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BAY AREA AIR QUALITY MANAGEMENT DISTRICT

September 29, 2016

Wayne Kino
Director of Compliance and Enforcement
Bay Area Air Quality Management District
375 Beale Street, Suite 600
San Francisco, CA 94105

Annual Update of Flare Minimization Plan - Public
Chevron Richmond Refinery
Modernization Project – New Hydrogen Plant

Dear Mr. Kino:

This is the annual update of the Flare Minimization Plan (FMP), pursuant to Regulation 12-12-400, for the new Hydrogen Plant that is part of the Chevron Richmond Refinery Modernization Project. This submittal includes administrative updates that reflect ownership change of the new Hydrogen Plant from Praxair to Chevron.

The content of Appendices A, B, C, and D in this public version of this FMP have been blocked out. Full copies of Appendices A, B, C, and D are included in a Trade Secret transmittal of the FMP, provided under a separate cover letter.

Trade Secret Information
Appendices A through D to this FMP contain confidential business information and are trade secrets of Chevron Products Company, a division of Chevron U.S.A. Inc, as defined by the California Public Records Act, Government Code Section 6254.7 et seq., and 40 CFR Part 2, Subpart B, 18 USC 1905 and 5 USC 552(b)(4). This response is protected from public disclosure under California law, including Government Code Section § 6254.7, and the District's procedures in Section 11 of the District's Administrative Code. Because of the sensitive and competitive nature of the information, Chevron Products Company requests that the BAAQMD afford the information Confidential Business Information treatment indefinitely.

If you have any questions, please contact Juan Li at (510) 242-5228.

Yours truly,

Shawn Lee

Attachments

Flare Minimization Plan

Chevron Products Company - Richmond Refinery
Modernization Project – New Hydrogen Plant
Public Version

Chevron Products Company

Flare Minimization Plan

Refinery Modernization Project

New Hydrogen Plant

Submitted to

Bay Area Air Quality Management District

August 31, 2007

Revised on October 1, 2007

Revised on April 24, 2008

Revised on September 4, 2008

Revised on October 24, 2008

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Revised on December 15, 2008

Revised on October 1, 2015

Revised on September 29, 2016

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Certification Statement

Based on information and belief formed after reasonable inquiry, I, Richmond Refinery HES Manager, certify that this Flare Minimization Plan Project-Specific Update is accurate true, and complete.

Signature ________________ Date 9-29-16

1.0 Introduction

This is a project specific update for the Flare Minimization Plan for the Hydrogen Plant Flare, to be built as a part of the Chevron Refinery Modernization Project at the Chevron Richmond Refinery (the "Refinery"). This update is provided pursuant to the requirements of Regulation 12, Rule 12, which was adopted by the Bay Air Quality Management District (BAAQMD) on July 20, 2005. The FMP defines a series of measures intended to reduce flaring to the extent that is feasible without compromising safety and necessary refinery and hydrogen plant operations and practices. The key tools utilized are design and planning to minimize flaring.

The Hydrogen Plant flare is required mainly for safety reasons. The flare system is designed to handle excess gases in the event of a safety related rapid unit depressurization at the Hydrogen Plant. There will be no routine flaring operations. The flare will be operated infrequently in accordance with condition 28 of the Authority to Construct permit and this plan. The process gas that may be flared from the Hydrogen Plant would contain minimal precursor organic compounds (POC) content, so the primary purpose of the flare would be for the combustion of CO in the gas stream that could otherwise pose a significant safety hazard if released at the refinery. The use of a refinery flare for safety reasons is consistent with Regulation 12, Rule 12, Section 101.

The potential use of the existing refinery flare system to flare gas streams from the new Hydrogen Plant was evaluated, and it has been determined that this option is not feasible. The existing flares at the refinery are each located far enough from the new Hydrogen Plant (approximately 3000 feet) that the back pressure required would present a safety issue. The previous hydrogen plant being replaced by the new plant was flared via source S-6012 at the refinery, so any flaring occurring at the new Hydrogen Plant flare will be balanced by a reduction in flaring from flare S-6012. The new Hydrogen Plant is anticipated to be more efficient and more reliable than the previous plant, and an overall reduction in flaring events is anticipated. As a result, the use of the new Hydrogen Plant flare is consistent with the philosophy of refinery flare minimization.

The authority to construct permit for the Hydrogen Plant, in conjunction with the Chevron Refinery Modernization Project, was reissued on February 11, 2015 (Plant No. A0010, Application No. 12842). This FMP addresses all of the applicable requirements of Regulation 12, Rule 12, Section 400. Certain requirements related to historical operations are not applicable, since the Hydrogen Plant comprises entirely new equipment and the Hydrogen Plant flare has not yet been constructed.

