Marathon Oil

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DOCUMENT NO.	RP	PR	ROMS	EL08	PPL	0003

TITLE: RESOURCE PLAY HYDRATE REMOVAL MANAGEMENT STANDARD OPERATING PROCEDURE

REV	ISSUE PURPOSE	REVISION DESCRIPTION	REVIEW DATE	DOCUMENT OWNER	
				APPROVAL	DATE
001	A	Approved for use		M. Stuart	23-Jul-24

Issue Purpose:
R - Issued for review / comment
A - Approved for use
V - Void (Cancelled)
S - Superseded

Discipline Codes:
Refer to Master Discipline Code Key located on the ROMS Interface Tool (Element 13)

Note: Administrative and content changes do not reset the Review Cycle Start Date.

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1.0 SCOPE AND APPLICATION

Hydrate formation is unfavorable and represents a challenge for flow assurance and production system integrity. With time, the formation, deposition and adsorption of hydrates on the internal surfaces of pipes, wellbore, processing facilities and piping components restricts and disrupts hydrocarbon production, and in worst cases, the production ceases.

Hydrates pose a significant risk to personnel and equipment and will be handled with extreme caution. This Resource Play Hydrate Removal Management Standard Operating Procedure (SOP) establishes minimum requirements for safely managing hydrates.

This SOP applies to all hydrate management activities within the Resource Play BU’s owned and operated facilities (hereinafter collectively referred to as “Marathon”).

2.0 ROLES AND RESPONSIBILITIES

Role	Responsibility
Supervisor	• Ensure no individual performs this procedure until the requirements in section 7.0 have been met.
Operator	• Ensure SOP will always be available for adherence during job tasks. • Complete annual Read & Acknowledge, and Field Verification through QMS assignment.

3.0 WARNINGS & PRECAUTIONS

- A hydrate may contain up to 180 volumes (at standard conditions) of gas per unit volume of hydrate. A hydrate plug release can also act as a piston with an associated shock wave to cause loss of containment due to overpressure.
- Special personal protective equipment (PPE) may be necessary for a gas stream with a significant concentration of H_2S. See the PPE Hazard Assessment for additional information.
- The release of a hydrate plug may cause personal injury and significant damage to equipment; always assess the location and potential direction of flow and maintain a position out of the line-of-fire to minimize the risk of personal injury. A hydrate plug can release with enough differential pressure to act as a projectile with a speed of > 500 fps.
- High pressure gas and hazardous liquids can be released from a large hydrate plug or trapped between multiple hydrate plugs. This can cause the release of a hydrate plug even though the pressure on both sides of the multiple hydrate plugs is equalized. Over pressurization can occur and a loss of containment can result.
- Do not attempt to remove a hydrate plug with a source of expansive energy such as a compressor or a gas pipeline. Always isolate potential sources of fluid energy on both sides of a hydrate plug.
- When removing a hydrate plug pressure gauges/meters will be utilized both upstream and downstream of the plug to monitor differential pressures.
- Do not attempt to only de-pressure downstream of a hydrate plug to dislodge or to move the plug with gas pressure.
- Do not use a hammer or similar tool to apply an impact load to the piping to release a hydrate plug; this is a dangerous and potentially catastrophic practice.
- Do not apply direct flame heat sources to piping; this may weaken the steel material and result in failure of the piping and personal injury or cause rapid melting leading to a localized pressure build-up and pipeline rupture due to overpressure.
- Stay out of the line-of-fire of a potential hydrate plug release. Avoid locations such as the end of a pipe or a change in direction of piping downstream of the hydrate plug.
- Be aware of the potential for false pressure transmitter readings due to ice or hydrate formation.
- Methanol is commonly used to aid in melting hydrates. The use of methanol requires knowledge of proper handling practices and PPE. Review the SDS prior to use.
- Be aware of any check valves within a section of line when monitoring pressure (trapped pressure).

4.0 HYDRATE FORMATION

- Free water facilitates the formation of hydrates.
- Clathrate hydrates consist of solid, ice-like crystals comprised of cages of water molecules that surround “guest” light hydrocarbons such as methane, ethane propane, butane or impurity (H2S and CO2) molecules.
- Hydrates have the appearance of ice, snow or slush, mixed with process fluid.

