6/7/8 on Oil Tank TK-5001/2/3/6/7/8 set at -4 oz/in2 designed to break vacuum and prevent tank collapse						
			5. Pressure Vacuum Relief Valve PVRV-4001/4 on Water Tank TK-4001/4 set at -4 oz/in2 designed to break vacuum and prevent tank collapse						
			6. Secondary and tertiary containment for Oil Tank TK-5001/2/3/6/7/8						
			7. Secondary and tertiary containment for Water Tank TK-4001/4						
			8. Emergency Response Plan (ERP)						
		2.1.3. **IF PVRV SAFEGUARDS WORK AS DESIGNED:** Potential to increase flow of produced gas and decrease pressure in LP Gas Compressor C-2510. Potential to decrease and lose produced gas from Horizontal Separator V-1120. Potential to decrease and lose blanket gas for Oil Tank TK-5001/2/3/6/7/8 and Water Tank TK-4001/4. Potential to create vacuum and for air ingress into Oil Tank TK-5001/2/3/6/7/8 and Water Tank TK-4001/4 during truck loadout. Potential to create explosive mixture in Oil Tank TK-5001/2/3/6/7/8. Potential fire/explosion. Potential to release produced oil and produced gas	1. Operating procedures address proper manual valve alignment	1	5	M	15. Provide a supplemental source of blanket gas from the Fuel Gas System for the Oil Tanks TK-5001/2/3/6/7/8 and Water Tanks TK-4001/4.	Summit Engineering	Trucks could be in the area of the event when this hazard scenario event occurs.
			2. Daily checks of equipment and operating conditions by Operator				16. Evaluate adding a visual alarm at the truck loadout area to alert the truck driver(s) to a loss of blanket gas for the Oil Tanks TK-5001/2/3/6/7/8, to enable them to cease loadout operations to prevent creating a vacuum in and collapsing the tanks.	Summit Engineering	
			3. Other well(s) provides supplemental blanket gas (assuming ESD has not shut down all production trains)						
			4. Secondary and tertiary containment for Oil Tank TK-5001/2/3/6/7/8						

Node: 2. **Produced Gas** from: (1) Gas outlet of Horizontal Separator V-1120 (PG4); (2) Gas outlet of Vapor Recovery Tower V-2000 (PG6) thru VRU Gas Compressor C-3510 (PG7), commingled in C-2510 Suction Header thru C-2510 Suction Scrubber V-3510 thru LP Gas Compressor C-2510 (PG5), and (3) Gas outlet of 2-Phase Separator V-001 thru Produced Gas Meter Skid (PG1), commingled in Sales Gas Header thru Sales Gas Scrubber V-3450 thru Sales Gas Meter M-101/102 to Sales Gas Compressor (PGX); and (3) Gas outlet of Horizontal Separator V-1120 thru Blanket Gas Header (PG2) into Oil Tank TK-5006 as Blanket Gas (PG3) **(yellow)**

Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1409; 8365-01-1413; 8365-01-1415; 8365-01-1416; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
		(blanket gas). Potential fire/explosion. Potential personnel injury. Potential environmental impact. (downstream)	5. Secondary and tertiary containment for Water Tank TK-4001/4 6. Emergency Response Plan (ERP)						
	2.2. 2" Pressure Control Valve PCV-0102 downstream of Horizontal Separator V-1120 malfunctions open or set in error	2.2.1. Potential to increase flow of produced gas to Blanket Gas Header. Potential to decrease and lose flow of produced gas from C-2510 Suction Scrubber V-3510. Potential to decrease flow of produced gas to LP Gas Compressor C-2510. Potential to starve compressor. Potential to damage compressor with no external release. No hazardous consequences. Operability issue only. (upstream)	1. Operating procedures address proper manual valve alignment						
		2.2.2. Potential to increase flow of produced gas to Blanket Gas Header. Potential to increase pressure in and overpressure and rupture Oil Tank TK-5001/2/3/6/7/8. Potential to release produced oil and produced gas into atmosphere and onto ground. Potential fire/explosion. Potential personnel injury. Potential environmental impact. (downstream)	1. Operating procedures address proper manual valve alignment 2. Daily checks of equipment and operating conditions by Operator 3. Pressure Relief Valve PRV-5110 on Flare Gas line on Oil Tank TK-5001/2/3/6/7/8 set at 14 oz/in2 relieves to atmosphere at a safe location (above top of tank) 4. Pressure Vacuum Relief Valve PVRV-5101/2/3/6/7/8 on Oil Tank TK-5001/2/3/6/7/8 set at 16 oz/in2 designed to relieve into atmosphere at a safe location (above top of tank) 5. Periodic inspection and testing of PSVs, PRVs, and PVRVs 6. Secondary and tertiary containment for Oil Tank TK-5001/2/3/6/7/8 7. Emergency Response Plan (ERP)	1	5	M	17. Size the vapor lines from the Oil Tanks TK-5001/2/3/6/7/8 to the Emission Control Device (ECDs) BR-9010/20 for the maximum blanket gas flow rate and pressure, to prevent overpressuring and rupturing tanks from a malfunctioning 2" Pressure Control Valve PCV-0102 downstream of the Horizontal Separator V-1120.	Summit Engineering	Trucks could be in the area of the event when this hazard scenario event occurs.
	2.3. 2" Pressure Control Valve PCV-2200 downstream of C-2510 Suction Scrubber V-3510 malfunctions open or set in error	2.3.1. Potential to increase flow and pressure to LP Gas Compressor C-2510. Potential to decrease produced gas to Sales. No hazardous consequences. Operability issue only. (upstream)							
		2.3.2. Potential to increase flow and pressure to LP Gas Compressor C-2510. Potential to decrease efficiency of compressor. No hazardous consequences. Operability issue only. (downstream)							
	2.4. 3" Pressure Control Valve PCV-101/102 (pipeline pressure protection valve) malfunctions open	2.4.1. No credible consequences since these specialized valves are intended to remain open and flow is lost only when they close upon high pipeline pressure or when the 3" manual isolation valves around Pressure Control Valve PCV-101/102 are closed.							
3. Reverse Flow	3.1. No new causes, refer to No/Less Flow deviation in this node								
	3.2. Normal filling of Oil Tank TK-5001/2/3/6/7/8	3.2.1. Potential to increase pressure in Oil Tank TK-5001/2/3/6/7/8. Potential to send blanket gas back through Blanket Gas Header instead of intended destination of Emission Control Device BR-9010/20. No hazardous consequences. Operability issue only.	1. 2" check valve on inlet of Blanket Gas Header for Oil Tanks 2. 2" check valve on produced gas outlet of Horizontal Separator V-1120 downstream of Pressure Control Valve PCV-0102 is designed to prevent backflow from Blanket Gas Header						
4. As Well As Flow	4.1. No credible causes identified by PHA Team								
5. Misdirected Flow	5.1. 1" normally closed (NC) manual valve on blowdown line on Vapor Recovery Tower V-2000 open in error or leaks through	5.1.1. Potential to send produced gas into produced water to Water Tank TK-4001/4. Potential to decrease produced gas to Sales. No hazardous consequences. Operability issue only. (upstream)							
		5.1.2. Potential to send produced gas into produced water to Water Tank TK-4001/4. Potential to increase pressure in and overpressure and rupture Water Tank TK-	1. Operating procedures address proper manual valve alignment 2. Daily checks of equipment and operating						

Node: 2. **Produced Gas** from: (1) Gas outlet of Horizontal Separator V-1120 (PG4); (2) Gas outlet of Vapor Recovery Tower V-2000 (PG6) thru VRU Gas Compressor C-3510 (PG7), commingled in C-2510 Suction Header thru C-2510 Suction Scrubber V-3510 thru LP Gas Compressor C-2510 (PG5), and (3) Gas outlet of 2-Phase Separator V-001 thru Produced Gas Meter Skid (PG1), commingled in Sales Gas Header thru Sales Gas Scrubber V-3450 thru Sales Gas Meter M-101/102 to Sales Gas Compressor (PGX); and (3) Gas outlet of Horizontal Separator V-1120 thru Blanket Gas Header (PG2) into Oil Tank TK-5006 as Blanket Gas (PG3) **(yellow)**

Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1409; 8365-01-1413; 8365-01-1415; 8365-01-1416; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
		4001/4. Potential to release produced water with residual condensate into atmosphere and onto ground. No hazardous consequences. Operability issue only. (downstream)	conditions by Operator 3. Pressure Relief Valve PRV-5110 on Flare Gas line on Oil Tank TK-5001 set at 14 oz/in2 relieves to atmosphere at a safe location (above top of tank) 4. Pressure Vacuum Relief Valve PVRV-4001/4 on Water Tank TK-4001/4 set at 16 oz/in2 relieves to atmosphere at a safe location (above top of tank) 5. Periodic inspection and testing of PSVs, PRVs, and PVRVs 6. Secondary and tertiary containment for Water Tank TK-4001/4						
	5.2. 6" normally closed (NC) manual valve on bypass line around Sales Gas Scrubber V-3450 open in error or leaks through	5.2.1. Potential to bypass flow of produced gas around Sales Gas Scrubber V-3450. Potential to decrease produced water and condensate flow to Water Tank TK-4001/4. No hazardous consequences. Operability issue only. (upstream)							
		5.2.2. Potential to bypass flow of produced gas around Sales Gas Scrubber V-3450. Potential to send produced gas with residual condensate and produced water to Sales Gas. No hazardous consequences. Operability issue only. (downstream)							
	5.3. 4" normally closed (NC) manual valve in bypass line around C-2510 Suction Scrubber V-3510 open in error or leaks through	5.3.1. Potential to bypass flow of produced gas around C-2510 Suction Scrubber V-3510. Potential to decrease produced water and condensate flow to Water Tank TK-4001/4. No hazardous consequences. Operability issue only. (upstream)							
		5.3.2. Potential to bypass flow of produced gas around C-2510 Suction Scrubber V-3510. Potential to send produced gas with residual condensate and produced water to Sales Gas. No hazardous consequences. Operability issue only.					35. Verify with the vendor that the LP Gas Compressor C-2510 is equipped with a dedicated scrubber.	Summit Engineering	Damage to compressor is not deemed credible.
	5.4. Pressure Safety Valve PSV-0101 on Horizontal Separator V-1120 set in error or leaks through	5.4.1. Potential to release unignited gas to atmosphere at a safe location (10-15 feet above grade). Potential to decrease production of Sales Gas. No hazardous consequences. Operability issue only. (upstream)							
		5.4.2. Potential to release unignited gas to atmosphere at a safe location (10-15 feet above grade). No hazardous consequences. Operability issue only. (downstream)	1. Periodic inspection and testing of PSVs, PRVs, and PVRVs 2. Daily checks of equipment and operating conditions by Operator 3. Leak detection and repair (LDAR) program to periodically monitor emissions 4. Air Quality Monitoring System to continuously monitor emissions						Release of lighter-than-air flammable gas into the atmosphere at an elevated safe location is expected to disperse and not produce a fire since an ignition source is not present.
	5.5. Pressure Safety Valve PSV-0102 on 2-Phase Separator V-001 set in error or leaks through	5.5.1. Potential to release unignited gas to atmosphere at a safe location (10-15 feet above grade). Potential to decrease production of Sales Gas. No hazardous consequences. Operability issue only. (upstream)							
		5.5.2. Potential to release unignited gas to atmosphere at a safe location (10-15 feet above grade). No hazardous consequences. Operability issue only. (downstream)	1. Periodic inspection and testing of PSVs, PRVs, and PVRVs 2. Daily checks of equipment and operating conditions by Operator 3. Leak detection and repair (LDAR) program to periodically monitor emissions 4. Air Quality Monitoring System to continuously monitor emissions						Release of lighter-than-air flammable gas into the atmosphere at an elevated safe location is expected to disperse and not produce a fire since an ignition source is not present.
	5.6. Pressure Safety Valve PSV-2100 on Vapor Recovery Tower V-2000 set in error or	5.6.1. Potential to release unignited gas to atmosphere at a safe location (~40 feet above grade). Potential to							

Node: 2. **Produced Gas** from: (1) Gas outlet of Horizontal Separator V-1120 (PG4); (2) Gas outlet of Vapor Recovery Tower V-2000 (PG6) thru VRU Gas Compressor C-3510 (PG7), commingled in C-2510 Suction Header thru C-2510 Suction Scrubber V-3510 thru LP Gas Compressor C-2510 (PG5), and (3) Gas outlet of 2-Phase Separator V-001 thru Produced Gas Meter Skid (PG1), commingled in Sales Gas Header thru Sales Gas Scrubber V-3450 thru Sales Gas Meter M-101/102 to Sales Gas Compressor (PGX); and (3) Gas outlet of Horizontal Separator V-1120 thru Blanket Gas Header (PG2) into Oil Tank TK-5006 as Blanket Gas (PG3) **(yellow)**

Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1409; 8365-01-1413; 8365-01-1415; 8365-01-1416; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
	leaks through	decrease production of Sales Gas. No hazardous consequences. Operability issue only. (upstream)							
		5.6.2. Potential to release unignited gas to atmosphere at a safe location (~40 feet above grade). No hazardous consequences. Operability issue only. (downstream)	1. Periodic inspection and testing of PSVs, PRVs, and PVRVs 2. Daily checks of equipment and operating conditions by Operator 3. Leak detection and repair (LDAR) program to periodically monitor emissions 4. Air Quality Monitoring System to continuously monitor emissions						Release of lighter-than-air flammable gas into the atmosphere at an elevated safe location is expected to disperse and not produce a fire since an ignition source is not present.
	5.7. Pressure Safety Valve PSV-3450 on Sales Gas Scrubber V-3450 set in error or leaks through	5.7.1. Potential to release unignited gas to atmosphere at a safe location (above top of vessel). Potential to decrease production of Sales Gas. No hazardous consequences. Operability issue only. (upstream)							
		5.7.2. Potential to release unignited gas to atmosphere at a safe location (above top of vessel). No hazardous consequences. Operability issue only. (downstream)	1. Periodic inspection and testing of PSVs, PRVs, and PVRVs 2. Daily checks of equipment and operating conditions by Operator 3. Leak detection and repair (LDAR) program to periodically monitor emissions 4. Air Quality Monitoring System to continuously monitor emissions						Release of lighter-than-air flammable gas into the atmosphere at an elevated safe location is expected to disperse and not produce a fire since an ignition source is not present.
	5.8. Pressure Safety Valve PSV-3510 on C-2510 Suction Scrubber V-3510 set in error or leaks through	5.8.1. Potential to release unignited gas to atmosphere at a safe location (above top of vessel). Potential to decrease production of Sales Gas. No hazardous consequences. Operability issue only. (upstream)							
		5.8.2. Potential to release unignited gas to atmosphere at a safe location (above top of vessel). No hazardous consequences. Operability issue only. (downstream)	1. Periodic inspection and testing of PSVs, PRVs, and PVRVs 2. Daily checks of equipment and operating conditions by Operator 3. Leak detection and repair (LDAR) program to periodically monitor emissions 4. Air Quality Monitoring System to continuously monitor emissions						Release of lighter-than-air flammable gas into the atmosphere at an elevated safe location is expected to disperse and not produce a fire since an ignition source is not present.
6. No Pressure (Vacuum)	6.1. No credible causes identified by PHA Team								
7. Lower Pressure	7.1. No new causes, refer to No/Less and Higher Flow deviations in this node								
8. Higher Pressure	8.1. No new causes, refer to No/Less Flow deviation in this node								
9. No/Lower Level	9.1. No credible causes identified by PHA Team								
10. Higher Level	10.1. No new causes, refer to Higher Flow deviation in this node								
11. Lower Temperature	11.1. No credible causes identified by PHA Team								
12. Higher Temperature	12.1. External fire nearby C-2510 Suction Scrubber V-3510	12.1.1. Potential to increase temperature and exceed vessel design temperature and/or increase pressure and overpressure and rupture C-2510 Suction Scrubber V-3510. Potential to release produced gas (condensate) and produced gas into atmosphere and onto ground. Potential fire/explosion. Potential personnel injury. Potential environmental impact. (downstream)	1. Fire prevention practices (e.g. policy for smoking in designated areas only, housekeeping to minimize combustibles around vessels, hot work permits) 2. Daily checks of equipment and operating conditions by Operator 3. Pressure Safety Valve PSV-3510 on C-2510 Suction Scrubber V-3510 set at 150 psig (fire case) relieves to atmosphere at a safe location (above top of vessel) 4. Periodic inspection and testing of PSVs, PRVs, and PVRVs	2	4	M			PHA team deemed existing safeguards were adequate (sufficient and effective) for this hazard scenario Trucks could be in the area of the event when this hazard scenario event occurs.

Node: 2. **Produced Gas** from: (1) Gas outlet of Horizontal Separator V-1120 (PG4); (2) Gas outlet of Vapor Recovery Tower V-2000 (PG6) thru VRU Gas Compressor C-3510 (PG7), commingled in C-2510 Suction Header thru C-2510 Suction Scrubber V-3510 thru LP Gas Compressor C-2510 (PG5), and (3) Gas outlet of 2-Phase Separator V-001 thru Produced Gas Meter Skid (PG1), commingled in Sales Gas Header thru Sales Gas Scrubber V-3450 thru Sales Gas Meter M-101/102 to Sales Gas Compressor (PGX); and (3) Gas outlet of Horizontal Separator V-1120 thru Blanket Gas Header (PG2) into Oil Tank TK-5006 as Blanket Gas (PG3) **(yellow)**

Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1409; 8365-01-1413; 8365-01-1415; 8365-01-1416; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
			5. Manual isolation valve upstream of PSV is car sealed open (CSO) 6. Emergency Response Plan (ERP)						
13. Composition	13.1. No new causes, refer to No/Less Flow deviation in this node								
14. Contamination	14.1. No new causes, refer to Higher Flow deviations in this node								
15. Instrumentation	15.1. No new causes, refer to No/Less and Higher Flow deviations in this node								
16. Sampling	16.1. Sampling of produced gas at designated sample point(s) in error or sampling equipment (e.g. gas sampling cylinder) malfunctions	16.1.1. Potential to release hot (~120 F) produced gas during sampling. Potential fire. Potential thermal exposure. Potential personnel injury. Potential environmental impact.	1. Planned use of fit-for-purpose gas sampling cylinder 2. Emergency Response Plan (ERP)	4	3	L	29. Develop a written safe work practice for sampling produced gas from identified sample points in the process system, including addressing the hazards of sampling (e.g. flash fire, thermal exposure), references to relevant safety data sheets (SDS), and requirements for personal protective equipment (PPE), to provide assurance for safely conducting production activities.	GMT	The produced gas is not expected to contain any hydrogen sulfide (H2S).
17. Leak/Rupture	17.1. Flange / gasket / tubing / valve	17.1.1. Potential to leak hydrocarbons into atmosphere. Potential fire/explosion. Potential thermal exposure and personnel injury. Potential environmental impact.	1. Gasket replacement program as part of maintenance activity 2. Daily checks of equipment and operating conditions by Operator 3. Leak detection and repair (LDAR) program to periodically monitor emissions 4. Air Quality Monitoring System to continuously monitor emissions 5. Emergency Response Plan (ERP)	3	4	L			
18. Corrosion	18.1. No credible causes identified by PHA Team								
19. Erosion	19.1. No credible causes identified by PHA Team								
20. Loss of Utility	20.1. No credible causes identified by PHA Team								
21. Service Failure	21.1. No credible causes identified by PHA Team								
22. Startup	22.1. No credible causes identified by PHA Team								
23. Shutdown	23.1. No credible causes identified by PHA Team								
24. Maintenance	24.1. 4" manual valve on liquid outlet of Vapor Recovery Tower V-2000 closed in error **AND** 4" manual valve on gas outlet of Vapor Recovery Tower V-2000 closed in error (following maintenance of Vapor Recovery Tower V-2000)	24.1.1. Potential to decrease lose flow of produced oil to Oil Tank TK-5001/2/3/6/7/8 and produced gas to VRU Gas Compressor C-3510. Potential to increase level in and overfill Vapor Recovery Tower V-2000 and increase pressure in and overpressure and rupture Vapor Recovery Tower V-2000. Potential to release produced oil, produced water (condensate) and produced gas into atmosphere and onto ground. Potential fire/explosion. Potential personnel injury. Potential environmental impact. (upstream)	1. Operating procedures address proper manual valve alignment 2. Daily checks of equipment and operating conditions by Operator 3. High-High Level Alarm LAHH-2000 on Vapor Recovery Tower V-2000 4. Level Switch High-High LSHH-2000 on Vapor Recovery Tower V-2000 activates an ESD 5. Ability to manually activate an Emergency Shutdown (ESD) 6. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead 7. Pressure Safety Valve PSV-2100 on Vapor Recovery Tower V-2000 set at ??? psig relieves to atmosphere at a safe location (40 feet above grade)	2	4	M	18. Verify and document the sizing basis and set point for Pressure Safety Valve PSV-2100 on the Vapor Recovery Tower V-2000.	Summit Engineering	Trucks could be in the area of the event when this hazard scenario event occurs.

Node: 2. **Produced Gas** from: (1) Gas outlet of Horizontal Separator V-1120 (PG4); (2) Gas outlet of Vapor Recovery Tower V-2000 (PG6) thru VRU Gas Compressor C-3510 (PG7), commingled in C-2510 Suction Header thru C-2510 Suction Scrubber V-3510 thru LP Gas Compressor C-2510 (PG5), and (3) Gas outlet of 2-Phase Separator V-001 thru Produced Gas Meter Skid (PG1), commingled in Sales Gas Header thru Sales Gas Scrubber V-3450 thru Sales Gas Meter M-101/102 to Sales Gas Compressor (PGX); and (3) Gas outlet of Horizontal Separator V-1120 thru Blanket Gas Header (PG2) into Oil Tank TK-5006 as Blanket Gas (PG3) **(yellow)**

Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1409; 8365-01-1413; 8365-01-1415; 8365-01-1416; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
			8. Periodic inspection and testing of PSVs, PRVs, and PVRVs 9. Manual isolation valve upstream of PSV is car sealed open (CSO) 10. Emergency Response Plan (ERP)						
		24.1.2. Potential to decrease lose flow of produced oil to Oil Tank TK-5001/2/3/6/7/8. Potential to decrease production of produced oil. No hazardous consequences. Operability issue only. (downstream)							
		24.1.3. Potential to decrease and lose flow of produced gas from Vapor Recovery Tower V-2000. Potential to decrease and lose flow of produced to VRU Gas Compressor C-3510. Potential to starve compressor. Potential to damage compressor, but with no external release of gas. Potential to decrease flow of produced gas to Sales Gas. No hazardous consequences. Operability issue only. (downstream)	1. Operating procedures address proper manual valve alignment 2. Daily checks of equipment and operating conditions by Operator						
25. Inspection	25.1. No credible causes identified by PHA Team								
26. Human Factors	26.1. No new causes, refer to Sampling deviation in this node								
27. Facility Siting	27.1. Pressure Safety Valve PSV-0101 on Horizontal Separator V-1120 relieves to atmosphere at a safe location (10-15 feet above grade)	27.1.1. Refer to hazard scenarios where Pressure Safety Valve PSV-0101 on Horizontal Separator V-1120 was used as a safeguard.					37. Verify that the location (height and orientation) of all relief lines to atmosphere from Pressure Safety Valves (PSVs), particularly PSV-0101 on the Horizontal Separator V-1120, are routed to a safe location away from personnel on walkways and elevated platforms.	Summit Engineering	
	27.2. Vehicular traffic operating in close proximity to process equipment	27.2.1. Potential for vehicles to collide with or otherwise contact process equipment, piping or instrumentation containing produced fluids. Potential to release produced gas, produced oil, and produced water (condensate) into atmosphere and onto ground. Potential fire/explosion. Potential personnel injury. Potential environmental impact.	1. Daily checks of equipment and operating conditions by Operator 2. Physical barriers designed to protect process equipment and piping 3. Emergency Response Plan (ERP)	3	3	M	11. Develop a written vehicular Traffic Safety Control Plan with prevention and mitigation measures around any vulnerable process equipment, to provide assurance that safe work practices for the control of hazards during production activities are in place.	GMT	

Node: 3. **Flare Gas** from: (1) Gas outlet of Sales Gas Scrubber V-3450 (FL1) thru ECD Knockout Drum V-9055 (FL2) thru Emission Control Device BR-9010/20 with Flame Arrestors and Burner Management System BMS-9010/20; (2) Oil Tank TK-5001/2/3/6/7/8 and Water Tank TK-4001/4 (FL3, FL4, FL5) thru ECD Knockout Drum V-9050 (FL6) thru Emission Control Device BR-9010/20 with Flame Arrestors; (3) Gas outlet of C-2510 Suction Scrubber V-3510 to inlet of ECD Knockout Drum V-9055 (FL7); Gas outlet of Vapor Recovery Tower V-2000 to inlet of ECD Knockout Drum V-9050 (FL8) **(pink)**

Drawings / References: 8365-01-1409; 8365-01-1410; 8365-01-1413; 8365-01-1414; 8365-01-1415; 8365-01-1417; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
1. No/Less Flow	1.1. HP System (ECD Knockout Drum V-9055)								
	1.2. Stream FL1								
	1.3. 4" Pressure Control Valve PCV-3107 downstream of Sales Gas Scrubber V-3450 malfunctions closed or set in error or either 4" manual isolation valve around PCV-3107 closed in error (when Emission Control Device BR-9010/9020 is intended to be used)	1.3.1. Potential to decrease and lose flow of flare gas from Sales Gas Scrubber V-3450 to ECD Knockout Drum V-9055. Potential inability to flare excess gas from producing wells. Potential to increase backpressure on entire system. Refer to hazard scenarios for all other upstream gas scenarios resulting in overpressure and rupture of vessels. (upstream)	1. Refer to safeguards in hazard scenarios for all other upstream gas scenarios resulting in overpressure and rupture of vessels with relief to flare, **plus:** 2. Manual isolation valves upstream and downstream of Pressure Control Valve PCV-3107 on flare gas line to Emission Control Device BR-9010/20 are car sealed open (CSO)	1	5	M	21. Verify and document in the design basis the sizing of pressure safety valves (PSVs) for all pressure vessels to be able to accommodate the worst case of shutting in the Sales Gas pipeline with an inability to combust flare gas in the Emission Control Devices (i.e. cases for blocked flow to the ECDs). 19. Evaluate providing a means of redundancy for the 4" Pressure Control Valve PCV-3107 downstream of the Sales Gas Scrubber V-3450 on the flare gas line, to provide assurance for an open path to the Emission Control Devices (ECDs) BR-9010/20 in case of a malfunction or during maintenance of PCV-3107. 20. Verify and document the design basis (e.g. sizing, metallurgy, height, etc.) for the Emission Control Devices (ECDs) BR-9010/20, to provide assurance for handling the worst case scenario of all Sales Gas flow being sent to the ECDs.	Summit Engineering Summit Engineering Summit Engineering	
		1.3.2. Potential to decrease and lose flow of flare gas to ECD Knockout Drum V-9055 and Emission Control Device BR-9010/20. No hazardous consequences. Operability issue only. (downstream)							
	1.4. Stream FL7								
	1.5. 2" Pressure Control Valve PCV-2202 on flare gas line to ECD Knockout Drum V-9055 malfunctions closed or set in error or either 2" manual isolation valve around PCV-2202 closed in error (when Emission Control Device BR-9010/9020 is intended to be used)	1.5.1. Potential to decrease and lose flow of flare gas to ECD Knockout Drum V-9055. Potential inability to flare excess gas from C-2510 Suction Header when needed. Refer to hazard scenario for PCV-2200 malfunctions closed for Stream PG7 & PG4, No/Less Flow deviation in Node 2 Produced Gas. (upstream)							
		1.5.2. Potential to decrease and lose flow of flare gas to ECD Knockout Drum V-9050 and Emission Control Device BR-9010/20. No hazardous consequences. Operability issue only. (downstream)							
	1.6. Stream FL1 & FL7								
	1.7. 4" manual valve on inlet of ECD Knockout Drum V-9055 closed in error (when Emission Control Device BR-9010/9020 is intended to be used)	1.7.1. Potential to decrease and lose flow of flare gas from Sales Gas Scrubber V-3450 to ECD Knockout Drum V-9055. Potential inability to flare excess gas from producing wells. Potential to increase backpressure on entire system. Refer to hazard scenarios for all other upstream gas scenarios resulting in overpressure and rupture of vessels. (upstream)	1. Refer to safeguards in hazard scenarios for all other upstream gas scenarios resulting in overpressure and rupture of vessels with relief to flare, **plus:** 2. 4" manual valve on inlet of ECD Knockout Drum V-9055 is car sealed open (CSO)	1	5	M	21. Verify and document in the design basis the sizing of pressure safety valves (PSVs) for all pressure vessels to be able to accommodate the worst case of shutting in the Sales Gas pipeline with an inability to combust flare gas in the Emission Control Devices (i.e. cases for blocked flow to the ECDs).	Summit Engineering	
		1.7.2. Potential to decrease and lose flow of flare gas to ECD Knockout Drum V-9055 and Emission Control Device BR-9010/20. No hazardous consequences. Operability issue only. (downstream)							
	1.8. 4" manual valve on outlet of ECD Knockout Drum V-9055 closed in error or both 4" manual valves on inlet of Emission Control Device BR-9010/20 closed in error or Flame Arrestor plugged (when Emission	1.8.1. Potential to decrease and lose flow of flare gas from ECD Knockout Drum V-9055. Potential inability to flare excess gas from producing wells. Potential to increase backpressure on entire system. Refer to hazard scenarios for all other upstream gas scenarios	1. Refer to safeguards in hazard scenarios for all other upstream gas scenarios resulting in overpressure and rupture of vessels with relief to flare, **plus:** 2. 4" manual valve on outlet of ECD Knockout	1	5	M	21. Verify and document in the design basis the sizing of pressure safety valves (PSVs) for all pressure vessels to be able to accommodate the worst case of shutting in the Sales Gas pipeline with an inability to	Summit Engineering	

Node: 3. **Flare Gas** from: (1) Gas outlet of Sales Gas Scrubber V-3450 (FL1) thru ECD Knockout Drum V-9055 (FL2) thru Emission Control Device BR-9010/20 with Flame Arrestors and Burner Management System BMS-9010/20; (2) Oil Tank TK-5001/2/3/6/7/8 and Water Tank TK-4001/4 (FL3, FL4, FL5) thru ECD Knockout Drum V-9050 (FL6) thru Emission Control Device BR-9010/20 with Flame Arrestors; (3) Gas outlet of C-2510 Suction Scrubber V-3510 to inlet of ECD Knockout Drum V-9055 (FL7); Gas outlet of Vapor Recovery Tower V-2000 to inlet of ECD Knockout Drum V-9050 (FL8) **(pink)**

Drawings / References: 8365-01-1409; 8365-01-1410; 8365-01-1413; 8365-01-1414; 8365-01-1415; 8365-01-1417; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
	Control Device BR-9010/9020 is intended to be used)	resulting in overpressure and rupture of vessels. (upstream)	Drum V-9055 is car sealed open (CSO) 3. Preventive maintenance program for Emission Control Device BR-9010/20 and Flame Arrestors				combust flare gas in the Emission Control Devices (i.e. cases for blocked flow to the ECDs).		
		1.8.2. Potential to decrease and lose flow of flare gas to ECD Knockout Drum V-9055 and Emission Control Device BR-9010/20. Potential inability to flare excess gas from C-2510 Suction Header when needed. Refer to hazard scenario for PCV-2200 malfunctions closed for Stream PG7 & PG4, No/Less Flow deviation in Node 2 Produced Gas. (upstream)							
		1.8.3. Potential to decrease and lose flow of flare gas from ECD Knockout Drum V-9055 to Emission Control Device BR-9010/20. Potential to increase pressure in and overpressure and rupture ECD Knockout Drum V-9055. Potential to release flare gas and produced water (condensate) into atmosphere and onto ground. Potential fire/explosion. Potential personnel injury. Potential environmental impact. (upstream)	1. Operating procedures address proper manual valve alignment 2. 4" manual valve on outlet of ECD Knockout Drum V-9055 is car sealed open (CSO) 3. Preventive maintenance program for Emission Control Device BR-9010/20 and Flame Arrestors 4. Daily checks of equipment and operating conditions by Operator 5. Pressure Safety Valve PSV-9055 on the ECD Knockout Drum V-9055 set at ??? psig relieves to atmosphere to a safe location (above top of vessel) 6. Periodic inspection and testing of PSVs, PRVs, and PVRVs 7. Manual isolation valve upstream of PSV is car sealed open (CSO) 8. Emergency Response Plan (ERP)	1	5	M	22. Verify and document the sizing basis for Pressure Safety Valve PSV-9055 on the ECD Knockout Drum V-9055 to determine whether a blocked flow case is required in addition to the fire case.	Summit Engineering	
		1.8.4. Potential to decrease and lose flow of flare gas from ECD Knockout Drum V-9055 to Emission Control Device BR-9010/20. No hazardous consequences. Operability issue only. (downstream)							
	1.9. 4" manual valve on inlet of a single Emission Control Device BR-9010/20 closed in error or Flame Arrestor plugged (when Emission Control Device BR-9010/9020 is intended to be used)	1.9.1. Potential to increase flow of flare gas to other Emission Control Device BR-9010/20 with open path. No hazardous consequences. Operability issue only for closed path to Emission Control Device BR-9010/20 (upstream)							
		1.9.2. Potential to increase flow of flare gas to other Emission Control Device BR-9010/20 with open path. Potential to exceed flow design limit of the Emission Control Device BR-9010/20. Potential for partial combustion with visible flame and smoke and/or flameout with unignited hydrocarbon emissions. Potential environmental impact. (downstream)	1. Operating procedures address proper manual valve alignment	3	4	L	32. Determine and document the maximum supply flow rate of flare gas to the Emission Control Devices (ECDs) BR-9010/20 from both the ECD Knockout Drum V-9050 (LP system) and ECD Knockout Drum V-9055 (HP system).	Summit Engineering	
			2. 4" manual valve on inlet of each Emission Control Device BR-9010/20 is car sealed open (CSO)				30. Verify with the vendor the effects on the Emission Control Devices (ECDs) BR-9010/20 for maximum flare gas flow rates from both the ECD Knockout Drum V-9050 (LP system) and ECD Knockout Drum V-9055 (HP system).	Summit Engineering	
			3. Preventive maintenance program for Emission Control Device BR-9010/20 and Flame Arrestors 4. Daily checks of equipment and operating conditions by Operator				31. Determine the required action(s) by the Burner Management System (BMS) BMS-9010/20 for the Emission Control Devices (ECDs) BR-9010/20 for a higher temperature in and/or higher flare gas flow through an ECD caused by an increased flow of flare gas to an ECD with an open path when the flare gas flow to the other ECD is blocked (e.g. 4" manual valve closed in error or Flame Arrestor is	Summit Engineering	

Node: 3. **Flare Gas** from: (1) Gas outlet of Sales Gas Scrubber V-3450 (FL1) thru ECD Knockout Drum V-9055 (FL2) thru Emission Control Device BR-9010/20 with Flame Arrestors and Burner Management System BMS-9010/20; (2) Oil Tank TK-5001/2/3/6/7/8 and Water Tank TK-4001/4 (FL3, FL4, FL5) thru ECD Knockout Drum V-9050 (FL6) thru Emission Control Device BR-9010/20 with Flame Arrestors; (3) Gas outlet of C-2510 Suction Scrubber V-3510 to inlet of ECD Knockout Drum V-9055 (FL7); Gas outlet of Vapor Recovery Tower V-2000 to inlet of ECD Knockout Drum V-9050 (FL8) **(pink)**

Drawings / References: 8365-01-1409; 8365-01-1410; 8365-01-1413; 8365-01-1414; 8365-01-1415; 8365-01-1417; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
							plugged).		
	1.10. LP System (ECD Knockout Drum V-9050)								
	1.11. Stream FL5								
	1.12. 6" Pressure Control Valve PCV-5000 malfunctions closed or set in error or either 6" manual isolation valve around PCV-5000 (when Emission Control Device BR-9010/9020 is intended to be used)	1.12.1. Potential to decrease and lose flow of LP flare gas from Water Tank TK-4001/4 and Oil Tank TK-5001/2/3/6/7/8. Potential to increase pressure in and overpressure and rupture Water and Oil Tanks. Potential to release flare gas and produced oil and produced water into atmosphere and onto ground. Potential fire/explosion. Potential personnel injury. Potential environmental impact. (upstream)	1. Operating procedures address proper manual valve alignment 2. Both 6" manual isolation valves around Pressure Control Valve PCV-5000 are car sealed open (CSO) 3. Daily checks of equipment and operating conditions by Operator 4. Pressure Relief Valve PRV-5110 on Flare Gas line on Oil Tank TK-5001/2/3/6/7/8 and Water Tank TK-4001/4 set at 14 oz/in2 relieves to atmosphere at a safe location (above top of tank) 5. Pressure Vacuum Relief Valve PVRV-5101/2/3/6/7/8 on Oil Tank TK-5001/2/3/6/7/8 set at 16 oz/in2 designed to relieve into atmosphere at a safe location (above top of tank) 6. Pressure Vacuum Relief Valve PVRV-4001/4 on Water Tank TK-4001/4 set at 16 oz/in2 designed to relieve into atmosphere at a safe location (above top of tank) 7. Periodic inspection and testing of PSVs, PRVs, and PVRVs 8. Emergency Response Plan (ERP)	1	5	M			PHA team deemed existing safeguards were adequate (sufficient and effective) for this hazard scenario All Oil Tanks and Water Tanks are connected by a common overfill line.
		1.12.2. Potential to decrease and lose flow of flare gas from ECD Knockout Drum V-9050 to Emission Control Device BR-9010/20. No hazardous consequences. Operability issue only. (downstream)							
	1.13. Stream F8								
	1.14. No credible causes identified by PHA Team	1.14.1. Pressure Control Valve PCV-2301 on flare gas line to ECD Knockout Drum V-9050 malfunctions closed or either 2" manual isolation valve around PCV-2301 closed in error or set in error was addressed as a safeguard failure, not a direct cause of a hazard scenario							
	1.15. Stream FL5 & FL8								
	1.16. 6" manual valve on inlet of ECD Knockout Drum V-9050 closed in error (when Emission Control Device BR-9010/9020 is intended to be used)	1.16.1. Potential to decrease and lose flow of LP flare gas from Water Tank TK-4001/4 and Oil Tank TK-5001/2/3/6/7/8. Potential to increase pressure in and overpressure and rupture Water and Oil Tanks. Potential to release flare gas and produced oil and produced water into atmosphere and onto ground. Potential fire/explosion. Potential personnel injury. Potential environmental impact. (upstream)	1. Operating procedures address proper manual valve alignment 2. 6" manual valve on inlet of ECD Knockout Drum V-9050 is car sealed open (CSO) 3. Daily checks of equipment and operating conditions by Operator 4. Pressure Relief Valve PRV-5110 on Flare Gas line on Oil Tank TK-5001/2/3/6/7/8 and Water Tank TK-4001/4 set at 14 oz/in2 relieves to atmosphere at a safe location (above top of tank) 5. Pressure Vacuum Relief Valve PVRV-5101/2/3/6/7/8 on Oil Tank TK-5001/2/3/6/7/8 set at 16 oz/in2 designed to relieve into	1	5	M			PHA team deemed existing safeguards were adequate (sufficient and effective) for this hazard scenario All Oil Tanks and Water Tanks are connected by a common overfill line.