1.1 Background Information on Flare Systems

Refineries process crude oil by separating it into a range of components, or fractions, and then processing those components to produce a planned yield of desired refined products. Petroleum fractions include heavy oils and residual materials used to make fuel oil, mid-range materials such as diesel, jet fuel and gasoline, and lighter products such as butane, propane, and fuel gases.

The Richmond Refinery requires substantial amounts of hydrogen in operating processes and for other uses. Hydrogen is used in refining to increase the fraction of crude oil which can be used to produce gasoline as well as other higher-value petroleum products. Hydrogen is also used in conjunction with a desulfurization catalyst to remove sulfur and nitrogen from hydrocarbon products.

Refinery will supply Refinery Process Gas (RPG) to the Hydrogen Plant. During normal operations, the RPG will be received by into Hydrogen Plant, compressed and routed through the hydrogen manufacturing process described below. During start-up, or if the Steam Methane Reformers are off-line, the RPG can be routed back to the refinery fuel gas system. When this happens, the RPG will be managed as part of the normal refinery fuel gas load.

The manufacturing of hydrogen consists of five basic steps:

1. Natural gas or Refinery Process Gas (RPG) is mixed with hydrogen gas in the presence of a catalyst. Any incoming sulfur compounds are converted to H2S gas that is then captured in a bed of zinc oxide.

2. After H2S removal, the hydrogen-methane mixture is combined with steam. The combination is heated in the steam methane reformer (SMR) furnace tubes in the presence of a catalyst and is converted to hydrogen, carbon monoxide, and carbon dioxide. Heat from the hot flue gas exiting the SMR furnace is used to generate steam.

3. The cooled hydrogen rich synthesis gas ('syngas') stream flows to vessels where, in the presence of another catalyst the carbon monoxide reacts with steam to produce carbon dioxide and more hydrogen.

4. The syngas stream flows through a set of heat exchangers to recover a significant portion of the heat energy before being purified.

5. In the Pressure Swing Adsorption (PSA) unit, the hydrogen is separated from carbon dioxide (CO2), carbon monoxide (CO), methane (CH4), and nitrogen (N2) in the adsorption units.

The hydrogen gas product will then be routed to the Refinery as feedstock to be used in its process plant, or in the future, as hydrogen feedstock to other refineries. A simplified block flow diagram is included as Appendix D.

The following section describes how gases are handled by Hydrogen Plant flare systems. The Hydrogen Plant flare (S-6021) is designed to safely treat any unplanned over-pressurization of the processing streams and the CO, hydrogen, and methane vented during startup and shutdown in the Hydrogen Plant trains by combusting them prior to release into the atmosphere. To burn the released process gases the flare maintains a pilot burner that is supplied with natural gas and would be operating at all times.

The planned Hydrogen Plant flare will be equipped with a velocity seal. The velocity seal is a Venturi type restriction located near the end of the flare. The seal locally increases the velocity of the purge gas, preventing air from entering the flare. The velocity seal is very dependable and requires minimal maintenance.

Gases exit the flare via a tip which is designed to promote proper combustion over a range of gas flow rates. The flare will be steam assisted and have precursor organic compound destruction efficiency of at least 98%. Natural gas pilot flames are kept burning at all times at the flare tip to ignite any gas exiting the flare. Additionally, a small flow of "purge" gas is required to maintain a positive upwards flow and prevent air ingress into the flare stack where it could create an explosive environment. Purge gas is generally either nitrogen (an inert gas) or an easily combusted gas – the Hydrogen Plant will use nitrogen for its purge flows. The flare is designed with a steam assist. In the unlikely event that any smoke is created during flaring, steam will mitigate visible emissions.

The flare system is designed to handle excess gases in the event of a safety related rapid depressurization. Although maintenance-related flows can be large, the design and sizing of the flare system is driven by the need for safe and controlled destruction and release of much larger quantities of gases during upsets and emergencies. A major emergency event will require the safe disposal of a very large quantity of flammable gas during a very short period of time in order to prevent a potentially catastrophic increase in system pressure. Flares are used to safely and properly combust gases that accumulate in process equipment during emergencies. As a consequence, flaring also prevents hydrocarbons and waste gases from being released to the atmosphere. Additionally, flaring is a sound engineering practice since it prevents injuries to employees, equipment, etc.