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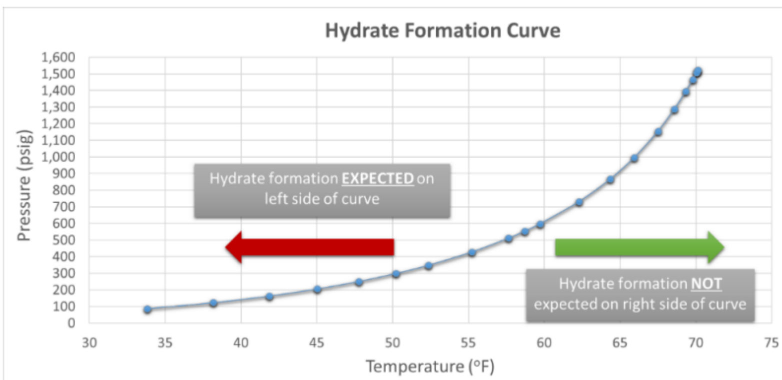
- Hydrates do not form with heavier hydrocarbons (pentane and hexane) since they are too large to “fit” in the water molecule cage.
- As an example, Hydrates may form between 65-70˚F at a pressure of 1,000 psig.
- The presence of H_2S and CO_2 tend to promote hydrate formation at a higher temperature.
- Richer gas (greater C3 and C4 concentrations) tends to promote hydrate formation at higher temperatures and lower pressures.
- The presence of salt reduces the temperature at which hydrates form.
- Fluid pressure drops and turbulence encourage hydrate formation.



Note: This is a typical hydrate formation curve. Actual conditions will vary for each location.

5.0 PROCEDURE

5.1 INDICATORS OF HYDRATE FORMATION

Hydrates, like any other obstruction, can be detected by the consequences they create. The following may indicate the presence of hydrates:

- Decreased or lack of process flow
- Increased upstream pressure or decreased downstream pressure
- Increased differential pressure across the obstruction
- Decreased temperature often accompanied by the formation of condensation, frost or ice on the outside surface of the equipment or piping
- Observation of hydrate particles on received pigs

5.2 WAYS TO IDENTIFY THE EXISTENCE AND LOCATION OF A HYDRATE PLUG

Below are a few ways to identify the existence of a hydrate plug (but is not an exhaustive list)

- Use a thermal infrared (IR) device (if available) for above ground piping
- Identify cold gas temperatures (60˚F or less)
- Identify the formation of frost on above ground piping
- Identify low points or points of high liquid hold-up for below grade piping
- Gas Lift - identify differential pressure (ex. gas lift meter pressure vs casing transmitter pressure)
- Gas Lift - Identify gas lift pressure at zero in SCADA
- Gas Lift Lateral – all wells on pad have zero gas lift flow rate

Note: Where an ice plug in a gas lift line is suspected <u>and</u> gas temps are greater than 60˚F, the blockage could be the result of a gas lift control valve malfunction.

- Compressor Dump – Compressor goes down on 2nd – 3rd stage scrubber level
- Compressor Dump – Dump valve indicates that it tried to open but could not dump

5.3 HYDRATE IN GAS LIFT LINES ON PAD WITH REMOTE COMPRESSION	
No.	**Actions**
	Before starting procedure notify Control Room and Lead Operator
1	**CLOSE** the valve directly upstream of the gas lift meter.
2	**CLOSE** any block valve downstream of the casing transmitter.

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3	**MANUALY OPEN** the gas lift control valve to 100% so the valve doesn't shut during the bleed down.
4	**BLEED** down from the higher-pressure side first: • Open the bleeder downstream of the automatic gas lift control valve. • Then immediately open the well head bleeder closest to where the gas lift line comes out of the ground to minimize pressure differential. • Leave the bleeder valves open to allow hydrate to melt. **Note:** Written for single operator preforming the task, if two operators present simultaneously depressurize both sides
5	**MONITOR** pressures via SCADA from a safe location (>50ft) away from either end of the line. **Note:** The time to melt an ice plug will vary. After bleeders have equalized to atmospheric pressure, a secondary release of pressure from either bleeder is an indication that the plug has likely melted. This process typically takes 20 – 30 minutes but be patient as it could take longer depending on site specific conditions and current weather.
6	**CLOSE** bleeders on both sides and return the gas lift control valve to automatic.
7	**OPEN** the valve upstream of the gas lift meter.
8	**OPEN** the valve downstream of the casing transmitter.
9	**OBSERVE** the pressure indicated by the gas lift meter and compare it to the pressure on the casing. If pressure is the same, then the plug has cleared. **Note:** If there is a differential pressure between the gas lift meter and casing, plug has not cleared. Repeat steps 1 – 9.