Node: 3. **Flare Gas** from: (1) Gas outlet of Sales Gas Scrubber V-3450 (FL1) thru ECD Knockout Drum V-9055 (FL2) thru Emission Control Device BR-9010/20 with Flame Arrestors and Burner Management System BMS-9010/20; (2) Oil Tank TK-5001/2/3/6/7/8 and Water Tank TK-4001/4 (FL3, FL4, FL5) thru ECD Knockout Drum V-9050 (FL6) thru Emission Control Device BR-9010/20 with Flame Arrestors; (3) Gas outlet of C-2510 Suction Scrubber V-3510 to inlet of ECD Knockout Drum V-9055 (FL7); Gas outlet of Vapor Recovery Tower V-2000 to inlet of ECD Knockout Drum V-9050 (FL8) **(pink)**

Drawings / References: 8365-01-1409; 8365-01-1410; 8365-01-1413; 8365-01-1414; 8365-01-1415; 8365-01-1417; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
			atmosphere at a safe location (above top of tank)						
			6. Pressure Vacuum Relief Valve PVRV-4001/4 on Water Tank TK-4001/4 set at 16 oz/in2 designed to relieve into atmosphere at a safe location (above top of tank)						
			7. Periodic inspection and testing of PSVs, PRVs, and PVRVs						
			8. Emergency Response Plan (ERP)						
		1.16.2. Potential to decrease and lose flow of flare gas from ECD Knockout Drum V-9050 to Emission Control Device BR-9010/20. No hazardous consequences. Operability issue only. (downstream)							
	1.17. 6" manual valve on outlet of ECD Knockout Drum V-9050 closed in error or both 4" manual valves on inlet of Emission Control Device BR-9010/20 closed in error or Flame Arrestor plugged (when Emission Control Device BR-9010/9020 is intended to be used)	1.17.1. Potential to decrease and lose flow of LP flare gas from Water Tank TK-4001/4 and Oil Tank TK-5001/2/3/6/7/8. Potential to increase pressure in and overpressure and rupture Water and Oil Tanks. Potential to release flare gas and produced oil and produced water into atmosphere and onto ground. Potential fire/explosion. Potential personnel injury. Potential environmental impact. (upstream)	1. Operating procedures address proper manual valve alignment	1	5	M			PHA team deemed existing safeguards were adequate (sufficient and effective) for this hazard scenario
			2. 6" manual valve on outlet of ECD Knockout Drum V-9050 is car sealed open (CSO)						Overpressure of ECD Knockout Drum V-9050 is not deemed credible, but the vessel is protected for a fire case (refer to Higher Temperature deviation in this node)
			3. Preventive maintenance program for Emission Control Device BR-9010/20 and Flame Arrestors						All Oil Tanks and Water Tanks are connected by a common overfill line.
			4. Daily checks of equipment and operating conditions by Operator						
			5. Pressure Relief Valve PRV-5110 on Flare Gas line on Oil Tank TK-5001/2/3/6/7/8 and Water Tank TK-4001/4 set at 14 oz/in2 relieves to atmosphere at a safe location (above top of tank)						
			6. Pressure Vacuum Relief Valve PVRV-5101/2/3/6/7/8 on Oil Tank TK-5001/2/3/6/7/8 set at 16 oz/in2 designed to relieve into atmosphere at a safe location (above top of tank)						
			7. Pressure Vacuum Relief Valve PVRV-4001/4 on Water Tank TK-4001/4 set at 16 oz/in2 designed to relieve into atmosphere at a safe location (above top of tank)						
			8. Periodic inspection and testing of PSVs, PRVs, and PVRVs						
			9. Emergency Response Plan (ERP)						
		1.17.2. Potential to decrease and lose flow of flare gas from ECD Knockout Drum V-9050 to Emission Control Device BR-9010/20. No hazardous consequences. Operability issue only. (downstream)							
	1.18. 4" manual valve on inlet of a single Emission Control Device BR-9010/20 closed in error or Flame Arrestor plugged (when Emission Control Device BR-9010/9020 is intended to be used)	1.18.1. Potential to increase flow of flare gas to other Emission Control Device BR-9010/20 with open path. No hazardous consequences. Operability issue only for closed path to Emission Control Device BR-9010/20 (upstream)							
		1.18.2. Potential to increase flow of flare gas to other Emission Control Device BR-9010/20 with open path. Potential to exceed flow design limit of the Emission Control Device BR-9010/20. Potential for partial combustion with visible flame and smoke and/or flameout with unignited hydrocarbon emissions.	1. Operating procedures address proper manual valve alignment	3	4	L	32. Determine and document the maximum supply flow rate of flare gas to the Emission Control Devices (ECDs) BR-9010/20 from both the ECD Knockout Drum V-9050 (LP system) and ECD Knockout Drum V-9055 (HP system).	Summit Engineering	

Node: 3. **Flare Gas** from: (1) Gas outlet of Sales Gas Scrubber V-3450 (FL1) thru ECD Knockout Drum V-9055 (FL2) thru Emission Control Device BR-9010/20 with Flame Arrestors and Burner Management System BMS-9010/20; (2) Oil Tank TK-5001/2/3/6/7/8 and Water Tank TK-4001/4 (FL3, FL4, FL5) thru ECD Knockout Drum V-9050 (FL6) thru Emission Control Device BR-9010/20 with Flame Arrestors; (3) Gas outlet of C-2510 Suction Scrubber V-3510 to inlet of ECD Knockout Drum V-9055 (FL7); Gas outlet of Vapor Recovery Tower V-2000 to inlet of ECD Knockout Drum V-9050 (FL8) **(pink)**

Drawings / References: 8365-01-1409; 8365-01-1410; 8365-01-1413; 8365-01-1414; 8365-01-1415; 8365-01-1417; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
		Potential environmental impact. (downstream)							
			2. 4" manual valve on inlet of each Emission Control Device BR-9010/20 is car sealed open (CSO)				30. Verify with the vendor the effects on the Emission Control Devices (ECDs) BR-9010/20 for maximum flare gas flow rates from both the ECD Knockout Drum V-9050 (LP system) and ECD Knockout Drum V-9055 (HP system).	Summit Engineering	
			3. Preventive maintenance program for Emission Control Device BR-9010/20 and Flame Arrestors				31. Determine the required action(s) by the Burner Management System (BMS) BMS-9010/20 for the Emission Control Devices (ECDs) BR-9010/20 for a higher temperature in and/or higher flare gas flow through an ECD caused by an increased flow of flare gas to an ECD with an open path when the flare gas flow to the other ECD is blocked (e.g. 4" manual valve closed in error or Flame Arrestor is plugged).	Summit Engineering	
			4. Daily checks of equipment and operating conditions by Operator						
2. Higher Flow	2.1. 4" Pressure Control Valve PCV-3107 on flare gas line to ECD Knockout Drum V-9055 malfunctions opens or set in error (when Emission Control Device BR-9010/9020 is intended to be used)	2.1.1. Potential to increase flow of flare gas to ECD Knockout Drum V-9055. Potential to decrease flow and production of Sales Gas. No hazardous consequences. Operability issue only. (upstream)							
		2.1.2. Potential to increase flow of flare gas to ECD Knockout Drum V-9055. Potential to burn excess flare gas and to waste Sales Gas. No hazardous consequences. Operability issue only. (downstream)							Emission Control Device BR-9010/20 designed to handle full Sales Gas flow.
	2.2. 4" Pressure Control Valve PCV-2202 on flare gas line to ECD Knockout Drum V-9055 malfunctions opens or set in error (when Emission Control Device BR-9010/9020 is intended to be used)	2.2.1. Potential to increase flow of flare gas to ECD Knockout Drum V-9055. Potential to decrease flow and production of Sales Gas. No hazardous consequences. Operability issue only. (upstream)							
		2.2.2. Potential to increase flow of flare gas to ECD Knockout Drum V-9055. Potential to burn excess flare gas and to waste Sales Gas. No hazardous consequences. Operability issue only. (downstream)							Emission Control Device BR-9010/20 designed to handle full Sales Gas flow.
	2.3. 6" Pressure Control Valve PCV-5000 on flare gas line to ECD Knockout Drum V-9050 malfunctions opens or set in error (when Emission Control Device BR-9010/9020 is intended to be used)	2.3.1. Potential to increase flow of flare gas to ECD Knockout Drum V-9050. Potential to decrease flow and production of Sales Gas. No hazardous consequences. Operability issue only. (upstream)							
		2.3.2. Potential to increase flow of flare gas to ECD Knockout Drum V-9050. Potential to burn excess flare gas and to waste Sales Gas. No hazardous consequences. Operability issue only. (downstream)					36. Review the maximum volume of blanket gas supply from the Oil Tanks TK-5001/2/3/6/7/8 and Water Tanks TK-4001/4 versus the maximum capacity of the 6" Pressure Control Valve PCV-5000 on the flare gas line to ECD Knockout Drum V-9050.	Summit Engineering	Emission Control Device BR-9010/20 designed to handle full Sales Gas flow.
	2.4. 2" Pressure Control Valve PCV-2301 on flare gas line to Knockout Drum V-9050 malfunctions opens or set in error (when Emission Control Device BR-9010/9020 is intended to be used)	2.4.1. Potential to increase flow of flare gas to ECD Knockout Drum V-9050. Potential to decrease flow and production of Sales Gas. No hazardous consequences. Operability issue only. (upstream)							
		2.4.2. Potential to increase flow of flare gas to ECD Knockout Drum V-9050. Potential to burn excess flare gas and to waste Sales Gas. No hazardous consequences. Operability issue only. (downstream)							Emission Control Device BR-9010/20 designed to handle full Sales Gas flow.
	2.5. No new causes, refer to No/Less and Misdirected Flow deviations in this node	2.5.1. Refer to scenarios involving a higher flow rate through the open path when s single 4" manual valve on inlet of a single Emission Control Device BR-9010/20 closed in error or Flame Arrestor plugged; or when ECD Knockout Drum V-9050/9055 is bypassed and condensate is entrained in the flare gas.							
3. Reverse Flow	3.1. No credible causes identified by PHA Team								

Node: 3. **Flare Gas** from: (1) Gas outlet of Sales Gas Scrubber V-3450 (FL1) thru ECD Knockout Drum V-9055 (FL2) thru Emission Control Device BR-9010/20 with Flame Arrestors and Burner Management System BMS-9010/20; (2) Oil Tank TK-5001/2/3/6/7/8 and Water Tank TK-4001/4 (FL3, FL4, FL5) thru ECD Knockout Drum V-9050 (FL6) thru Emission Control Device BR-9010/20 with Flame Arrestors; (3) Gas outlet of C-2510 Suction Scrubber V-3510 to inlet of ECD Knockout Drum V-9055 (FL7); Gas outlet of Vapor Recovery Tower V-2000 to inlet of ECD Knockout Drum V-9050 (FL8) **(pink)**

Drawings / References: 8365-01-1409; 8365-01-1410; 8365-01-1413; 8365-01-1414; 8365-01-1415; 8365-01-1417; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
4. As Well As Flow	4.1. No credible causes identified by PHA Team								
5. Misdirected Flow	5.1. 6" manual valve in bypass line around ECD Knockout Drum V-9050 open in error or leaks through	5.1.1. Potential to bypass flow around ECD Knockout Drum V-9050. Potential to send condensate mist to Emission Control Device BR-9010/20. Potential for partial combustion with visible flame and smoke and/or flameout with unignited hydrocarbon emissions. Potential environmental impact. (downstream)	1. Operating procedures address proper manual valve alignment 2. 6" manual valve in bypass line around ECD Knockout Drum V-9050 is car sealed closed (CSC) 3. Daily checks of equipment and operating conditions by Operator 4. Burner Management System BMS-9010/20 for Emission Control Device BR-9010/20 indicates and alarms for intermittent loss of fuel gas to pilot	3	4	L			
	5.2. 4" manual valve in bypass line around ECD Knockout Drum V-9055 open in error or leaks through	5.2.1. Potential to bypass flow around ECD Knockout Drum V-9055, send condensate mist to Emission Control Device BR-9010/20. Potential for partial combustion with visible flame and smoke and/or flameout with unignited hydrocarbon emissions. Potential environmental impact. (downstream)	1. Operating procedures address proper manual valve alignment 2. 6" manual valve in bypass line around ECD Knockout Drum V-9055 is car sealed closed (CSC) 3. Daily checks of equipment and operating conditions by Operator 4. Burner Management System BMS-9010/20 for Emission Control Device BR-9010/20 indicates and alarms for intermittent loss of fuel gas to pilot	3	4	L			
	5.3. Pressure Safety Valve PSV-9050 on ECD Knockout Drum V-9050 set in error or leaks through	5.3.1. Potential to release unignited gas to atmosphere at a safe location (above top of vessel). Potential to decrease flow of flare gas to Emission Control Device BR-9010/20. No hazardous consequences. Operability issue only. (upstream)							
		5.3.2. Potential to release unignited flare gas to atmosphere at a safe location (above top of vessel). No hazardous consequences. Operability issue only. (downstream)	1. Periodic inspection and testing of PSVs, PRVs, and PVRVs 2. Daily checks of equipment and operating conditions by Operator 3. Leak detection and repair (LDAR) program to periodically monitor emissions 4. Air Quality Monitoring System to continuously monitor emissions						Release of lighter-than-air flammable gas into the atmosphere at an elevated safe location is expected to disperse and not produce a fire since an ignition source is not present.
	5.4. Pressure Safety Valve PSV-9055 on ECD Knockout Drum V-9055 set in error or leaks through	5.4.1. Potential to release unignited gas to atmosphere at a safe location (above top of vessel). Potential to decrease flow of flare gas to Emission Control Device BR-9010/20. No hazardous consequences. Operability issue only. (upstream)							
		5.4.2. Potential to release unignited flare gas to atmosphere at a safe location (above top of vessel). No hazardous consequences. Operability issue only. (downstream)	1. Periodic inspection and testing of PSVs, PRVs, and PVRVs 2. Daily checks of equipment and operating conditions by Operator 3. Leak detection and repair (LDAR) program to periodically monitor emissions 4. Air Quality Monitoring System to continuously monitor emissions						Release of lighter-than-air flammable gas into the atmosphere at an elevated safe location is expected to disperse and not produce a fire since an ignition source is not present.
	5.5. Pressure Relief Valve PRV-5110 on blanket gas line on Oil Tank TK-5001/2/3/6/7/8 and Water Tank TK-4001/4 set in error or leaks through	5.5.1. Potential to release produced gas (blanket gas) to atmosphere above top of tank. Potential to decrease flow of flare gas to Emission Control Device BR-9010/20. No hazardous consequences. Operability issue only. (upstream)							
		5.5.2. Potential to release produced gas (blanket gas) to atmosphere above top of tank. Potential fire. Potential personnel injury. Potential environmental impact. (downstream)	1. Periodic inspection and testing of PSVs, PRVs, and PVRVs 2. Fire prevention practices (e.g. policy for smoking in designated areas only,	3	4	L			

Node: 3. **Flare Gas** from: (1) Gas outlet of Sales Gas Scrubber V-3450 (FL1) thru ECD Knockout Drum V-9055 (FL2) thru Emission Control Device BR-9010/20 with Flame Arrestors and Burner Management System BMS-9010/20; (2) Oil Tank TK-5001/2/3/6/7/8 and Water Tank TK-4001/4 (FL3, FL4, FL5) thru ECD Knockout Drum V-9050 (FL6) thru Emission Control Device BR-9010/20 with Flame Arrestors; (3) Gas outlet of C-2510 Suction Scrubber V-3510 to inlet of ECD Knockout Drum V-9055 (FL7); Gas outlet of Vapor Recovery Tower V-2000 to inlet of ECD Knockout Drum V-9050 (FL8) **(pink)**

Drawings / References: 8365-01-1409; 8365-01-1410; 8365-01-1413; 8365-01-1414; 8365-01-1415; 8365-01-1417; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
			housekeeping to minimize combustibles around vessels, hot work permits) 3. Daily checks of equipment and operating conditions by Operator 4. Leak detection and repair (LDAR) program to periodically monitor emissions 5. Emergency Response Plan (ERP)						
	5.6. Pressure Vacuum Relief Valve PVRV-5101/2/3/6/7/8 on Oil Tank TK-5001/2/3/6/7/8 set in error or leaks through	5.6.1. Potential to release produced gas (blanket gas) to atmosphere above top of tank. Potential to decrease flow of flare gas to Emission Control Device BR-9010/20. No hazardous consequences. Operability issue only. (upstream)							
		5.6.2. Potential to release produced gas (blanket gas) to atmosphere above top of tank. Potential fire. Potential personnel injury. Potential environmental impact. (downstream)	1. Periodic inspection and testing of PSVs, PRVs, and PVRVs 2. Fire prevention practices (e.g. policy for smoking in designated areas only, housekeeping to minimize combustibles around vessels, hot work permits) 3. Daily checks of equipment and operating conditions by Operator 4. Leak detection and repair (LDAR) program to periodically monitor emissions 5. Emergency Response Plan (ERP)	3	4	L			
	5.7. Pressure Vacuum Relief Valve PVRV-4001/4 on Water Tank TK-4001/4 set in error or leaks through	5.7.1. Potential to release produced gas (blanket gas) to atmosphere above top of tank. Potential to decrease flow of flare gas to Emission Control Device BR-9010/20. No hazardous consequences. Operability issue only. (upstream)							
		5.7.2. Potential to release produced gas (blanket gas) to atmosphere above top of tank. Potential fire. Potential personnel injury. Potential environmental impact. (downstream)	1. Periodic inspection and testing of PSVs, PRVs, and PVRVs 2. Fire prevention practices (e.g. policy for smoking in designated areas only, housekeeping to minimize combustibles around vessels, hot work permits) 3. Daily checks of equipment and operating conditions by Operator 4. Leak detection and repair (LDAR) program to periodically monitor emissions 5. Emergency Response Plan (ERP)	3	4	L			
6. No Pressure (Vacuum)	6.1. No credible causes identified by PHA Team								
7. Lower Pressure	7.1. No new causes, refer to No/Less Flow deviation in this node								
8. Higher Pressure	8.1. Abnormal operation of Emission Control Device BR-9010/20 (when intended to be used)	8.1.1. Potential to send (reverse flow) flame from Emission Control Device BR-9010/20 to ECD Knockout Drum V-9055 and ECD Knockout Drum V-9050. Potential detonation explosion. Potential to rupture V-9050/V-9055. Potential to release flare gas and produced water (condensate) into atmosphere and onto ground. Potential personnel injury. Potential environmental impact. (upstream)	1. Startup procedure addresses purging air from ECD Knockout Drum V-9050	1	5	M	23. Develop and implement a written procedure for Pre-Startup Safety Review (PSSR), to provide assurance that prior to the introduction of highly hazardous chemicals to the process: (1) Construction and equipment is in accordance with design specifications; (2) Safety, operating, maintenance, and emergency procedures are in place and are adequate; (3) For new facilities, a process hazard analysis has been performed and recommendations have been resolved or implemented before startup; and modified facilities meet the requirements contained in management of change (MOC) procedure; and (4) Training of each employee involved in operating the facility has been completed.	GMT	

Node: 3. **Flare Gas** from: (1) Gas outlet of Sales Gas Scrubber V-3450 (FL1) thru ECD Knockout Drum V-9055 (FL2) thru Emission Control Device BR-9010/20 with Flame Arrestors and Burner Management System BMS-9010/20; (2) Oil Tank TK-5001/2/3/6/7/8 and Water Tank TK-4001/4 (FL3, FL4, FL5) thru ECD Knockout Drum V-9050 (FL6) thru Emission Control Device BR-9010/20 with Flame Arrestors; (3) Gas outlet of C-2510 Suction Scrubber V-3510 to inlet of ECD Knockout Drum V-9055 (FL7); Gas outlet of Vapor Recovery Tower V-2000 to inlet of ECD Knockout Drum V-9050 (FL8) **(pink)**

Drawings / References: 8365-01-1409; 8365-01-1410; 8365-01-1413; 8365-01-1414; 8365-01-1415; 8365-01-1417; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
			2. Startup procedure addresses purging air from ECD Knockout Drum V-9055 3. Preventive maintenance program for Emission Control Device BR-9010/20 and Flame Arrestors 4. Daily checks of equipment and operating conditions by Operator 5. Flame Arrestor on LP flare gas line from ECD Knockout Drum V-9050 to Emission Control Device BR-9010/20 designed to prevent detonation 6. Flame Arrestor on HP flare gas line from ECD Knockout Drum V-9055 to Emission Control Device BR-9010/20 designed to prevent detonation 7. Emergency Response Plan (ERP)				4. Develop written operating procedures, including a startup procedure (e.g. purging the entire process system with nitrogen to assure an oxygen free environment; proper alignment of process and isolation valves; proper isolation of master valves on the production tree prior to ESD reset); monitoring and inspection of process equipment and conditions to support daily checks by operators during normal operations; closing the master valves and flow line valve; entering setpoints for controllers and control valves; and manually activating an emergency shutdown (ESD), in order to provide assurance for safely conducting production activities.	GMT	
9. No/Lower Level	9.1. No credible causes identified by PHA Team								
10. Higher Level	10.1. No credible causes identified by PHA Team								
11. Lower Temperature	11.1. No credible causes identified by PHA Team								
12. Higher Temperature	12.1. External fire nearby ECD Knockout Drum V-9050	12.1.1. Potential to increase temperature and exceed vessel design temperature and/or increase pressure and overpressure and rupture ECD Knockout Drum V-9050. Potential to release produced water (condensate) and flare gas into atmosphere and onto ground. Potential fire/explosion. Potential personnel injury. Potential environmental impact. (downstream)	1. Fire prevention practices (e.g. policy for smoking in designated areas only, housekeeping to minimize combustibles around vessels, hot work permits) 2. Daily checks of equipment and operating conditions by Operator 3. Pressure Safety Valve PSV-9050 on the ECD Knockout Drum V-9050 set at ??? psig (fire case) relieves to atmosphere to a safe location (above top of vessel) 4. Periodic inspection and testing of PSVs, PRVs, and PVRVs 5. Manual isolation valve upstream of PSV is car sealed open (CSO) 6. Emergency Response Plan (ERP)	2	4	M			PHA team deemed existing safeguards were adequate (sufficient and effective) for this hazard scenario Overpressure of ECD Knockout Drum V-9050 is not deemed credible, but the vessel is protected for a fire case.
	12.2. External fire nearby ECD Knockout Drum V-9055	12.2.1. Potential to increase temperature and exceed vessel design temperature and/or increase pressure and overpressure and rupture ECD Knockout Drum V-9055. Potential to release produced water (condensate) and flare gas into atmosphere and onto ground. Potential fire/explosion. Potential personnel injury. Potential environmental impact. (downstream)	1. Fire prevention practices (e.g. policy for smoking in designated areas only, housekeeping to minimize combustibles around vessels, hot work permits) 2. Daily checks of equipment and operating conditions by Operator 3. Pressure Safety Valve PSV-9055 on the ECD Knockout Drum V-9055 set at ??? psig (fire case) relieves to atmosphere to a safe location (above top of vessel) 4. Periodic inspection and testing of PSVs, PRVs, and PVRVs 5. Manual isolation valve upstream of PSV is car sealed open (CSO) 6. Emergency Response Plan (ERP)	2	4	M			PHA team deemed existing safeguards were adequate (sufficient and effective) for this hazard scenario
13. Composition	13.1. No credible causes identified by PHA Team								
14. Contamination	14.1. No new causes, refer to Misdirected Flow deviation in this node								
15. Instrumentation	15.1. No credible causes identified by PHA Team								

Node: 3. **Flare Gas** from: (1) Gas outlet of Sales Gas Scrubber V-3450 (FL1) thru ECD Knockout Drum V-9055 (FL2) thru Emission Control Device BR-9010/20 with Flame Arrestors and Burner Management System BMS-9010/20; (2) Oil Tank TK-5001/2/3/6/7/8 and Water Tank TK-4001/4 (FL3, FL4, FL5) thru ECD Knockout Drum V-9050 (FL6) thru Emission Control Device BR-9010/20 with Flame Arrestors; (3) Gas outlet of C-2510 Suction Scrubber V-3510 to inlet of ECD Knockout Drum V-9055 (FL7); Gas outlet of Vapor Recovery Tower V-2000 to inlet of ECD Knockout Drum V-9050 (FL8) **(pink)**

Drawings / References: 8365-01-1409; 8365-01-1410; 8365-01-1413; 8365-01-1414; 8365-01-1415; 8365-01-1417; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
16. Sampling	16.1. No credible causes identified by PHA Team								
17. Leak/Rupture	17.1. Flange / gasket / tubing / valve	17.1.1. Potential to leak hydrocarbons into atmosphere. Potential fire/explosion. Potential thermal exposure and personnel injury. Potential environmental impact.	1. Gasket replacement program as part of maintenance activity 2. Daily checks of equipment and operating conditions by Operator 3. Leak detection and repair (LDAR) program to periodically monitor emissions 4. Emergency Response Plan (ERP)	3	4	L			
18. Corrosion	18.1. No credible causes identified by PHA Team								
19. Erosion	19.1. No credible causes identified by PHA Team								
20. Loss of Utility	20.1. No credible causes identified by PHA Team								
21. Service Failure	21.1. No credible causes identified by PHA Team								
22. Startup	22.1. No new causes, refer to Higher Pressure deviation in this node								
23. Shutdown	23.1. No credible causes identified by PHA Team								
24. Maintenance	24.1. No new causes, refer to Higher Flow deviation in this node								
25. Inspection	25.1. No credible causes identified by PHA Team								
26. Human Factors	26.1. No new causes, refer to Higher Pressure deviation in this node								
27. Facility Siting	27.1. Vehicular traffic operating in close proximity to process equipment	27.1.1. Potential for vehicles to collide with or otherwise contact process equipment, piping or instrumentation containing produced fluids. Potential to release flare gas and produced water (condensate) into atmosphere and onto ground. Potential fire/explosion. Potential personnel injury. Potential environmental impact.	1. Daily checks of equipment and operating conditions by Operator 2. Physical barriers designed to protect process equipment and piping 3. Emergency Response Plan (ERP)	3	3	M	11. Develop a written vehicular Traffic Safety Control Plan with prevention and mitigation measures around any vulnerable process equipment, to provide assurance that safe work practices for the control of hazards during production activities are in place.	GMT	
	27.2. No new causes, refer to Higher Pressure deviation in this node								

Node: 4. **Fuel Gas** from: Gas outlet of Sales Gas Scrubber V-3450 (FG1) thru Fuel Gas Scrubber V-3011 to Fuel Gas Header with supplies to: (1) Fuel Gas Scrubber V-201 and Burner Unit B-201 for Heater Unit H-101 for Horizontal Separator V-1120 (FG2); (2) Engine for LP Gas Compressor C-2510 (FG3); and (3) Pilots for Emission Control Device BR-9010/20 with Burner Management System BMS-9010/20 (FG4) **(orange)**

Drawings / References: 8365-01-1403; 8365-01-1409; 8365-01-1412; 8365-01-1413; 8365-01-1417

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
1. No/Less Flow	1.1. 2" manual valve in fuel gas line from Fuel Gas Header closed in error or 2" Pressure Control Valve PCV-3011 upstream of Fuel Gas Scrubber V-3011 malfunctions closed or set in error or either 2" manual isolation valve around PCV-3011 closed in error	1.1.1. Potential to decrease and lose flow of fuel gas from Fuel Gas Header. Potential to decrease and lose flow of fuel gas to Fuel Gas Scrubber V-3011. No hazardous consequences. Operability issue only. (upstream)							Loss of fuel gas does not affect any upstream process equipment.
		1.1.2. Potential to decrease and lose flow of fuel gas from Fuel Gas Header. Potential to decrease and lose flow of fuel gas to Fuel Gas Scrubber V-3011. Potential to decrease and lose flow of fuel gas to LP Gas Compressor C-2510. Refer to hazard scenario for LP Gas Compressor C-2510 not running for any reason (e.g. loss of fuel gas) in No/Less Flow deviation in Node 2 Produced Gas. (downstream)	1. Fuel gas supply from Horizontal Separator V-1120/1220 is a sufficient supplement (with 2" manual valve on Fuel Gas Scrubber V-201/202)						
		1.1.3. Potential to decrease and lose flow of fuel gas from Fuel Gas Header. Potential to decrease and lose flow of fuel gas pilot for Emission Control Device BR-9010/20. Potential to lose ability to control emissions. Potential to emit uncombusted fuel gas (natural gas) into atmosphere. Potential environmental impact only. (downstream)	1. Operating procedures address proper manual valve alignment 2. Daily checks of equipment and operating conditions by Operator 3. Burner Management System BMS-9010/20 for Emission Control Device BR-9010/20 indicates and alarms for intermittent loss of fuel gas to pilot 4. Fuel gas supply from Horizontal Separator V-1120/1220 is a sufficient supplement (with 2" manual valve on Fuel Gas Scrubber V-201/202) 5. Air Quality Monitoring System to continuously monitor emissions	3	4	L			
	1.2. 2" manual valve on gas outlet of Fuel Gas Scrubber V-3011 closed in error or Pressure Control Valve PCV-3012 downstream of Fuel Gas Scrubber V-3011 malfunctions closed or set in error or either 2" manual isolation valve around PCV-3012 closed in error	1.2.1. Potential to decrease and lose flow of fuel gas from Fuel Gas Header. Potential to decrease and lose flow of fuel gas to Fuel Gas Scrubber V-3011. No hazardous consequences. Operability issue only. (upstream)							Loss of fuel gas does not affect any upstream process equipment.
		1.2.2. Potential to decrease and lose flow of fuel gas from Fuel Gas Scrubber V-3011. Potential to increase pressure in and overpressure and rupture Fuel Gas Scrubber V-3011. Potential to release fuel gas and produced water (condensate) into atmosphere and onto ground. Potential fire/explosion. Potential personnel injury. Potential environmental impact. (upstream)	1. Operating procedures address proper manual valve alignment 2. Daily checks of equipment and operating conditions by Operator 3. Pressure Control Valve PCV-3011 closes to reduce source pressure to Fuel Gas Scrubber V-3011 4. Pressure Control Valve PCV-3107 on flare gas line to Emission Control Device BR-9010/20 opens to reduce source pressure to Fuel Gas Scrubber V-3011 5. Pressure Safety Valve PSV-3011 on Fuel Gas Scrubber V-3011 set at ??? psig relieves to atmosphere at a safe location (above top of vessel) 6. Periodic inspection and testing of PSVs, PRVs, and PVRVs 7. Manual isolation valve upstream of PSV is car sealed open (CSO) 8. Emergency Response Plan (ERP)	2	4	M	13. Verify and document the sizing basis and set point for Pressure Safety Valve PSV-3011 on the Fuel Gas Scrubber V-3011. 24. Verify the design intent of the 4" Pressure Control Valve PCV-3107 downstream of the Sales Gas Scrubber V-3450 on the flare gas line to the Emission Control Devices (ECDs) BR-9010/20.	Summit Engineering Summit Engineering	
		1.2.3. Potential to decrease and lose flow of fuel gas from Fuel Gas Scrubber V-3011. Potential to decrease and lose flow of fuel gas to Fuel Gas Scrubber V-3011. Potential to decrease and lose flow of fuel gas to LP Gas Compressor C-2510. Refer to hazard scenario for LP Gas Compressor C-2510 not running for any reason (e.g. loss of fuel gas) in No/Less Flow	1. Fuel gas supply from Horizontal Separator V-1120/1220 is a sufficient supplement (with 2" manual valve on Fuel Gas Scrubber V-201/202)						

Node: 4. **Fuel Gas** from: Gas outlet of Sales Gas Scrubber V-3450 (FG1) thru Fuel Gas Scrubber V-3011 to Fuel Gas Header with supplies to: (1) Fuel Gas Scrubber V-201 and Burner Unit B-201 for Heater Unit H-101 for Horizontal Separator V-1120 (FG2); (2) Engine for LP Gas Compressor C-2510 (FG3); and (3) Pilots for Emission Control Device BR-9010/20 with Burner Management System BMS-9010/20 (FG4) **(orange)**

Drawings / References: 8365-01-1403; 8365-01-1409; 8365-01-1412; 8365-01-1413; 8365-01-1417

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
		deviation in Node 2 Produced Gas. (downstream)							
		1.2.4. Potential to decrease and lose flow of fuel gas from Fuel Gas Scrubber V-3011. Potential to decrease and lose flow of fuel gas pilot for Emission Control Device BR-9010/20. Potential to lose ability to control emissions. Potential to emit uncombusted fuel gas (natural gas) into atmosphere. Potential environmental impact only. (downstream)	1. Operating procedures address proper manual valve alignment 2. Daily checks of equipment and operating conditions by Operator 3. Burner Management System BMS-9010/20 for Emission Control Device BR-9010/20 indicates and alarms for intermittent loss of fuel gas to pilot 4. Fuel gas supply from Horizontal Separator V-1120/1220 is a sufficient supplement (with 2" manual valve on Fuel Gas Scrubber V-201/202) 5. Air Quality Monitoring System to continuously monitor emissions	3	4	L			
	1.3. 2" manual valve or 1" manual valve in fuel gas line to LP Gas Compressor C-2510 closed in error	1.3.1. Potential to decrease and lose flow of fuel gas to LP Gas Compressor C-2510. No hazardous consequences. Operability issue only. (upstream)							
		1.3.2. Potential to decrease and lose flow of fuel gas to LP Gas Compressor C-2510. Refer to hazard scenario for LP Gas Compressor C-2510 not running for any reason (e.g. loss of fuel gas) in No/Less Flow deviation in Node 2 Produced Gas. (downstream)							
	1.4. 2" manual valve in fuel line from Fuel Gas Scrubber V-3011 closed in error or 2" common manual valve in fuel gas header to Emission Control Device BR-9010/20 closed in error or either 1/2" manual valve to pilot for Emission Control Device BR-9010/20 closed in error	1.4.1. Potential to decrease and lose flow of fuel gas pilot for Emission Control Device BR-9010/20. No hazardous consequences. Operability issue only. (upstream)							
		1.4.2. Potential to decrease and lose flow of fuel gas pilot for Emission Control Device BR-9010/20. Potential to lose ability to control emissions. Potential to emit uncombusted fuel gas (natural gas) into atmosphere. Potential environmental impact only. (downstream)	1. Operating procedures address proper manual valve alignment 2. Daily checks of equipment and operating conditions by Operator 3. Burner Management System BMS-9010/20 for Emission Control Device BR-9010/20 indicates and alarms for intermittent loss of fuel gas to pilot 4. Air Quality Monitoring System to continuously monitor emissions	3	4	L	33. Evaluate activating an Emergency Shutdown (ESD) upon loss of fuel gas flow to the pilots for the Emission Control Devices (ECDs) BR-9010/20.	Summit Engineering	
	1.5. 2" manual valve in fuel line from Fuel Gas Scrubber V-3011 closed in error or 1" manual valve or 1/2" manual valve in fuel gas line to inlet of Fuel Gas Scrubber V-201 closed in error	1.5.1. Potential to decrease and lose flow of fuel gas to Fuel Gas Scrubber V-201. No hazardous consequences. Operability issue only. (upstream)							
		1.5.2. Potential to decrease and lose flow of fuel gas to Fuel Gas Scrubber V-201. Potential to decrease and lose flow of fuel gas and pilot gas to Burner B-201 for Horizontal Separator V-1120 (if not enough fuel gas is being produced in V-1120). Potential to decrease and lose heat to break emulsions. Potential to send emulsified fluids to Water Tank TK-4001/4 and Oil Tank TK-5001/2/3/6/7/8. Potential to require recycling of water and/or oil. No hazardous consequences. Operability issue only. (downstream)	1. Daily checks of equipment and operating conditions by Operator 2. Fuel gas supply from Horizontal Separator V-1120/1220 is a sufficient supplement (with 2" manual valve on Fuel Gas Scrubber V-201/202)						Flow of fuel gas is bidirectional
	1.6. Either 1/2" manual valve from gas outlet of 2-Phase Separator V-001 closed in error or Pressure Control Valve PCV-0104 upstream of Fuel Gas Scrubber V-201 malfunctions closed or set in error	1.6.1. Potential to decrease and lose flow of fuel gas from Horizontal Separator V-1120. No hazardous consequences. Operability issue only. (upstream)							
		1.6.2. Potential to decrease and lose flow of fuel gas from Horizontal Separator V-1120. Potential to decrease and lose flow of fuel gas to V-201. Potential to decrease and lose flow of fuel gas and pilot gas to Burner B-201 for Horizontal Separator V-1120 (if not enough fuel gas is being supplied from V-3011). Potential to decrease and lose heat to break emulsions. Potential to send emulsified fluids to Water Tank TK-4001/4 and Oil Tank TK-5001/2/3/6/7/8. Potential to require recycling of water and/or oil. No	1. Daily checks of equipment and operating conditions by Operator 2. Fuel gas supply from Horizontal Separator V-1120/1220 is a sufficient supplement (with 2" manual valve on Fuel Gas Scrubber V-201/202)						Flow of fuel gas is bidirectional

Node: 4. **Fuel Gas** from: Gas outlet of Sales Gas Scrubber V-3450 (FG1) thru Fuel Gas Scrubber V-3011 to Fuel Gas Header with supplies to: (1) Fuel Gas Scrubber V-201 and Burner Unit B-201 for Heater Unit H-101 for Horizontal Separator V-1120 (FG2); (2) Engine for LP Gas Compressor C-2510 (FG3); and (3) Pilots for Emission Control Device BR-9010/20 with Burner Management System BMS-9010/20 (FG4) **(orange)**

Drawings / References: 8365-01-1403; 8365-01-1409; 8365-01-1412; 8365-01-1413; 8365-01-1417

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
		hazardous consequences. Operability issue only. (downstream)							
	1.7. Internal liquid float in Fuel Gas Scrubber V-201 functions as designed or 1" Pressure Control Valve PCV-0103 on fuel gas to Burner B-201 of H-201 Heater for Horizontal Separator V-1120 malfunctions closed or set in error or 1" manual valve upstream of PCV-103 closed in error or 1" Motor Operated Valve MOV-0103 malfunctions closed or closed in error or 1" Temperature Control Valve TCV-0104 malfunctions closed or set in error or 1/2" manual valve in fuel line to Burner B-201 closed in error	1.7.1. Potential to decrease and lose flow of fuel gas from Fuel Gas Scrubber V-201. No hazardous consequences. Operability issue only. (upstream)							
		1.7.2. Potential to decrease and lose flow of fuel gas from Fuel Gas Scrubber V-201. Potential to decrease and lose flow of fuel gas to V-201. Potential to decrease and lose flow of fuel gas to Burner B-201 of H-201 Heater for Horizontal Separator V-1120. Potential to decrease and lose heat to break emulsions. Potential to send emulsified fluids to Water Tank TK-4001/4 and Oil Tank TK-5001/2/3/6/7/8. Potential to require recycling of water and/or oil. No hazardous consequences. Operability issue only. (downstream)	1. Daily checks of equipment and operating conditions by Operator 2. Periodic inspection and testing of control valves						Flow of fuel gas is bidirectional
	1.8. 1/4" Pressure Control Valve PCV-0108 on pilot gas line from Fuel Gas Scrubber V-201 to Burner B-201 of Heater H-201 for Horizontal Separator V-1120 malfunctions closed or set in error or 1/4" manual valve upstream of PCV-0108 closed in error	1.8.1. Potential to decrease and lose flow of pilot gas from Fuel Gas Scrubber V-201. No hazardous consequences. Operability issue only. (upstream)							
		1.8.2. Potential to decrease and lose flow of pilot gas from Fuel Gas Scrubber V-201. Potential to decrease and lose flow of pilot gas to Burner B-201 for Horizontal Separator V-1120. Potential to send unignited fuel gas through B-201 into atmosphere. Potential for local fire/explosion in Burner B-201 in Heater H-201. Potential personnel injury. Potential environmental impact. (downstream)	1. Operating procedures address proper manual valve alignment 2. Daily checks of equipment and operating conditions by Operator 3. Air Quality Monitoring System to continuously monitor emissions 4. Burner Management System BMS-unlabeled for Burner B-201 in Heater H-201 for Horizontal Separator V-1120 indicates and alarms for intermittent loss of fuel gas to pilot 5. Emergency Response Plan (ERP)	3	4	L	34. Determine the required action(s) by the Burner Management System (BMS) for the Burner B-201 in Heater H-201 for the Horizontal Separator V-1120 upon loss of pilot gas and flame to the Burner B-201 (e.g. 1/4" PCV-0108 malfunctions closed or set in error), to prevent sending unignited fuel gas through Heater H-201 into the atmosphere.	Summit Engineering	
2. Higher Flow	2.1. 2" Pressure Control Valve PCV-3011 upstream of Fuel Gas Scrubber V-3011 malfunctions open or set in error	2.1.1. Potential to increase flow of fuel gas to Fuel Gas Scrubber V-3011. Potential decrease flow and production of Sales Gas. No hazardous consequences. Operability issue only. (upstream)							
		2.1.2. Potential to increase flow of fuel gas to Fuel Gas Scrubber V-3011. Potential to increase pressure in and overpressure and rupture Fuel Gas Scrubber V-3011. Potential to release fuel gas and produced water (condensate) into atmosphere and onto ground. Potential fire/explosion. Potential personnel injury. Potential environmental impact. (downstream)	1. Daily checks of equipment and operating conditions by Operator 2. Pressure Safety Valve PSV-3011 on Fuel Gas Scrubber V-3011 set at ??? psig relieves to atmosphere at a safe location (above top of vessel) 3. Periodic inspection and testing of PSVs, PRVs, and PVRVs 4. Manual isolation valve upstream of PSV is car sealed open (CSO) 5. Emergency Response Plan (ERP)	2	4	M	13. Verify and document the sizing basis and set point for Pressure Safety Valve PSV-3011 on the Fuel Gas Scrubber V-3011. 24. Verify the design intent of the 4" Pressure Control Valve PCV-3107 downstream of the Sales Gas Scrubber V-3450 on the flare gas line to the Emission Control Devices (ECDs) BR-9010/20.	Summit Engineering Summit Engineering	
		2.1.3. Potential to increase flow and pressure of fuel gas to Fuel Gas Scrubber V-3011. Potential to increase pressure in and overpressure fuel gas in piping and/or LP Gas Compressor C-2510. Potential to release fuel gas into atmosphere. Potential fire/explosion. Potential personnel injury. Potential environmental impact. (downstream)	1. Daily checks of equipment and operating conditions by Operator 2. Pressure Control Valve PCV-3012 closes to reduce source pressure to LP Gas Compressor C-2510 3. Emergency Response Plan (ERP)	2	4	M	1. Verify with the vendor that the LP Gas Compressor C-2510 is equipped with a pressure safety valve (PSV) on the fuel gas line to its engine. 2. Evaluate installing a Pressure Indicator Transmitter (PIT) in the fuel gas line downstream of the 2" Pressure Control Valve PCV-3012 downstream of the Fuel Gas Scrubber V-3011 with a high-high pressure interlock to activate an Emergency Shutdown (ESD). 3. Evaluate installing a pressure safety valve (PSV) in the fuel gas line downstream of the 2" Pressure Control Valve PCV-3012 downstream of Fuel Gas Scrubber V-3011 to protect against on overpressure of the fuel	Summit Engineering Summit Engineering Summit Engineering	