1.2 Trade Secret Information

Appendices A through D to this FMP Update contain confidential business information and are trade secrets of Chevron Products Company, a division of Chevron U.S.A. Inc., as defined by the California Public Records Act, Government Code Section 6254.7 et seq., and 40 CFR Part 2, Subpart B, 18 USC 1905 and 5 USC 552(b)(4). This response is protected from public disclosure under California law, including Government Code Section § 6254.7, and the District's procedures in Section 11 of the District's Administrative Code. Because of the sensitive and competitive nature of the information, Chevron Products Company requests that the BAAQMD afford the information Confidential Business Information treatment indefinitely.

2.0 Technical Data

Pursuant to the requirements of Regulation 12, Rule 12, Section 401.1, the following section provides descriptions and technical information for the flare systems and upstream equipment and processes that send gas to the flare at the Hydrogen Plant.

2.1 Description of Flaring Systems

The proposed Hydrogen Plant flare will have no routine flaring emissions, and will be operated primarily for safety reasons. The flare at the Hydrogen Plant will be operated in a manner consistent with permit condition 28 in the Authority to Construct permit for the Hydrogen Plant issued by BAAQMD and this plan. The proposed flare is a steam assisted, elevated flare and will be maintained by a flare pilot, which will be fired by natural gas. The pilot flame and purge gas operate at all times.

The primary gases combusted in the proposed Hydrogen Plant flare will be comprised of hydrogen, methane, carbon dioxide and carbon monoxide. In addition, very small volumes of ammonia may be flared from the ammonia drum vent valve during upset or maintenance conditions. For the primary gases, the flare may operate for the following scenarios in addition to startup, shutdown, emergency upset and breakdown:

1. **The loss of hydrogen purity due to feedstock variability (e.g. high nitrogen in the natural gas).** During this event, the product hydrogen may be out of contractual requirements, potentially causing a problem for the downstream use of hydrogen. Gas may need to be flared until the problem is corrected. See Section 5.2 for more details.

2. **Loss of a PSA bed on PSA1 or PSA2 due to an automatic valve malfunction.** Valve malfunctions on the PSA are occasional occurrences due to the number of valves (72 automatic valves on PSA1 alone) and they operate in cyclical service. The valves cycle every few minutes. The malfunction of a PSA automatic valve can cause a PSA bed to be taken out of service. This, in turn, increases the PSA tail gas flow. Depending on the dynamics of the increase of PSA tail gas flow, it may not always be possible to immediately send the additional flow to the furnace without overheating the

furnace. Eventually, the natural gas is backed down to make room for the additional PSA tail gas flow. But in the meantime, flaring can occur during this disturbance.

Two key events can cause the loss of hydrogen purity from the PSA: (1) variability in the PSA feed concentration and (2) high tail gas pressure. The malfunction of a PSA automatic valve increases the tail gas flow. Sending this additional flow to the furnace increases the furnace temperature, which increases the reaction temperature on the process side, which changes the PSA feed composition. Therefore, changes in tail gas flow to the furnace must be made in a relatively slow, controlled fashion to maintain constant furnace temperature. The other option is to maintain constant tail gas flow and let the pressure build within the PSA tail gas surge tank. Unfortunately, the pressure builds quickly and above 6 psig, a loss of hydrogen purity can occur. As a result, the predominant strategy in the industry is to temporarily send the additional tail gas to the flare when the pressure in the surge tank reaches 6 psig. Ultimately, the tail gas flow is increased to the furnace and the flaring of the tail gas ceases. The flaring in this scenario may lead to a flaring event as defined in Regulation 12-12-208. The estimated flaring from the loss of a PSA automatic valve is 1,000,000 cubic feet per hour. The actual flaring amount may be more or less depending on the circumstances. The flaring event duration is anticipated to be less than two hours. It should also be noted that the pressure set point of 6 psig is not applicable during startup. The tail gas is often flared at a lower pressure during a startup to decrease the time it takes to achieve hydrogen product purity.

3. **Sudden change in hydrogen demand.** Under normal circumstances, a reduction in hydrogen demand will be anticipated and coordinated ahead of time. In this way, production can be reduced prior to the reduction in demand to avoid flaring. It is only under circumstances that are "unplanned" and "beyond reasonable control" that the reduction in hydrogen demand can lead to flaring. Each reformer furnace is able to adjust production without flaring at a rate of 1% capacity every 7 minutes. This translates into a change of 1.15 MMSCFD of hydrogen production every 7 minutes. Reductions in the hydrogen demand at a rate greater than 1.15 MMSCFD every 7 minutes can lead to temporarily flaring the hydrogen product until the plant rate can be brought in line. Depending on the magnitude of change, this may lead to a flaring event as defined in Regulation 12-12-208.