5.4 HYDRATE IN GAS LIFT LATERALS, WHERE THERE IS AN ADJACENT LOWER PRESSURE GATHERING LINE

Step	Actions
1	**NOTIFY** your Supervisor to discuss next steps prior to moving forward. If given approval to move forward with plug removal, follow steps 2 – 15. **Note**: Removal of ice plug from gas lift laterals requires at least 2 Operators.
2	**INSTALL** pressure gauge at tie-in to main pipeline junction. **Note:** If pipeline tie-in is at normal operating pressure, this indicates that the ice plug is located in the lateral.
3	**CLOSE** pipeline junction valve to lateral.

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4	**CLOSE** valve(s) downstream of the pressure gauge on well pad gas lift high-pressure manifold.
5	**APPLY** LOTO to valves to allow for the installation of jumpers between the gas lift line and the lower pressure gathering line. **Note:** For systems with permanent jumpers installed, disregard steps 5-7 and 15
6	**Initiate a Temporary Management of Change (MoC) for the installation of a temporary jumper line**
7	**Upon approval of the Temporary MoC, REQUEST** crew to install temporary jumper between the high-pressure lateral and low-pressure lateral. • Ensure crew reviews ECP/isolations, places personal locks on the lockbox and completes a JSA prior to commencing work. • Ensure temporary iron is rated for the appropriate pressures and has whip-checks or restraints installed on unions.
8	**Remove LOTO**
9	**OPEN** the valve on the low-pressure side of the jumper first, then open the valve on the high-pressure side of the jumper. • Ensure 1 Operator is located on the high-pressure manifold and a 2nd Operator is located at the high-pressure pipeline junction.
10	**BLEED** the high-pressure manifold down to no more than 20% above the pressure of the low-pressure manifold. (Minimizing DP to avoid hydrate formation) **Note:** Operators must remain in constant communication with each other to ensure bleed down at the same rate. Ensure no differential more than 20% as you reduce pressure.
11	**CLOSE** the jumper valves.
12	**CLOSE** the pipeline junction valve and valve(s) at the high-pressure manifold.
13	**MONITOR** differential pressures on both sides. Equalization is an indication that the hydrate has cleared.
14	**ONCE THE PRESSURE EQUALIZES,** introduce high-pressure gas from the HP junction back into the lateral, slowly raising pressure. • If both sides rise together, the hydrate remains cleared • If the differential pressure begins to rise, pause and wait for equalization **Note:** Operators must remain in constant communication with each other to ensure both sides rise together. Ensure no differential more than 20% as you increase pressure.
15	**ONCE BACK TO FULL PRESSURE,** open valve at the high-pressure manifold to reintroduce gas for the gas lift system.
16	**REAPPLY** LOTO so that the jumpers can be removed and close the MoC once complete.

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5.5 HYDRATE IN COMPRESSOR DUMP, USE OF EXTERNAL HEAT	
Step	**Actions**
1	**DO NOT** blow down the compressor.
2	**CLOSE** the upstream and downstream valves directly off the scrubber and downstream of the bleeder.
3	Utilize Hotsy or forced air heater to apply warmth externally to attempt to disassociate the hydrate. **Note:** Be conscious of Hotsy or heater equipment location due to Hot Work Permitting requirements.
4	**WATCH** the scrubber level to see if the plug cleared and fluids dumped. If fluids do not dump, repeat.

5.6 HYDRATE WITHIN GAS LIFT SYSTEM WITH ON PAD COMPRESSION	
Step	**Actions**
1	**CHECK PRESSURES and VERIFY PRESSURES** from the compressor discharge all the way through the process to tubing and casing utilizing the ROC to help narrow down the potential area for a hydrate across the entire gas lift system **Note:** If pressure is higher than normal, then there's a problem (ex. if casing pressure typically runs at 700psi and the local controls shows 950 psi) and you'll need to move to Step 2. This may not be an indication of a hydrate, but troubleshooting needs to be performed. Listen and look for anything out of the ordinary (i.e. rain caps missing, ice, blowing gas, etc.)
2	**CLOSE** the compressor suction valve
3	**CLOSE** the compressor discharge valve
4	**OPEN** (slowly) the blow down valve between the closed suction and discharge valves **Note:** Listen for pressure to release. No indication of pressure release is good.
5	**VERIFY** low or zero pressure at the compressor control panel. If pressure is less than 100 psi, then you can slowly open the bypass valve. **Note:** There should be 0 psi indicated on the compressor control panel after this step.
6	**CLOSE** the casing valve at the wellhead **Note:** Turn valve all the way to the right, then do a quarter turn to the left to prevent sticking