Node: 4. **Fuel Gas** from: Gas outlet of Sales Gas Scrubber V-3450 (FG1) thru Fuel Gas Scrubber V-3011 to Fuel Gas Header with supplies to: (1) Fuel Gas Scrubber V-201 and Burner Unit B-201 for Heater Unit H-101 for Horizontal Separator V-1120 (FG2); (2) Engine for LP Gas Compressor C-2510 (FG3); and (3) Pilots for Emission Control Device BR-9010/20 with Burner Management System BMS-9010/20 (FG4) **(orange)**

Drawings / References: 8365-01-1403; 8365-01-1409; 8365-01-1412; 8365-01-1413; 8365-01-1417

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
							gas line.		
		2.1.4. Potential to increase flow of fuel gas to Fuel Gas Scrubber V-3011. Potential to increase pressure in and overpressure and rupture fuel gas in piping and/or to pilot system for Emission Control Device BR-9010/20. Potential to release fuel gas into atmosphere. Potential fire/explosion. Potential personnel injury. Potential environmental impact. (downstream)	1. Daily checks of equipment and operating conditions by Operator	3	4	L	25. Verify with the vendor that the fuel gas pilot system for the Emission Control Devices (ECDs) BR-9010/20 is equipped with a pressure safety valve (PSV) on the fuel gas line to the ECDs.	Summit Engineering	
			2. Pressure Control Valve PCV-3012 closes to reduce source pressure to fuel gas pilot for Emission Control Device BR-9010/20.				2. Evaluate installing a Pressure Indicator Transmitter (PIT) in the fuel gas line downstream of the 2" Pressure Control Valve PCV-3012 downstream of the Fuel Gas Scrubber V-3011 with a high-high pressure interlock to activate an Emergency Shutdown (ESD).	Summit Engineering	
			3. Emergency Response Plan (ERP)				3. Evaluate installing a pressure safety valve (PSV) in the fuel gas line downstream of the 2" Pressure Control Valve PCV-3012 downstream of Fuel Gas Scrubber V-3011 to protect against on overpressure of the fuel gas line.	Summit Engineering	
		2.1.5. Potential to increase flow of fuel gas to Fuel Gas Scrubber V-3011. Potential to increase pressure in and overpressure Fuel Gas Scrubber V-201 and/or piping. Potential to release fuel gas into atmosphere. Potential fire/explosion. Potential personnel injury. Potential environmental impact. (downstream)	1. Daily checks of equipment and operating conditions by Operator	3	5	N	12. Verify and document the sizing basis and set point for Pressure Safety Valve PSV-0103 on the Fuel Gas Scrubber V-201.	Summit Engineering	
			2. Pressure Control Valve PCV-3012 closes to reduce source pressure to Fuel Gas Scrubber V-201				2. Evaluate installing a Pressure Indicator Transmitter (PIT) in the fuel gas line downstream of the 2" Pressure Control Valve PCV-3012 downstream of the Fuel Gas Scrubber V-3011 with a high-high pressure interlock to activate an Emergency Shutdown (ESD).	Summit Engineering	
			3. Pressure Safety Valve PSV-0103 on Fuel Gas Scrubber V-201 set at ??? psig relieves to atmosphere to a safe location (outside of building)				3. Evaluate installing a pressure safety valve (PSV) in the fuel gas line downstream of the 2" Pressure Control Valve PCV-3012 downstream of Fuel Gas Scrubber V-3011 to protect against on overpressure of the fuel gas line.	Summit Engineering	
			4. Periodic inspection and testing of PSVs, PRVs, and PVRVs						
			5. Manual valve upstream of PSV is car sealed open (CSO)						
			6. Emergency Response Plan (ERP)						
	2.2. 2" Pressure Control Valve PCV-3012 downstream of Fuel Gas Scrubber V-3011 malfunctions open or set in error	2.2.1. Potential to maintain flow and pressure of fuel gas from Fuel Gas Scrubber V-3011. Potential to maintain pressure in Fuel Gas Scrubber V-3011. No hazardous consequences. Operability issue only. (upstream)							
		2.2.2. Potential to maintain flow and pressure of fuel gas from Fuel Gas Scrubber V-3011. Potential to maintain pressure to LP Gas Compressor C-2510. No hazardous consequences. Operability issue only. (downstream)							
		2.2.3. Potential to maintain flow and pressure of fuel gas from Fuel Gas Scrubber V-3011. Potential to maintain pressure to pilot system for Emission Control Device BR-9010/20. No hazardous consequences. Operability issue only. (downstream)							
		2.2.4. Potential to maintain flow and pressure of fuel gas from Fuel Gas Scrubber V-3011. Potential to maintain pressure to Fuel Gas Scrubber V-201. No hazardous consequences. Operability issue only. (downstream)							
	2.3. 1" Pressure Control Valve PCV-0104 on fuel gas line from Horizontal Separator V-1120 malfunctions open or set in error	2.3.1. Potential to increase flow of fuel gas to V-201. Potential to increase pressure in and overpressure Fuel Gas Scrubber V-201 and/or piping. Potential to release fuel gas into atmosphere. Potential fire/explosion. Potential personnel injury. Potential	1. Daily checks of equipment and operating conditions by Operator	2	4	M	26. Analyze and document the hydraulics of the fuel gas flow through Pressure Control Valve PCV-0104 on the fuel gas from the Horizontal Separator V-1120 versus the flow of downstream fuel gas users to	Summit Engineering	
			2. Fuel gas system user demands provide some relief of pressure						
			3. Pressure Safety Valve PSV-0103 on Fuel Gas						

Node: 4. **Fuel Gas** from: Gas outlet of Sales Gas Scrubber V-3450 (FG1) thru Fuel Gas Scrubber V-3011 to Fuel Gas Header with supplies to: (1) Fuel Gas Scrubber V-201 and Burner Unit B-201 for Heater Unit H-101 for Horizontal Separator V-1120 (FG2); (2) Engine for LP Gas Compressor C-2510 (FG3); and (3) Pilots for Emission Control Device BR-9010/20 with Burner Management System BMS-9010/20 (FG4) **(orange)**

Drawings / References: 8365-01-1403; 8365-01-1409; 8365-01-1412; 8365-01-1413; 8365-01-1417

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
		environmental impact. (downstream)	Scrubber V-201 set at ??? psig relieves to atmosphere to a safe location (outside of building)				reduce the potential for an overpressure and rupture of the Fuel Gas Scrubber V-201 and/or its piping in case of PCV-0104 malfunctioning open.		
			4. Periodic inspection and testing of PSVs, PRVs, and PVRVs						
			5. Manual valve upstream of PSV is car sealed open (CSO)						
			6. Emergency Response Plan (ERP)						
3. Reverse Flow	3.1. Increased demand on Horizontal Separator V-1120 from Fuel Gas Header	3.1.1. Potential to send fuel gas with liquids to Fuel Gas System. No hazardous consequences. Operability issue only.	1. 1/2" check valve between Fuel Gas Scrubber V-201 and Fuel Gas Header						
			2. Fuel Gas Scrubber V-201 designed to knock out liquids						
			3. Ability to manually drain Fuel Gas Scrubber V-201						
4. As Well As Flow	4.1. No credible causes identified by PHA Team								
5. Misdirected Flow	5.1. 2" normally closed (NC) manual valve in bypass line around Fuel Gas Scrubber V-3011 open in error or leaks through	5.1.1. Potential to bypass flow around Fuel Gas Scrubber V-3011. Potential decrease flow and production of Sales Gas. No hazardous consequences. Operability issue only. (upstream)							
		5.1.2. Potential to bypass flow around Fuel Gas Scrubber V-3011. Potential to increase pressure in and overpressure fuel gas in piping and/or LP Gas Compressor C-2510. Potential to release fuel gas into atmosphere. Potential fire/explosion. Potential personnel injury. Potential environmental impact. (downstream)	1. Operating procedures address proper manual valve alignment	2	3	MH	1. Verify with the vendor that the LP Gas Compressor C-2510 is equipped with a pressure safety valve (PSV) on the fuel gas line to its engine.	Summit Engineering	
			2. Daily checks of equipment and operating conditions by Operator				2. Evaluate installing a Pressure Indicator Transmitter (PIT) in the fuel gas line downstream of the 2" Pressure Control Valve PCV-3012 downstream of the Fuel Gas Scrubber V-3011 with a high-high pressure interlock to activate an Emergency Shutdown (ESD).	Summit Engineering	
			3. Pressure Control Valve PCV-3012 closes to reduce source pressure to LP Gas Compressor C-2510				3. Evaluate installing a pressure safety valve (PSV) in the fuel gas line downstream of the 2" Pressure Control Valve PCV-3012 downstream of Fuel Gas Scrubber V-3011 to protect against on overpressure of the fuel gas line.	Summit Engineering	
			4. Emergency Response Plan (ERP)						
		5.1.3. Potential to bypass flow around Fuel Gas Scrubber V-3011. Potential to increase pressure in and overpressure and rupture fuel gas in piping and/or to pilot system for Emission Control Device BR-9010/20. Potential to release fuel gas into atmosphere. Potential fire/explosion. Potential personnel injury. Potential environmental impact. (downstream)	1. Operating procedures address proper manual valve alignment	3	3	M	25. Verify with the vendor that the fuel gas pilot system for the Emission Control Devices (ECDs) BR-9010/20 is equipped with a pressure safety valve (PSV) on the fuel gas line to the ECDs.	Summit Engineering	
			2. Daily checks of equipment and operating conditions by Operator				2. Evaluate installing a Pressure Indicator Transmitter (PIT) in the fuel gas line downstream of the 2" Pressure Control Valve PCV-3012 downstream of the Fuel Gas Scrubber V-3011 with a high-high pressure interlock to activate an Emergency Shutdown (ESD).	Summit Engineering	
			3. Pressure Control Valve PCV-3012 closes to reduce source pressure to fuel gas pilot for Emission Control Device BR-9010/20.				3. Evaluate installing a pressure safety valve (PSV) in the fuel gas line downstream of the 2" Pressure Control Valve PCV-3012 downstream of Fuel Gas Scrubber V-3011 to protect against on overpressure of the fuel gas line.	Summit Engineering	
			4. Emergency Response Plan (ERP)						
		5.1.4. Potential to bypass flow around Fuel Gas Scrubber V-3011. Potential to increase pressure in and overpressure Fuel Gas Scrubber V-201 and/or piping. Potential to release fuel gas into atmosphere. Potential fire/explosion. Potential personnel injury. Potential environmental impact. (downstream)	1. Operating procedures address proper manual valve alignment	3	4	L	12. Verify and document the sizing basis and set point for Pressure Safety Valve PSV-0103 on the Fuel Gas Scrubber V-201.	Summit Engineering	
			2. Daily checks of equipment and operating conditions by Operator				2. Evaluate installing a Pressure Indicator Transmitter (PIT) in the fuel gas line downstream of the 2" Pressure Control	Summit Engineering	

Node: 4. **Fuel Gas** from: Gas outlet of Sales Gas Scrubber V-3450 (FG1) thru Fuel Gas Scrubber V-3011 to Fuel Gas Header with supplies to: (1) Fuel Gas Scrubber V-201 and Burner Unit B-201 for Heater Unit H-101 for Horizontal Separator V-1120 (FG2); (2) Engine for LP Gas Compressor C-2510 (FG3); and (3) Pilots for Emission Control Device BR-9010/20 with Burner Management System BMS-9010/20 (FG4) **(orange)**

Drawings / References: 8365-01-1403; 8365-01-1409; 8365-01-1412; 8365-01-1413; 8365-01-1417

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
							Valve PCV-3012 downstream of the Fuel Gas Scrubber V-3011 with a high-high pressure interlock to activate an Emergency Shutdown (ESD).		
			3. Pressure Control Valve PCV-3012 closes to reduce source pressure to Fuel Gas Scrubber V-201				3. Evaluate installing a pressure safety valve (PSV) in the fuel gas line downstream of the 2" Pressure Control Valve PCV-3012 downstream of Fuel Gas Scrubber V-3011 to protect against on overpressure of the fuel gas line.	Summit Engineering	
			4. Pressure Safety Valve PSV-0103 on Fuel Gas Scrubber V-201 set at ??? psig relieves to atmosphere to a safe location (outside of building)						
			5. Periodic inspection and testing of PSVs, PRVs, and PVRVs						
			6. Manual valve upstream of PSV is car sealed open (CSO)						
			7. Emergency Response Plan (ERP)						
	5.2. Pressure Safety Valve PSV-0103 on Fuel Gas Scrubber V-201 set in error or leaks through	5.2.1. Potential to release unignited gas into atmosphere at a safe location (outside of building). Potential to decrease supply of fuel gas to Fuel Gas System. No hazardous consequences. Operability issue only. (upstream)							
		5.2.2. Potential to release unignited gas into atmosphere at a safe location (outside of building). No hazardous consequences. Operability issue only. (downstream)	1. Periodic inspection and testing of PSVs, PRVs, and PVRVs						Release of lighter-than-air flammable gas into the atmosphere at an elevated safe location is expected to disperse and not produce a fire since an ignition source is not present.
			2. Daily checks of equipment and operating conditions by Operator						
			3. Leak detection and repair (LDAR) program to periodically monitor emissions						
			4. Air Quality Monitoring System to continuously monitor emissions						
	5.3. Pressure Safety Valve PSV-3011 on Fuel Gas Scrubber V-3011 set in error or leaks through	5.3.1. Potential to release unignited gas into atmosphere at a safe location (above top of vessel). Potential to decrease supply of fuel gas to Fuel Gas System. No hazardous consequences. Operability issue only. (upstream)							
		5.3.2. Potential to release unignited gas into atmosphere at a safe location (above top of vessel). No hazardous consequences. Operability issue only. (downstream)	1. Periodic inspection and testing of PSVs, PRVs, and PVRVs						Release of lighter-than-air flammable gas into the atmosphere at an elevated safe location is expected to disperse and not produce a fire since an ignition source is not present.
			2. Daily checks of equipment and operating conditions by Operator						
			3. Leak detection and repair (LDAR) program to periodically monitor emissions						
			4. Air Quality Monitoring System to continuously monitor emissions						
	5.4. 1" manual valve from gas outlet of Fuel Gas Scrubber V-201 open in error or leaks through	5.4.1. Potential to release unignited gas into atmosphere at a safe location (outside of building). Potential to decrease supply of fuel gas to Fuel Gas System. No hazardous consequences. Operability issue only. (upstream)							
		5.4.2. Potential to release unignited gas into atmosphere at a safe location (outside of building). No hazardous consequences. Operability issue only. (downstream)	1. Operating procedures address proper manual valve alignment						Release of lighter-than-air flammable gas into the atmosphere at an elevated safe location is expected to disperse and not produce a fire since an ignition source is not present.
			2. Daily checks of equipment and operating conditions by Operator						
			3. Leak detection and repair (LDAR) program to periodically monitor emissions						
			4. Air Quality Monitoring System to continuously monitor emissions						
6. No Pressure (Vacuum)	6.1. No credible causes identified by PHA Team								
7. Lower Pressure	7.1. No new causes, refer to No/Less Flow deviation in this node								

Node: 4. **Fuel Gas** from: Gas outlet of Sales Gas Scrubber V-3450 (FG1) thru Fuel Gas Scrubber V-3011 to Fuel Gas Header with supplies to: (1) Fuel Gas Scrubber V-201 and Burner Unit B-201 for Heater Unit H-101 for Horizontal Separator V-1120 (FG2); (2) Engine for LP Gas Compressor C-2510 (FG3); and (3) Pilots for Emission Control Device BR-9010/20 with Burner Management System BMS-9010/20 (FG4) **(orange)**

Drawings / References: 8365-01-1403; 8365-01-1409; 8365-01-1412; 8365-01-1413; 8365-01-1417

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
8. Higher Pressure	8.1. No new causes, refer to Higher Flow deviation in this node								
9. No/Lower Level	9.1. No new causes, refer to Higher Flow and Higher Temperature deviation in this node								
10. Higher Level	10.1. No new causes, refer to Contamination deviation in this node								
11. Lower Temperature	11.1. No new causes, refer to No/Less Flow deviation in this node								
12. Higher Temperature	12.1. Burner Management System BMS-unlabeled malfunctions high or excess upstream fuel gas flow to Burner B-201 of Heater H-201 for Horizontal Separator V-1120 or 1" Pressure Control Valve PCV-0103 malfunctions open or set in error or 1" Temperature Control Valve TCV-0104 malfunctions open or set in error or both 1/4" manual valves in bypass line around Fuel Gas Scrubber V-201 open in error or leak through	12.1.1. Potential to increase fuel gas flow to Burner B-201 of Heater H-201 for Horizontal Separator V-1120. Potential to decrease and lose production of Sales Gas. No hazardous consequences. Operability issue only. (upstream)							
		12.1.2. Potential to increase fuel gas flow to Burner B-201 of Heater H-201 for Horizontal Separator V-1120. Potential to increase heat to and temperature in Horizontal Separator V-1120. Potential to decrease and lose level in Horizontal Separator V-1120 and increase pressure in and overpressure and rupture Horizontal Separator V-1120. Potential to damage gaskets and burner tubes. Potential to create an open flame inside of Horizontal Separator V-1120. Potential to release produced oil, produced water and produced gas into atmosphere and onto ground. Potential fire/explosion. Potential personnel injury. Potential environmental impact. (downstream)	1. Operating procedures address proper manual valve alignment 2. Periodic inspection and testing of Burner Management System BMS-unlabeled for Burner B-201 in Heater H-201 for Horizontal Separator V-1120 3. Periodic inspection and testing of control valves 4. Daily checks of equipment and operating conditions by Operator 5. Temperature Control Valve TCV-0104 closes to maintain temperature (if loop does not malfunction) 6. Temperature Controller TC-103 closes MOV-0103 upon detection of high temperature 7. Level Switch Low-Low LSLL-0101 on Horizontal Separator V-1120 alarms and BMS-unlabeled for Burner B-201 in Heater H-201 for Horizontal Separator V-1120 shuts off fuel gas supply 8. High Pressure Alarm on Pressure Indicator PI-0102 on Horizontal Separator V-1120 9. High-High Pressure Alarm on Pressure Indicator PI-0102 on Horizontal Separator V-1120 10. High-High Pressure Indicator Transmitter PIT-0102 on gas outlet of Horizontal Separator V-1120 activates an ESD 11. Ability to manually activate an Emergency Shutdown (ESD) 12. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead 13. Pressure Safety Valve PSV-0101 on Horizontal Separator V-1120 set at 125 psig relieves to atmosphere at a safe location (10-15 feet above grade) 14. Periodic inspection and testing of PSVs, PRVs, and PVRVs 15. Manual valve upstream of PSV is car sealed open (CSO) 16. Emergency Response Plan (ERP)	1	5	M	27. Review the temperature control scheme (e.g. Temperature Control Valve TCV-0104) for the Horizontal Separator V-1120 based on the vendor package. 28. Verify the sizing basis for Pressure Safety Valve PSV-0101 on the Horizontal Separator V-1120 for steam service, in case of Burner Management System BMS-201 malfunctioning high or an excess upstream fuel gas flow to the Heater H-201 causing a high temperature deviation with steam generation.	Summit Engineering Summit Engineering	
13. Composition	13.1. No credible causes identified by PHA Team								

Node: 4. **Fuel Gas** from: Gas outlet of Sales Gas Scrubber V-3450 (FG1) thru Fuel Gas Scrubber V-3011 to Fuel Gas Header with supplies to: (1) Fuel Gas Scrubber V-201 and Burner Unit B-201 for Heater Unit H-101 for Horizontal Separator V-1120 (FG2); (2) Engine for LP Gas Compressor C-2510 (FG3); and (3) Pilots for Emission Control Device BR-9010/20 with Burner Management System BMS-9010/20 (FG4) **(orange)**

Drawings / References: 8365-01-1403; 8365-01-1409; 8365-01-1412; 8365-01-1413; 8365-01-1417

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
14. Contamination	14.1. Internal liquid float in Fuel Gas Scrubber V-201 malfunctions open	14.1.1. Potential to increase level in Fuel Gas Scrubber V-201 and send fuel gas with liquids to Fuel Gas System and Burner B-201 in Heater H-201 for Horizontal Separator V-1120. No hazardous consequences. Operability issue only.	1. Ability to manually drain Fuel Gas Scrubber V-201						
15. Instrumentation	15.1. No new causes, refer to Higher Temperature deviation in this node								
16. Sampling	16.1. No credible causes identified by PHA Team								
17. Leak/Rupture	17.1. Flange / gasket / tubing / valve	17.1.1. Potential to leak hydrocarbons into atmosphere. Potential fire/explosion. Potential thermal exposure and personnel injury. Potential environmental impact.	1. Gasket replacement program as part of maintenance activity 2. Daily checks of equipment and operating conditions by Operator 3. Leak detection and repair (LDAR) program to periodically monitor emissions 4. Air Quality Monitoring System to continuously monitor emissions 5. Emergency Response Plan (ERP)	3	4	L			
18. Corrosion	18.1. No credible causes identified by PHA Team								
19. Erosion	19.1. No credible causes identified by PHA Team								
20. Loss of Utility	20.1. No credible causes identified by PHA Team								
21. Service Failure	21.1. No credible causes identified by PHA Team								
22. Startup	22.1. No credible causes identified by PHA Team								
23. Shutdown	23.1. No credible causes identified by PHA Team								
24. Maintenance	24.1. No credible causes identified by PHA Team								
25. Inspection	25.1. No credible causes identified by PHA Team								
26. Human Factors	26.1. No new causes, refer to No/Lower Level deviation in this node								
27. Facility Siting	27.1. Vehicular traffic operating in close proximity to process equipment	27.1.1. Potential for vehicles to collide with or otherwise contact process equipment, piping or instrumentation containing produced fluids. Potential to release fuel gas and produced water (condensate) into atmosphere and onto ground. Potential fire/explosion. Potential personnel injury. Potential environmental impact.	1. Daily checks of equipment and operating conditions by Operator 2. Physical barriers designed to protect process equipment and piping 3. Emergency Response Plan (ERP)	3	3	M	11. Develop a written vehicular Traffic Safety Control Plan with prevention and mitigation measures around any vulnerable process equipment, to provide assurance that safe work practices for the control of hazards during production activities are in place.	GMT	

Node: 5. **Produced Oil** from: Liquid outlet of 2-Phase Separator V-001 (PO1) into and thru Horizontal Separator V-1120 (PO2) thru Produced Oil Header thru liquid separation from Vapor Recovery Tower V-2000 (PO3) and thru Oil Tank TK-5001/2/3/6/7/8 to Truck Loadout **(green)**

Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
1. No/Less Flow	1.1. No new causes, refer to Higher Level deviation in this node								
2. Higher Flow	2.1. No new causes, refer to No/Lower Level deviation in this node								
3. Reverse Flow	3.1. No new causes, refer to No/Lower Level and Higher Level deviations in this node	3.1.1.							
	3.2. No credible causes identified by PHA Team	3.2.1.	1. 4" check valve on produced oil outlet of Vapor Recovery Tower V-2000 is designed to prevent backflow from Produced Oil Header						
4. As Well As Flow	4.1. No new causes, refer to No/Lower Level deviation in this node	4.1.1. Refer to scenarios for gas blowby in No/Lower Level deviation in this node							
5. Misdirected Flow	5.1. 6" manual valve on bypass line around Vapor Recovery Tower V-2000 open in error or leaks through	5.1.1. Potential to send produced oil through bypass line around Vapor Recovery Tower V-2000 and directly to Oil Tank TK-5001/2/3/6/7/8. Potential to decrease flow of produced gas to Sales Gas. No hazardous consequence. Operability issue only. (upstream)							
		5.1.2. Potential to send produced oil through bypass line around Vapor Recovery Tower V-2000 and directly to Oil Tank TK-5001/2/3/6/7/8 without recovering produced gas. Potential to send produced gas into Oil Tank TK-5001/2/3/6/7/8. Potential to increase flow of produced gas from Oil Tank TK-5001/2/3/6/7/8 to Emission Control Device BR-9010/20. No hazardous consequence. Operability issue only. (downstream)							
	5.2. 3" manual valve on inlet of a single Oil Tank TK-5001/2/3/6/7/8 closed in error	5.2.1. Potential to decrease flow of produced oil to tank with closed valve. Potential to misdirect produced oil to and overfill tank with open valve. Potential to equalize levels of tanks via common overfill line. No hazard consequences. Operability issue only.							
6. No Pressure (Vacuum)	6.1. No credible causes identified by PHA Team	6.1.1. Refer to hazard scenario for loss of blanket gas and potential to decrease and lose blanket gas for Oil Tank TK-5001/2/3/6/7/8 and Water Tank TK-4001/4; potential to create vacuum in and collapse Oil Tank TK-5001/2/3/6/7/8 and/or Water Tank TK-4001/4 during truck loadout in No/Less Flow deviation in Node 2.							
7. Lower Pressure	7.1. No credible causes identified by PHA Team								
8. Higher Pressure	8.1. No new causes, refer to No/Lower Level deviation in this node								
9. No/Lower Level	9.1. 2" Level Control Valve LCV-0103 on 2-Phase Separator V-001 malfunctions open or open in error or set in error	9.1.1. Potential to decrease flow of produced gas to Sales Gas Header. Potential to decrease flow and production of Sales Gas. Operability issue only. (upstream)							
		9.1.2. Potential to decrease and lose level in 2-Phase Separator V-001. Potential to send (gas blowby) produced gas to Horizontal Separator V-1120. Potential to increase pressure in and overpressure and rupture Horizontal Separator V-1120. Potential to release produced fluids into atmosphere and onto ground. Potential fire/explosion. Potential personnel injury. Potential environmental impact. (downstream)	1. Periodic inspection and testing of control valves	1	5	M			PHA team deemed existing safeguards were adequate (sufficient and effective) for this hazard scenario
			2. Daily checks of equipment and operating conditions by Operator						Trucks could be in the area of the event when this hazard scenario event occurs.
			3. Low-Low Level Alarm LALL-0104 on 2-Phase Separator V-001 (independent of LC-0103)						
			4. Level Switch Low-Low LSLL-0104 on 2-Phase Separator V-001 (independent of LC-0103) activates an ESD						
			5. High Pressure Alarm on Pressure Indicator Transmitter PIT-0102 on gas outlet of Horizontal Separator V-1120						
			6. High-High Pressure Alarm on Pressure Indicator Transmitter PIT-0102 on gas outlet of						

Node: 5. **Produced Oil** from: Liquid outlet of 2-Phase Separator V-001 (PO1) into and thru Horizontal Separator V-1120 (PO2) thru Produced Oil Header thru liquid separation from Vapor Recovery Tower V-2000 (PO3) and thru Oil Tank TK-5001/2/3/6/7/8 to Truck Loadout **(green)**
Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
			Horizontal Separator V-1120						
			7. High-High Pressure on Pressure Indicator Transmitter PIT-0102 on gas outlet of Horizontal Separator V-1120 activates an ESD						
			8. Ability to manually activate an Emergency Shutdown (ESD)						
			9. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead						
			10. Level Control Valve LCV-0101 on Horizontal Separator V-1120 designed to open to maintain level and may relieve some pressure						
			11. Pressure Safety Valve PSV-0101 on Horizontal Separator V-1120 set at 125 psig relieves to atmosphere at a safe location (10-15 feet above grade)						
			12. Periodic inspection and testing of PSVs, PRVs, and PVRVs						
			13. Manual isolation valve upstream of PSV is car sealed open (CSO)						
			14. Emergency Response Plan (ERP)						
		9.1.3. Potential to send (reverse flow) produced gas from other sources from C-2510 Suction Header and Blanket Gas Header to increase release amount and escalate fire/explosion. Potential personnel injury. Potential environmental impact. (downstream)	1. Periodic inspection and testing of control valves	1	5	M			PHA team deemed existing safeguards were adequate (sufficient and effective) for this hazard scenario
			2. Daily checks of equipment and operating conditions by Operator						Trucks could be in the area of the event when this hazard scenario event occurs.
			3. Low-Low Level Alarm LALL-0104 on 2-Phase Separator V-001 (independent of LC-0103)						
			4. Level Switch Low-Low LSLL-0104 2-Phase Separator V-001 (independent of LC-0103) activates an ESD						
			5. High Pressure Alarm on Pressure Indicator Transmitter PIT-0102 on gas outlet of Horizontal Separator V-1120						
			6. High-High Pressure Alarm on Pressure Indicator Transmitter PIT-0102 on gas outlet of Horizontal Separator V-1120						
			7. High-High Pressure on Pressure Indicator Transmitter PIT-0102 on gas outlet of Horizontal Separator V-1120 activates an ESD						
			8. Ability to manually activate an Emergency Shutdown (ESD)						
			9. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead						
			10. Level Control Valve LCV-0101 on Horizontal Separator V-1120 designed to open to maintain level and may relieve some pressure						
			11. Pressure Safety Valve PSV-0101 on Horizontal Separator V-1120 set at 125 psig relieves to atmosphere at a safe location (10-15 feet above grade)						
			12. Periodic inspection and testing of PSVs, PRVs, and PVRVs						
			13. Manual isolation valve upstream of PSV is car sealed open (CSO)						
			14. 2" check valve on produced gas outlet of Horizontal Separator V-1120 downstream of Pressure Control Valve PCV-0101 is designed						

Node: 5. **Produced Oil** from: Liquid outlet of 2-Phase Separator V-001 (PO1) into and thru Horizontal Separator V-1120 (PO2) thru Produced Oil Header thru liquid separation from Vapor Recovery Tower V-2000 (PO3) and thru Oil Tank TK-5001/2/3/6/7/8 to Truck Loadout **(green)**
Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
			to prevent backflow from C-2510 Suction Header to leak point						
			15. 2" check valve on produced gas outlet of Horizontal Separator V-1120 downstream of Pressure Control Valve PCV-0102 is designed to prevent backflow from Blanket Gas Header to leak point						
			16. 6" check valve at Produced Gas Meter Skid is designed to prevent backflow from Sales Gas Header to leak point						
			17. Emergency Response Plan (ERP)						
		9.1.4. Potential to send (reverse flow) produced oil from other sources from Produced Oil Header to increase release amount and escalate fire/explosion. Potential personnel injury. Potential environmental impact. Refer to above hazard scenario with same cause for No/Lower Level deviation in this node. (downstream)	1. Periodic inspection and testing of control valves	1	5	M			PHA team deemed existing safeguards were adequate (sufficient and effective) for this hazard scenario
			2. Daily checks of equipment and operating conditions by Operator						Trucks could be in the area of the event when this hazard scenario event occurs.
			3. Low-Low Level Alarm LALL-0104 on 2-Phase Separator V-001 (independent of LC-0103)						
			4. Level Switch Low-Low LSLL-0104 on 2-Phase Separator V-001 (independent of LC-0103) activates an ESD						
			5. High Pressure Alarm on Pressure Indicator Transmitter PIT-0102 on gas outlet of Horizontal Separator V-1120						
			6. High-High Pressure Alarm on Pressure Indicator Transmitter PIT-0102 on gas outlet of Horizontal Separator V-1120						
			7. High-High Pressure on Pressure Indicator Transmitter PIT-0102 on gas outlet of Horizontal Separator V-1120 activates an ESD						
			8. Ability to manually activate an Emergency Shutdown (ESD)						
			9. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead						
			10. Level Control Valve LCV-0101 on Horizontal Separator V-1120 designed to open to maintain level and may relieve some pressure						
			11. Pressure Safety Valve PSV-0101 on Horizontal Separator V-1120 set at 125 psig relieves to atmosphere at a safe location (10-15 feet above grade)						
			12. Periodic inspection and testing of PSVs, PRVs, and PVRVs						
			13. Manual isolation valve upstream of PSV is car sealed open (CSO)						
			14. 2" check valve on produced oil outlet of Horizontal Separator V-1120 is designed to prevent backflow from Produced Oil Header to leak point						
			15. Emergency Response Plan (ERP)						
	9.2. 2" Level Control Valve LCV-0101 on Horizontal Separator V-1120 malfunctions open or open in error	9.2.1. Potential to decrease level in Horizontal Separator V-1120. Potential to send (gas blowby) produced gas to Vapor Recovery Tower V-2000. Potential to increase pressure in but insufficient to overpressure Vapor Recovery Tower V-2000. Potential to decrease level in Vapor Recovery Tower V-2000 and send (gas blowby) produced gas to Oil Tank TK-5001/2/3/6/7/8 and/or Water Tank TK-4001/4. Potential to increase pressure	1. Periodic inspection and testing of control valves	1	5	M			PHA team deemed existing safeguards were adequate (sufficient and effective) for this hazard scenario
			2. Daily checks of equipment and operating conditions by Operator						Trucks could be in the area of the event when this hazard scenario event occurs.
			3. Restricted Orifice RO-0101 in produced oil line restricts flow						

Node: 5. **Produced Oil** from: Liquid outlet of 2-Phase Separator V-001 (PO1) into and thru Horizontal Separator V-1120 (PO2) thru Produced Oil Header thru liquid separation from Vapor Recovery Tower V-2000 (PO3) and thru Oil Tank TK-5001/2/3/6/7/8 to Truck Loadout **(green)**
Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
		and overpressure and rupture Oil Tank TK-5001/2/3/6/7/8 and/or Water Tank TK-4001/4. Potential to release produced oil and/or produced water and produced gas into atmosphere and onto ground. Potential fire/explosion. Potential personnel injury. Potential environmental impact. (downstream)	4. Low-Low Level Alarm LALL-0101 on Horizontal Separator (independent of LC-0101) activates an ESD						
			5. Low-Low Level Alarm LALL-2000 on Vapor Recovery Tower V-2000						
			6. Level Switch Low-Low LSLL-2000 on Vapor Recovery Tower V-2000 activates an ESD						
			7. Ability to manually activate an Emergency Shutdown (ESD)						
			8. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead						
			9. Pressure Control Valve PCV-2301 on flare gas line to Emission Control Device BR-9010/20 relieves some of the pressure						
			10. Manual isolation valves upstream and downstream of Pressure Control Valve PCV-2301 on flare gas line to Emission Control Device BR-9010/20 are car sealed open (CSO)						
			11. Pressure Relief Valve PRV-5110 on Flare Gas line on Oil Tank TK-5001/2/3/6/7/8 and Water Tank TK-4001/4 set at 14 oz/in2 relieves to atmosphere at a safe location (above top of tank)						
			12. Pressure Vacuum Relief Valve PVRV-5101/2/3/6/7/8 on Oil Tank TK-5001/2/3/6/7/8 set at 16 oz/in2 designed to relieve into atmosphere at a safe location (above top of tank)						
			13. Pressure Vacuum Relief Valve PVRV-4001/4 on Water Tank TK-4001/4 set at 16 oz/in2 designed to relieve into atmosphere at a safe location (above top of tank)						
			14. Periodic inspection and testing of PSVs, PRVs, and PVRVs						
			15. Secondary and tertiary containment for Oil Tank TK-5001/2/3/6/7/8						
			16. Secondary and tertiary containment for Water Tank TK-4001/4						
			17. Emergency Response Plan (ERP)						
		9.2.2. Potential to temporarily increase flow of produced oil to Produced Oil Header. Potential to temporarily increase flow and production of produced oil. Operability issue only. (downstream)							
10. Higher Level	10.1. 2" Level Control Valve LCV-0103 on 2-Phase Separator V-001 malfunctions closed or closed in error or set in error or either 2" manual isolation valve around LCV-0103 closed in error	10.1.1. Potential to increase level in and overfill 2-Phase Separator V-001. Potential to send (carry over) produced oil to Sales Gas Header. Potential to increase level in and overfill Sales Gas Scrubber V-3450. Potential to send (carry over) produced oil to and contaminate Sales Gas. Potential to damage Sales Gas Compressor (if compressor is in scope later). No hazardous consequences. Operability issue only. (upstream/ downstream)							
		10.1.2. Potential to increase level in and overfill 2-Phase Separator V-001. Potential to send (carry over) produced oil to Produced Gas Header. Potential to increase level in and overfill Sales Gas Scrubber V-3450. Potential to send (carry over) produced oil to and contaminate fuel gas system. Potential to send (carry over) produced oil to Fuel Gas Scrubber V-3011. Potential to increase level in and overfill Fuel	1. Operating procedures address proper manual valve alignment	3	5	N			
			2. Periodic inspection and testing of control valves						
			3. Daily checks of equipment and operating conditions by Operator						
			4. High-High Level Alarm LAHH-0104 on 2-Phase Separator V-001 (independent of LC-0103)						

Node: 5. **Produced Oil** from: Liquid outlet of 2-Phase Separator V-001 (PO1) into and thru Horizontal Separator V-1120 (PO2) thru Produced Oil Header thru liquid separation from Vapor Recovery Tower V-2000 (PO3) and thru Oil Tank TK-5001/2/3/6/7/8 to Truck Loadout **(green)**
Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
		Gas Scrubber V-3011. Potential to send (carry over) produced oil into and contaminate fuel gas system. Potential to send produced oil in fuel gas to Emission Control Device BR-9010/20 with release of hot burning or unignited liquid into atmosphere and onto ground. Potential personnel injury. Potential environmental impact. (upstream/ downstream)	5. Level Switch High-High LSHH-0104 on 2-Phase Separator V-001 (independent of LC-0103) activates an ESD						
			6. Ability to manually activate an Emergency Shutdown (ESD)						
			7. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead						
			8. Level Control Valve LCV-3450 on Sales Gas Scrubber V-3450 designed to maintain level						
			9. High-High Level Alarm LAHH-3450 on Sales Gas Scrubber V-3450 (independent of LC-3450)						
			10. Level Control Valve LCV-3011 on Fuel Gas Scrubber V-3011 designed to maintain level						
			11. High-High Level Alarm LAHH-3011 on Fuel Gas Scrubber V-3011 (independent of LC-3011)						
			12. Ability to manually drain Fuel Gas Scrubber V-3011						
			13. ECD Pilot Scrubber Pot						
			14. Burner Management System BMS-9010/20 for Emission Control Device BR-9010/20 indicates and alarms for intermittent loss of fuel gas to pilot						
			15. Emergency Response Plan (ERP)						
		10.1.3. Potential to increase level in and overfill 2-Phase Separator V-001. Potential to send (carry over) produced oil to Produced Gas Header. Potential to increase level in and overfill Sales Gas Scrubber V-3450. Potential to send (carry over) produced oil into and contaminate fuel gas system. Potential to send (carry over) oil to Fuel Gas Scrubber V-3011. Potential to increase level in and overfill Fuel Gas Scrubber V-3011. Potential to send (carry over) produced oil into and contaminate fuel gas system. Potential to send produced oil in fuel gas to and damage LP Gas Compressor C-2150 engine. No hazardous consequences. Operability issue only. (upstream/ downstream)	1. Operating procedures address proper manual valve alignment						
			2. Periodic inspection and testing of control valves						
			3. Daily checks of equipment and operating conditions by Operator						
			4. High-High Level Alarm LAHH-0104 on 2-Phase Separator V-001 (independent of LC-0103)						
			5. Level Switch High-High LSHH-0104 on 2-Phase Separator V-001 (independent of LC-0103) activates an ESD						
			6. Ability to manually activate an Emergency Shutdown (ESD)						
			7. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead						
			8. Level Control Valve LCV-3450 on Sales Gas Scrubber V-3450 designed to maintain level						
			9. High-High Level Alarm LAHH-3450 on Sales Gas Scrubber V-3450 (independent of LC-3450)						
			10. Level Control Valve LCV-3011 on Fuel Gas Scrubber V-3011 designed to maintain level						
			11. High-High Level Alarm LAHH-3011 on Fuel Gas Scrubber V-3011 (independent of LC-3011)						
			12. Ability to manually drain Fuel Gas Scrubber V-3011						
			13. Compressor Fuel Gas Scrubber Pot						
	10.2. 2" Level Control Valve LCV-0101 on Horizontal Separator V-1120 malfunctions closed or closed in error or any one of three 2" manual isolation valves around LCV-0101 closed in error or 4" manual	10.2.1. Potential to increase level in and overfill Horizontal Separator V-1120. Potential to increase pressure in and overpressure and rupture Horizontal Separator V-1120. Potential to release produced fluids into atmosphere and onto ground. Potential	1. Operating procedures address proper manual valve alignment	1	5	M			PHA team deemed existing safeguards were adequate (sufficient and effective) for this hazard scenario
			2. Periodic inspection and testing of control valves						Trucks could be in the area

Node: 5. **Produced Oil** from: Liquid outlet of 2-Phase Separator V-001 (PO1) into and thru Horizontal Separator V-1120 (PO2) thru Produced Oil Header thru liquid separation from Vapor Recovery Tower V-2000 (PO3) and thru Oil Tank TK-5001/2/3/6/7/8 to Truck Loadout **(green)**

Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
	valve on inlet of Vapor Recovery Tower V-2000 closed in error	fire/explosion. Potential personnel injury. Potential environmental impact. (upstream)	3. Daily checks of equipment and operating conditions by Operator						of the event when this hazard scenario event occurs.
			4. Level Switch High-High LSHH-0101 on Horizontal Separator V-1120 (independent of LC-0101) closes Shutdown Valve SDV-0101						
			5. High Pressure Alarm on Pressure Indicator Transmitter PIT-0102 on gas outlet of Horizontal Separator V-1120						
			6. High-High Pressure Alarm on Pressure Indicator Transmitter PIT-0102 on gas outlet of Horizontal Separator V-1120						
			7. High-High Pressure Indicator Transmitter PIT-0102 on gas outlet of Horizontal Separator V-1120 activates an ESD						
			8. Ability to manually activate an Emergency Shutdown (ESD)						
			9. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead						
			10. Pressure Safety Valve PSV-0101 on Horizontal Separator V-1120 set at 125 psig relieves to atmosphere at a safe location (10-15 feet above grade)						
			11. Periodic inspection and testing of PSVs, PRVs, and PVRVs						
			12. Manual isolation valve upstream of PSV is car sealed open (CSO)						
			13. Emergency Response Plan (ERP)						
		10.2.2. Potential to send (reverse flow) produced gas from other sources from C-2510 Suction Header and Blanket Gas Header to increase release amount and escalate fire/explosion. Potential personnel injury. Potential environmental impact. (upstream)	1. Operating procedures address proper manual valve alignment	1	5	M			PHA team deemed existing safeguards were adequate (sufficient and effective) for this hazard scenario
			2. Periodic inspection and testing of control valves						Trucks could be in the area of the event when this hazard scenario event occurs.
			3. Daily checks of equipment and operating conditions by Operator						
			4. Level Switch High-High LSHH-0101 on Horizontal Separator V-1120 (independent of LC-0101) closes Shutdown Valve SDV-0101						
			5. High Pressure Alarm on Pressure Indicator Transmitter PIT-0102 on gas outlet of Horizontal Separator V-1120						
			6. High-High Pressure Alarm on Pressure Indicator Transmitter PIT-0102 on gas outlet of Horizontal Separator V-1120						
			7. High-High Pressure Indicator Transmitter PIT-0102 on gas outlet of Horizontal Separator V-1120 activates an ESD						
			8. Ability to manually activate an Emergency Shutdown (ESD)						
			9. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead						
			10. Pressure Safety Valve PSV-0101 on Horizontal Separator V-1120 set at 125 psig relieves to atmosphere at a safe location (10-15 feet above grade)						
			11. Periodic inspection and testing of PSVs, PRVs, and PVRVs						
			12. Manual isolation valve upstream of PSV is car sealed open (CSO)						

Node: 5. **Produced Oil** from: Liquid outlet of 2-Phase Separator V-001 (PO1) into and thru Horizontal Separator V-1120 (PO2) thru Produced Oil Header thru liquid separation from Vapor Recovery Tower V-2000 (PO3) and thru Oil Tank TK-5001/2/3/6/7/8 to Truck Loadout **(green)**
Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
			13. 2" check valve on produced gas outlet of Horizontal Separator V-1120 downstream of Pressure Control Valve PCV-0101 is designed to prevent backflow from C-2510 Suction Header to leak point						
			14. 2" check valve on produced gas outlet of Horizontal Separator V-1120 downstream of Pressure Control Valve PCV-0102 is designed to prevent backflow from Blanket Gas Header to leak point						
			15. 6" check valve at Produced Gas Meter Skid is designed to prevent backflow from Sales Gas Header to leak point						
			16. Emergency Response Plan (ERP)						
		10.2.3. Potential to increase level in and overfill Horizontal Separator V-1120. Potential to decrease flow of produced oil to Produced Oil Header. Potential to decrease flow and production of produced oil. No hazardous consequences. Operability issue only. (downstream)							
	10.3. 4" manual valve on liquid outlet of Vapor Recovery Tower V-2000 closed in error or 6" common manual valve in Produced Oil Header closed in error or any one of 3" manual valves on liquid inlet of Oil Tank TK-5001/2/3/6/7/8 closed in error	10.3.1. Potential to decrease and lose flow of produced oil to Oil Tank TK-5001/2/3/6/7/8. Potential to increase level in and overfill Vapor Recovery Tower V-2000. Potential to send produced oil to VRU Gas Compressor C-3510. Potential to damage compressor with no external release of produced oil or produced gas to atmosphere. No hazardous consequences. Operability issue only. (upstream)							
		10.3.2. Potential to decrease and lose flow of produced oil to Oil Tank TK-5001/2/3/6/7/8. Potential to increase level in and overfill Vapor Recovery Tower V-2000. Potential to send produced oil to ECD Knockout Drum V-9055. Potential to increase level in and overfill (overwhelm) ECD Knockout Drum V-9055. Potential to send produced oil to Emission Control Device BR-9010/20 with release of hot burning or unignited liquid into atmosphere and onto ground. Potential personnel injury. Potential environmental impact. (upstream)	1. Operating procedures address proper manual valve alignment	3	5	N			
			2. Daily checks of equipment and operating conditions by Operator						
			3. High-High Level Alarm LAHH-2000 on Vapor Recovery Tower V-2000						
			4. Level Switch High-High LSHH-2000 on Vapor Recovery Tower V-2000 activates an ESD						
			5. Ability to manually activate an Emergency Shutdown (ESD)						
			6. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead						
			7. Level Indicator Controller LIC-9055 on ECD Knockout Drum V-9055 turns on ECD Knockout Pump P-9055 at high level and may provide temporary relief of overfilling						
			8. High-High Level Alarm LAHH-9055 on ECD Knockout Drum V-9055						
			9. Level Switch High-High LSHH-9055 on ECD Knockout Drum V-9055 activates an ESD						
			10. ECD Pilot Scrubber Pot						
			11. Emergency Response Plan (ERP)						
		10.3.3. Potential to decrease and lose flow of produced oil to Oil Tank TK-5001/2/3/6/7/8. Potential to decrease production of produced oil. No hazardous consequences. Operability issue only. (downstream)							
	10.4. 4" manual valve on outlet of a single Oil Tank TK-5001/2/3/6/7/8 closed in error (during loadout)	10.4.1. Potential to decrease and lose flow of produced oil to truck loadout. Potential to increase flow of produced oil to and overfill Oil Tank TK-5001/2/3/6/7/8 with closed outlet valve. Potential to misdirect produced oil to tank with open valve. Potential to equalize levels of tanks via common overfill line. No hazard							

Node: 5. **Produced Oil** from: Liquid outlet of 2-Phase Separator V-001 (PO1) into and thru Horizontal Separator V-1120 (PO2) thru Produced Oil Header thru liquid separation from Vapor Recovery Tower V-2000 (PO3) and thru Oil Tank TK-5001/2/3/6/7/8 to Truck Loadout **(green)**
Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
		consequences. Operability issue only. (upstream)							
		10.4.2. Potential to decrease and lose flow of produced oil to truck loadout. No hazardous consequences. Operability issue only. (downstream)							
	10.5. 6" manual valve on produced oil line to truck loadout closed in error	10.5.1. Potential to increase level in and overfill Oil Tank TK-5001/2/3/6/7/8 and equalize levels in other Oil Tank TK-5001/2/3/6/7/8. Potential to continue to increase level in and overfill all Oil Tank TK-5001/2/3/6/7/8. Potential to send produced oil into blanket gas system. Potential to increase pressure in and overpressure and rupture Oil Tank TK-5001/2/3/6/7/8. Potential to release produced oil and produced gas into atmosphere and onto ground. Potential fire/explosion. Potential personnel injury. Potential environmental impact. (upstream)	1. Operating procedures address proper manual valve alignment 2. Daily checks of equipment and operating conditions by Operator 3. Pressure Relief Valve PRV-5110 on Flare Gas line on Oil Tank TK-5001 set at 14 oz/in2 relieves to atmosphere at a safe location (above top of tank) 4. Pressure Vacuum Relief Valve PVRV-5101/2/3/6/7/8 on Oil Tank TK-5001/2/3/6/7/8 set at 16 oz/in2 designed to relieve into atmosphere at a safe location (above top of tank) 5. Periodic inspection and testing of PSVs, PRVs, and PVRVs 6. Secondary and tertiary containment for Oil Tank TK-5001/2/3/6/7/8 7. Emergency Response Plan (ERP)	1	5	M			Trucks could be in the area of the event when this hazard scenario event occurs.
		10.5.2. Potential to increase level in and overfill Oil Tank TK-5001/2/3/6/7/8 and equalize levels in other Oil Tank TK-5001/2/3/6/7/8. Potential inability to load trucks with produced oil. No hazardous consequences. Operability issue only. (downstream)							
11. Lower Temperature	11.1. No credible causes identified by PHA Team								
12. Higher Temperature	12.1. No credible causes identified by PHA Team								
13. Composition	13.1. No credible causes identified by PHA Team								
14. Contamination	14.1. No credible causes identified by PHA Team								
15. Instrumentation	15.1. No credible causes identified by PHA Team								
16. Sampling	16.1. No credible causes identified by PHA Team								
17. Leak/Rupture	17.1. Flange / gasket / tubing / hose / valve	17.1.1. Potential to leak hydrocarbons into atmosphere or onto ground. Potential fire/explosion. Potential thermal exposure and personnel injury. Potential environmental impact.	1. Gasket replacement program as part of maintenance activity 2. Daily checks of equipment and operating conditions by Operator 3. Leak detection and repair (LDAR) program to periodically monitor emissions 4. Emergency Response Plan (ERP)	3	4	L			
18. Corrosion	18.1. No credible causes identified by PHA Team								
19. Erosion	19.1. No credible causes identified by PHA Team								
20. Loss of Utility	20.1. No credible causes identified by PHA Team								
21. Service Failure	21.1. No credible causes identified by PHA Team								
22. Startup	22.1. No credible causes identified by PHA Team								
23. Shutdown	23.1. No credible causes identified by PHA Team								

Node: 5. **Produced Oil** from: Liquid outlet of 2-Phase Separator V-001 (PO1) into and thru Horizontal Separator V-1120 (PO2) thru Produced Oil Header thru liquid separation from Vapor Recovery Tower V-2000 (PO3) and thru Oil Tank TK-5001/2/3/6/7/8 to Truck Loadout **(green)**

Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1418

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
24. Maintenance	24.1. 4" manual valve on liquid outlet of Vapor Recovery Tower V-2000 closed in error **AND** 4" manual valve on gas outlet of Vapor Recovery Tower V-2000 closed in error (following maintenance of Vapor Recovery Tower V-2000)	24.1.1. Potential to decrease lose flow of produced oil to Oil Tank TK-5001/2/3/6/7/8 and to VRU Gas Compressor C-3510. Potential to increase level in and overfill Vapor Recovery Tower V-2000 and increase pressure in and overpressure and rupture Vapor Recovery Tower V-2000. Potential to release produced oil, produced water (condensate) and produced gas into atmosphere and onto ground. Potential fire/explosion. Potential personnel injury. Potential environmental impact. (upstream)	1. Operating procedures address proper manual valve alignment 2. Daily checks of equipment and operating conditions by Operator 3. High-High Level Alarm LAHH-2000 on Vapor Recovery Tower V-2000 4. Level Switch High-High LSHH-2000 on Vapor Recovery Tower V-2000 activates an ESD 5. Ability to manually activate an Emergency Shutdown (ESD) 6. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead 7. Pressure Safety Valve PSV-2100 on Vapor Recovery Tower V-2000 set at ??? psig relieves to atmosphere at a safe location (40 feet above grade) 8. Periodic inspection and testing of PSVs, PRVs, and PVRVs 9. Manual isolation valve upstream of PSV is car sealed open (CSO) 10. Emergency Response Plan (ERP)	2	4	M	18. Verify and document the sizing basis and set point for Pressure Safety Valve PSV-2100 on the Vapor Recovery Tower V-2000.	Summit Engineering	
		24.1.2. Potential to decrease lose flow of produced oil to Oil Tank TK-5001/2/3/6/7/8. Potential to decrease production of produced oil. No hazardous consequences. Operability issue only. (downstream)							
		24.1.3. Potential to decrease and lose flow of produced gas from Vapor Recovery Tower V-2000. Potential to decrease and lose flow of produced to VRU Gas Compressor C-3510. Potential to starve compressor. Potential to damage compressor, but with no external release of gas. Potential to decrease flow of produced gas to Sales Gas. No hazardous consequences. Operability issue only. (downstream)	1. Operating procedures address proper manual valve alignment 2. Daily checks of equipment and operating conditions by Operator						
25. Inspection	25.1. No credible causes identified by PHA Team								
26. Human Factors	26.1. No credible causes identified by PHA Team								
27. Facility Siting	27.1. Vehicular traffic operating in close proximity to process equipment	27.1.1. Potential for vehicles to collide with or otherwise contact process equipment, piping or instrumentation containing produced fluids. Potential to release produced oil and produced water (condensate) into atmosphere and onto ground. Potential fire. Potential personnel injury. Potential environmental impact.	1. Daily checks of equipment and operating conditions by Operator 2. Physical barriers designed to protect process equipment and piping 3. Emergency Response Plan (ERP)	3	3	M	11. Develop a written vehicular Traffic Safety Control Plan with prevention and mitigation measures around any vulnerable process equipment, to provide assurance that safe work practices for the control of hazards during production activities are in place.	GMT	

Node: 6. **Produced Water** from: Water outlet of Horizontal Separator V-1120 (PW1) to Produced Water Header and thru Water Tank TK-4001/4 to Truck Loadout **(rose)**

Drawings / References: 8365-01-1403; 8365-01-1410

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
1. No/Less Flow	1.1. No new causes, refer to Higher Level deviation in this node								
2. Higher Flow	2.1. No new causes, refer to No/Lower Level deviation in this node								
3. Reverse Flow	3.1. No credible causes identified by PHA Team	3.1.1.	1. 2" check valve on produced water outlet of Horizontal Separator V-1120 downstream of Level Control Valve LCV-0102 is designed to prevent backflow from Produced Water Header						
4. As Well As Flow	4.1. No credible causes identified by PHA Team								
5. Misdirected Flow	5.1. 4" manual valve on inlet of a single Water Tank TK-4001/4 closed in error	5.1.1. Potential to decrease flow of produced water to tank with closed valve. Potential to misdirect produced water to and overfill tank with open valve. Potential to equalize levels of tanks via common overfill line. No hazard consequences. Operability issue only.							
6. No Pressure (Vacuum)	6.1. No credible causes identified by PHA Team	6.1.1. Refer to hazard scenario for loss of blanket gas and potential to decrease and lose blanket gas for Oil Tank TK-5001/2/3/6/7/8 and Water Tank TK-4001/4; potential to create vacuum in and collapse Oil Tank TK-5001/2/3/6/7/8 and/or Water Tank TK-4001/4 during truck loadout in No/Less Flow deviation in Node 2.							
7. Lower Pressure	7.1. No new causes, refer to No/Less Flow deviation in this node								
8. Higher Pressure	8.1. No new causes, refer to Higher Flow deviation in this node								
9. No/Lower Level	9.1. Level Control Valve LCV-0102 on Horizontal Separator V-1120 malfunctions open or open in error or set in error	9.1.1. Potential to decrease and lose water level in Horizontal Separator V-1120. Potential to send produced oil with produced water to Water Tank TK-4001/4. Potential to decrease flow of produced oil to Oil Tank TK-5001/2/3/6/7/8. Potential to decrease production of produced oil. No hazardous consequences. Operability issue only. (upstream)							
		9.1.2. Potential to decrease and lose water level in Horizontal Separator V-1120. Potential to send produced oil with produced water to Water Tank TK-4001/4. Potential to contaminate produced water in tanks and require recycling of water and oil. No hazardous consequences. Operability issue only. (downstream)	1. Periodic inspection and testing of control valves 2. Daily checks of equipment and operating conditions by Operator 3. Restricted Orifice RO-0102 in produced water line restricts flow						
10. Higher Level	10.1. Level Control Valve LCV-0102 on Horizontal Separator V-1120 malfunctions closed or closed in error or set in error or either 2" manual isolation valve around LCV-0102 closed in error or produced water line plugged due to cold weather or 6" common manual valve in Produced Water Header closed in error	10.1.1. Potential to increase water level in and overfill Horizontal Separator V-1120. Potential to send produced water with produced oil to Oil Tank TK-5001/2/3/6/7/8. Potential to contaminate produced oil in tanks and require recycling of oil and water. Potential to decrease production of produced oil. No hazardous consequences. Operability issue only. (upstream)	1. Periodic inspection and testing of control valves 2. Daily checks of equipment and operating conditions by Operator 3. Produced water line is heat traced and insulated						
		10.1.2. Potential to increase water level in and overfill Horizontal Separator V-1120. Potential to send produced water with produced oil to Oil Tank TK-5001/2/3/6/7/8. Potential decrease flow of produced water to Water Tank TK-4001/4. No hazardous consequences. Operability issue only. (downstream)	1. Periodic inspection and testing of control valves 2. Daily checks of equipment and operating conditions by Operator 3. Produced water line is heat traced and insulated						
	10.2. 6" common manual valve in Produced Water Header closed in error	10.2.1. Refer to all scenarios for Higher Level deviation in Node 7 Condensate							
	10.3. 4" manual valve on outlet of a single Water Tank TK-4001/4 closed in error (during loadout)	10.3.1. Potential to decrease and lose flow of produced water to truck loadout. Potential to increase flow of produced water to and overfill Water Tank TK-4001/4 with closed outlet valve. Potential to misdirect produced water to tank with open valve. Potential to							

Node: 6. **Produced Water** from: Water outlet of Horizontal Separator V-1120 (PW1) to Produced Water Header and thru Water Tank TK-4001/4 to Truck Loadout **(rose)**

Drawings / References: 8365-01-1403; 8365-01-1410

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
		equalize levels of tanks via common overfill line. No hazard consequences. Operability issue only. (upstream)							
		10.3.2. IF second tank is already full, then:							
		10.3.3. Potential to increase level in and overfill Water Tank TK-4001/4 and equalize levels in other Water Tank TK-4001/4. Potential to continue to increase level in and overfill both Water Tank TK-4001/4. Potential to send produced water into blanket gas system. Potential to increase pressure in and overpressure and rupture Water Tank TK-4001/4. Potential to release produced water with residual condensate into atmosphere and onto ground. No hazardous consequences. Operability issue only. (upstream)	1. Operating procedures address proper manual valve alignment 2. Daily checks of equipment and operating conditions by Operator 3. Pressure Relief Valve PRV-5110 on Flare Gas line on Oil Tank TK-5001 set at 14 oz/in2 relieves to atmosphere at a safe location (above top of tank) 4. Pressure Vacuum Relief Valve PVRV-4001/4 on Water Tank TK-4001/4 set at 16 oz/in2 relieves to atmosphere at a safe location (above top of tank) 5. Periodic inspection and testing of PSVs, PRVs, and PVRVs 6. Secondary and tertiary containment for Water Tank TK-4001/4						
		10.3.4. Potential to decrease and lose flow of produced water to truck loadout. No hazardous consequences. Operability issue only. (downstream)							
	10.4. 4" manual valve on produced water line to truck loadout closed in error	10.4.1. Potential to increase level in and overfill Water Tank TK-4001/4 and equalize levels in other Water Tank TK-4001/4. Potential to continue to increase level in and overfill both Water Tank TK-4001/4. Potential to send produced water into blanket gas system. Potential to increase pressure in and overpressure and rupture Water Tank TK-4001/4. Potential to release produced water with residual condensate into atmosphere and onto ground. No hazardous consequences. Operability issue only. (upstream)	1. Operating procedures address proper manual valve alignment 2. Daily checks of equipment and operating conditions by Operator 3. Pressure Relief Valve PRV-5110 on Flare Gas line on Oil Tank TK-5001 set at 14 oz/in2 relieves to atmosphere at a safe location (above top of tank) 4. Pressure Vacuum Relief Valve PVRV-4001/4 on Water Tank TK-4001/4 set at 16 oz/in2 relieves to atmosphere at a safe location (above top of tank) 5. Periodic inspection and testing of PSVs, PRVs, and PVRVs 6. Secondary and tertiary containment for Water Tank TK-4001/4						
		10.4.2. Potential to increase level in and overfill Water Tank TK-4001/4 and equalize levels in other Water Tank TK-4001/4. Potential inability to load trucks with produced water. No hazardous consequences. Operability issue only. (downstream)							
11. Lower Temperature	11.1. No credible causes identified by PHA Team								
12. Higher Temperature	12.1. Water temperature in Water Tank TK-4001/4 for any reason	12.1.1. Potential to degrade tank lining. Potential to increase corrosion rate for tank. Potential to leak produced water with residual condensate onto ground. No hazardous consequences. Operability issue only. (upstream)	1. Secondary and tertiary containment for Water Tank TK-4001/4						
13. Composition	13.1. No credible causes identified by PHA Team								
14. Contamination	14.1. No new causes, refer to No/Lower and Higher Level deviations in this node								
15. Instrumentation	15.1. No credible causes identified by PHA Team								
16. Sampling	16.1. No credible causes identified by PHA Team								

Node: 6. **Produced Water** from: Water outlet of Horizontal Separator V-1120 (PW1) to Produced Water Header and thru Water Tank TK-4001/4 to Truck Loadout **(rose)**

Drawings / References: 8365-01-1403; 8365-01-1410

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
17. Leak/Rupture	17.1. Flange / gasket / tubing / hose / valve	17.1.1. Potential to leak produced water with residual condensate into atmosphere or onto ground. No hazardous consequences. Operability issue only. (upstream)	1. Gasket replacement program as part of maintenance activity 2. Daily checks of equipment and operating conditions by Operator 3. Leak detection and repair (LDAR) program to periodically monitor emissions 4. Emergency Response Plan (ERP)						
18. Corrosion	18.1. No credible causes identified by PHA Team								
19. Erosion	19.1. No credible causes identified by PHA Team								
20. Loss of Utility	20.1. No credible causes identified by PHA Team								
21. Service Failure	21.1. No credible causes identified by PHA Team								
22. Startup	22.1. No credible causes identified by PHA Team								
23. Shutdown	23.1. No credible causes identified by PHA Team								
24. Maintenance	24.1. No credible causes identified by PHA Team								
25. Inspection	25.1. No credible causes identified by PHA Team								
26. Human Factors	26.1. No credible causes identified by PHA Team								
27. Facility Siting	27.1. Vehicular traffic operating in close proximity to process equipment	27.1.1. Potential for vehicles to collide with or otherwise contact process equipment, piping or instrumentation containing produced fluids. Potential to release produced water with residual condensate into atmosphere and onto ground. No hazardous consequence. Operability issue only.	1. Daily checks of equipment and operating conditions by Operator 2. Physical barriers designed to protect process equipment and piping				11. Develop a written vehicular Traffic Safety Control Plan with prevention and mitigation measures around any vulnerable process equipment, to provide assurance that safe work practices for the control of hazards during production activities are in place.	GMT	

Node: 7. **Condensate** from: Liquid outlet of: (1) Sales Gas Scrubber V-3450 (CO1); (2) Vapor Recovery Tower V-2000 (CO2); (3) Fuel Gas Scrubber V-3011 (CO3); (4) C-2510 Suction Scrubber V-3510 (CO4); (5) ECD Knockout Drum V-9050 via ECD Knockout Pump P-9050 and ECD Knockout Drum V-9055 via ECD Knockout Pump V-9055 (CO5); VRU Gas Compressor C-3510 (CO6); all to Condensate Header (COX) and into Produced Water Header to Water Tank TK-4001/4. Condensate from Fuel Gas Scrubber V-201 and Sump Tank SU-701 via manual drain **(blue)**

Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1409; 8365-01-1410; 8365-01-1412; 8365-01-1413; 8365-01-1414; 8365-01-1415; 8365-01-1421

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
1. No/Less Flow	1.1. No new causes, refer to Higher Level deviation in this node								
2. Higher Flow	2.1. No new causes, refer to No/Lower Level deviation in this node								
3. Reverse Flow	3.1. 6" common manual valve in Produced Water Header closed in error or Water Tank TK-4001/4 are full for any reason	3.1.1. Potential to decrease flow of produced water or condensate from any source of produced water (condensate) to Water Tank TK-4001/4. Potential to send (reverse flow) produced water (condensate) to one or more alternate source(s). Refer to scenarios for overfilling vessels in Higher Level deviation in this node.	1. Refer to safeguards for scenarios for overfilling vessels in Higher Level deviation in this node, **plus**: 2. 1" check valve on produced water (condensate) line downstream of Level Control Valve LCV-3450 on Sales Gas Scrubber V-3450 3. 2" check valve on produced water (condensate) line downstream of Level Control Valve LCV-3011 on Fuel Gas Scrubber V-3011 4. 2" check valve on produced water (condensate) line downstream of Level Control Valve LCV-3510 on C-2510 Suction Scrubber V-3510 5. 2" check valve on produced water (condensate) line downstream of ECD Knockout Pump P-9050 on ECD Knockout Drum V-9050 6. 2" check valve on produced water (condensate) line downstream of ECD Knockout Pump P-9055 on ECD Knockout Drum V-9055 7. Three 1" check valves on drain lines from VRU Gas Compressor C-3510						
4. As Well As Flow	4.1. No new causes, refer to No/Lower Level deviation in this node								
5. Misdirected Flow	5.1. No credible causes identified by PHA Team								
6. No Pressure (Vacuum)	6.1. No credible causes identified by PHA Team								
7. Lower Pressure	7.1. No new causes, refer to Higher Level deviation in this node								
8. Higher Pressure	8.1. No new causes, refer to No/Lower Level deviation in this node								
9. No/Lower Level	9.1. 2" manual drain valve on liquid outlet of Vapor Recovery Tower V-2000 left open in error (after draining vessel)	9.1.1. Potential to increase flow of produced water (condensate) from liquid outlet of Vapor Recovery Tower V-2000. Potential to decrease and lose water level in Vapor Recovery Tower V-2000. Potential to send produced oil with produced water (condensate) to Water Tank TK-4001/4. Potential decrease production of produced oil. No hazardous consequences. Operability issue only. (upstream)							
		9.1.2. Potential to increase flow of produced water (condensate) from liquid outlet of Vapor Recovery Tower V-2000. Potential to decrease and lose water level in Vapor Recovery Tower V-2000. Potential to send produced oil with produced water (condensate) to Water Tank TK-4001/4. Potential to contaminate produced water in tanks and require recycling of water and oil. No hazardous consequences. Operability issue only. (downstream)	1. Operating procedures address proper manual valve alignment 2. Daily checks of equipment and operating conditions by Operator 3. Low-Low Level Alarm LALL-2000 on Vapor Recovery Tower V-2000 4. Level Switch Low-Low LSLL-2000 on Vapor Recovery Tower V-2000 activates an ESD 5. Ability to manually activate an Emergency Shutdown (ESD) 6. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead						
	9.2. 1" Level Control Valve LCV-3450 on Sales Gas Scrubber V-3450 malfunctions open or open in error or set in error	9.2.1. Potential to increase flow of produced water (condensate) from liquid outlet of Sales Gas Scrubber V-3450. Potential to decrease and lose level of							

Node: 7. **Condensate** from: Liquid outlet of: (1) Sales Gas Scrubber V-3450 (CO1); (2) Vapor Recovery Tower V-2000 (CO2); (3) Fuel Gas Scrubber V-3011 (CO3); (4) C-2510 Suction Scrubber V-3510 (CO4); (5) ECD Knockout Drum V-9050 via ECD Knockout Pump P-9050 and ECD Knockout Drum V-9055 via ECD Knockout Pump V-9055 (CO5); VRU Gas Compressor C-3510 (CO6); all to Condensate Header (COX) and into Produced Water Header to Water Tank TK-4001/4. Condensate from Fuel Gas Scrubber V-201 and Sump Tank SU-701 via manual drain **(blue)**

Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1409; 8365-01-1410; 8365-01-1412; 8365-01-1413; 8365-01-1414; 8365-01-1415; 8365-01-1421

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
		produced water (condensate) in Sales Gas Scrubber V-3450. Potential to decrease and lose flow of produced gas to Sales Gas Header. Potential to decrease and lose production of Sales Gas. No hazardous consequences. Operability issue only. (upstream)							
		9.2.2. Potential to increase flow of produced water (condensate) from liquid outlet of Sales Gas Scrubber V-3450. Potential to send produced gas into produced water to Water Tank TK-4001/4. Potential to slightly increase level in but insufficient to overfill Water Tank TK-4001/4. Potential to increase pressure in and overpressure and rupture Water Tank TK-4001/4. Potential to release produced water with residual condensate into atmosphere and onto ground. No hazardous consequences. Operability issue only. (downstream)	1. Periodic inspection and testing of control valves 2. Daily checks of equipment and operating conditions by Operator 3. Pressure Relief Valve PRV-5110 on Flare Gas line on Oil Tank TK-5001 set at 14 oz/in2 relieves to atmosphere at a safe location (above top of tank) 4. Pressure Vacuum Relief Valve PVRV-4001/4 on Water Tank TK-4001/4 set at 16 oz/in2 relieves to atmosphere at a safe location (above top of tank) 5. Periodic inspection and testing of PSVs, PRVs, and PVRVs 6. Secondary and tertiary containment for Water Tank TK-4001/4						
	9.3. 2" Level Control Valve LCV-3011 on Fuel Gas Scrubber V-3011 malfunctions open or open in error or set in error or 1" normally closed (NC) manual bypass (drain) valve around LCV-3011 open in error or leaks through	9.3.1. Potential to increase flow of produced water (condensate) from liquid outlet of Fuel Gas Scrubber V-3011. Potential to decrease and lose level in Fuel Gas Scrubber V-3011. Potential to send (gas blowby) fuel gas to Condensate Header. Potential to decrease and lose flow of fuel gas to LP Gas Compressor C-2510. Refer to hazard scenario for LP Gas Compressor C-2510 not running for any reason (e.g. loss of fuel gas) in No/Less Flow deviation in Node 2 Produced Gas. (upstream)	1. Fuel gas supply from Horizontal Separator V-1120/1220 is a sufficient supplement (with 2" manual valve on Fuel Gas Scrubber V-201/202)						
		9.3.2. Potential to increase flow of produced water (condensate) from liquid outlet of Fuel Gas Scrubber V-3011. Potential to decrease and lose level in Fuel Gas Scrubber V-3011. Potential to send (gas blowby) fuel gas to Condensate Header. Potential to decrease and lose flow of fuel gas pilot for Emission Control Device BR-9010/20. Potential to lose ability to control emissions. Potential to emit uncombusted fuel gas (natural gas) into atmosphere. Potential environmental impact only. (upstream)	1. Operating procedures address proper manual valve alignment 2. Daily checks of equipment and operating conditions by Operator 3. Burner Management System BMS-9010/20 for Emission Control Device BR-9010/20 indicates and alarms for intermittent loss of fuel gas to pilot 4. Fuel gas supply from Horizontal Separator V-1120/1220 is a sufficient supplement (with 2" manual valve on Fuel Gas Scrubber V-201/202) 5. Air Quality Monitoring System to continuously monitor emissions	3	4	L			
		9.3.3. Potential to increase flow of produced water (condensate) from liquid outlet of Fuel Gas Scrubber V-3011. Potential to decrease and lose level in Fuel Gas Scrubber V-3011. Potential to send (gas blowby) fuel gas to Condensate Header. Potential to send fuel gas into produced water to Water Tank TK-4001/4. Potential to slightly increase level in but insufficient to overfill Water Tank TK-4001/4. Potential to increase pressure in and overpressure and rupture Water Tank TK-4001/4. Potential to release produced water with residual condensate into atmosphere and onto ground. No hazardous consequences. Operability issue only. (downstream)	1. Operating procedures address proper manual valve alignment 2. Periodic inspection and testing of control valves 3. Daily checks of equipment and operating conditions by Operator 4. Pressure Relief Valve PRV-5110 on Flare Gas line on Oil Tank TK-5001 set at 14 oz/in2 relieves to atmosphere at a safe location (above top of tank) 5. Pressure Vacuum Relief Valve PVRV-4001/4 on Water Tank TK-4001/4 set at 16 oz/in2 relieves to atmosphere at a safe location (above top of tank) 6. Periodic inspection and testing of PSVs, PRVs, and PVRVs 7. Secondary and tertiary containment for Water						

Node: 7. **Condensate** from: Liquid outlet of: (1) Sales Gas Scrubber V-3450 (CO1); (2) Vapor Recovery Tower V-2000 (CO2); (3) Fuel Gas Scrubber V-3011 (CO3); (4) C-2510 Suction Scrubber V-3510 (CO4); (5) ECD Knockout Drum V-9050 via ECD Knockout Pump P-9050 and ECD Knockout Drum V-9055 via ECD Knockout Pump V-9055 (CO5); VRU Gas Compressor C-3510 (CO6); all to Condensate Header (COX) and into Produced Water Header to Water Tank TK-4001/4. Condensate from Fuel Gas Scrubber V-201 and Sump Tank SU-701 via manual drain **(blue)**

Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1409; 8365-01-1410; 8365-01-1412; 8365-01-1413; 8365-01-1414; 8365-01-1415; 8365-01-1421

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
			Tank TK-4001/4						
	9.4. 2" Level Control Valve LCV-3510 on C-2510 Suction Scrubber V-3510 malfunctions open or open in error or set in error or 2" normally closed (NC) manual bypass (drain) valve around LCV-3510 closed in error or leaks through	9.4.1. Potential to increase flow of produced water (condensate) from liquid outlet of C-2510 Suction Scrubber V-3510. Potential to decrease and lose level in C-2510 Suction Scrubber V-3510. Potential to decrease flow of produced gas from C-2510 Suction Scrubber V-3510. Potential to decrease flow of produced gas to LP Gas Compressor C-2510. Potential to starve compressor. Potential to damage compressor with no external release of fluids. No hazardous consequences. Operability issue only. (upstream)							
		9.4.2. Potential to increase flow of produced water (condensate) from liquid outlet of C-2510 Suction Scrubber V-3510. Potential to decrease and lose level in C-2510 Suction Scrubber V-3510. Potential to send (gas blowby) produced gas to Condensate Header. Potential to send produced gas into produced water to Water Tank TK-4001/4. Potential to slightly increase level in but insufficient to overfill Water Tank TK-4001/4. Potential to increase pressure in and overpressure and rupture Water Tank TK-4001/4. Potential to release produced water with residual condensate into atmosphere and onto ground. No hazardous consequences. Operability issue only. (downstream)	1. Operating procedures address proper manual valve alignment 2. Periodic inspection and testing of control valves 3. Daily checks of equipment and operating conditions by Operator 4. Pressure Relief Valve PRV-5110 on Flare Gas line on Oil Tank TK-5001 set at 14 oz/in2 relieves to atmosphere at a safe location (above top of tank) 5. Pressure Vacuum Relief Valve PVRV-4001/4 on Water Tank TK-4001/4 set at 16 oz/in2 relieves to atmosphere at a safe location (above top of tank) 6. Periodic inspection and testing of PSVs, PRVs, and PVRVs 7. Secondary and tertiary containment for Water Tank TK-4001/4						
	9.5. ECD Knockout Pump P-9050 on produced water (condensate) line from ECD Knockout Drum V-9050 malfunctions on or controller set in error (when drum is not intended to be drained)	9.5.1. Potential to increase flow of produced water (condensate) from ECD Knockout Pump P-9050. Potential to decrease and lose level of produced water (condensate) in ECD Knockout Drum V-9050. Potential to send (gas blowby) flare gas to pump but insufficient to overpressure pump. Potential to cavitate pump. Potential to damage pump, but with no external release of fluids. No hazardous consequences. Operability issue only. (downstream)							
		9.5.2. Potential to increase flow of produced water (condensate) from ECD Knockout Pump P-9050. Potential to decrease and lose level of produced water (condensate) in ECD Knockout Drum V-9050. Potential to send (gas blowby) flare gas to pump. Potential to temporarily decrease flow of flare gas to Emission Control Device BR-9010/20. No hazardous consequences. Operability issue only. (downstream)							
	9.6. ECD Knockout Pump P-9055 on produced water (condensate) line from ECD Knockout Drum V-9055 malfunctions on or controller set in error (when drum is not intended to be drained)	9.6.1. Potential to increase flow of produced water (condensate) from ECD Knockout Pump P-9055. Potential to decrease and lose flow of produced water (condensate) to ECD Knockout Pump P-9055. Potential to send (gas blowby) flare gas to pump but insufficient to overpressure pump. Potential to cavitate pump. Potential to damage pump, but with no external release of fluids. No hazardous consequences. Operability issue only. (downstream)							
		9.6.2. Potential to increase flow of produced water (condensate) from ECD Knockout Pump P-9055. Potential to decrease and lose level of produced water (condensate) in ECD Knockout Drum V-9055. Potential to send (gas blowby) flare gas to pump. Potential to temporarily decrease flow of flare gas to Emission Control Device BR-9010/20. No hazardous							

Node: 7. **Condensate** from: Liquid outlet of: (1) Sales Gas Scrubber V-3450 (CO1); (2) Vapor Recovery Tower V-2000 (CO2); (3) Fuel Gas Scrubber V-3011 (CO3); (4) C-2510 Suction Scrubber V-3510 (CO4); (5) ECD Knockout Drum V-9050 via ECD Knockout Pump P-9050 and ECD Knockout Drum V-9055 via ECD Knockout Pump V-9055 (CO5); VRU Gas Compressor C-3510 (CO6); all to Condensate Header (COX) and into Produced Water Header to Water Tank TK-4001/4. Condensate from Fuel Gas Scrubber V-201 and Sump Tank SU-701 via manual drain **(blue)**

Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1409; 8365-01-1410; 8365-01-1412; 8365-01-1413; 8365-01-1414; 8365-01-1415; 8365-01-1421

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
		consequences. Operability issue only. (downstream)							
	9.7. One or more 1" manual drain valves on VRU Gas Compressor C-3510 open in error (after draining compressor)	9.7.1. Potential to decrease and lose level of produced water (condensate) in compressor drain pot. Potential to send produced gas to Condensate Header. Potential to send produced gas into produced water to Water Tank TK-4001/4. Potential to decrease flow of produced gas to Sales Gas Header. Potential to decrease and lose production of Sales Gas. No hazardous consequences. Operability issue only. (upstream)							
		9.7.2. Potential to decrease and lose level of produced water (condensate) in compressor drain pot. Potential to send produced gas to Condensate Header. Potential to send produced gas into produced water to Water Tank TK-4001/4. Potential to slightly increase level in but insufficient to overfill Water Tank TK-4001/4. Potential to increase pressure in and overpressure and rupture Water Tank TK-4001/4. Potential to release produced water with residual condensate into atmosphere and onto ground. No hazardous consequences. Operability issue only. (downstream)	1. Operating procedures address proper manual valve alignment 2. Daily checks of equipment and operating conditions by Operator 3. Pressure Relief Valve PRV-5110 on Flare Gas line on Oil Tank TK-5001 set at 14 oz/in2 relieves to atmosphere at a safe location (above top of tank) 4. Pressure Vacuum Relief Valve PVRV-4001/4 on Water Tank TK-4001/4 set at 16 oz/in2 relieves to atmosphere at a safe location (above top of tank) 5. Periodic inspection and testing of PSVs, PRVs, and PVRVs 6. Secondary and tertiary containment for Water Tank TK-4001/4						
	9.8. One or more 1" manual drain valves on Emission Control Device BR-9010/20 drain pot open in error or leaks through **AND** 1' manual valve to Sump Tank SU-701 open in error or leaks through (after draining pot)	9.8.1. Potential to decrease and lose level of produced water (condensate) in Emission Control Device BR-9010/20 drain pot. No hazardous consequences. Operability issue only. (upstream)							Path of least resistance of flare gas is through the Emission Control Device BR-9010/20 rather than the Sump Tank SU-701.
		9.8.2. Potential to decrease and lose level of produced water (condensate) in Emission Control Device BR-9010/20 drain pot. No hazardous consequences. Operability issue only. (downstream)	1. Operating procedures address proper manual valve alignment 2. Daily checks of equipment and operating conditions by Operator						Path of least resistance of flare gas is through the Emission Control Device BR-9010/20 rather than the Sump Tank SU-701.
10. Higher Level	10.1. 2" manual drain valve on liquid outlet of Vapor Recovery Tower V-2000 closed in error (vessel not drained) or 6" common manual valve in Produced Water Header closed in error	10.1.1. Potential to decrease and lose flow of produced water (condensate) from liquid outlet of Vapor Recovery Tower V-2000. Potential to increase water level in Vapor Recovery Tower V-2000 up to produced oil outlet of vessel. Potential to send produced water (condensate) with produced oil to Oil Tank TK-5001/2/3/6/7/8. Potential to contaminate produced oil in tanks and require recycling of oil and water. Potential to decrease production of produced oil. No hazardous consequences. Operability issue only. (upstream)	1. Operating procedures address proper manual valve alignment 2. Daily checks of equipment and operating conditions by Operator						
		10.1.2. Refer to scenarios for Higher Level deviation in Node 6 Produced Water for 6" common manual valve in Produced Water Header closed in error. (upstream)							
		10.1.3. Potential to decrease and lose flow of produced water (condensate) from liquid outlet of Vapor Recovery Tower V-2000. Potential to increase water level in Vapor Recovery Tower V-2000 up to produced oil outlet of vessel. Potential to send produced water (condensate) with produced oil to Oil Tank TK-5001/2/3/6/7/8. Potential to decrease production of produced water (condensate). No hazardous consequences. Operability issue only. (downstream)							
	10.2. 1" Level Control Valve LCV-3450 on Sales Gas Scrubber V-3450 malfunctions	10.2.1. Potential to decrease and lose flow of produced water (condensate) from liquid outlet of Sales Gas	1. Operating procedures address proper manual valve alignment						