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Step	Diagnosis Actions
7	**BLOW DOWN** both sides of the check valves closest to the compressor on the injector meter run; paying attention to the wind direction and ensuring that you are upwind of the blowdown.
8	**OPEN** (slowly) the needle valve on the meter run if available. **Note:** If there is pressure release (hissing) then there's potentially a plug in between the last blowdown and the current check valve.
9	**REMOVE** the bull plug and **OPEN** the well head needle valve; ensuring that you do not stand over the valve. **Note:** If there is pressure release (hissing) then there could be a hydrate plug from the meter run to needle valve. Leave the blowdowns open as the lack of pressure can help melt the hydrate over time.
10	**IF** you cannot verify that the hydrate plug is gone, continue with the following actions. **CLOSE** the blowdown at the beginning of the meter run next to the compressor.
11	**CLOSE AND APPLY LOTO** to the valve just below (upstream of) the blow down pipe **NOTE:** Single point isolation does not require the use of an Energy Control Procedure
12	**REMOVE** the blowdown pipe and **INSTALL** the methanol launcher **Note:** This device is intended to give the operator the ability to have a closed valve between them and the process piping at all times while adding Methanol. Two valves are required
13	**UTILIZE A BONDING CABLE** with clamps to bond the Methanol safety can to the launcher. **Note:** A proper bond is required to reduce the potential of static discharge when transferring flammable liquids
14	**OPEN** the valve on top of the launcher and pour Methanol into the launcher. Wear appropriate chemical gloves.
15	**CLOSE** the valve on top of the launcher and install a bull plug.
16	**REMOVE LOTO** from the valve just below the launcher (reverse of step 11) and **OPEN** the valve to release Methanol into the line. Wait approximately 30 minutes to 1 hour.
17	**CLOSE** all blowdown valves, except the needle valve at the wellhead.
18	**OPEN** the compressor discharge valve and suction valve.

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	Note: Do not start the compressor as this will push pressure to the well head and needle valve.
Step	**Diagnosis Actions**
19	**CONFIRM** that gas is coming out of the needle valve at the well head and then **CLOSE** the needle valve. **Note:** If you hear gas from the well head needle valve, the line should not have a solid hydrate. If you do not hear gas (hissing), then you likely still have a solid hydrate.
20	Steps 11 – 16 may need to be repeated multiple times if steps 17 – 19 do not confirm that the hydrate has been removed.
21	Begin placing the well back in service by working backwards from the well head to reverify that all blow downs are closed.
22	**OPEN** the casing valve slowly
23	**PURGE** the meter run
24	Initiate the compressor startup procedure

5.7 POTENITAL HYDRATES IN OTHER PROCESS PIPING	
Step	**Actions**
1	For scenarios not covered in the prior sections, communicate with your Supervisor and wait on a directions.
2	Supervisors shall develop a plan to address the issue with the support from HES and engineering as needed. Plan should consider the following risk factors at a minimum: • Environmental and safety requirements • Location specific layout • Process complexities • Required materials • Resource experience
3	Once there is an approved plan, the Supervisor shall communicate and provide the plan to the field personnel to execute.

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6.0 RECORDKEEPING

All records are maintained according to the Company Records Retention Schedule.

7.0 TRAINING

Job roles followed by training level for this procedure are as follows:

- Production Supervision, Level 1
- Production Operator, Level 2

Level 1 (Awareness): Read procedure and acknowledge when complete.
Level 2 (Advanced): Level 1 AND explain procedure to supervisor or designee. The supervisor or designee must approve when the individual has satisfied the Level 2 requirement.

Note: All levels of training will be assigned and managed in the QMS system. Qualifying criteria will expire (requiring requalification) in accordance with the review cycle defined in the title of this procedure.

8.0 DEFINITIONS

Term	Definitions
Hydrate	Hydrates are white, solid, ice-like substances that form at elevated pressures and low temperatures because of an interaction between a liquid water phase and light natural light gas components. Hydrate formation is unfavorable in most cases since it represents a challenge for flow assurance and production system integrity.

9.0 REFERENCES

N/A

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APPENDIX A – CHANGE REGISTER

Summary of Changes:

Section #	Description of Change
Date of Change	
07/15/2024	New RP level organizational SOP

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