Node: 7. **Condensate** from: Liquid outlet of: (1) Sales Gas Scrubber V-3450 (CO1); (2) Vapor Recovery Tower V-2000 (CO2); (3) Fuel Gas Scrubber V-3011 (CO3); (4) C-2510 Suction Scrubber V-3510 (CO4); (5) ECD Knockout Drum V-9050 via ECD Knockout Pump P-9050 and ECD Knockout Drum V-9055 via ECD Knockout Pump V-9055 (CO5); VRU Gas Compressor C-3510 (CO6); all to Condensate Header (COX) and into Produced Water Header to Water Tank TK-4001/4. Condensate from Fuel Gas Scrubber V-201 and Sump Tank SU-701 via manual drain **(blue)**

Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1409; 8365-01-1410; 8365-01-1412; 8365-01-1413; 8365-01-1414; 8365-01-1415; 8365-01-1421

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
	closed or closed in error or set in error or either 1" manual isolation valve around LCV-3450 closed in error or 6" common manual valve in Produced Water Header closed in error	Scrubber V-3450. Potential to increase water level in and overfill Sales Gas Scrubber V-3450. Potential to send produced water (condensate) into and contaminate Sales Gas. Potential to damage Sales Gas Compressor (if compressor is in scope later). No hazardous consequences. Operability issue only. (upstream)	2. Periodic inspection and testing of control valves 3. Daily checks of equipment and operating conditions by Operator 4. High-High Level Alarm LAHH-3450 on Sales Gas Scrubber V-3450 (independent of LC-3450)						
		10.2.2. Potential to decrease and lose flow of produced water (condensate) from liquid outlet of Sales Gas Scrubber V-3450. Potential to increase water level in and overfill Sales Gas Scrubber V-3450. Potential to send (carry over) produced water (condensate) to Fuel Gas Scrubber V-3011. Potential to increase level in and overfill Fuel Gas Scrubber V-3011. Potential to send (carry over) produced water (condensate) into and contaminate fuel gas system. Potential to send produced water (condensate) in fuel gas to and damage LP Gas Compressor C-2150 engine. No hazardous consequences. Operability issue only. (upstream)	1. Operating procedures address proper manual valve alignment 2. Periodic inspection and testing of control valves 3. Daily checks of equipment and operating conditions by Operator 4. High-High Level Alarm LAHH-3450 on Sales Gas Scrubber V-3450 (independent of LC-3450) 5. Level Control Valve LCV-3011 on Fuel Gas Scrubber V-3011 designed to maintain level 6. High-High Level Alarm LAHH-3011 on Fuel Gas Scrubber V-3011 (independent of LC-3011) 7. Ability to manually drain Fuel Gas Scrubber V-3011 8. Compressor Fuel Gas Scrubber Pot						
		10.2.3. Potential to decrease and lose flow of produced water (condensate) from liquid outlet of Sales Gas Scrubber V-3450. Potential to increase water level in and overfill Sales Gas Scrubber V-3450. Potential to send (carry over) produced water (condensate) to Fuel Gas Scrubber V-3011. Potential to increase level in and overfill Fuel Gas Scrubber V-3011. Potential to send (carry over) produced water (condensate) into and contaminate fuel gas system. Potential to send condensate mist to Emission Control Device BR-9010/20. Potential for partial combustion with visible flame and smoke and/or flameout with unignited hydrocarbon emissions. Potential environmental impact. (upstream)	1. Operating procedures address proper manual valve alignment 2. Periodic inspection and testing of control valves 3. Daily checks of equipment and operating conditions by Operator 4. High-High Level Alarm LAHH-3450 on Sales Gas Scrubber V-3450 (independent of LC-3450) 5. Level Control Valve LCV-3011 on Fuel Gas Scrubber V-3011 designed to maintain level 6. High-High Level Alarm LAHH-3011 on Fuel Gas Scrubber V-3011 (independent of LC-3011) 7. Ability to manually drain Fuel Gas Scrubber V-3011 8. Burner Management System BMS-9010/20 for Emission Control Device BR-9010/20 indicates and alarms for intermittent loss of fuel gas to pilot	3	4	L			
		10.2.4. Refer to scenarios for Higher Level deviation in Node 6 Produced Water for 6" common manual valve in Produced Water Header closed in error. (upstream)							
		10.2.5. Potential to decrease and lose flow of produced water (condensate) from liquid outlet of Sales Gas Scrubber V-3450. Potential to decrease and lose flow of produced water (condensate) to Water Tank TK-4001/4. Potential to decrease production of produced water (condensate). No hazardous consequences. Operability issue only. (downstream)							
	10.3. 2" Level Control Valve LCV-3011 on Fuel Gas Scrubber V-3011 malfunctions closed or set in error or either 2" manual isolation valve around LCV-3011 closed in error or 6" common manual valve in Produced Water Header closed in error	10.3.1. Potential to decrease and lose flow of produced water (condensate) from liquid outlet of Fuel Gas Scrubber V-3011. Potential to increase level of produced water (condensate) in and overfill Fuel Gas Scrubber V-3011. Potential to send (carry over) produced water (condensate) into and contaminate fuel gas system. Potential to send produced water (condensate) in fuel gas to and damage LP Gas	1. Operating procedures address proper manual valve alignment 2. Periodic inspection and testing of control valves 3. Daily checks of equipment and operating conditions by Operator 4. High-High Level Alarm LAHH-3011 on Fuel Gas Scrubber V-3011 (independent of LC-						

Node: 7. **Condensate** from: Liquid outlet of: (1) Sales Gas Scrubber V-3450 (CO1); (2) Vapor Recovery Tower V-2000 (CO2); (3) Fuel Gas Scrubber V-3011 (CO3); (4) C-2510 Suction Scrubber V-3510 (CO4); (5) ECD Knockout Drum V-9050 via ECD Knockout Pump P-9050 and ECD Knockout Drum V-9055 via ECD Knockout Pump V-9055 (CO5); VRU Gas Compressor C-3510 (CO6); all to Condensate Header (COX) and into Produced Water Header to Water Tank TK-4001/4. Condensate from Fuel Gas Scrubber V-201 and Sump Tank SU-701 via manual drain **(blue)**

Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1409; 8365-01-1410; 8365-01-1412; 8365-01-1413; 8365-01-1414; 8365-01-1415; 8365-01-1421

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
		Compressor C-2150 engine. No hazardous consequences. Operability issue only. (upstream)	3011) 5. Ability to manually drain Fuel Gas Scrubber V-3011 6. Compressor Fuel Gas Scrubber Pot						
		10.3.2. Potential to decrease and lose flow of produced water (condensate) from liquid outlet of Fuel Gas Scrubber V-3011. Potential to increase level in and overfill Fuel Gas Scrubber V-3011. Potential to send (carry over) produced water (condensate) into and contaminate fuel gas system. Potential to send condensate mist to Emission Control Device BR-9010/20. Potential for partial combustion with visible flame and smoke and/or flameout with unignited hydrocarbon emissions. Potential environmental impact. (upstream)	1. Operating procedures address proper manual valve alignment 2. Periodic inspection and testing of control valves 3. Daily checks of equipment and operating conditions by Operator 4. High-High Level Alarm LAHH-3011 on Fuel Gas Scrubber V-3011 (independent of LC-3011) 5. Ability to manually drain Fuel Gas Scrubber V-3011 6. Burner Management System BMS-9010/20 for Emission Control Device BR-9010/20 indicates and alarms for intermittent loss of fuel gas to pilot	3	4	L			
		10.3.3. Refer to scenarios for Higher Level deviation in Node 6 Produced Water for 6" common manual valve in Produced Water Header closed in error. (upstream)							
		10.3.4. Potential to decrease and lose flow of produced water (condensate) from liquid outlet of Fuel Gas Scrubber V-3011. Potential to decrease and lose flow of produced water (condensate) to Water Tank TK-4001/4. Potential to decrease production of produced water (condensate). No hazardous consequences. Operability issue only. (downstream)							
	10.4. 2" Level Control Valve LCV-3510 on C-2510 Suction Scrubber V-3510 malfunctions closed or set in error or either 2" manual isolation valve around LCV-3510 closed in error or 6" common manual valve in Produced Water Header closed in error	10.4.1. Potential to decrease and lose flow of produced water (condensate) from liquid outlet of C-2510 Suction Scrubber V-3510. Potential to increase level of produced water (condensate) in and overfill C-2510 Suction Scrubber V-3510. Potential to send (carry over) produced water (condensate) into and contaminate produced gas. Potential to send produced gas with residual condensate to LP Gas Compressor C-2510 with no damage. No hazardous consequences. Operability issue only. (upstream)	1. Operating procedures address proper manual valve alignment 2. Periodic inspection and testing of control valves 3. Daily checks of equipment and operating conditions by Operator 4. High-High Level Alarm LAHH-3510 on C-2510 Suction Scrubber V-3510 (independent of LC-3510) 5. Ability to manually drain C-2510 Suction Scrubber V-3510				35. Verify with the vendor that the LP Gas Compressor C-2510 is equipped with a dedicated scrubber.	Summit Engineering	Damage to compressor is not deemed credible.
		10.4.2. Potential to decrease and lose flow of produced water (condensate) from liquid outlet of C-2510 Suction Scrubber V-3510. Potential to increase level of produced water (condensate) in and overfill C-2510 Suction Scrubber V-3510. Potential to send (carry over) produced water (condensate) into and contaminate produced gas. Potential send produced gas with residual condensate from LP Gas Compressor C-2510 to Sales Gas Scrubber V-3450. Potential to increase water level in and overfill Sales Gas Scrubber V-3450. Potential to send produced water (condensate) into and contaminate Sales Gas. Potential to damage Sales Gas Compressor (if compressor is in scope later). No hazardous consequences. Operability issue only. (upstream)	1. Operating procedures address proper manual valve alignment 2. Periodic inspection and testing of control valves 3. Daily checks of equipment and operating conditions by Operator 4. High-High Level Alarm LAHH-3510 on C-2510 Suction Scrubber V-3510 (independent of LC-3510) 5. Ability to manually drain C-2510 Suction Scrubber V-3510 6. High-High Level Alarm LAHH-3450 on Sales Gas Scrubber V-3450 (independent of LC-3450)						
		10.4.3. Potential to decrease and lose flow of produced water (condensate) from liquid outlet of C-2510 Suction Scrubber V-3510. Potential to increase level in and overfill C-2510 Suction Scrubber V-3510. Potential to send (carry over) produced water (condensate) into and contaminate flare gas system. Potential to send condensate mist to Emission Control Device BR-9010/20. Potential for partial	1. Operating procedures address proper manual valve alignment 2. Periodic inspection and testing of control valves 3. Daily checks of equipment and operating conditions by Operator 4. High-High Level Alarm LAHH-3510 on C-2510 Suction Scrubber V-3510 (independent of LC-	3	4	L			

Node: 7. **Condensate** from: Liquid outlet of: (1) Sales Gas Scrubber V-3450 (CO1); (2) Vapor Recovery Tower V-2000 (CO2); (3) Fuel Gas Scrubber V-3011 (CO3); (4) C-2510 Suction Scrubber V-3510 (CO4); (5) ECD Knockout Drum V-9050 via ECD Knockout Pump P-9050 and ECD Knockout Drum V-9055 via ECD Knockout Pump V-9055 (CO5); VRU Gas Compressor C-3510 (CO6); all to Condensate Header (COX) and into Produced Water Header to Water Tank TK-4001/4. Condensate from Fuel Gas Scrubber V-201 and Sump Tank SU-701 via manual drain **(blue)**

Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1409; 8365-01-1410; 8365-01-1412; 8365-01-1413; 8365-01-1414; 8365-01-1415; 8365-01-1421

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
		combustion with visible flame and smoke and/or flameout with unignited hydrocarbon emissions. Potential environmental impact. (upstream)	3510) 5. Ability to manually drain C-2510 Suction Scrubber V-3510 6. Burner Management System BMS-9010/20 for Emission Control Device BR-9010/20 indicates and alarms for intermittent loss of fuel gas to pilot						
		10.4.4. Refer to scenarios for Higher Level deviation in Node 6 Produced Water for 6" common manual valve in Produced Water Header closed in error. (upstream)							
		10.4.5. Potential to decrease and lose flow of produced water (condensate) from liquid outlet of C-2510 Suction Scrubber V-3510. Potential to decrease and lose flow of produced water (condensate) to Water Tank TK-4001/4. Potential to decrease production of produced water (condensate). No hazardous consequences. Operability issue only. (downstream)							
	10.5. 2" manual valve on liquid outlet from ECD Knockout Drum V-9050 closed in error (when intended to drain ECD Knockout Drum V-9050)	10.5.1. Potential to decrease and lose flow of produced water (condensate) from ECD Knockout Drum V-9050 to ECD Knockout Pump P-9050. Potential to increase level of produced water (condensate) in and overfill ECD Knockout Drum V-9050. Potential to send (carry over) produced water (condensate) into and contaminate flare gas system. Potential to send condensate mist to Emission Control Device BR-9010/20. Potential for partial combustion with visible flame and smoke and/or flameout with unignited hydrocarbon emissions. Potential environmental impact. (upstream)	1. Operating procedures address proper manual valve alignment 2. Daily checks of equipment and operating conditions by Operator 3. High-High Level Alarm LAHH-9050 on ECD Knockout Drum V-9050 4. Level Switch High-High LSHH-9050 on ECD Knockout Drum V-9050 activates an ESD 5. Ability to manually activate an Emergency Shutdown (ESD) 6. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead 7. Burner Management System BMS-9010/20 for Emission Control Device BR-9010/20 indicates and alarms for intermittent loss of fuel gas to pilot	3	4	L			
		10.5.2. Potential to decrease and lose flow of produced water (condensate) from ECD Knockout Drum V-9050 to ECD Knockout Pump P-9050. Potential to cavitate and damage pump, but with no external release of fluids. No hazardous consequences. Operability issue only. (downstream)							
		10.5.3. Potential to decrease and lose flow of produced water (condensate) from ECD Knockout Drum V-9050 to ECD Knockout Pump P-9050. Potential to decrease and lose flow of produced water (condensate) to Water Tank TK-4001/4. Potential to decrease production of produced water (condensate). No hazardous consequences. Operability issue only. (downstream)							
	10.6. ECD Knockout Pump P-9050 not running for any reason (when intended to drain ECD Knockout Drum V-9050)	10.6.1. Potential to decrease and lose flow of produced water (condensate) from ECD Knockout Drum V-9050 to ECD Knockout Pump P-9050. Potential to increase level of produced water (condensate) in and overfill ECD Knockout Drum V-9050. Potential to send (carry over) produced water (condensate) into and contaminate flare gas system. Potential to send condensate mist to Emission Control Device BR-9010/20. Potential for partial combustion with visible flame and smoke and/or flameout with unignited hydrocarbon emissions. Potential environmental impact. (upstream)	1. Preventive maintenance program for compressors and pumps 2. Daily checks of equipment and operating conditions by Operator 3. High-High Level Alarm LAHH-9050 on ECD Knockout Drum V-9050 4. Level Switch High-High LSHH-9050 on ECD Knockout Drum V-9050 activates an ESD 5. Ability to manually activate an Emergency Shutdown (ESD) 6. Ability to close either of the master valves and flow line valve to shut off flow from the	3	4	L			

Node: 7. **Condensate** from: Liquid outlet of: (1) Sales Gas Scrubber V-3450 (CO1); (2) Vapor Recovery Tower V-2000 (CO2); (3) Fuel Gas Scrubber V-3011 (CO3); (4) C-2510 Suction Scrubber V-3510 (CO4); (5) ECD Knockout Drum V-9050 via ECD Knockout Pump P-9050 and ECD Knockout Drum V-9055 via ECD Knockout Pump V-9055 (CO5); VRU Gas Compressor C-3510 (CO6); all to Condensate Header (COX) and into Produced Water Header to Water Tank TK-4001/4. Condensate from Fuel Gas Scrubber V-201 and Sump Tank SU-701 via manual drain **(blue)**

Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1409; 8365-01-1410; 8365-01-1412; 8365-01-1413; 8365-01-1414; 8365-01-1415; 8365-01-1421

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
			Wellhead						
			7. Burner Management System BMS-9010/20 for Emission Control Device BR-9010/20 indicates and alarms for intermittent loss of fuel gas to pilot						
		10.6.2. Potential to decrease and lose flow of produced water (condensate) from ECD Knockout Drum V-9050 to ECD Knockout Pump P-9050. Potential to decrease and lose flow of produced water (condensate) to Water Tank TK-4001/4. Potential to decrease production of produced water (condensate). No hazardous consequences. Operability issue only. (downstream)							
	10.7. 2" manual valve on discharge of ECD Knockout Pump P-9050 closed in error (when intended to drain ECD Knockout Drum V-9050)	10.7.1. Potential to decrease and lose flow of produced water (condensate) from ECD Knockout Pump P-9050. Potential to increase level of produced water (condensate) in and overfill ECD Knockout Drum V-9050. Potential to send (carry over) produced water (condensate) into and contaminate flare gas system. Potential to send condensate mist to Emission Control Device BR-9010/20. Potential for partial combustion with visible flame and smoke and/or flameout with unignited hydrocarbon emissions. Potential environmental impact. (upstream)	1. Operating procedures address proper manual valve alignment	3	4	L			
			2. Daily checks of equipment and operating conditions by Operator						
			3. High-High Level Alarm LAHH-9050 on ECD Knockout Drum V-9050						
			4. Level Switch High-High LSHH-9050 on ECD Knockout Drum V-9050 activates an ESD						
			5. Ability to manually activate an Emergency Shutdown (ESD)						
			6. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead						
			7. Burner Management System BMS-9010/20 for Emission Control Device BR-9010/20 indicates and alarms for intermittent loss of fuel gas to pilot						
		10.7.2. Potential to decrease and lose flow of produced water (condensate) from ECD Knockout Pump P-9050. Potential to deadhead and damage pump, but with no external release of fluids. No hazardous consequences. Operability issue only. (downstream)							
		10.7.3. Potential to decrease and lose flow of produced water (condensate) from ECD Knockout Pump P-9050. Potential to decrease and lose flow of produced water (condensate) to Water Tank TK-4001/4. Potential to decrease production of produced water (condensate). No hazardous consequences. Operability issue only. (downstream)							
	10.8. 2" manual valve on liquid outlet from ECD Knockout Drum V-9055 closed in error (when intended to drain ECD Knockout Drum V-9055)	10.8.1. Potential to decrease and lose flow of produced water (condensate) from ECD Knockout Drum V-9055 to ECD Knockout Pump P-9055. Potential to increase level of produced water (condensate) in and overfill ECD Knockout Drum V-9055. Potential to send (carry over) produced water (condensate) into and contaminate flare gas system. Potential to send condensate mist to Emission Control Device BR-9010/20. Potential for partial combustion with visible flame and smoke and/or flameout with unignited hydrocarbon emissions. Potential environmental impact. (upstream)	1. Operating procedures address proper manual valve alignment	3	4	L			
			2. Daily checks of equipment and operating conditions by Operator						
			3. High-High Level Alarm LAHH-9055 on ECD Knockout Drum V-9055						
			4. Level Switch High-High LSHH-9055 on ECD Knockout Drum V-9055 activates an ESD						
			5. Ability to manually activate an Emergency Shutdown (ESD)						
			6. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead						
			7. Burner Management System BMS-9010/20 for Emission Control Device BR-9010/20 indicates and alarms for intermittent loss of fuel gas to pilot						

Node: 7. **Condensate** from: Liquid outlet of: (1) Sales Gas Scrubber V-3450 (CO1); (2) Vapor Recovery Tower V-2000 (CO2); (3) Fuel Gas Scrubber V-3011 (CO3); (4) C-2510 Suction Scrubber V-3510 (CO4); (5) ECD Knockout Drum V-9050 via ECD Knockout Pump P-9050 and ECD Knockout Drum V-9055 via ECD Knockout Pump V-9055 (CO5); VRU Gas Compressor C-3510 (CO6); all to Condensate Header (COX) and into Produced Water Header to Water Tank TK-4001/4. Condensate from Fuel Gas Scrubber V-201 and Sump Tank SU-701 via manual drain **(blue)**

Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1409; 8365-01-1410; 8365-01-1412; 8365-01-1413; 8365-01-1414; 8365-01-1415; 8365-01-1421

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
		10.8.2. Potential to decrease and lose flow of produced water (condensate) from ECD Knockout Drum V-9055 to ECD Knockout Pump P-9055. Potential to cavitate and damage pump, but with no external release of fluids. No hazardous consequences. Operability issue only. (downstream)							
		10.8.3. Potential to decrease and lose flow of produced water (condensate) from ECD Knockout Drum V-9055 to ECD Knockout Pump P-9055. Potential to decrease and lose flow of produced water (condensate) to Water Tank TK-4001/4. Potential to decrease production of produced water (condensate). No hazardous consequences. Operability issue only. (downstream)							
	10.9. ECD Knockout Pump P-9055 not running for any reason (when intended to drain ECD Knockout Drum V-9055)	10.9.1. Potential to decrease and lose flow of produced water (condensate) from ECD Knockout Drum V-9055 to ECD Knockout Pump P-9055. Potential to increase level of produced water (condensate) in and overfill ECD Knockout Drum V-9055. Potential to send (carry over) produced water (condensate) into and contaminate flare gas system. Potential to send condensate mist to Emission Control Device BR-9010/20. Potential for partial combustion with visible flame and smoke and/or flameout with unignited hydrocarbon emissions. Potential environmental impact. (upstream)	1. Preventive maintenance program for compressors and pumps 2. Daily checks of equipment and operating conditions by Operator 3. High-High Level Alarm LAHH-9055 on ECD Knockout Drum V-9055 4. Level Switch High-High LSHH-9055 on ECD Knockout Drum V-9055 activates an ESD 5. Ability to manually activate an Emergency Shutdown (ESD) 6. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead 7. Burner Management System BMS-9010/20 for Emission Control Device BR-9010/20 indicates and alarms for intermittent loss of fuel gas to pilot	3	4	L			
		10.9.2. Potential to decrease and lose flow of produced water (condensate) from ECD Knockout Drum V-9055 to ECD Knockout Pump P-9055. Potential to decrease and lose flow of produced water (condensate) to Water Tank TK-4001/4. Potential to decrease production of produced water (condensate). No hazardous consequences. Operability issue only. (downstream)							
	10.10. 2" manual valve on discharge of ECD Knockout Pump P-9055 closed in error (when intended to drain ECD Knockout Drum V-9055)	10.10.1. Potential to decrease and lose flow of produced water (condensate) from ECD Knockout Pump P-9055. Potential to increase level of produced water (condensate) in and overfill ECD Knockout Drum V-9055. Potential to send (carry over) produced water (condensate) into and contaminate flare gas system. Potential to send condensate mist to Emission Control Device BR-9010/20. Potential for partial combustion with visible flame and smoke and/or flameout with unignited hydrocarbon emissions. Potential environmental impact. (upstream)	1. Operating procedures address proper manual valve alignment 2. Daily checks of equipment and operating conditions by Operator 3. High-High Level Alarm LAHH-9055 on ECD Knockout Drum V-9055 4. Level Switch High-High LSHH-9055 on ECD Knockout Drum V-9055 activates an ESD 5. Ability to manually activate an Emergency Shutdown (ESD) 6. Ability to close either of the master valves and flow line valve to shut off flow from the Wellhead 7. Burner Management System BMS-9010/20 for Emission Control Device BR-9010/20 indicates and alarms for intermittent loss of fuel gas to pilot	3	4	L			
		10.10.2. Potential to decrease and lose flow of produced water (condensate) from ECD Knockout Pump P-9055. Potential to deadhead and damage pump, but with no external release of fluids. No hazardous							

Node: 7. **Condensate** from: Liquid outlet of: (1) Sales Gas Scrubber V-3450 (CO1); (2) Vapor Recovery Tower V-2000 (CO2); (3) Fuel Gas Scrubber V-3011 (CO3); (4) C-2510 Suction Scrubber V-3510 (CO4); (5) ECD Knockout Drum V-9050 via ECD Knockout Pump P-9050 and ECD Knockout Drum V-9055 via ECD Knockout Pump V-9055 (CO5); VRU Gas Compressor C-3510 (CO6); all to Condensate Header (COX) and into Produced Water Header to Water Tank TK-4001/4. Condensate from Fuel Gas Scrubber V-201 and Sump Tank SU-701 via manual drain **(blue)**

Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1409; 8365-01-1410; 8365-01-1412; 8365-01-1413; 8365-01-1414; 8365-01-1415; 8365-01-1421

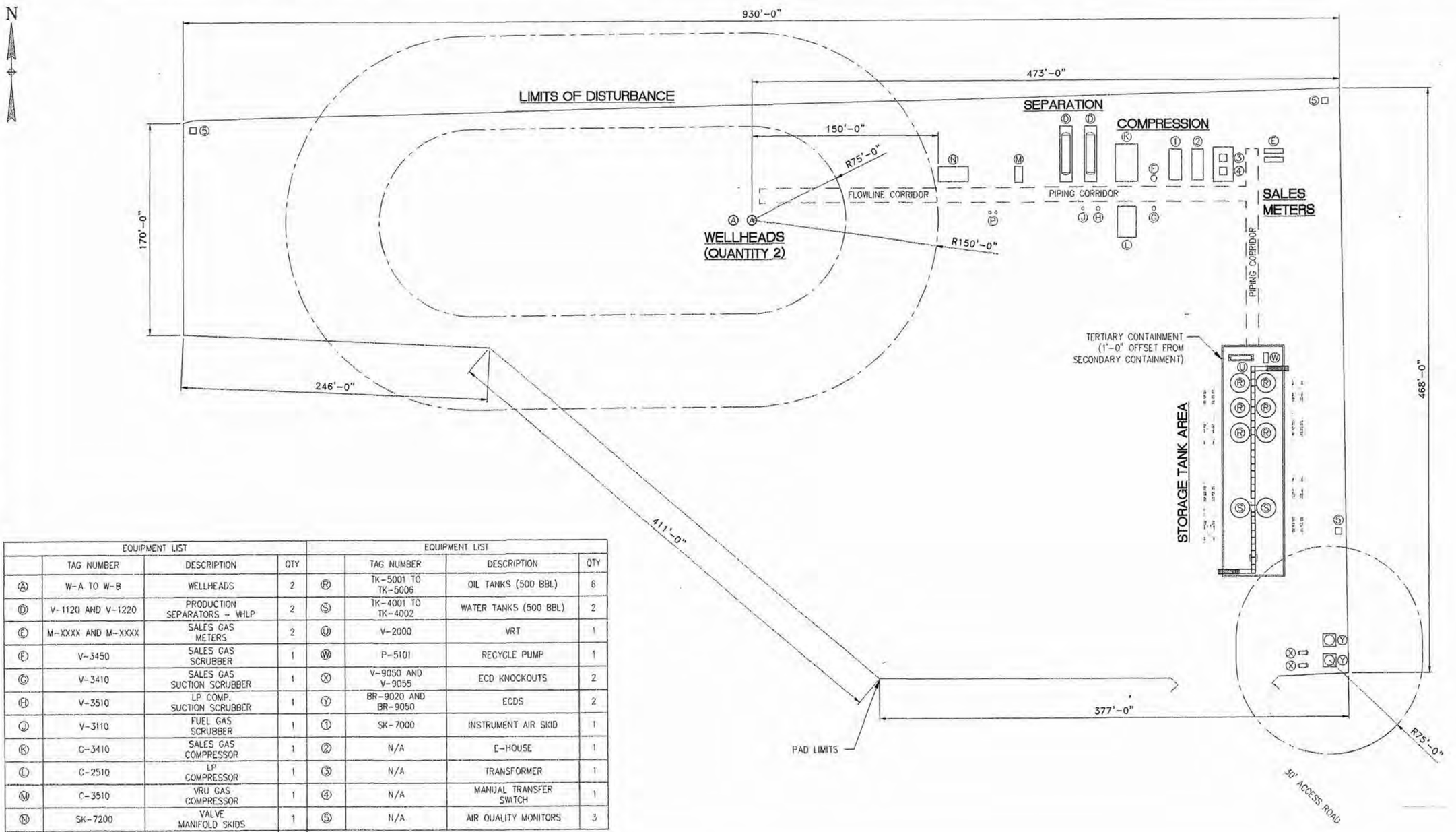
Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
		consequences. Operability issue only. (downstream)							
		10.10.3. Potential to decrease and lose flow of produced water (condensate) from ECD Knockout Pump P-9055. Potential to decrease and lose flow of produced water (condensate) to Water Tank TK-4001/4. Potential to decrease production of produced water (condensate). No hazardous consequences. Operability issue only. (downstream)							
	10.11. Accumulation of produced water (condensate) in VRU Gas Compressor C-3510 drain pot (not manually drained when needed) or 6" common manual valve in Produced Water Header closed in error	10.11.1. Potential to decrease and lose flow of produced water (condensate) from VRU Gas Compressor C-3510. Potential to leave produced water (residual condensate) in produced gas through VRU Gas Compressor C-3510 with no compressor damage. No hazardous consequences. Operability issue only. (upstream)	1. Operating procedures address proper manual valve alignment 2. Daily checks of equipment and operating conditions by Operator						Damage to compressor is not deemed credible.
		10.11.2. Potential to decrease and lose flow of produced water (condensate) from VRU Gas Compressor C-3510. Potential to leave produced water (condensate) in produced gas through VRU Gas Compressor C-3510. Potential to send limited amount of produced water (condensate) to C-2510 Suction Scrubber V-3510. No hazardous consequences. Operability issue only. (upstream)							
		10.11.3. Potential to decrease and lose from of produced water (condensate) from VRU Gas Compressor C-3510. Potential to decrease and lose flow of produced water (condensate) to Water Tank TK-4001/4. Potential to decrease production of produced water (condensate). No hazardous consequences. Operability issue only. (downstream)							
	10.12. Accumulation of produced water (condensate) in Fuel Gas Scrubber V-201 (not manually drained when needed)	10.12.1. Potential to increase level in Fuel Gas Scrubber V-201 and send fuel gas with liquids to Fuel Gas System and Burner B-201 in Heater H-201 for Horizontal Separator V-1120. No hazardous consequences. Operability issue only. (upstream)							
		10.12.2. Potential to increase level in Fuel Gas Scrubber V-201 and send fuel gas with liquids to Fuel Gas System and Burner B-201 in Heater H-201 for Horizontal Separator V-1120. No hazardous consequences. Operability issue only. (downstream)							
	10.13. Accumulation of produced water (condensate) in either Emission Control Device BR-9010/20 drain pot (not manually drained when needed)	10.13.1. Potential to increase level of produced water (condensate) in Emission Control Device BR-9010/20 drain pot. Potential to send condensate mist to Emission Control Device BR-9010/20. Potential for partial combustion with visible flame and smoke and/or flameout with unignited hydrocarbon emissions. Potential environmental impact. (downstream)	1. Operating procedures address proper manual valve alignment 2. Daily checks of equipment and operating conditions by Operator 3. Burner Management System BMS-9010/20 for Emission Control Device BR-9010/20 indicates and alarms for intermittent loss of fuel gas to pilot	3	4	L			
		10.13.2. Potential to increase level of produced water (condensate) in Emission Control Device BR-9010/20 drain pot. No hazardous consequences. Operability issue only. (downstream)							
11. Lower Temperature	11.1. No credible causes identified by PHA Team								
12. Higher Temperature	12.1. No credible causes identified by PHA Team								
13. Composition	13.1. No credible causes identified by PHA Team								

Node: 7. **Condensate** from: Liquid outlet of: (1) Sales Gas Scrubber V-3450 (CO1); (2) Vapor Recovery Tower V-2000 (CO2); (3) Fuel Gas Scrubber V-3011 (CO3); (4) C-2510 Suction Scrubber V-3510 (CO4); (5) ECD Knockout Drum V-9050 via ECD Knockout Pump P-9050 and ECD Knockout Drum V-9055 via ECD Knockout Pump V-9055 (CO5); VRU Gas Compressor C-3510 (CO6); all to Condensate Header (COX) and into Produced Water Header to Water Tank TK-4001/4. Condensate from Fuel Gas Scrubber V-201 and Sump Tank SU-701 via manual drain **(blue)**

Drawings / References: 8365-01-1403; 8365-01-1408; 8365-01-1409; 8365-01-1410; 8365-01-1412; 8365-01-1413; 8365-01-1414; 8365-01-1415; 8365-01-1421

Deviation	Cause	Consequences	Safeguards	S	L	RR	Recommendations	Responsible Party	Comments
14. Contamination	14.1. No new causes, refer to No/Lower Level and Higher Level deviations in this node								
15. Instrumentation	15.1. No credible causes identified by PHA Team								
16. Sampling	16.1. No credible causes identified by PHA Team								
17. Leak/Rupture	17.1. Flange / gasket / tubing / valve	17.1.1. Potential to leak produced water (condensate) and/or produced gas, fuel gas, flare gas into atmosphere or onto ground. Potential fire/explosion. Potential thermal exposure and personnel injury. Potential environmental impact.	1. Gasket replacement program as part of maintenance activity 2. Daily checks of equipment and operating conditions by Operator 3. Leak detection and repair (LDAR) program to periodically monitor emissions 4. Emergency Response Plan (ERP)	3	4	L			
18. Corrosion	18.1. No credible causes identified by PHA Team								
19. Erosion	19.1. No credible causes identified by PHA Team								
20. Loss of Utility	20.1. No credible causes identified by PHA Team								
21. Service Failure	21.1. No credible causes identified by PHA Team								
22. Startup	22.1. No credible causes identified by PHA Team								
23. Shutdown	23.1. No credible causes identified by PHA Team								
24. Maintenance	24.1. No credible causes identified by PHA Team								
25. Inspection	25.1. No credible causes identified by PHA Team								
26. Human Factors	26.1. No credible causes identified by PHA Team								
27. Facility Siting	27.1. Vehicular traffic operating in close proximity to process equipment	27.1.1. Potential for vehicles to collide with or otherwise contact process equipment, piping or instrumentation containing produced fluids. Potential to release produced water (condensate) and/or produced gas, fuel gas, flare gas. Potential fire/explosion. Potential personnel injury. Potential environmental impact.	1. Daily checks of equipment and operating conditions by Operator 2. Physical barriers designed to protect process equipment and piping 3. Emergency Response Plan (ERP)	3	3	M	11. Develop a written vehicular Traffic Safety Control Plan with prevention and mitigation measures around any vulnerable process equipment, to provide assurance that safe work practices for the control of hazards during production activities are in place.	GMT	

Appendix E – Reference Drawings



EQUIPMENT LIST			
	TAG NUMBER	DESCRIPTION	QTY
Ⓐ	W-A TO W-B	WELLHEADS	2
Ⓓ	V-1120 AND V-1220	PRODUCTION SEPARATORS - VHLP	2
Ⓔ	M-XXXX AND M-XXXX	SALES GAS METERS	2
Ⓕ	V-3450	SALES GAS SCRUBBER	1
Ⓖ	V-3410	SALES GAS SUCTION SCRUBBER	1
Ⓗ	V-3510	LP COMP. SUCTION SCRUBBER	1
Ⓙ	V-3110	FUEL GAS SCRUBBER	1
Ⓚ	C-3410	SALES GAS COMPRESSOR	1
Ⓛ	C-2510	LP COMPRESSOR	1
Ⓜ	C-3510	VRU GAS COMPRESSOR	1
Ⓝ	SK-7200	VALVE MANIFOLD SKIDS	1
Ⓟ	V-0310 TO V-0320	SAND SEPARATORS	2

EQUIPMENT LIST			
	TAG NUMBER	DESCRIPTION	QTY
Ⓡ	TK-5001 TO TK-5006	OIL TANKS (500 BBL)	6
Ⓢ	TK-4001 TO TK-4002	WATER TANKS (500 BBL)	2
Ⓤ	V-2000	VRT	1
Ⓦ	P-5101	RECYCLE PUMP	1
Ⓧ	V-9050 AND V-9055	ECD KNOCKOUTS	2
Ⓨ	BR-9020 AND BR-9050	ECDS	2
①	SK-7000	INSTRUMENT AIR SKID	1
②	N/A	E-HOUSE	1
③	N/A	TRANSFORMER	1
④	N/A	MANUAL TRANSFER SWITCH	1
⑤	N/A	AIR QUALITY MONITORS	3

NOTE:

REFERENCE DRAWINGS

NO.	TITLE

SUMMIT ENGINEERING SERVICES
400 Inverness Parkway, #200
Englewood, CO 80112
303.768.9191 Office
303.768.9292 Fax

REVISIONS

NO.	DATE	DESCRIPTION	BY	CHK.	APP.
N	10/09/19	ISSUED FOR PERMITTING	EAC	KMA	JKK
M	09/26/19	ISSUED FOR PERMITTING	NAS	KAP	KAP
L	06/11/19	ISSUED FOR REVIEW	EAC	KAP	KAP
K	05/23/19	ISSUED FOR REVIEW	EAC	KAP	KAP
J	05/23/19	ISSUED FOR REVIEW	EAC	KAP	KAP
H	01/03/19	ISSUED FOR REVIEW	BME	MRG	
G	12/28/18	ISSUED FOR REVIEW	BME	MRG	JPB
F	11/16/18	ISSUED FOR REVIEW	RAM	MRG	JPB

ENGINEERING RECORD

	BY	DATE
DRN:	MSH	01/17/18
DES:	MSH	01/17/18
CHK:	MRG	01/17/18
APP:	LLL	01/17/18
AFE No.		
SESI JOB NO.		8365
PROJ. ENGR:		
SCALE: (FORMATTED 22"x34")	1" = 40'-0"	

GMT Exploration Company LLC

GMT EXPLORATION COMPANY LLC
MAJESTIC - 16 WELL PAD
NORTH WELL AND FACILITY PAD
INITIAL DEVELOPMENT SITE LAYOUT

DWG. NO. 8365-01-0100

REV N

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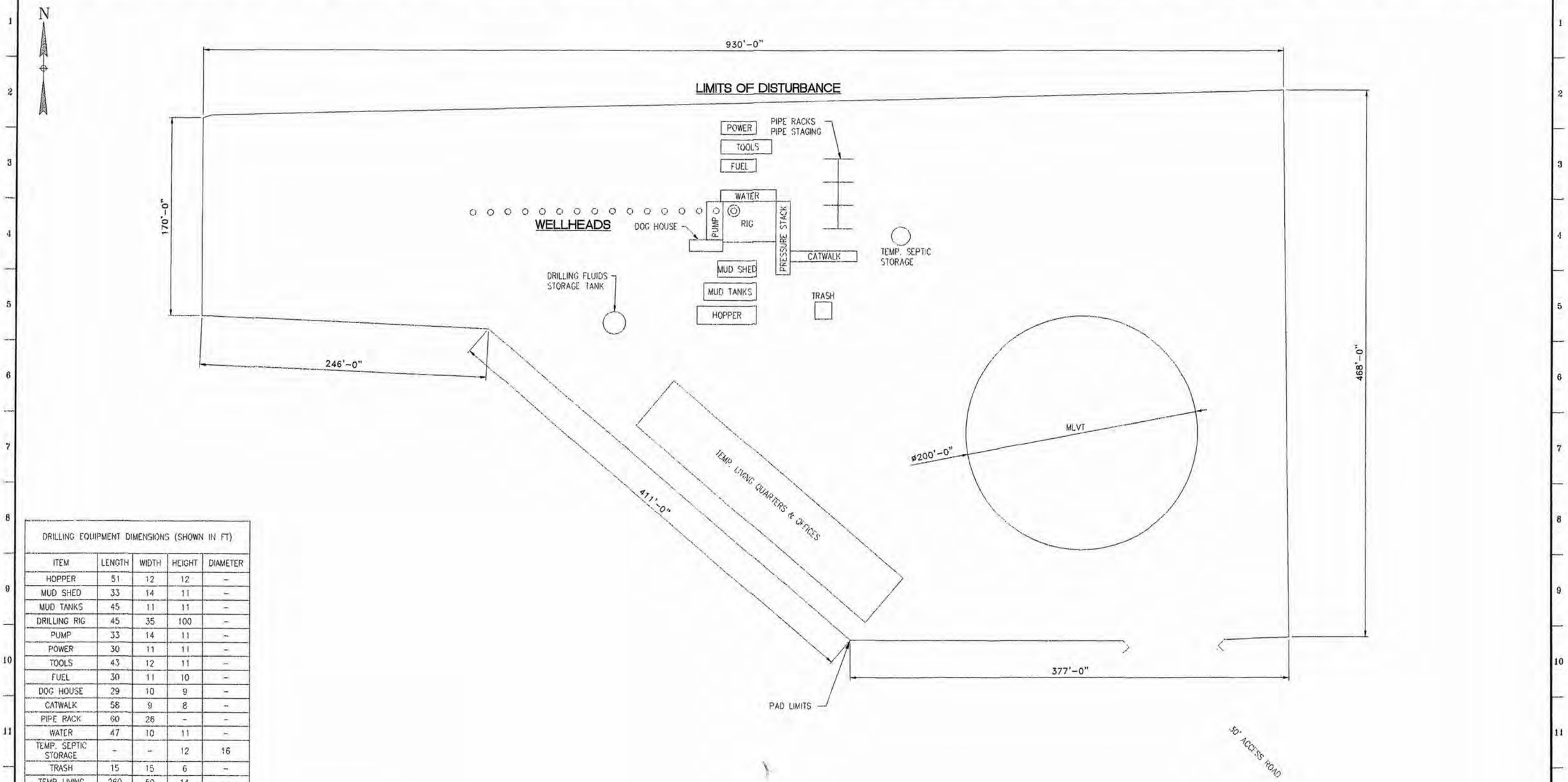

DRILLING EQUIPMENT DIMENSIONS (SHOWN IN FT)				
ITEM	LENGTH	WIDTH	HEIGHT	DIAMETER
HOPPER	51	12	12	–
MUD SHED	33	14	11	–
MUD TANKS	45	11	11	–
DRILLING RIG	45	35	100	–
PUMP	33	14	11	–
POWER	30	11	11	–
TOOLS	43	12	11	–
FUEL	30	11	10	–
DOG HOUSE	29	10	9	–
CATWALK	58	9	8	–
PIPE RACK	60	26	–	–
WATER	47	10	11	–
TEMP. SEPTIC STORAGE	–	–	12	16
TRASH	15	15	6	–
TEMP. LIVING	260	50	14	–
STORAGE TANK	–	–	12	20
MLVT	–	–	12	200

NOTE:

REFERENCE DRAWINGS	
NO.	TITLE

REVISIONS					
NO.	DATE	DESCRIPTION	BY	CHK.	APP.
C	10/09/19	ISSUED FOR PERMITTING	EAC	KMA	JKK
B	09/26/19	ISSUED FOR PERMITTING	NAS	KAP	KAP
A	05/23/19	ISSUED FOR REVIEW	EAC	KAP	KAP

ENGINEERING RECORD	
BY	DATE
DRN: EAC	05/23/19
DES: EAC	05/23/19
CHK: KAP	05/23/19
APP: KAP	05/23/19
AFE No.	
SESI JOB NO.	8365
PROJ. ENGR:	
SCALE: 1" = 40'-0" (FORMATTED 22"x34")	

SUMMIT ENGINEERING SERVICES
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GMT Exploration Company LLC

GMT EXPLORATION COMPANY LLC
MAJESTIC – 16 WELL PAD
NORTH WELL AND FACILITY PAD
RIG LAYOUT

DWG. NO. 8365-01-0101

REV C

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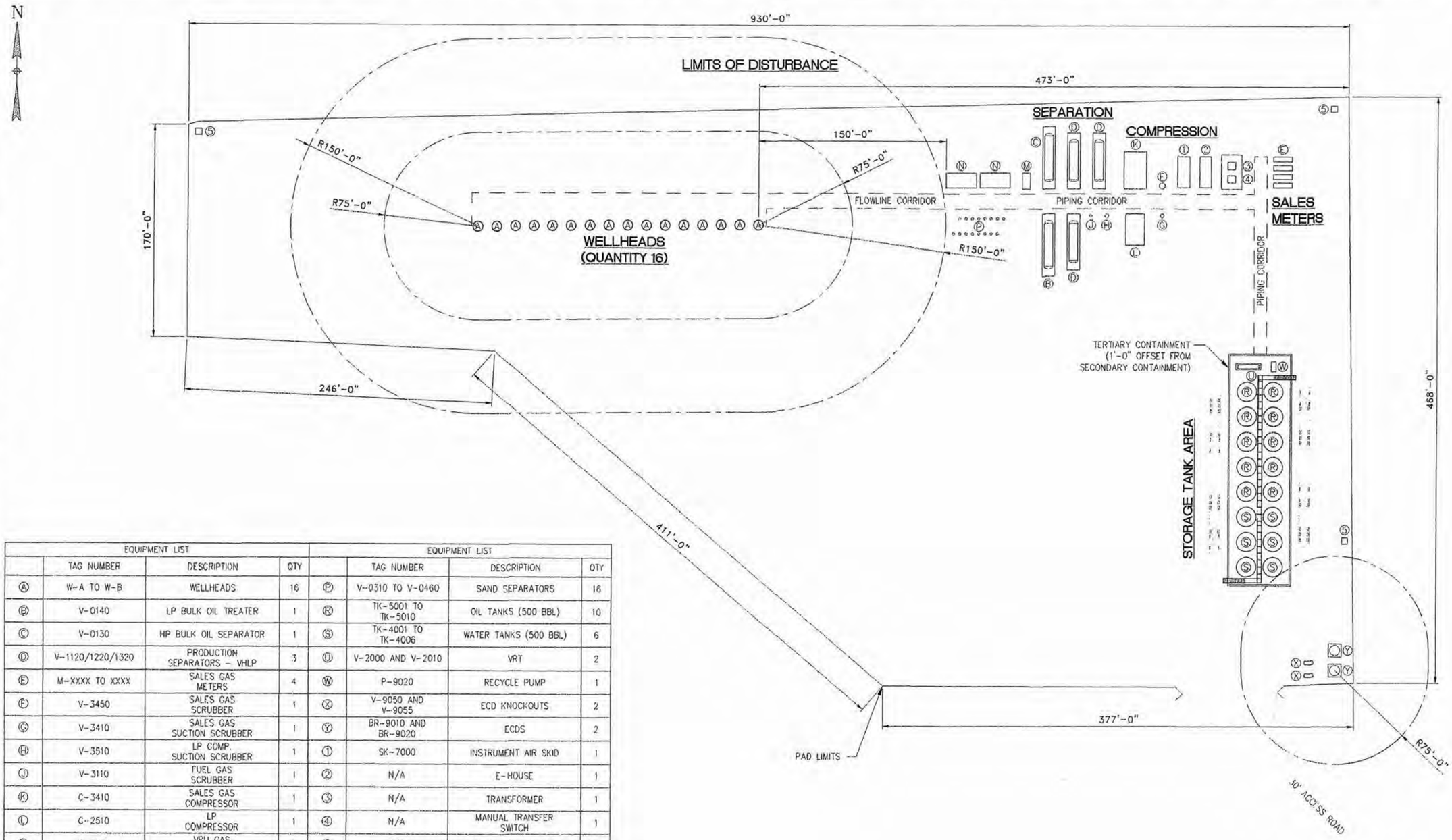

EQUIPMENT LIST			
	TAG NUMBER	DESCRIPTION	QTY
Ⓐ	W-A TO W-B	WELLHEADS	16
Ⓔ	V-0140	LP BULK OIL TREATER	1
Ⓒ	V-0130	HP BULK OIL SEPARATOR	1
Ⓓ	V-1120/1220/1320	PRODUCTION SEPARATORS - VHLP	3
Ⓔ	M-XXXX TO XXXX	SALES GAS METERS	4
Ⓕ	V-3450	SALES GAS SCRUBBER	1
Ⓖ	V-3410	SALES GAS SUCTION SCRUBBER	1
Ⓗ	V-3510	LP COMP. SUCTION SCRUBBER	1
Ⓙ	V-3110	FUEL GAS SCRUBBER	1
Ⓚ	C-3410	SALES GAS COMPRESSOR	1
Ⓛ	C-2510	LP COMPRESSOR	1
Ⓜ	C-3510	VRU GAS COMPRESSOR	1
Ⓝ	SK-7200 AND SK-7300	VALVE MANIFOLD SKIDS	2

EQUIPMENT LIST			
	TAG NUMBER	DESCRIPTION	QTY
Ⓟ	V-0310 TO V-0460	SAND SEPARATORS	16
Ⓡ	TK-5001 TO TK-5010	OIL TANKS (500 BBL)	10
Ⓢ	TK-4001 TO TK-4006	WATER TANKS (500 BBL)	6
Ⓤ	V-2000 AND V-2010	VRT	2
Ⓦ	P-9020	RECYCLE PUMP	1
Ⓧ	V-9050 AND V-9055	ECD KNOCKOUTS	2
Ⓨ	BR-9010 AND BR-9020	ECDS	2
①	SK-7000	INSTRUMENT AIR SKID	1
②	N/A	E-HOUSE	1
③	N/A	TRANSFORMER	1
④	N/A	MANUAL TRANSFER SWITCH	1
Ⓢ	N/A	AIR QUALITY MONITORS	3

NOTE:

REFERENCE DRAWINGS	
NO.	TITLE

REVISIONS						
NO.	DATE	DESCRIPTION	BY	CHK.	APP.
E	10/09/19	ISSUED FOR PERMITTING	EAC	KMA	JKK
D	09/26/19	ISSUED FOR PERMITTING	NAS	KAP	KAP
C	06/11/19	ISSUED FOR REVIEW	EAC	KAP	KAP
B	05/23/19	ISSUED FOR REVIEW	EAC	KAP	KAP
A	05/23/19	ISSUED FOR REVIEW	EAC	KAP	KAP

ENGINEERING RECORD	
BY	DATE
DRN: EAC	05/23/19
DES: EAC	05/23/19
CHK: KAP	05/23/19
APP: KAP	05/23/19
AFE No.	
SESI JOB NO.	8365
PROJ. ENGR:	
SCALE: 1" = 40'-0" (POSTED AT 22"x34")	

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GMT Exploration Company LLC

GMT EXPLORATION COMPANY LLC
MAJESTIC - 16 WELL PAD
NORTH WELL AND FACILITY PAD
FULL DEVELOPMENT SITE LAYOUT

DWG. NO. 8365-01-0102 REV E

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SUMMIT ENGINEERING SERVICES

GMT Exploration Company LLC

GMT
MAJESTIC – 16 WELL PAD
PIPING & INSTRUMENTATION DIAGRAM
DECEMBER 3, 2019

DRAWING NUMBER	DESCRIPTION	REV	DATE	
8365-01-1000	PIPING & INSTRUMENTATION – COVER SHEET	C	12/3/2019	
8365-01-1200	PROCESS FLOW DIAGRAM – PROCESS FLOW DIAGRAM	J	12/3/2019	
8365-01-1201	PROCESS FLOW DIAGRAM – STREAM SUMMARY	A	12/3/2019	HOLD
8365-01-1300	PIPING & INSTRUMENTATION – LEGEND SHEET 1	C	12/3/2019	
8365-01-1301	PIPING & INSTRUMENTATION – LEGEND SHEET 2	C	12/3/2019	
8365-01-1401	PIPING & INSTRUMENTATION – TYPICAL WELLHEAD W-A	C	12/3/2019	
8365-01-1402	PIPING & INSTRUMENTATION – SELECTION MANIFOLD	C	12/3/2019	
8365-01-1403	PIPING & INSTRUMENTATION – VHLP SEPARATOR V-1120	C	12/3/2019	
8365-01-1404	PIPING & INSTRUMENTATION – VHLP SEPARATOR V-1220	C	12/3/2019	
8365-01-1405	PIPING & INSTRUMENTATION – VHLP SEPARATOR V-1320 (FUTURE)	C	12/3/2019	
8365-01-1406	PIPING & INSTRUMENTATION – HP BULK OIL SEPARATOR #1 (FUTURE)	C	12/3/2019	
8365-01-1407	PIPING & INSTRUMENTATION – LP BULK OIL TREATER #1 (FUTURE)	B	12/3/2019	
8365-01-1408	PIPING & INSTRUMENTATION – VAPOR RECOVERY TOWERS	C	12/3/2019	
8365-01-1409	PIPING & INSTRUMENTATION – SALES GAS HEADER	C	12/3/2019	
8365-01-1410	PIPING & INSTRUMENTATION – WATER TANKS	C	12/3/2019	
8365-01-1411	PIPING & INSTRUMENTATION – WATER TANKS (FUTURE)	C	12/3/2019	
8365-01-1412	PIPING & INSTRUMENTATION – FUEL GAS HEADER	C	12/3/2019	
8365-01-1413	PIPING & INSTRUMENTATION – LOW PRESSURE COMPRESSION C-2510	C	12/3/2019	
8365-01-1414	PIPING & INSTRUMENTATION – FLARE KNOCKOUTS AND PUMPS	C	12/3/2019	
8365-01-1415	PIPING & INSTRUMENTATION – VRU GAS COMPRESSOR C-3510	C	12/3/2019	
8365-01-1416	PIPING & INSTRUMENTATION – BLANKET GAS HEADER	C	12/3/2019	
8365-01-1417	PIPING & INSTRUMENTATION – ECDs	C	12/3/2019	
8365-01-1418	PIPING & INSTRUMENTATION – OIL TANKS – HOLDING	C	12/3/2019	
8365-01-1419	PIPING & INSTRUMENTATION – OIL TANKS (FUTURE)	C	12/3/2019	
8365-01-1420	PIPING & INSTRUMENTATION – MAINTENANCE HEADER	C	12/3/2019	
8365-01-1421	PIPING & INSTRUMENTATION – CONDENSATE HEADER	C	12/3/2019	
8365-01-1422	PIPING & INSTRUMENTATION – INSTRUMENT AIR	C	12/3/2019	
8365-01-1423	PIPING & INSTRUMENTATION – LIQUID LOAD OUT	A	12/3/2019	

NOTE:

"ISSUED FOR DESIGN"
"NOT FOR CONSTRUCTION"

REFERENCE DRAWINGS

NO.	TITLE

SUMMIT ENGINEERING SERVICES
400 Inverness Parkway, #200
Englewood, CO 80112
303.768.9191 Office
303.768.9292 Fax

REVISIONS

NO.	DATE	DESCRIPTION	BY	CHK.	APP.
C	12/03/19	ISSUED FOR DESIGN	PEH	JAH	JKK
B	10/18/19	ISSUED FOR DESIGN	MJB	JAH	JKK
A	09/27/19	ISSUED FOR REVIEW	PEH	JAH	JKK

ENGINEERING RECORD

	BY	DATE
DRN:	PEH	09/23/19
DES:	PEH	09/23/19
CHK:	JAH	09/27/19
APP:	JKK	09/27/19
AFE No.		
SESI JOB NO.		8365
PROJ. ENGR:		
(FORMATTED 22"x34") SCALE:		N.T.S.

GMT Exploration Company LLC

GMT
MAJESTIC – 16 WELL PAD
PIPING & INSTRUMENTATION DIAGRAM
COVER SHEET

DWG. NO. 8365-01-1000

REV C

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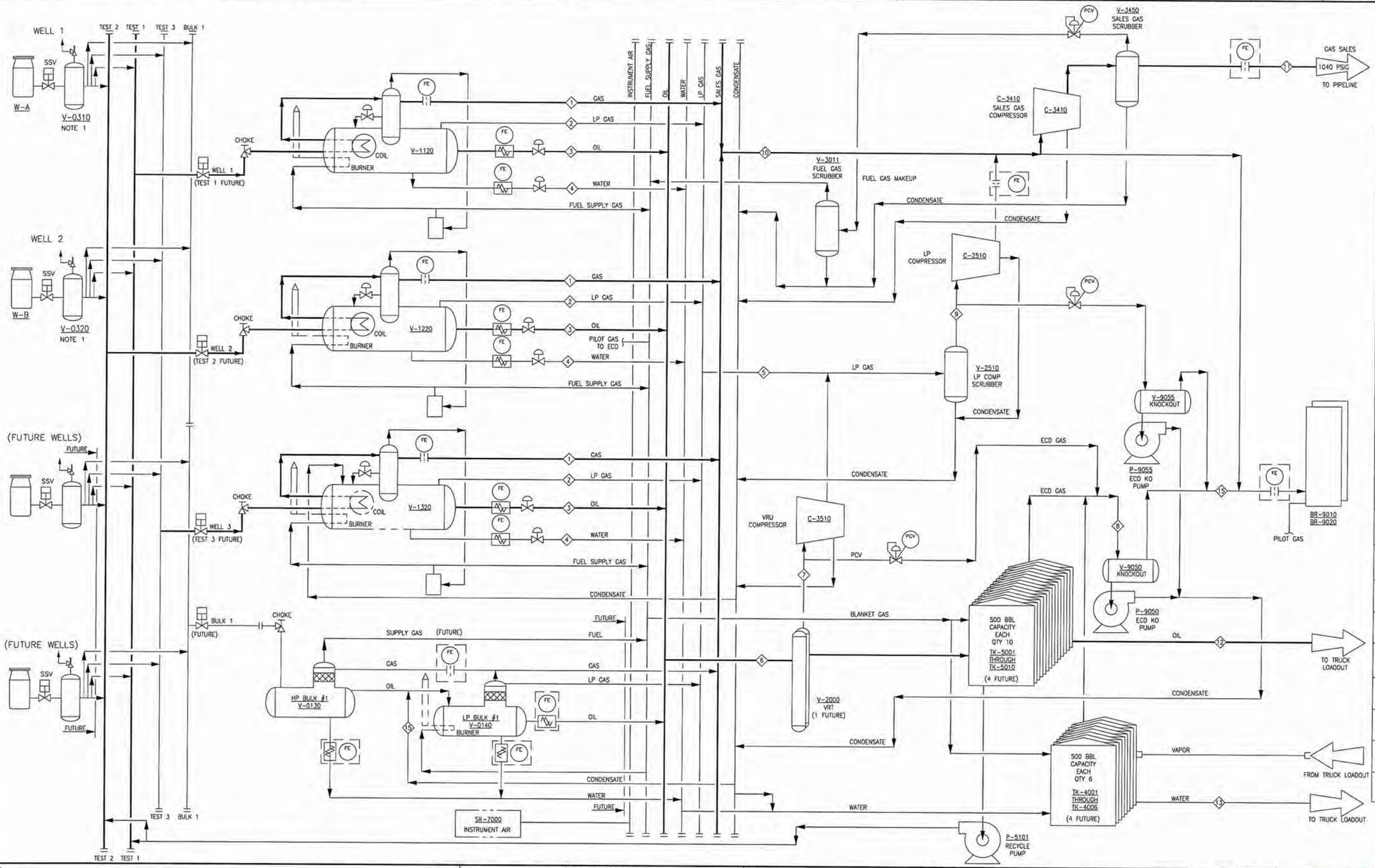

EQUIPMENT LIST		
EQUIP. NO.	DESCRIPTION	QTY
W-A TO W-R	WELLHEADS (14 FUTURE)	2
V-0310 TO V-0320	SAND CATCHERS (TEMPORARY)	2
V-1120 TO V-1220	SEPARATORS - VHLP (1 FUTURE)	2
V-0130	HP BULK #1 (FUTURE)	1
V-0140	LP BULK #1 (FUTURE)	1
V-2000 AND V-2010	VAPOR RECOVERY TOWERS (1 FUTURE)	1
V-3011	FUEL GAS SCRUBBER	1
V-3450	SALES GAS SCRUBBER	1
V-2510	LP COMP. SUCTION SCRUBBER	1
TK-5001 TO TK-5010	OIL TANKS (500 BBL) (4 FUTURE)	10
TK-4001 TO TK-4006	WATER TANKS (500 BBL) (4 FUTURE)	6
V-9050 AND V-9055	ECD KNOCKOUTS	2
BR-9010 TO BR-9020	ECDS	5
P-9050 P-9055	ECD KO PUMPS	2
C-3410	SALES GAS COMPRESSOR	1
C-3510	VRU COMPRESSOR	1
SK-7000	INSTRUMENT AIR	1
C-2510	LP COMPRESSOR	1
P-5101	RECYCLE PUMP	1

NOTE:
1. TEMPORARY SAND SEPARATORS MOVE TO NEW WELLS EACH YEAR.
2. BULK HEADER AND TEST HEADER WILL HAVE PROVISIONS FOR FUTURE BULK AND TESTING SEPARATION.

"ISSUED FOR DESIGN"
"NOT FOR CONSTRUCTION"

REFERENCE DRAWINGS

NO.	TITLE

SUMMIT ENGINEERING SERVICES
400 Inverness Parkway, #200
Englewood, CO 80112
303.768.9191 Office
303.662.0800 Fax

REVISIONS

NO.	DATE	DESCRIPTION	BY	CHK.	APP.
H	10/18/19	ISSUED FOR DESIGN	MJB	JAH	JKK
G	09/27/19	ISSUED FOR REVIEW	PEH	JAH	JKK
F	12/07/18	ISSUED FOR REVIEW	BPM	JAH	JPB
E	11/16/18	ISSUED FOR REVIEW	RAM	JAH	JPB
D	11/09/18	ISSUED FOR REVIEW	MSH	JAH	JPB
C	04/18/18	ISSUED FOR REVIEW	EMC	JAH	JPB
B	02/14/18	ISSUED FOR REVIEW	BME	JAH	LLL
J	12/03/19	ISSUED FOR DESIGN	PEH	JAH	JKK

ENGINEERING RECORD

	BY	DATE
DRN:	CWB	01/23/18
DES:	JAH	01/23/18
CHK:	JAH	01/23/18
APP:	JKK	01/23/18
AFE No.		
SESI JOB NO.		8365
PROJ. ENGR:		
(FORMATTED 22"x34") SCALE:		NTS

GMT Exploration Company LLC

GMT EXPLORATION COMPANY LLC
MAJESTIC - 16 WELL PAD
PROCESS FLOW DIAGRAM

DWG. NO. 8365-01-1200

REV J

X:\SESI Clients-Projects\GMT\8365 Majestic 16 Well Design (Adams County)\3-0_DESIGN\3-5_PROCESS\PFDs\8365-01-1200 (12/3/2019 2:39:03 PM)

VALVE SYMBOLS

- BALL VALVE
- CHECK VALVE
- BUTTERFLY VALVE
- PLUG VALVE
- GATE VALVE
- GLOBE VALVE
- NEEDLE VALVE
- INLINE CHOKE VALVE
- QUICK OPENING VALVE
- DIAPHRAGM VALVE
- SLIDE VALVE
- PINCH VALVE
- ANGLE VALVE
- ANGLE CHOKE VALVE
- PRESSURE RELIEF VALVE
- VACUUM RELIEF VALVE
- PRESSURE & VACUUM VALVE
- 3-WAY VALVE
- 4-WAY VALVE
- ANGLE DUMP VALVE
- GATE SOLENOID
- I/P — PY — IAS
- CONTROL VALVE W/ELECTRO PNEUMATIC CONVERTER
- PISTON OPERATED VALVE
- MOTOR OPERATED VALVE
- DIAPHRAGM VALVE
- REGULATOR (SELF CONTAINED)
- REGULATOR W/EXTERNAL PRESSURE TAP
- 3-WAY SOLENOID VALVE
- 4-WAY SOLENOID VALVE
- ANGLE DIAPHRAGM VALVE
- 3-WAY DIAPHRAGM VALVE
- 4-WAY DIAPHRAGM VALVE
- 3-WAY THERMOSTATIC VALVE
- GAUGE VALVE

METER SYMBOLS

- FI XXX — ROTAMETER
- ORIFICE METER SENIOR FITTING
- INTEGRAL ORIFICE PLATE
- STANDARD PITOT TUBE
- AVERAGING PITOT TUBE
- TURBINE/PROPELLER FLOWMETER
- VORTEX SHEDDING FLOWMETER
- TARGET FLOWMETER
- MAGNETIC FLOWMETER
- ΔT — THERMAL MASS FLOWMETER
- POSITIVE DISPLACEMENT FLOWMETER
- CONE/ANNULAR ORIFICE METER
- WEDGE METER
- CORIOLIS FLOWMETER
- SONIC/ULTRASONIC FLOWMETER
- VARIABLE AREA FLOWMETER

FITTING SYMBOLS

- FLANGE
- BLEED RING W/VALVE
- SPECTACLE BLIND (OPEN)
- SPECTACLE BLIND (CLOSED)
- SG — SIGHT GLASS
- RESTRICTION ORIFICE
- ORIFICE PLATE W/VALVES
- ORIFICE PLATE W/VALVES (TAPPED)
- RUPTURE DISC (PRESSURE)
- RUPTURE DISC (VACUUM)
- CONCENTRIC REDUCER
- ECCENTRIC REDUCER
- WELD CAP
- THREADED CAP
- THREADED PLUG
- TRUCK CONNECTION
- HOSE CONNECTION

INLINE EQUIPMENT

- VENTURI
- VENTURI W/TAPS
- OPEN CHANNEL WEIR PLATE
- STRAIGHTENING VANES
- FLOW — TEMPORARY STRAINER
- F = FILTER, L = LUBRICATOR, R = REGULATOR
- FLEXIBLE HOSE
- Y-STRAINER W/VALVE
- SIMPLEX STRAINER
- DUPLEX STRAINER
- PULSATION DAMPENER
- TANK VENT
- S — SILENCER (VENT)
- PIPE BREAK
- DCA / DCB — MATERIAL, INSULATION, OR PIPING SPECIFICATION
- AG / UG — ABOVE/UNDERGROUND
- BY OTHERS / BY OTHERS — BATTERY LIMITS
- BASKET STRAINER
- OPEN DRAIN — CS = CHEMICAL SEWER, FD = FLOOR DRAIN, HS = SANITARY SEWER, OS = ONLY SEWER, SS = STORM SEWER
- EXPANSION JOINT
- INLINE MIXER
- DIAPHRAGM SEAL
- TP XX — TIE-IN POINT
- CC — CORROSION COUPON
- T — STEAM OR DRAIN TRAP
- SP XX — SPECIALTY ITEM
- FA — FLAME ARRESTOR
- I — FLANGE INSULATION KIT
- A — EQUIPMENT CONNECTION
- CLEAN-OUT TEE
- THIEF HATCH
- 2" — INSULATION
- EQUIPMENT INSULATION
- 1" / 10' — SLOPE INDICATOR (LINE SLOPES IN DIRECTION OF ARROW)

PIPING SERVICE CODES	
CODE	SERVICE
PG	PRODUCED GAS
PF	PRODUCED FLUID
CO	CRUDE OIL
RW	RAW WATER
PO	PRODUCED OIL
PW	PRODUCED WATER
WW	WASTE WATER
DR	DRAIN
HC	HYDROCARBON GAS
HL	HYDROCARBON LIQUID
BG	BLANKET GAS
FG	FUEL GAS
IG	INSTRUMENT GAS
IA	INSTRUMENT AIR
FL	FLARE
VG	VENT GAS
CW	COOLING WATER
CH	CHILLED WATER
HW	HEATING WATER
CD	CONDENSATE
HO	HOT OIL
MI	METHANOL INJECTION
CI	CHEMICAL INJECTION
SG	SUPPLY GAS
THIRD CHARACTER	
__S	SUPPLY
__R	RETURN
__X	CORROSIVE

VALVE SYMBOL MODIFIERS

- FLANGED
- THREADED
- SOCKET WELD
- VALVE W/PLUG
- 1020 — VALVE NUMBER
- 2" — VALVE SIZE
- BDR — VALVE TYPE
- LO — LOCK POSITION
- XX — INSTRUMENT ID TAG
- 2" — VALVE SIZE
- BDR — VALVE TYPE
- LO — LOCK POSITION

VALVE IDENTIFICATION (NON-INSTRUMENT)

1ST (TYPE) — BDR — 3RD (END CONN.); 2ND (PRESSURE CLASS)

1ST	VALVE TYPE	2ND	PRESSURE CLASS	MAWP	3RD	END CONNECTION
B	BALL	A	CLASS 150	285 PSIG	B	BUTT WELD (BOTH ENDS)
C	CHECK	B	CLASS 300	740 PSIG	C	BUTT WELD x FLANGED, RF
E	GAUGE	D	CLASS 600	990 PSIG	D	BUTT WELD x FLANGED, RTJ
F	BUTTERFLY	E	CLASS 900	1480 PSIG	F	FLANGED, FLAT FACE (BOTH ENDS)
G	GATE	F	CLASS 1500	2220 PSIG	J	FLANGED, RING JOINT (BOTH ENDS)
H	CHOKE	G	6000 CWP	3705 PSIG	M	THREADED (MNPT x FNPT)
L	GLOBE	0	750 CWP	6170 PSIG	N	INTEGRALLY REINFORCED MALE END
N	NEEDLE	1	1000 CWP, DI, S	750 PSIG	P	SOCKET WELD x THD. (FEM X MNPT)
P	PLUG	2	2000 CWP, DI, S	1000 PSIG	Q	SOCKET WELD x THD. (FEM x FNPT)
Z	PROJECT SPECIFIC	3	3000 CWP, CS, (C)	2000 PSIG	R	FLANGED, RAISED FACE
		5	1000 CWP, DI, F	3000 PSIG	S	SOCKET WELD (FEM x FEM)
		6	2000 CWP, DI, F	5000 PSIG	T	THREADED BOTH ENDS (FNPT)
		7	2000 CWP, CS, F	6000 PSIG	W	WAFER
		8	3000 CWP, CS, F			

SPECIAL: E50 – 1/2" x 1/2" GAUGE VALVE, E75 – 3/4" x 1/2" GAUGE VALVE
PRESSURE CLASS 3 (C) TO BE USED FOR SERIES C SWING CHECK VALVE.

PROCESS LINE TYPES

- MAJOR PRIMARY LINE
- MAJOR SECONDARY LINE
- MINOR PRIMARY LINE
- MINOR SECONDARY LINE
- INSTRUMENT LINE
- ELECTRIC LINE
- HYDRAULIC LINE
- CAPILLARY TUBE
- PNEUMATIC TUBING LINE
- FUTURE LINE
- LOGIC SYSTEM LINK
- MECHANICAL LINK
- GUIDED ELECTROMAGNETIC LINE
- UNGUIDED ELECTROMAGNETIC LINE
- WIRELESS

CONTINUATION SYMBOLS

- CONTINUATION IN/OUTSIDE OF WORK AREA
- STA-01-XX — CONTINUATION ARROW (INSTRUMENTATION)
- TO/FROM EQUIPMENT NO. / SERVICE / DRAWNG TO/FROM — CONTINUATION ARROW (PROCESS)
- FLOW ARROW

INSULATION AND TRACING CODES

1ST INSULATION TYPE; INSULATION THICKNESS — 2H; 2ND TRACING TYPE — ET

1ST	INSULATION TYPE	2ND	TRACING TYPE
C	COLD	ET	ELECTRICAL
H	HOT	MT	MEDIA (GLYCOL, HOT OIL, ETC.)
PP	PERSONNEL PROTECTION	ST	STEAM

LINE NUMBERING SCHEDULE

SIZE — XX-XX-XXXX-XXX-X/XX/XX — INSULATION SIZE/TYPE/TRACE; SERVICE; SPECIFICATION (SEE BELOW); NUMBER

PIPING SPECIFICATION CODES

1ST (CLASS); 2ND (MATERIAL); 3RD (TRIM, OPTION); DCA

1ST	CLASS	2ND	MATERIAL	3RD	TRIM, OPTION
A	ASME 150	C	CARBON STEEL	A	NO NACE, 0.063 CA
B	ASME 300	F	FIBERGLASS	B	NO NACE, 0.125 CA
C	ASME 400	N	INCOLOY	C	NO NACE, 0.000 CA
D	ASME 600	P	HDPE	D	SOUR/NACE, 0.125 CA
E	ASME 900	Q	SPOOL PIPE (HDPE)	E	HIGH EROSION, 0.250 CA
F	ASME 1500	R	CHROME MOLY	H	HIGH TEMP., 0.063 CA
G	ASME 2500	S	STAINLESS STEEL	T	THREADED
H	TUBING, LOW PRESS.	T	TITANIUM	V	VICTAULIC
J	TUBING, HIGH PRESS.	V	CPVC	X	0.188" W.T.
P	UNRATED, ATMOS.				

EQUIPMENT NUMBERING STANDARD

XX-XXXX(E)
EQUIPMENT IDENTIFICATION CODE
SEQUENTIAL NUMERICAL IDENTIFIER
INDICATES EXISTING EQUIPMENT

EQUIPMENT IDENTIFICATION	
CODE	TYPE
AC	AIR COOLER
BL	BLOWER
B	BURNER
C	COMPRESSOR
E	EXCHANGER
F	FILTER
FL	FLARE/ECD
G	GENERATOR
H	HEATER/VHLP
M	METER
P	PUMP
PX	PIG LAUNCHER \ RECEIVER
SK	SKID
SU	SUMP
T	TANK
V	VESSEL
W	WELLHEAD

NOTE:

"ISSUED FOR DESIGN"
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REFERENCE DRAWINGS

NO.	TITLE

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AFE No.		
SESI JOB NO.		8365
PROJ. ENGR:		
SCALE: (FORMATTED 22"x34")	N.T.S.	

GMT Exploration Company LLC

GMT
MAJESTIC – 16 WELL PAD
PIPING & INSTRUMENTATION DIAGRAM
LEGEND SHEET 1

DWG. NO. 8365-01-1300 | REV C

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INSTRUMENT BALLOON SYMBOLS

	FIELD MOUNTED INSTRUMENTS	CENTRAL PANEL MOUNTED INSTRUMENTS	LOCAL PANEL MOUNTED INSTRUMENTS CENTRAL PANEL	INACCESSIBLE INSTRUMENTS	LOCAL PANEL INACCESSIBLE INSTRUMENT (SKID MOUNTED)
INSTRUMENTS	XXX <...>	XXX <...>	XXX <...>	XXX <...>	XXX <...>
PROGRAMMABLE LOGIC CONTROLLER (UNIT)	XXX <...>	XXX <...>	XXX <...>	XXX <...>	XXX <...>
STATION CONTROLLER	XXX <...>	XXX <...>	XXX <...>	XXX <...>	XXX <...>
UNIT CONTROLLER	XXX <...>	XXX <...>	XXX <...>	XXX <...>	XXX <...>

XXX <...> XXX <...> — INSTRUMENT SHARING COMMON HOUSING

PILOT LIGHT

C/12 — PANEL MOUNTED PATCHBOARD POINT 12

NOTES:

XXX REFERS TO INSTRUMENT TAG IDENTIFICATION FROM LIST.

--- INDICATES INSTRUMENT NUMBER.

INTERLOCK LOGIC

COMPLEX OR UNDEFINED INTERLOCK

AND — OUTPUT ONLY IF ALL INPUTS PRESENT

OR — OUTPUT IF ANY INPUTS PRESENT

R — RESET

P — PILOT

EMERGENCY SHUTDOWN LOGIC

RELAY FUNCTION DESIGNATIONS

SELECT LOW SIGNAL

SELECT HIGH SIGNAL

SELECT HIGH/LOW SIGNAL

M/P — MOTOR TO PNEUMATIC TRANSDUCER

P/I — PNEUMATIC TO CURRENT TRANSDUCER

I/P — CURRENT TO PNEUMATIC TRANSDUCER

Σ — TtotalIZER

SQUARE ROOT

R/I — RESISTANCE TO CURRENT TRANSDUCER

E/H — ELECTROHYDRAULIC TRANSDUCER

A/M — AUTO/MANUAL LOADING STATION

INSTRUMENT IDENTIFICATION TABLE

FIRST LETTER	MEASURING DEVICES							CONTROLLING DEVICES						ALARMS *					SWITCHES *						MISC.
SYMBOL	MEASURED OR INITIAL VARIABLE	E PRIMARY ELEMENT	W WELL	R READOUT (RECORDING)	I READOUT (INDICATING)	T TRANSMITTER (BLIND)	G OBSERVATION (LOCAL)	RC CONTROLLING (RECORDING)	IC CONTROLLING (INDICATING)	C CONTROLLERS (BLIND)	CV SELF CONTAIN. CONTROL VLV.	V CONTROL VALVE	YV SOLENOID VALVE	A BLIND	F FAILURE	L LOW	LL LOW LOW	H HIGH	HH HIGH HIGH	IS INDICATING	S BLIND	Y RELAY	SLL SHUTDOWN LOW (SLL)	SHH SHUTDOWN HIGH (SHH)	SO POSITION LOW (OPEN)	SC POSITION HIGH (CLOSED)	SAFETY DEVICE
A	ANALYZER	AE	AW	AR	AI	AT		ARC	AIC	AC		AV		AA		AAL/AALL		AAH/AAHH		AIS	AS	AY	ASLL	ASHH			
B	BURNER, COMBUSTION	BE	BW	BR	BI	BT	BC	BRC	BIC	BC				BA		BAL/BALL		BAH/BAHH		BIS	BS	BY	BSLL	BSHH			
C	CONDUCTIVITY (ELECTRICAL)	CE		CR	CI	CT		CRC	CIC	CC				CA		CAL/CALL		CAH/CAHH		CIS	CS	CY	CSLL	CSHH			
D	DENSITY OR SPECIFIC GRAVITY	DE		DR	DI	DT		DRC	DIC	DC				DA		DAL/DALL		DAH/DAHH		DIS	DS	DY	DSLL	DSHH			
E	VOLTAGE (EMF)	EE		ER	EI	ET		ERC	EIC	EC				EA		EAL/EALL		EAH/EAHH		EIS	ES	EY	ESLL	ESHH			
F	FLOW	FE		FR	FI	FT	FG	FRC	FIC	FC	FCV	FV		FA		FAL/FALL		FAH/FAHH		FIS	FS	FY	FSLL	FSHH			
G	GAUGING (DIM)			GR	GI	GT															GS						
H	HAND INITIATED								HIC	HC	HCV	HV									HS	HY					
I	CURRENT (ELECTRICAL)	IE		IR	II	IT		IRC	IIC					IA		IAL/IALL		IAH/IAHH		IIS	IS	IY	ISLL	ISHH			
J	POWER	JE		JR	JI	JT		JRC	JIC					JA		JAL/JALL		JAH/JAHH		JIS	JS	JY	JSLL	JSHH			
K	TIME OR TIME SCHEDULE	KE		KR	KI	KT		KRC	KIC	KC	KCV			KA		KAL/KALL		KAH/KAHH		KIS	KS	KY	KSLL	KSHH			
L	LEVEL	LE	LW	LR	LI	LT	LG	LRC	LIC	LC	LCV	LV		LA		LAL/LALL		LAH/LAHH		LIS	LS	LY	LSLL	LSHH			
M	MOISTURE OR HUMIDITY	ME		MR	MI	MT		MRC	MIC	MC		MV		MA		MAL/MALL		MAH/MAHH		MIS	MS	MY	MSLL	MSHH			
N	MULTI-VARIABLE																	NXAH						NSHH			
O	USER'S CHOICE																										
P	PRESSURE OR VACUUM	PE		PR	PI	PT		PRC	PIC	PC	PCV	PV		PA		PAL/PALL		PAH/PAHH		PIS	PS	PY	PSLL	PSHH			PSV PSE
Q	QUANTITY OR EVENT	QE		QR	QI	QT		QRC	QIC					QA		QAL/QALL		QAH/QAHH		QIS	QS	QY	QSLL	QSHH			
R	RADIATION	RE	RW	RR	RI	RT		RRC	RIC	RC				RA		RAL/RALL		RAH/RAHH		RIS	RS	RY	RSLL	RSHH			
S	SPEED OR FREQUENCY	SE		SR	SI	ST		SRC	SIC	SC	SCV	SV		SA		SAL/SALL		SAH/SAHH		SIS	SS	SY	SSLL	SSHH			
T	TEMPERATURE	TE	TW	TR	TI	TT		TRC	TIC	TC	TCV	TV		TA		TAL/TALL		TAH/TAHH		TIS	TS	TY	TSLL	TSHH			TSE
U	UNIT											UV		UA								UY		UU			
V	VIBRATION																										
W	WEIGHT OR FORCE	WE		WR	WI	WT		WRC	WIC	WC	WCV			WA		WAL/WALL		WAH/WAHH		WIS	WS	WY	WSLL	WSHH			
X	SHUTDOWN											XV	XYV	XA		XAL/XALL		XAH/XAHH			XS	XY					
Y	EVENT, STATE OR PRESENCE																										
Z	POSITION	ZE		ZR	ZI	ZT		ZRC	ZIC	ZC	ZCV	ZV		ZA	ZFL/ZFH	ZAL/CLOSE		ZAH/OPEN		ZIS	ZS	ZY			ZSO	ZSC	
Pd	PRESSURE DIFFERENTIAL				PDI	PDT			PDIC							PDAL		PDAH									

S, SWITCH _ THE ACTUATING DEVICE MAY BE USED IN THE SAME FASHION AS "A", ALARM. THE ANNUNCIATING DEVICE.

OTHER POSSIBLE COMBINATIONS:

RO _____ RESTRICTION ORIFICE
FRK, HIK ___ CONTROL STATION
FX _____ ACCESSORIES
TJR _____ SCANNING RECORDER
LLH _____ PILOT LIGHT
PRFT _____ RATIO
KQI _____ RUNNING TIME INDICATOR
QQI _____ INDICATING COUNTER
WKIC _____ RATE-OF-WEIGHT-LOSS CONTROLLER
HMS _____ HARD MOMENTARY SWITCH

PROCESS & MISCELLANEOUS ABBREVIATIONS

AG	ABOVE GROUND/GRADE	NC	NORMALLY CLOSED
ALM	ALARM	NO	NORMALLY OPEN
AOV	AIR OPERATED VALVE	OD	OUTSIDE DIAMETER
AR	AIR RELEASE	OP	OPERATING PRESSURE
AS	AIR SUPPLY	OT	OPERATING TEMPERATURE
ATC	AIR TO CLOSE	PP	PERSONNEL PROTECTION
ATM	ATMOSPHERE	PSD	PROCESS SHUTDOWN
ATO	AIR TO OPEN	PSIG	POUNDS PER SQUARE INCH GAUGE
BDV	BLOWDOWN VALVE	RO	RESTRICTION ORIFICE
BF	BLIND FLANGE	ROV	REMOTE OPERATED VALVE
BFP	BACKFLOW PREVENTER	SD	SHUTDOWN
BG	BELOW GROUND/GRADE	SDV	SHUTDOWN VALVE
BOP	BOTTOM OF PIPE	SOL	SOLENOID
CC	CORROSION COUPON	SP	SETPOINT
CO	CLEANOUT	S/S	SEAM TO SEAM
CP	CORROSION PROBE	ST	STEAM TRAP
CPLG	COUPLING	TE	TEMPERATURE ELEMENT
CSC	CAR SEAL CLOSED	TOC	TOP OF CONCRETE
CSO	CAR SEAL OPEN	TOS	TOP OF STEEL
DP	DESIGN PRESSURE	TP	TIE POINT
ECC	ECCENTRIC	TS	TEMPORARY STRAINER
EL	ELEVATION	TT	TANGENT TO TANGENT
E/E	END TO END	TYP	TYPICAL
ESD	EMERGENCY SHUTDOWN	US	UTILITY STATION
EX	EXISTING	USD	UNIT SHUTDOWN
FA	FLAME ARRESTOR	(V)	VENDOR FURNISHED
FB	FULL BORE	W	WITH
FBO	FURNISHED BY OWNER	W/O	WITHOUT
FC	FAIL CLOSED		
FE	FLOW ELEMENT		
FF	FLAT FACE		
FP	FREEZE PROTECTION		
FPV	FULL PORT VALVE		
FT	FEET		
HC	HOSE CONNECTION		
HP	HIGH PRESSURE OR HORSEPOWER		
ID	INSIDE DIAMETER		
IF	INSULATING FLANGE		
IN	INCHES		
LC	LOCK CLOSED		
LL	LOW LEVEL		
LLSD	LOW LEVEL SHUTDOWN		
LO	LOCK OPEN		
LP	LOW PRESSURE		
MCC	MOTOR CONTROL CENTER		
MW	MANWAY		
MAOP	MAXIMUM ALLOWABLE OPERATING PRESSURE		
MMSCFD	MILLION STANDARD CUBIC FEET PER DAY		

INSTRUMENT SYMBOLS

MMM (V) XXX <...> — FIELD MOUNTED

(V) XXX <...> XXX <...> — DUAL FUNCTION

SSS (V) XXX <...> — LOCAL PANEL OPERATOR ACCESSIBLE

SSS (V) XXX <...> — LOCAL PANEL NOT OPERATOR ACCESSIBLE

PROCESS CONTROL SYSTEM

MMM HH H L LL XXX <...>

LOCAL CONTROL SYSTEM

SSS XXX <...>

SAFETY SYSTEM

SSS (V) — HARDWIRED INTERLOCK

SSS = SYSTEM/PANEL
(V) = VENDOR FURNISHED

USE OF MODIFIER

MODIFIER IS ONLY APPLIED TO FIRST DEVICE FOR CLARIFICATION

AI AT pH

ZI ZS PIG

AI AT S&W

RSP PV FC OP

WHERE NECESSARY ADD ARROWS AND ID'S TO SIGNAL LINE

RSP = REMOTE SET POINT
PV = PROCESS VARIABLE
OP = CONTROLLER OUTPUT

NOTE:

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REFERENCE DRAWINGS

NO.	TITLE

REVISIONS

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ENGINEERING RECORD

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MAJESTIC – 16 WELL PAD
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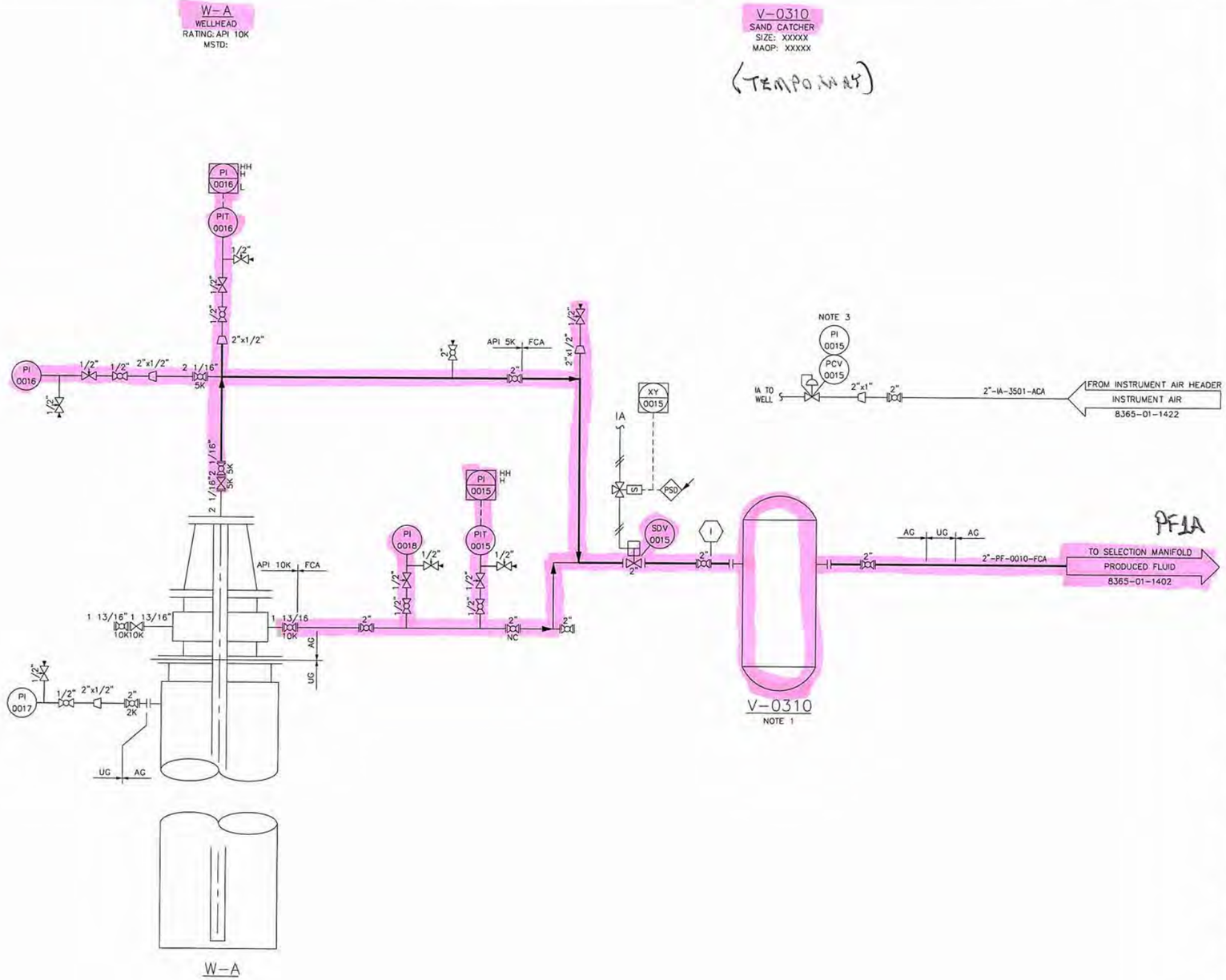
LEGEND SHEET 2

DWG. NO. 8365-01-1301

REV C

X:\SESI Clients-Projects\GMT\8365 Majestic 16 Well Design (Adams County)\3-0_DESIGN\3-5_PROCESS\P&IDs\8365-01-1301 (12/2/2019 11:00:39 AM)

	WELL HEAD #	SAND CATCHER #	FLOW LINE #	INSTRUMENT AIR LINE #
NEW	W-A	V-0310	2"-PF-0010-FCA	2"-IA-3501-ACA
	W-B	V-0320	2"-PF-0020-FCA	2"-IA-3502-ACA
FUTURE	W-C	V-0330	2"-PF-0030-FCA	2"-IA-3503-ACA
	W-D	V-0340	2"-PF-0040-FCA	2"-IA-3504-ACA
	W-E	V-0350	2"-PF-0050-FCA	2"-IA-3505-ACA
	W-F	V-0360	2"-PF-0060-FCA	2"-IA-3506-ACA
	W-G	V-0370	2"-PF-0070-FCA	2"-IA-3507-ACA
	W-H	V-0380	2"-PF-0080-FCA	2"-IA-3508-ACA
	W-J	V-0390	2"-PF-0090-FCA	2"-IA-3509-ACA
	W-K	V-0400	2"-PF-0100-FCA	2"-IA-3510-ACA
	W-L	V-0410	2"-PF-0110-FCA	2"-IA-3511-ACA
	W-M	V-0420	2"-PF-0120-FCA	2"-IA-3512-ACA
	W-N	V-0430	2"-PF-0130-FCA	2"-IA-3513-ACA
	W-P	V-0440	2"-PF-0140-FCA	2"-IA-3514-ACA
	W-Q	V-0450	2"-PF-0150-FCA	2"-IA-3515-ACA
	W-R	V-0460	2"-PF-0160-FCA	2"-IA-3516-ACA



NOTE:
1. SAND CATCHER IS INSTALLED TEMPORARILY AND WILL BE RELOCATED TO ANOTHER WELL IN THE FUTURE.
2. TYPICAL WELLHEAD PRESENTED. FLOW LINE AND INSTRUMENT AIR LINE NUMBERS ASSIGNED VIA THE GUIDANCE TABLE.
3. TO GENERATE INSTRUMENT TAGS FOR ADDITIONAL WELLS, MODIFY THE FIRST THREE DIGITS: PCV-0015 BECOMES PCV-0025 FOR WELL B.

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B	10/18/19	ISSUED FOR DESIGN	MJB	JAH	JKK
A	09/27/19	ISSUED FOR REVIEW	PEH	JAH	JKK

ENGINEERING RECORD

	BY	DATE
DRN:	PEH	09/23/19
DES:	PEH	09/23/19
CHK:	JAH	09/27/19
APP:	JKK	09/27/19
AFE No.		
SESI JOB NO.	8365	
PROJ. ENGR:		
(FORMATTED 22"x34") SCALE:	N.T.S.	

GMT Exploration Company LLC

GMT
MAJESTIC – 16 WELL PAD
PIPING & INSTRUMENTATION DIAGRAM
TYPICAL WELLHEAD W-A

DWG. NO. 8365-01-1401
REV C

X:\SESI Clients-Projects\GMT\8365 Majestic 16 Well Design (Adams County)\3-0_DESIGN\3-5_PROCESS\P&IDs\8365-01-1401 (12/2/2019 11:48:01 AM)

P-5101
RECYCLE PUMP

PF1A

W-A
PRODUCED FLUID
8365-01-1401

2"-PF-0010-FCA

FS 1011 3/4" FS 1012 3/4"

FCV 1011

PF1B

W-B
PRODUCED FLUID
8365-01-1401

2"-PF-0020-FCA

FS 1021 3/4" FS 1022 3/4"

FCV 1021

NEW FUTURE

PI 1011 ZIC 1011 ZIO 1011 ZSC 1011 ZSO 1011

PI 1012 ZIC 1012 ZIO 1012 ZSC 1012 ZSO 1012

PI 1013 ZIC 1013 ZIO 1013 ZSC 1013 ZSO 1013

PI 1014 ZIC 1014 ZIO 1014 ZSC 1014 ZSO 1014

PI 1021 ZIC 1021 ZIO 1021 ZSC 1021 ZSO 1021

PI 1022 ZIC 1022 ZIO 1022 ZSC 1022 ZSO 1022

PI 1023 ZIC 1023 ZIO 1023 ZSC 1023 ZSO 1023

PI 1024 ZIC 1024 ZIO 1024 ZSC 1024 ZSO 1024

NOTE 1

BULK

TEST 1

TEST 2

TEST 3

FUTURE NEW

FUTURE

TEST 3 2"-PF-1320-FCA TO V-1320 PRODUCED FLUID 8365-01-1405

TEST 2 2"-PF-1220-FCA TO V-1220 PRODUCED FLUID 8365-01-1404

PF2B

TEST 1 2"-PF-1120-FCA TO V-1120 PRODUCED FLUID 8365-01-1403

PF2A

BULK (FUTURE) 4"-PF-0130-FCA TO V-0130 PRODUCED FLUID 8365-01-1406

NOTE:
1. FUTURE WELL CONNECTION.
2. TO GENERATE INSTRUMENT TAGS FOR ADDITIONAL FLOWLINE TAGS, MODIFY THE SECOND AND THIRD DIGIT: PI-1011 ON LINE 2"-PF-0010-FCA BECOMES PI-1021 FOR FLOWLINE 2"-PF-0020-FCA.

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REFERENCE DRAWINGS	
NO.	TITLE

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400 Inverness Parkway, #200
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303.768.9191 Office
303.768.9292 Fax

GMT Exploration Company LLC

GMT
MAJESTIC - 16 WELL PAD
PIPING & INSTRUMENTATION DIAGRAM
SELECTION MANIFOLD

DWG. NO. 8365-01-1402 REV C

X:\SESI Clients-Projects\GMT\8365 Majestic 16 Well Design (Adams County)\3-0_DESIGN\3-5_PROCESS\P&IDs\8365-01-1402 (12/2/2019 11:00:24 AM)

B-201
BURNER UNIT
DUTY: 0.75 MMBTU/HR

V-1120
HORIZONTAL SEPARATOR
SIZE: 48" OD x 16'-0" L
RATING: 125 PSIG @ -20/350°F
VENDOR:

V-001
2-PHASE SEPARATOR
SIZE: 24" OD x 8'-0" L
RATING: 740 PSIG @ -20/350°F

V-201
FUEL GAS SCRUBBER
SIZE: 8" OD x 18" L
RATING: 125 PSIG @ -15/350°F

METER SKID

FROM RECYCLE PUMP P-5101
PRODUCED FLUID
8365-01-1421

FROM SELECTION MANIFOLD
PRODUCED FLUID
8365-01-1402

2"-PF-1120-FCA

H-101

B-201

V-001

V-1120

V-201

BUILDING LIMITS

VENDOR BY GMT
ON SKID OFF SKID

3"-PG-1301-BCA
TO SALES GAS HEADER
PRODUCED GAS
8365-01-1409

2"-PG-9501-ACA
TO BLANKET GAS HEADER
PRODUCED GAS
8365-01-1416

2"-PG-1701-ACA
TO C-2510 LP GAS COMPRESSOR
PRODUCED GAS
8365-01-1413

2"-PO-5001-ACA
TO VRT V-2000
PRODUCED OIL
8365-01-1408

2"-PW-4001-ACA-1 1/2"H/ET
TO WATER TANKS
PRODUCED WATER
8365-01-1410

2"-IA-3002-ACA
FROM INSTRUMENT AIR HEADER
INSTRUMENT AIR
8365-01-1422

1"-FG-5201-ACA
1"-PG-5101-ACA
1/2"-FG-6001-ACA
TO/FROM FUEL GAS HEADER
FUEL GAS
8365-01-1412

2"-PF-7701-ACA-1 1/2"H/ET
TO MAINTENANCE HEADER
PRODUCED FLUID
8365-01-1420

1"-FG-5301-ACA
1"-FG-5401-ACA

NOTE 1
MAINTENANCE BYPASS

PG1
PG4
PG2
PF2A
PW1
FG2
PF3

NOTE:
1. MAINTENANCE BYPASS TO TANK T-5001.

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SESI JOB NO.		8365
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GMT Exploration Company LLC

GMT
MAJESTIC - 16 WELL PAD
PIPING & INSTRUMENTATION DIAGRAM
VHLP SEPARATOR V-1120

DWG. NO. 8365-01-1403
REV C

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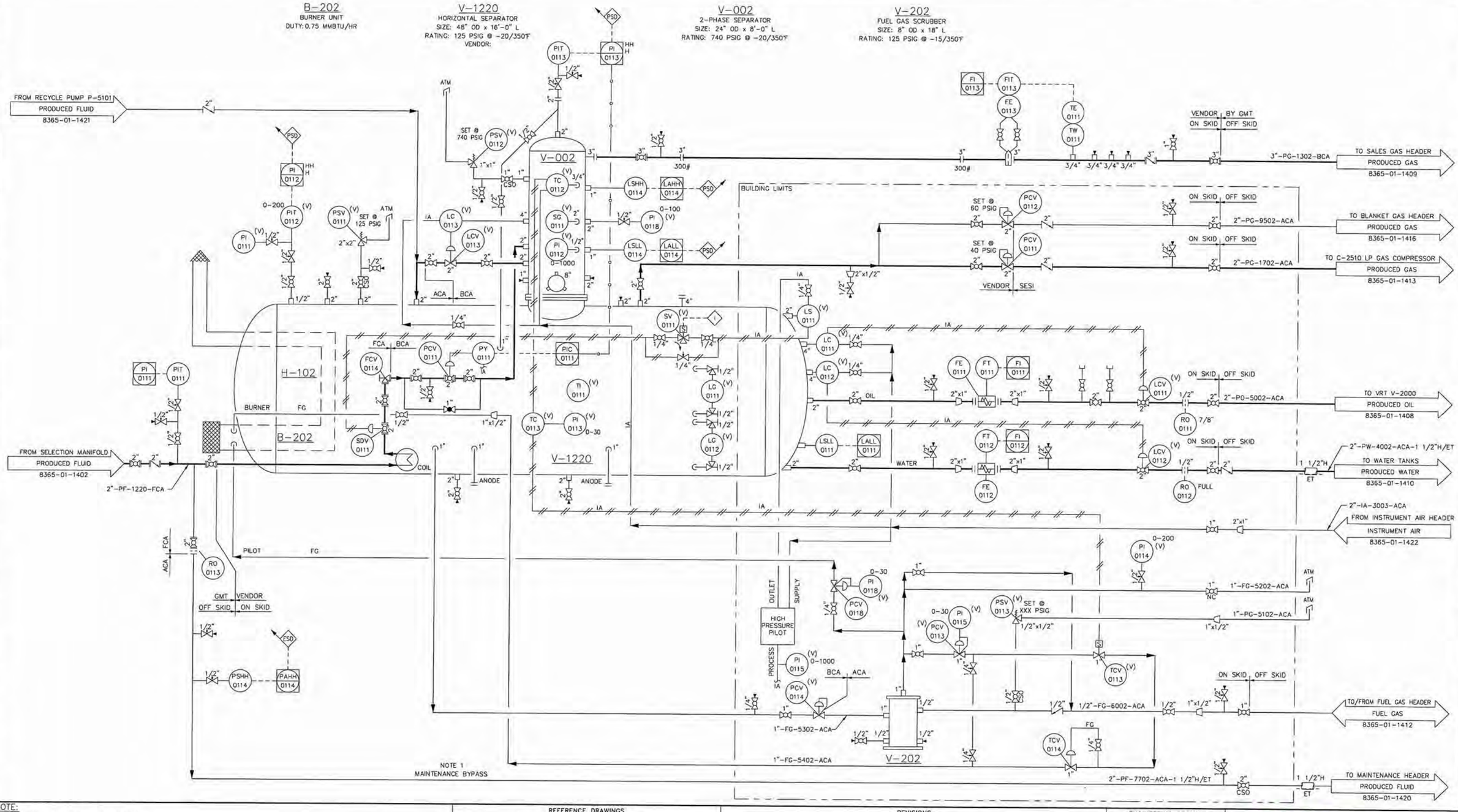

NOTE:

1. MAINTENANCE BYPASS TO TANK TK-5001.

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REFERENCE DRAWINGS	
NO.	TITLE

REVISIONS					
NO.	DATE	DESCRIPTION	BY	CHK.	APP.
C	12/03/19	ISSUED FOR DESIGN	PEH	JAH	JKK
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ENGINEERING RECORD		
	BY	DATE
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DES:	PEH	09/24/19
CHK:	JAH	09/27/19
APP:	JKK	09/27/19
AFE No.		
SESI JOB NO.		8365
PROJ. ENGR:		
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GMT Exploration Company LLC

GMT
MAJESTIC - 16 WELL PAD
PIPING & INSTRUMENTATION DIAGRAM
VHLP SEPARATOR V-1220

DWG. NO. 8365-01-1404

REV C

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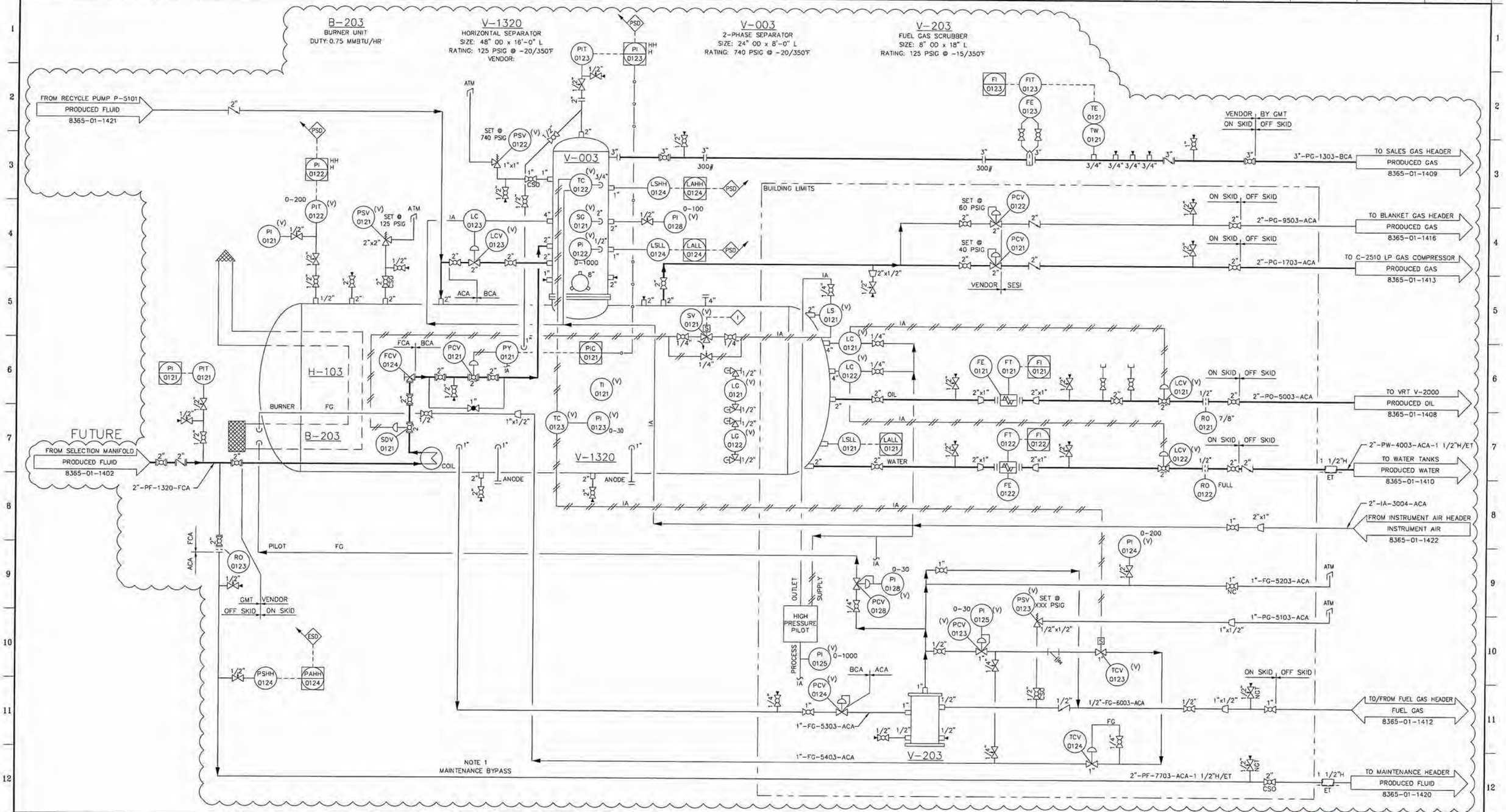

NOTE:
1. MAINTENANCE BYPASS TO TANK T-5001.
FUTURE

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REFERENCE DRAWINGS

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ENGINEERING RECORD

	BY	DATE
DRN:	PEH	09/23/19
DES:	PEH	09/23/19
CHK:	JAH	09/27/19
APP:	JKK	09/27/19
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SESI JOB NO.		8365
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GMT Exploration Company LLC

GMT
MAJESTIC – 16 WELL PAD
PIPING & INSTRUMENTATION DIAGRAM
VHLP SEPARATOR V-1320 (FUTURE)

DWG. NO. 8365-01-1405
REV C

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V-0130
HP BULK OIL SEPARATOR #1
SIZE:
RATING:
VENDOR:

FUTURE

FUTURE

FROM SELECTION MANIFOLD
PRODUCED FLUID
8365-01-1402

2"-PF-0130-FCA

2"-PO-5100-FCA

FCA BCA

PI 0130

PT 0130 0-300

PSV 0130 SET @ XX PSIG VTA

PSV 0131 SET @ XX PSIG VTA

PI 0130 0-300

2"x1/2"

TW 0130 TI 0130 3/4"

V-0130

24" M.W.

LC 0130

LG 0130

LG 0131

LC 0131

IA

IA TO SKID

NOTE 1

ANODE

SKID LIMITS

FI 0130

FT 0130

FE 0130

LCV 0130

RO 0130 2" NC FCA ACA

BYPASS

FI 0131

FT 0131

FE 0131

TE 0131

TW 0131

SET @ XX PSIG PCV 0131

4"-PG-5103-BCA → TO SALES GAS HEADER, PRODUCED GAS, 8365-01-1409

1"-FG-6003-ACA → TO FUEL GAS HEADER, FUEL GAS, 8365-01-1412

AG UC

2"-IA-3106-ACA → FROM INSTRUMENT AIR HEADER, INSTRUMENT AIR, 8365-01-1422

LCV 0131

6"-PO-5050-ACA → TO LP BULK V-0140, PRODUCED OIL, 8365-01-1407

2"-PO-5111-ACA

2"-PF-7704-ACA → TO MAINTENANCE HEADER, PRODUCED FLUID, 8365-01-1420

1 1/2"H ET

3"-PW-4024-ACA-1 1/2"H/ET → TO WATER TANKS, PRODUCED WATER, 8365-01-1410

NOTE:
1. REFER TO WORTHINGTON DWG. 900034A R2 FOR ADDITIONAL DETAILS.

HOLD FOR INFORMATION

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REVISIONS

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ENGINEERING RECORD

	BY	DATE
DRN:	MJB	09/24/19
DES:	PEH	09/24/19
CHK:	JAH	09/27/19
APP:	JKK	09/27/19
AFE No.		
SESI JOB NO.		8365
PROJ. ENGR:		
(FORMATTED 22"x34") SCALE:		N.T.S.

GMT Exploration Company LLC

GMT
MAJESTIC – 16 WELL PAD
PIPING & INSTRUMENTATION DIAGRAM
HP BULK SEPARATOR #1 (FUTURE)

DWG. NO. 8365-01-1406 REV C

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V-1110

V-0140
LP BULK OIL TREATER
SIZE:
DESIGN:
OPERATING:

B-0140
TREATER BURNER
NATURAL DRAFT
FIRE TUBE:
BURNER:

V-0111
TREATER FUEL GAS SCRUBBER
SIZE:
DESIGN:
OPERATING:

FUTURE

FUTURE

2"-PF-5009-ACA
FROM CONDENSATE HEADER
PRODUCED FLUID
8365-01-1421

FROM HP BULK V-0130
PRODUCED OIL
8365-01-1406

6"-PO-5050-ACA

TREATER BYPASS

FROM FUEL GAS SCRUBBER V-3011
FUEL GAS
8365-01-1412

2"-FG-2019-ACA

1"-FG-6004-ACA
TO FUEL GAS HEADER
FUEL GAS
8365-01-1412

2"-PG-5140-ACA
TO C-2510
PRODUCED GAS
8365-01-1413

2"-IA-3001-ACA
FROM IA SKID
INSTRUMENT AIR
8365-01-1422

6"-PO-5051-ACA
TO VRT
PRODUCED OIL
8365-01-1408

3"-PW-4025-ACA
TO WATER TANKS
PRODUCED WATER
8365-01-1410

CP-0140

V-0140

V-1110

B-0140

SKID LIMITS

NOTE:

1. TRANSMITTER SHALL BE REMOTE MOUNTED ON SKID FOR VISIBILITY.

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NO.	TITLE

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B	12/03/19	ISSUED FOR DESIGN	PEH	JAH	JKK
A	10/18/19	ISSUED FOR DESIGN	MJB	JAH	JKK

ENGINEERING RECORD

	BY	DATE
DRN:	MJB	10/15/19
DES:	MJB	10/15/19
CHK:	JAH	10/15/19
APP:	JKK	10/15/19
AFE No.		
SESI JOB NO.		8365
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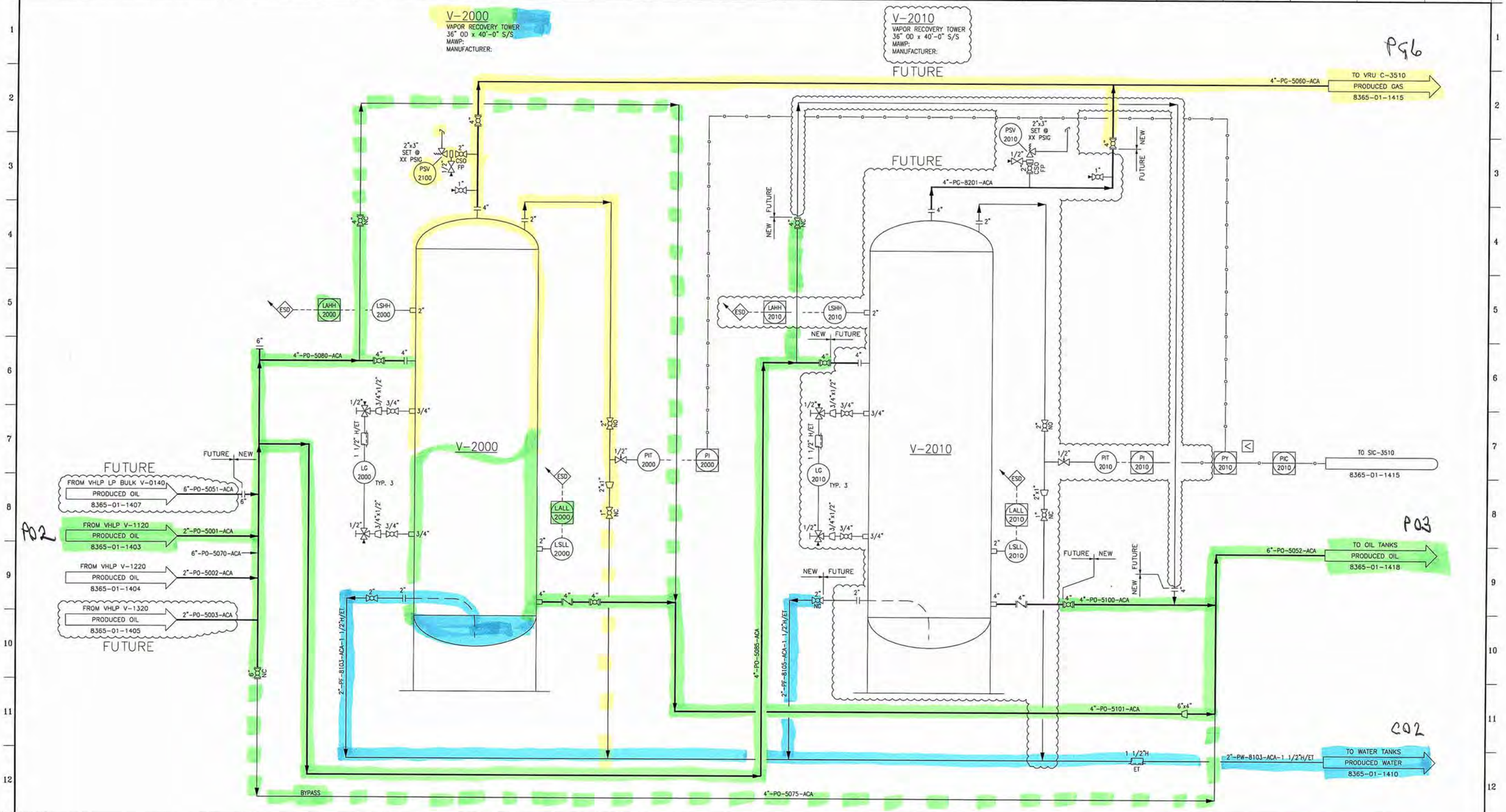
GMT Exploration Company LLC

GMT
MAJESTIC - 16 WELL PAD
PIPING & INSTRUMENTATION DIAGRAM
LP BULK OIL TREATER #1 (FUTURE)

DWG. NO. 8365-01-1407

REV B

X:\SESI Clients-Projects\GMT\8365 Majestic 16 Well Design (Adams County)\3-0_DESIGN\3-5_PROCESS\P&IDs\8365-01-1407 (12/2/2019 11:48:49 AM)



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CHK: JAH	09/27/19
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SESI JOB NO.	8365
PROJ. ENGR:	
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GMT Exploration Company LLC

GMT
MAJESTIC - 16 WELL PAD
PIPING & INSTRUMENTATION DIAGRAM
VAPOR RECOVERY TOWERS

DWG. NO. 8365-01-1408

REV C

X:\SESI Clients-Projects\GMT\8365 Majestic 16 Well Design (Adams County)\3-0_DESIGN\3-5_PROCESS\P&IDs\8365-01-1408 (12/2/2019 11:01:29 AM)

V-3450
SALES GAS SCRUBBER
SIZE: TBD
RATING: 1440 PSIG @ -20/120°F
VENDOR: TBD

M-101/102
SALES GAS METER
SIZE: 3"
RATING: CLASS 600
VENDOR: BY TBD

PG1

FROM LP GAS COMPRESSOR C-2510
PRODUCED GAS
8365-01-1413
3"-PG-1375-BCA

FUTURE
FROM VHLP V-1320
PRODUCED GAS
8365-01-1405
3"-PG-1303-BCA
FUTURE NEW

FROM VHLP V-1220
PRODUCED GAS
8365-01-1404
3"-PG-1302-BCA

PG1
FROM VHLP V-1120
PRODUCED GAS
8365-01-1403
3"-PG-1301-BCA

FUTURE
FROM HP BULK V-0130
PRODUCED GAS
8365-01-1406
4"-PG-5130-BCA
FUTURE NEW

3"-PG-1357-BCA
6"-PG-1350-BCA
6"-PG-1355-DCA
6"-PG-1353-DCA

V-3450

VTA
SET @ XX PSIG
PSV 3450
3/4"
PSL
FL
2"

BCA DCA
6" 6" 6"x4" 4"

LAHH 3450
LSHH 3450
LI 3450
1/2" 3/4" 2"

4" 6"x4" 6"
1" 1"x1/2"1/2"
PI 3450 0-1500 PSI
DPIT 3450
DPI 3450 HH H
IA
LC 3450
LCV 3450
2"x1" 1"

HOLD FOR INFORMATION

M-102 (FUTURE)
3"-PG-1352-BCA
PCV 102
FC
SET @ XX PSIG

M-101
3"-PG-1351-BCA
PCV 101
FC NEW FUTURE
SET @ XX PSIG

PCV 3107
SET @ XX PSIG
CSO 4" CSO
DCA ACA
4"-FL-9404-ACA
TO ECD K.O. V-9055
FLARE GAS
8365-01-1414
FL1

2"-FG-6600-DCA
TO FUEL GAS SCRUBBER
FUEL GAS
8365-01-1412
FG1

PGX

TO SALES
PRODUCED GAS

IA TO VESSEL
2"-IA-3006-ACA
FROM INSTRUMENT AIR HEADER
INSTRUMENT AIR
8365-01-1422
IA1

2"-PF-1380-ACA-1"H/ET
TO CONDENSATE HEADER
PRODUCED FLUID
8365-01-1421
PF1

6" 6"-PG-1350-BCA
SALES GAS HEADER
6" 6"-PG-1350-BCA

BCA DCA
6" NC
BYPASS

NOTE:

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GMT Exploration Company LLC

GMT
MAJESTIC - 16 WELL PAD
PIPING & INSTRUMENTATION DIAGRAM
SALES GAS HEADER

DWG. NO. 8365-01-1409
REV C

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TK-4001/4004
WATER TANKS
CAPACITY: 500 BBL
DIMENSIONS:
DESIGN PRESSURE:
MATERIAL:
VENDOR:

FL3

TO OIL TANK TK-5003
FLARE GAS
8365-01-1418
6"-FL-8001-ACX

TO OIL TANK TK-5005
FLARE GAS
8365-01-1419
6"-FL-8100-ACX
FUTURE
FUTURE NEW

6"-FL-8100-ACX NOTE 2

NEW FUTURE
FUTURE
6"-FL-8100-ACX
FROM WATER TANK TK-4002
FLARE GAS
8365-01-1411

4" ACX ACA

LT 4001 LI 4001 PT 4001 PI 4001 PI 4001
4"x2" 1/2"

AGW

NOTE 1
PVRV 4001

FROM BLANKET GAS HEADER
PRODUCED GAS
8365-01-1416
2"-PG-9600-ACA

TK-4001

4"-PW-4110-ACA-1 1/2"H/ET

NEW FUTURE
FUTURE
4"-PW-4112-ACA-1 1/2"H/ET
TO/FROM TK-4002
PRODUCED WATER
8365-01-1411

TO RECYCLE PUMP
RECYCLED WATER
8365-01-1421
2"-PF-4620-ACA-1 1/2"H/ET
1 1/2"H ET

4"-PW-4731-ACA-1 1/2"H/ET

MW

FL4

FROM OIL TANK TK-5008
FLARE GAS
8365-01-1418
6"-FL-8100-ACX

2"-PF-4622-ACA-1 1/2"H/ET

FL5

ACX ACA
8"-FL-8100-ACA
TO ECD KO V-9050
FLARE GAS
8365-01-1414

FROM OIL TANK TK-5010
FLARE GAS
8365-01-1419
6"-FL-8109-ACX
FUTURE
FUTURE NEW

4"-PW-4541-ACA

4"-PW-4110-ACA-1 1/2"H/ET

1 1/2"H ET

NEW FUTURE
FUTURE
6"-PW-4017-ACA-1 1/2"H/ET
TO TK-4002
PRODUCED WATER
8365-01-1411
FROM TK-4002
RECYCLED WATER
8365-01-1411
TO TK-4002
FLARE GAS
8365-01-1411
FROM TK-4005
PRODUCED WATER
8365-01-1411

CO2

FROM VRT V-2000/2010
PRODUCED WATER
8365-01-1408
2"-PW-8103-ACA-1 1/2"H/ET
FUTURE NEW

FROM LP BULK V-0140
PRODUCED WATER
8365-01-1407
3"-PW-4025-ACA-1 1/2"H/ET

FROM HP BULK V-0140
PRODUCED WATER
8365-01-1406
3"-PW-4024-ACA-1 1/2"H/ET
FUTURE

6"-PW-4017-ACA-1 1/2"H/ET

NOTE 2
6"-FL-8100-ACX

4" ACX ACA

6"-PW-4017-ACA

PW1

FROM VHLP V-1120
PRODUCED WATER
8365-01-1403
2"-PW-4001-ACA-1 1/2"H/ET

FROM VHLP V-1220
PRODUCED WATER
8365-01-1404
2"-PW-4002-ACA-1 1/2"H/ET
FUTURE NEW

FROM VHLP V-1320
PRODUCED WATER
8365-01-1405
2"-PW-4003-ACA-1 1/2"H/ET
FUTURE

FROM CONDENSATE HEADER
PRODUCED FLUID
8365-01-1421
2"-PF-5096-ACA-1 1/2"H/ET

LT 4004 LI 4004 PT 4004 PI 4004
4"x2" 1/2"

NOTE 1
PVRV 4004
PI 4004

TK-4004

4"-PW-4110-ACA-1 1/2"H/ET

NEW FUTURE
FUTURE
4"-PW-4113-ACA-1 1/2"H/ET
TO/FROM TK-4005
PRODUCED WATER
8365-01-1411
4"-PW-4021-ACA-1 1/2"H/ET
TO/FROM TK-4005
PRODUCED WATER
8365-01-1411

4"-PW-4021-ACA-1 1/2"H/ET

MW

4"-PW-4734-ACA-1 1/2"H/ET 1 1/2"H ET

NEW FUTURE
4"-PW-4720-ACA-1 1/2"H/ET
TO TRUCK LOAD OUT
PRODUCED WATER
8365-01-1423

2"-PF-4623-ACA-1 1/2"H/ET

GOX

PWX

NOTE:
1. ENARDO 688 LOCK DOWN HATCH.
2. SIX (6) INCH TANK VAPOR PIPING WILL BE INSTALLED AS 0.188" WALL THICKNESS TO REDUCE WEIGHT, ACX PIPING SPECIFICATION.
3. CONVERT TO OIL TANKS IN FUTURE.

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REFERENCE DRAWINGS

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	BY	DATE
DRN:	PEH	09/24/19
DES:	PEH	09/24/19
CHK:	JAH	09/27/19
APP:	JKK	09/27/19
AFE No.		
SESI JOB NO.	8365	
PROJ. ENGR:		
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GMT Exploration Company LLC

GMT
MAJESTIC - 16 WELL PAD
PIPING & INSTRUMENTATION DIAGRAM
WATER TANKS

DWG. NO. 8365-01-1410
REV C

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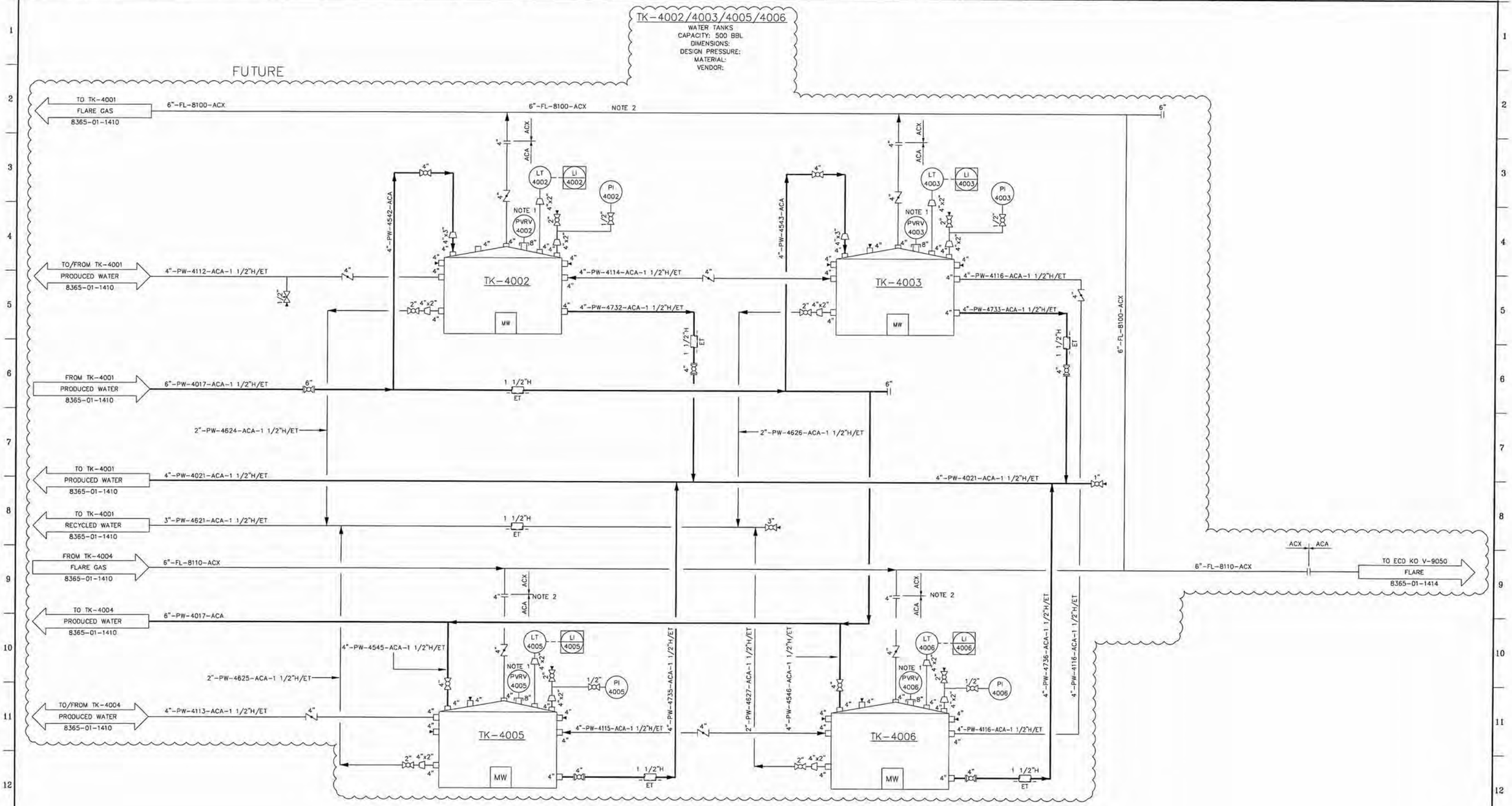

NOTE:
1. ENARDO 688 LOCK DOWN HATCH.
2. SIX (6) INCH TANK VAPOR PIPING WILL BE INSTALLED AS 0.188" WALL THICKNESS TO REDUCE WEIGHT, ACX PIPING SPECIFICATION.

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PROJ. ENGR:		
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GMT
MAJESTIC – 16 WELL PAD
PIPING & INSTRUMENTATION DIAGRAM
WATER TANKS – (FUTURE)

DWG. NO. 8365-01-1411
REV C

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V-3011
FUEL GAS SCRUBBER
SIZE:
RATING:
VENDOR:

FG1

FROM GAS SALES
FUEL GAS
8365-01-1409

2"-FG-6600-DCA

SET @ XX PSIG PCV 3011 DCA ACA 2" CSO 2" CSO 3/4"

2"-FG-6060-ACA

FUTURE NEW

FROM LP BULK V-0140
FUEL GAS
8365-01-1407
1"-FG-6004-ACA

FUTURE NEW

FROM HP BULK V-0130
FUEL GAS
8365-01-1406
1"-FG-6003-ACA

FG2

TO/FROM VHLP V-1120
SUPPLY GAS
8365-01-1403
1"-FG-6001-ACA

TO/FROM VHLP V-1220
FUEL GAS
8365-01-1404
1"-FG-6002-ACA

FUTURE NEW

TO/FROM VHLP V-1320
SUPPLY GAS
8365-01-1405
1"-FG-6003-ACA

FUEL GAS HEADER

2"-SG-6000-ACA

2" NC

2"-FG-2000-ACA

SET @ XX PSIG PCV 3012 2" CSO 2" CSO 1/2"

PI 3011

PSV 3011 SET @ XX PSIG ATM

2" 4"x2" 4"

2" CSO FP

V-3011

1" LSHH 3011 LAHH 3011

1/2" 1/2"

LG 3011

IA LC 3011 4"

H/ET

LCV 3011

2" 2" 2"x1" 2"x1" 1" 2" 2"

2"x1" 1" NC

1/2" PIT 3011 PI 3011 H

2"-PG-9504-ACA

TO BLANKET GAS HEADER
PRODUCED GAS
8365-01-1416

FG3

IA TO VESSEL 1" 2"x1" 2"-IA-3007-ACA

FROM INSTRUMENT AIR HEADER
INSTRUMENT AIR
8365-01-1422

FG3

1 1/2"H ET 2"-PF-9505-ACA-1 1/2"H/ET

TO CONDENSATE HEADER
PRODUCED FLUID
8365-01-1421

FUTURE

2" 2"-FG-2019-ACA

TO LP BULK OIL TREATER
FUEL GAS
8365-01-1407

FG4

2"-FG-6000-ACA 2" 2" 2"-FG-6701-ACA

TO ECDS
FUEL GAS
8365-01-1417

NOTE:

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BY	DATE
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CHK: JAH	09/27/19
APP: JKK	09/27/19
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SESI JOB NO.	8365
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GMT
MAJESTIC – 16 WELL PAD
PIPING & INSTRUMENTATION DIAGRAM
FUEL GAS HEADER

DWG. NO. 8365-01-1412

REV C

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V-2510
C-2510 SUCTION SCRUBBER
SIZE:
RATING:
VENDOR:

C-2510
LP GAS COMPRESSOR
COMPRESSOR:
MOTOR:
VENDOR:

FL7

SET @ XX PSIG
PCV 2202
2" CSO
2" CSO
2"-FL-9200-ACA
TO ECD KO V-9055
FLARE GAS
8365-01-1414

4" NC
PI 2510
4"-PG-1753-ACA
SET @ 150 PSIG
PSV 2510
ATM
4"-PG-1752-ACA
4"-PG-1751-ACA
4"-PG-1753-ACA
V-2510
LSHH 2510
LAHH 2510
LG 2510
LC 2510
LCV 2510
6"x4"
6"-PG-1751-ACA

1500# BCA
SET @ XXX PSIG
PCV 2200
3"x2"
3" 300#
ACA BCA
C-2510
480 VAC
A
B
C
D

FI 3200
FT 3200
TE 3200
TW 3200
FE 3200
3"-PG-1375-BCA
TO SALES GAS HEADER
PRODUCED GAS
8365-01-1409

Pg5

Pg7
FROM C-3510
PRODUCED GAS
8365-01-1415
3"-PG-5065-ACA

IA TO SKID
2"x1"
2"-IA-3008-ACA
FROM INSTRUMENT AIR HEADER
INSTRUMENT AIR
8365-01-1422

Pg4

FUTURE
FUTURE NEW
FROM LP BULK V-0140
PRODUCED GAS
8365-01-1407
2"-PG-5140-ACA

FROM VHLP V-1120
PRODUCED GAS
8365-01-1403
2"-PG-1701-ACA

FROM VHLP V-1220
PRODUCED GAS
8365-01-1404
2"-PG-1702-ACA

FUTURE
FUTURE NEW
FROM VHLP V-1320
PRODUCED GAS
8365-01-1405
2"-PG-1703-ACA

C-2510 SUCTION HEADER

1 1/2"H ET
2"
2"-PF-9501-ACA-1 1/2"H/ET
TO CONDENSATE HEADER
PRODUCED FLUID
8365-01-1421

Pg4

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	BY	DATE
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CHK:	JAH	09/27/19
APP:	JKK	09/27/19
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SESI JOB NO.		8365
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GMT
MAJESTIC - 16 WELL PAD
PIPING & INSTRUMENTATION DIAGRAM
LOW PRESSURE COMPRESSION C-2510

DWG. NO. 8365-01-1413
REV C

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FL5

FROM WATER TANKS
FLARE GAS
8365-01-1410

6"-FL-8100-ACA

PCV 5000 SET @ XX PSIG

2" CSO 2" CSO 1/2"

FUTURE

FROM TK-4006
FLARE GAS
8365-01-1411

6"-FL-8110-ACA

FUTURE NEW

FL8

FROM C-3510 SUCTION HEADER
FLARE GAS
8365-01-1415

2"-FL-9410-ACA

(LP)

V-9050
LP ECD KNOCKOUT DRUM
MANUFACTURER:
MAWP:
SIZE:

V-9055
HP ECD KNOCKOUT DRUM
MANUFACTURER:
MAWP: SIZE:

P-9050
ECD KNOCKOUT PUMP
HP:
DESIGN:
VENDOR:

P-9055
ECD KNOCKOUT PUMP
HP:
DESIGN:
VENDOR:

6" CSO

ATM

SET @ XX PSIG

PSV 9050

1/2" CSO

6" 1" 1" 6"

2" C

LSHH 9050

LAHH 9050

ESD

1/2" C 1/2"

LT 9050

LIC 9050 ON/OFF

V-9050

LG 9050

1/2" C 1/2"

1" 2"

2.5"H/ET

1" 2"x1"

H/ET

M

P-9050

1/2" 2" 2" 1/2" 3/4"

FIT 9050 FI 9050 ΔT

6"-FL-8101-ACA

TO ECDS
FLARE GAS
8365-01-1417

FL6

FL2

FIT 9055 FI 9055 ΔT

4"-FL-9401-ACA

TO ECDS
FLARE GAS
8365-01-1417

FL7

FROM C-2510 SUCTION HEADER
FLARE GAS
8365-01-1413

2"-FL-9200-ACA

4"-FL-9400-ACA

(HP)

FL1

FROM SALES GAS HEADER
FLARE GAS
8365-01-1409

4"-FL-9404-ACA

4" CSC 6"x4" CSO

ATM

SET @ XX PSIG

PSV 9055

1/2" CSO

6" 1" 1" 6"

2" C

LSHH 9055

LAHH 9055

ESD

1/2" C 1/2"

LT 9055

LIC 9055 ON/OFF

V-9055

LG 9055

1/2" C 1/2"

1" 2"

2.5"H/ET

1" 2"x1"

H/ET

M

P-9055

1/2" 2" 2" 1/2" 3/4"

1 1/2"H ET

2"-PF-9503-ACA-1 1/2"H/ET

TO CONDENSATE HEADER
PRODUCED FLUID
8365-01-1421

C05

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DES:	PEH	09/24/19
CHK:	JAH	09/27/19
APP:	JKK	09/27/19
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SESI JOB NO.		8365
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GMT
MAJESTIC - 16 WELL PAD
PIPING & INSTRUMENTATION DIAGRAM
FLARE KNOCKOUTS AND PUMPS

DWG. NO. 8365-01-1414

REV C

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C-3510
VRU
COMPRESSOR:
MOTOR:
VENDOR:

FL8

PCV 2301
SET @ XX PSIG
2"
2"
2"
3/4"
2"-FL-9410-ACA
TO ECD KO V-9050
FLARE GAS
8365-01-1414

PG6

FROM V-2000/2010 VRT
PRODUCED GAS
8365-01-1408
4"-PG-5060-ACA
4"x3"
3"-PG-5061-ACA
3"
150#

PG7

C-3510

3"
150#
3"
3"-PG-5065-ACA
TO C-2510 SUCTION HEADER
PRODUCED GAS
8365-01-1413

FROM PIC-2010
8365-01-1408
SIC 3510
VFD

480 VAC

DRAIN
DRAIN
DRAIN
1"
2"-PF-9302-ACA

C06

1 1/2"H
ET
2"-PF-9302-ACA-1 1/2"H/ET
TO CONDENSATE HEADER
PRODUCED FLUID
8365-01-1421

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GMT
MAJESTIC - 16 WELL PAD
PIPING & INSTRUMENTATION DIAGRAM
VRU GAS COMPRESSOR C-3510

DWG. NO. 8365-01-1415
REV C

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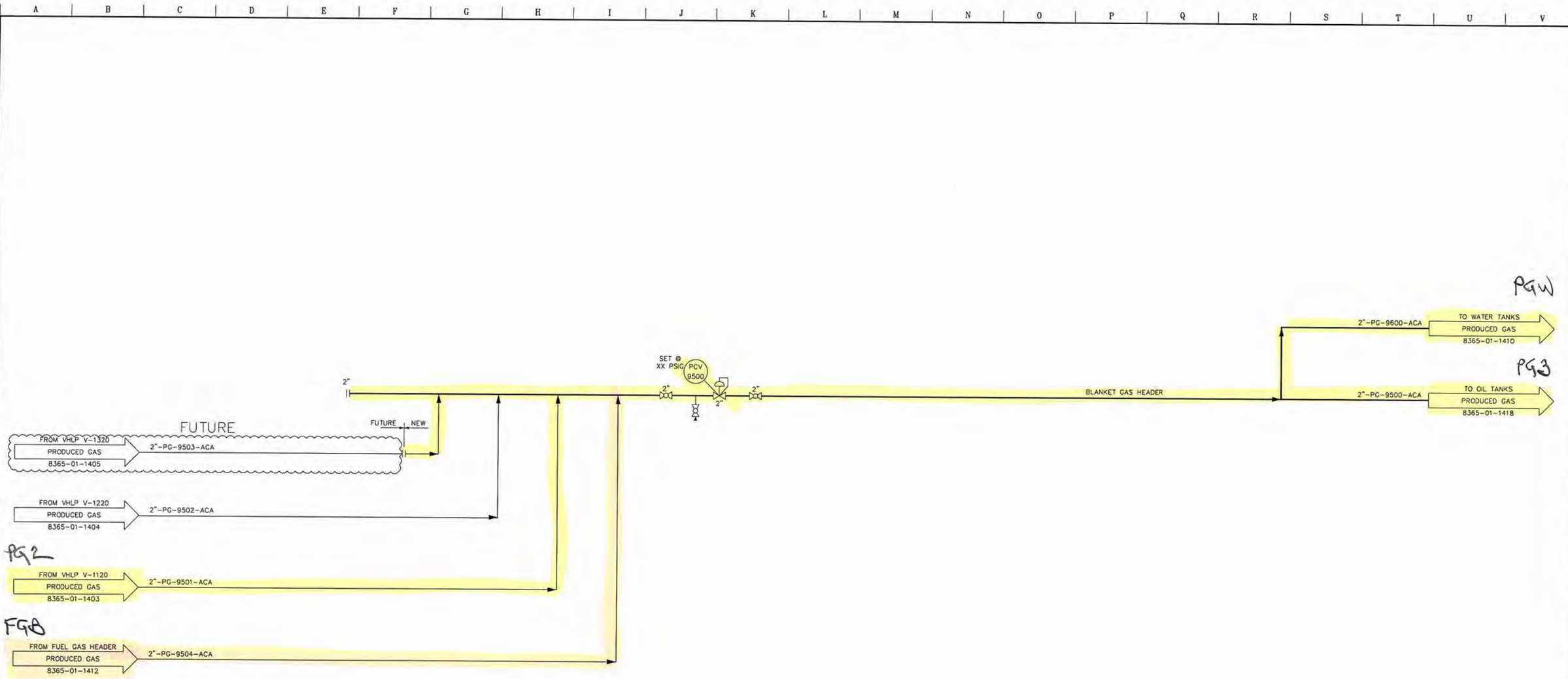

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GMT
MAJESTIC - 16 WELL PAD
PIPING & INSTRUMENTATION DIAGRAM
BLANKET GAS HEADER

DWG. NO. 8365-01-1416

REV C

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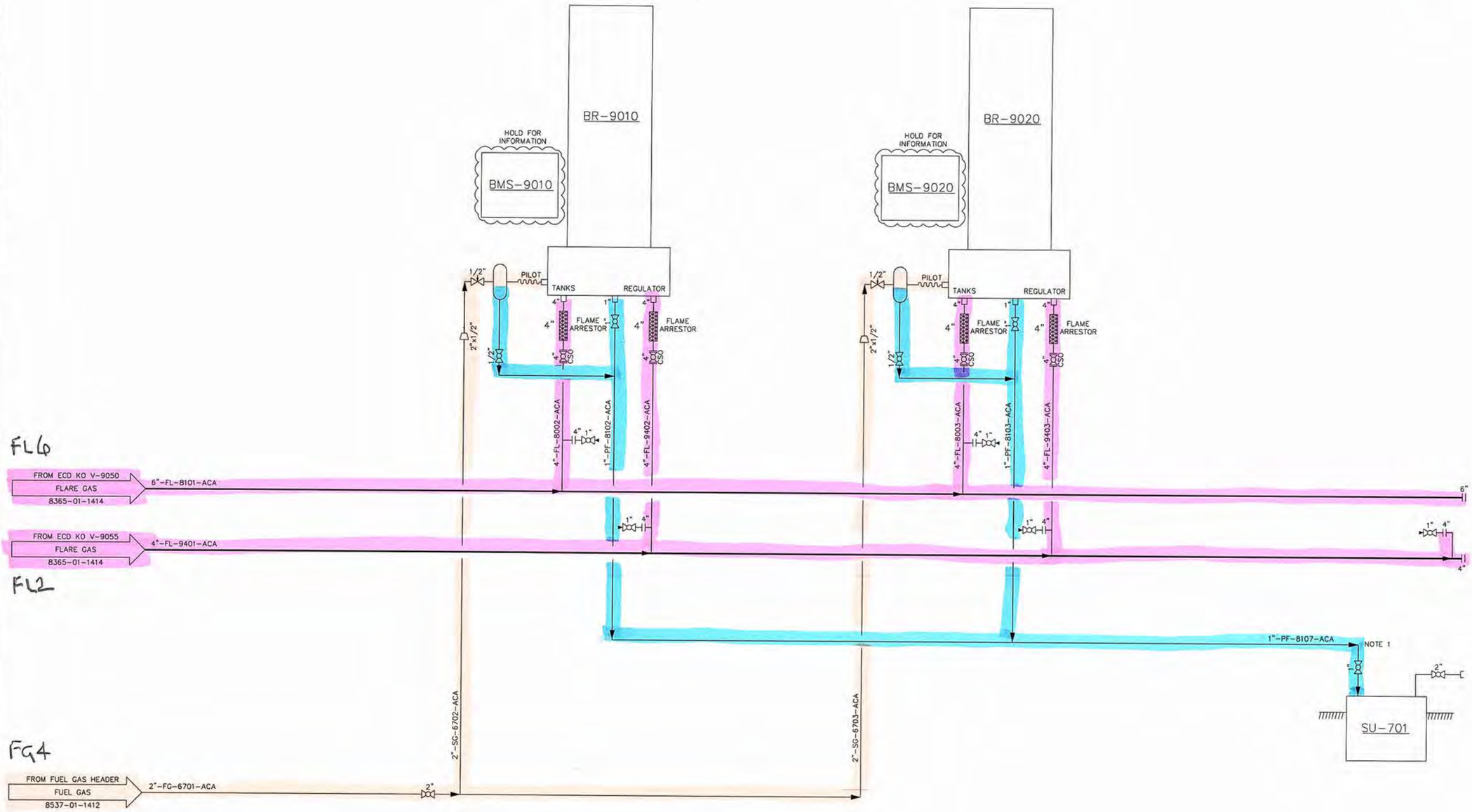
BR-9010
EMISSION CONTROL DEVICE
CAPACITY:
DESIGN PRESSURE:
VENDOR:

BR-9020
EMISSION CONTROL DEVICE
CAPACITY:
DESIGN PRESSURE:
VENDOR:

SU-701
SUMP TANK
CAPACITY:
DIMENSIONS:
VENDOR:



NOTE:
1. FIELD ROUTE SUMP DRAIN PIPING.

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AFE No.		
SESI JOB NO.		8365
PROJ. ENGR:		
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GMT Exploration Company LLC

GMT
MAJESTIC – 16 WELL PAD
PIPING & INSTRUMENTATION DIAGRAM
ECDS

DWG. NO. 8365-01-1417

REV C

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TK-5001/5002/5003/5006/5007/5008
OIL TANKS
CAPACITY: 500 BBL
DIMENSIONS:
DESIGN PRESSURE:
MATERIAL:
VENDOR:

FL7

FROM TRUCK LOADING
FLARE GAS
8365-01-1423
3"-FL-8210-AC1

FROM WATER TANK TK-4001
FLARE GAS
8365-01-1410
6"-FL-8001-ACX

FL3

NEW FUTURE
FROM TK-5004
FLARE GAS
8365-10-1419
FUTURE

ATM
PRV 5110 SET @ 14oz/IN²
6"-FL-8100-ACX NOTE 2

PF4
FROM MAINTENANCE HEADER
PRODUCED FLUID
8365-01-1420
2"-PF-7700-ACA
CSO

TK-5001
TK-5002
TK-5003
MW

LT 5101 LI 5101 PT 5101 PI 5101 PI 5101
LT 5102 LI 5102 PI 5102
LT 5103 LI 5103 PI 5103
NOTE 1
PVRV 5101
PVRV 5102
PVRV 5103

4"-PG-7415-ACA
4"-PG-7425-ACA
4"-PG-7435-ACA
NEW FUTURE
FUTURE
TO TK-5004
PRODUCED GAS
8365-01-1419

3"-PO-5411-ACA
6"-FL-8100-ACX
3"-PO-5421-ACA
3"-PO-5431-ACA

4"-PO-7010-ACA
4"-PO-7020-ACA
4"-PO-7030-ACA

PO3
FROM VRT
PRODUCED OIL
8365-01-1408
6"-PO-5052-ACA

2"-PF-4634-ACA-1 1/2"H/ET
2"-PF-4632-ACA-1 1/2"H/ET
2"-PF-4633-ACA-1 1/2"H/ET

NEW FUTURE
FUTURE
TO TK-5004
PRODUCED OIL
8365-01-1419
6"-PO-7000-ACA
TO TK-5004
PRODUCED OIL
8365-01-1419

6"-PO-7100-ACA
COT
TO TRUCK LOAD OUT
PRODUCED OIL
8365-01-1423

1 1/2"H
ET
2"-PF-4634-ACA-1 1/2"H/ET

NEW FUTURE
6"-FL-8100-ACX
TO TK-5009
FLARE GAS
8365-01-1419

NEW FUTURE
FUTURE
TO TK-5009
PRODUCED OIL
8365-01-1419
FUTURE

FL4

TO WATER TANKS TK-4004
FLARE GAS
8365-01-1410

PG3
FROM BLANKET GAS HEADER
PRODUCED GAS
8365-01-1416
2"-PG-9500-ACA

3"-PO-5461-ACA
3"-PO-5471-ACA
3"-PO-5481-ACA
4"-PO-7060-ACA
4"-PO-7050-ACA

TK-5006
TK-5007
TK-5008

LT 5106 LI 5106 PT 5106 PI 5106 PI 5106
LT 5107 LI 5107 PI 5107
LT 5108 LI 5108 PI 5108

4"-PG-7445-ACA
4"-PG-1455-ACA

NEW FUTURE
FUTURE
TO TK-5009
PRODUCED GAS
8365-01-1419

NEW FUTURE
FUTURE
FROM TK-5009
PRODUCED FLUID
8365-01-1419

TO RECYCLE PUMP
RECYCLED FLUID
8365-01-1421
2"-PF-4630-ACA-1 1/2"H/ET
2"-PF-4635-ACA-1 1/2"H/ET
2"-PF-4636-ACA-1 1/2"H/ET
2"-PF-4637-ACA-1 1/2"H/ET
1 1/2" ET

NOTE:
1. ENARDO 688 LOCK DOWN HATCH.
2. SIX (6) INCH TANK VAPOR PIPING WILL BE INSTALLED AS 0.188" WALL THICKNESS TO REDUCE WEIGHT, ACX PIPING SPECIFICATION.

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REFERENCE DRAWINGS

NO.	TITLE

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C	12/03/19	ISSUED FOR DESIGN	PEH	JAH	JKK
B	10/18/19	ISSUED FOR DESIGN	MSH	JAH	JKK
A	09/27/19	ISSUED FOR REVIEW	PEH	JAH	JKK

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	BY	DATE
DRN:	PEH	09/24/19
DES:	PEH	09/24/19
CHK:	JAH	09/27/19
APP:	JKK	09/27/19
AFE No.		
SESI JOB NO.		8365
PROJ. ENGR:		
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SUMMIT ENGINEERING SERVICES
400 Inverness Parkway, #200
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GMT Exploration Company LLC

GMT
MAJESTIC - 16 WELL PAD
PIPING & INSTRUMENTATION DIAGRAM
OIL TANKS - HOLDING

DWG. NO. 8365-01-1418
REV C

X:\SESI Clients-Projects\GMT\8365 Majestic 16 Well Design (Adams County)\3-0_DESIGN\3-5_PROCESS\P&IDs\8365-01-1418 (12/2/2019 11:51:17 AM)

TK-5004/5005/5009/5010
OIL TANKS
CAPACITY: 500 BBL
DIMENSIONS:
DESIGN PRESSURE:
MATERIAL:
VENDOR:

FUTURE

FUTURE

TO TK-5003
FLARE GAS
8365-01-1418

NOTE 2

6"-FL-8100-ACX

FROM WATER TANK TK-4001
FLARE GAS
8365-01-1410

FROM TK-5003
PRODUCED GAS
8365-01-1418

4"-PG-7435-ACA

TK-5004

TK-5005

4"-PG-7435-ACA

3"-PO-5441-ACA

6"-FL-8100-ACX

3"-PO-5451-ACA

2"-PF-4638-ACA-1 1/2"H/ET

4"-PO-7040-ACA

4"-PO-7050-ACA

2"-PF-4639-ACA-1 1/2"H/ET

FROM TK-5003
PRODUCED OIL
8365-01-1417

6"-PO-5052-ACA

6"-PO-5052-ACA

FROM TK-5003/5008
PRODUCED OIL
8365-01-1418

6"-PO-7000-ACA

6"-PO-7100-ACA

H/ET

FROM TK-5008
FLARE GAS
8365-01-1418

6"-FL-8100-ACA

6"-FL-8100-ACX

6"-FL-8109-ACX

TO WATER TANK TK-4004
FLARE GAS
8365-01-1410

FROM TK-5008
PRODUCED OIL
8365-01-1418

6"-PO-5053-ACA

3"-PO-5491-ACA

3"-PO-5401-ACA

2"-PF-4640-ACA-1 1/2"H/ET

4"-PO-7090-ACA

4"-PO-7095-ACA

TK-5009

TK-5010

FROM TK-5008
PRODUCED GAS
8365-01-1418

4"-PO-7465-ACA

4"-PG-7475-ACA

TO TK-5008
PRODUCED FLUID
8365-01-1418

2"-PF-4630-ACA-1 1/2"H/ET

2"-PF-4641-ACA-1 1/2"H/ET

2"-PF-4642-ACA-1 1/2"H/ET

NOTE:
1. ENARDO 688 LOCK DOWN HATCH.
2. SIX (6) INCH TANK VAPOR PIPING WILL BE INSTALLED AS 0.188" WALL THICKNESS TO REDUCE WEIGHT, ACX PIPING SPECIFICATION.

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AFE No.		
SESI JOB NO.		8365
PROJ. ENGR:		
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GMT Exploration Company LLC

GMT
MAJESTIC – 16 WELL PAD
PIPING & INSTRUMENTATION DIAGRAM
OIL TANKS – (FUTURE)

DWG. NO. 8365-01-1419

REV C

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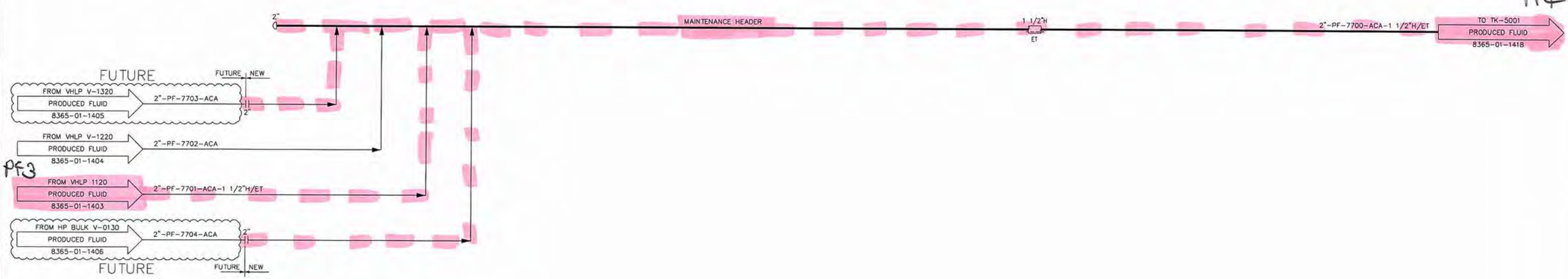

NOTE:

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APP: JKK	09/27/19
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SESI JOB NO.	8365
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GMT Exploration Company LLC

GMT
MAJESTIC – 16 WELL PAD
PIPING & INSTRUMENTATION DIAGRAM
MAINTENANCE HEADER

DWG. NO. 8365-01-1420

REV C

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P-5101
RECYCLE PUMP
HP:
DESIGN:
VENDOR:

XS 5101
HS 5101
HS 5101 HOA
M

FROM WATER TANKS
RECYCLED WATER
8365-01-1410
2"-PF-4620-ACA

FROM OIL TANKS
PRODUCED FLUID
8365-01-1418
2"-PF-4630-ACA-1 1/2"H/ET

1 1/2"H ET
P-5101

2"-PF-4650-ACA-1 1/2"H/ET → TO V-1120 PRODUCED FLUID 8365-01-1403
2"-PF-4651-ACA-1 1/2"H/ET → TO V-1220 PRODUCED FLUID 8365-01-1404
2"-PF-4652-ACA-1 1/2"H/ET → TO V-1320 PRODUCED FLUID 8365-01-1405
2"-PF-4253-ACA-1 1/2"H/ET
2"-PF-5009-ACA → TO LP BULK V-0140 PRODUCED FLUID 8365-01-1407
FUTURE
NEW | FUTURE
NOTE 1

2"-PG-9500-ACA
H/ET
CONDENSATE HEADER

FROM V-3011
PRODUCED FLUID
8365-01-1412
2"-PF-9505-ACA

FROM V-9050/9055
PRODUCED FLUID
8365-01-1414
2"-PF-9503-ACA-1 1/2"H/ET

FROM C-2510
PRODUCED FLUID
8365-01-1413
2"-PF-9501-ACA-1 1/2"H/ET

FROM C-3510
PRODUCED FLUID
8365-01-1415
2"-PF-9302-ACA

FROM V-3450
PRODUCED FLUID
8365-01-1409
2"-PF-1380-ACA-1"H/ET

2"-PF-5096-ACA-1 1/2"H/ET → TO WATER TANKS PRODUCED FLUID 8365-01-1410

NOTE:
1. CONDENSATE TO BE ROUTED TO LP BULK OIL TREATER IN FULL DEVELOPMENT STAGE.

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SESI JOB NO.	8365	
PROJ. ENGR:		
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MAJESTIC – 16 WELL PAD
PIPING & INSTRUMENTATION DIAGRAM
CONDENSATE HEADER

DWG. NO. 8365-01-1421
REV C

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SK-7000
INSTRUMENT AIR SKID
DUTY:
FOOTPRINT:

SU-702
SUMP TANK
CAPACITY:
DIMENSIONS:
VENDOR:

TO WELL A
INSTRUMENT AIR
8365-01-1401
2"-IA-3501-ACA
2"

TO WELL B
INSTRUMENT AIR
2"-IA-3502-ACA
2"

NEW
FUTURE
FUTURE

TO WELL C
INSTRUMENT AIR
2"-IA-3503-ACA
2"

TO WELL D
INSTRUMENT AIR
2"-IA-3504-ACA
2"

TO WELL E
INSTRUMENT AIR
2"-IA-3505-ACA
2"

TO WELL F
INSTRUMENT AIR
2"-IA-3506-ACA
2"

TO WELL G
INSTRUMENT AIR
2"-IA-3507-ACA
2"

TO WELL H
INSTRUMENT AIR
2"-IA-3508-ACA
2"

TO WELL-J
INSTRUMENT AIR
2"-IA-3509-ACA
2"

TO WELL-K
INSTRUMENT AIR
2"-IA-3510-ACA
2"

TO WELL-L
INSTRUMENT AIR
2"-IA-3511-ACA
2"

TO WELL-M
INSTRUMENT AIR
2"-IA-3512-ACA
2"

TO WELL-N
INSTRUMENT AIR
2"-IA-3513-ACA
2"

TO WELL-P
INSTRUMENT AIR
2"-IA-3514-ACA
2"

TO WELL-Q
INSTRUMENT AIR
2"-IA-3515-ACA
2"

TO WELL-R
INSTRUMENT AIR
8365-01-1401
2"-IA-3516-ACA
2"

SK-7000
INSTRUMENT AIR SKID

1"
1"

SU-702

2"-IA-3000-ACA

2"-IA-3101-ACA

2"-IA-3000-ACA

2"
2"-IA-3008-ACA
TO V-2510
INSTRUMENT AIR
8365-01-1413

2"
2"-IA-3007-ACA
TO V-3011
INSTRUMENT AIR
8365-01-1412

2"
2"-IA-3006-ACA
TO V-3450
INSTRUMENT AIR
8365-01-1409

NEW
FUTURE
FUTURE

2"
2"-IA-3004-ACA
TO VHLP V-1320
INSTRUMENT AIR
8365-01-1405

2"
2"-IA-3003-ACA
TO VHLP V-1220
INSTRUMENT AIR
8365-01-1404

2"
2"-IA-3002-ACA
TO VHLP V-1120
INSTRUMENT AIR
8365-01-1403

NEW
FUTURE
FUTURE

2"
2"-IA-3106-ACA
TO V-0130
INSTRUMENT AIR
8365-01-1406

NEW
FUTURE
FUTURE

2"
2"-IA-3001-ACA
TO V-0140
INSTRUMENT AIR
8365-01-1407

NOTE:

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GMT
MAJESTIC - 16 WELL PAD
PIPING & INSTRUMENTATION DIAGRAM
INSTRUMENT AIR

DWG. NO. 8365-01-1422
REV C

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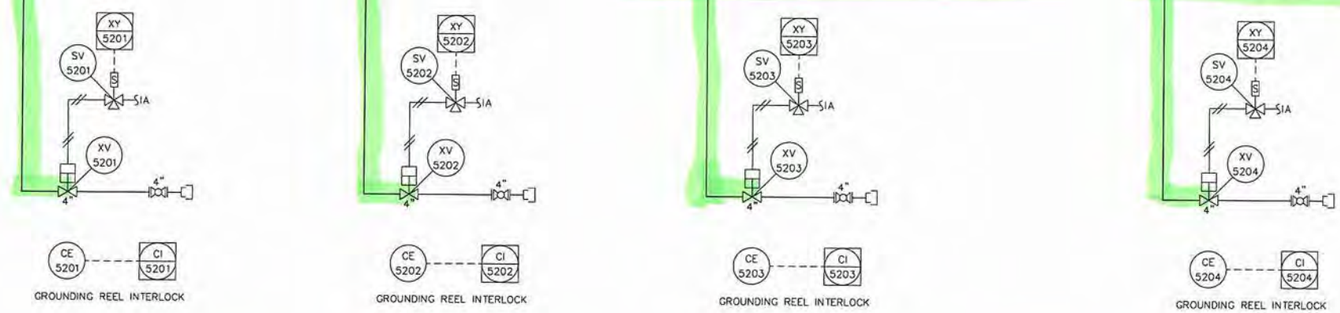
COT

FROM TANKS
PRODUCED OIL
8365-01-1418

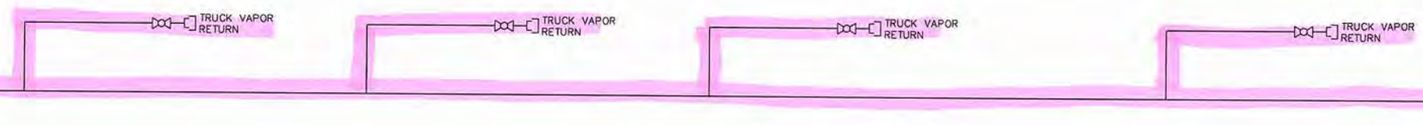
6"-PO-7100-ACA



FLT

TO TANKS
FLARE GAS
8365-01-1418

3"-FL-8210-ACA

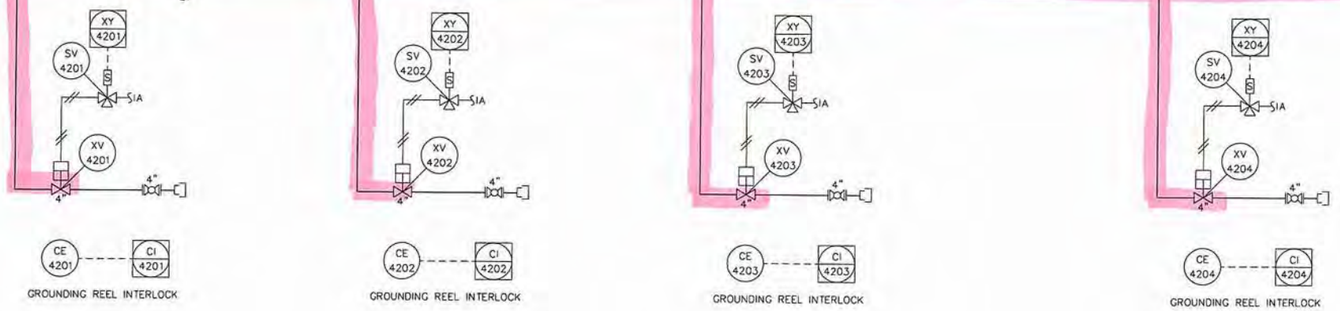


PWX

FROM TANKS
PRODUCED WATER
8365-01-1410

4"-PW-4720-ACA-1 1/2"H/ET

1 1/2"H
ET



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SESI JOB NO.		8365
PROJ. ENGR:		
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GMT Exploration Company LLC

GMT
MAJESTIC - 16 WELL PAD
PIPING & INSTRUMENTATION DIAGRAM
LIQUID LOAD OUT

DWG. NO. 8365-01-1423

REV A

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