4. **Purging to prepare equipment for maintenance.** In order to safely do maintenance on a piece of equipment, it must be purged to achieve a safe atmosphere.

   The equipment is isolated, depressurized, inerted with nitrogen, repaired, and brought back online. If the piece of equipment can be taken down with the remainder of the plant running, gas upstream of the equipment is not flared. The amount of flaring is small during these events, normally below 50,000 cubic feet/event. It may not be possible to send gas to the furnace in a maintenance situation, as the furnace may not be operational. Preparing equipment for maintenance can typically be done without triggering a flaring event as defined in Regulation 12-12-208. It is estimated that preparing equipment for maintenance may occur several times per year.

Under rare circumstances, refinery process gas (RPG) may be sent to the Hydrogen Plant flare. There are four identified scenarios under which RPG could be flared in the Hydrogen Plant flare.

1. **Compressor tail gas malfunction or shutdown**. There are three compressors that handle RPG. In the event of a sudden malfunction or shutdown of the tail gas portion of one of the compressors, independent of the rest of the compressor, RPG could be vented to the flare for approximately one minute while the shutdown process occurs.
2. **Maintenance of the Hydrogen Plant's RPG piping system**. Flaring may occur during isolation, depressurization, and inerting with nitrogen of the Hydrogen Plant's RPG piping system for maintenance (flaring prior to implementation of bypass of PSA system). This depressurization would take place through existing flare connections in the Hydrogen Recovery Unit (PSA3) unit. Once repaired it will be brought back online. If the piece of equipment can be taken down with the remainder of the plant running, the gas upstream of the equipment is not flared. The amount of flaring is small during these events, normally below 50,000 cubic feet/event. It may not be possible to send gas to a furnace in a maintenance situation, as the furnace may not be operational. Preparing equipment for maintenance can typically be done without triggering a flaring event as defined in Regulation 12-12-208. It is estimated that preparing equipment containing RPG for maintenance may occur two to three times per year.
3. **Loss of a PSA bed on Hydrogen Recovery Unit due to an automatic valve malfunction.** This is similar to an automatic valve malfunction on PSA1 or PSA2. There are 48 automatic valves on the Hydrogen Recovery Unit and they operate in cyclical service. The valves cycle every few minutes. The malfunction of a PSA automatic valve can cause a PSA bed to be taken out of service. This, in turn, increases the PSA tail gas flow. In almost all scenarios, the tail gas compressor will be able to process the additional tail gas flow. In rare circumstances the dynamics of the increase of PSA tail gas flow may cause the pressure in the Hydrogen Recovery Unit tail gas surge tank to rise to 6 psig. At 6 psig, a loss of hydrogen purity can occur, which can lead to a greater volume of gas being sent to the flare and an increased probability of a flaring event as defined in Regulation 12-12-208. As a result, the predominant strategy in the industry is to temporarily send the additional tail gas to the flare when the pressure in the surge tank reaches 6 psig.

   As the tail gas compressor is able to absorb changes in tail gas flow more easily than a SMR furnace, the likelihood of a flaring event as defined in Regulation 12-12-208 is greatly reduced. It is anticipated that the flaring event duration will be less than one hour and occur once every couple of years. The maximum flaring from the loss of a Hydrogen Recovery Unit automatic valve is still 1,000,000 cubic feet per hour. The actual flaring amount may be more or less depending on the circumstances.

4. **Compressor seal leakage into the nitrogen purge flow.** For safety reasons, gas would be flared in the event of compressor seal leakage into the nitrogen purge flow. As the flare is at an elevation of 195 feet, this allows the gas to be combusted at a height safely above any personnel. To send this gas to any device at a height less than 195 feet high potentially exposes personnel to radiation or flammable gas hazards. The estimated vent gas flow for a total compressor seal failure is 11,600,000 cubic feet/day. The compressor will be shut down immediately on a total compressor seal failure.

A "telltale" has been installed on each seal system at the Hydrogen Plant that provides an alert prior to a total compressor seal failure. There is a temperature measurement on each "telltale", with high alarm, in the Control System. The amount of gas sent to the flare from the "telltale" will not generate a flaring event. Upon detection of a high temperature alarm, provisions will be made to take the affected compressor out of service and the seal fixed.

These scenarios are discussed in more detail in sections 5.1.1 and 5.1.3.

A Simplified Flow Diagram for the flare system is included in Appendix A to this document. Please note the following in relation to this flow diagram:

- Since all piping and equipment listed on this diagram is new, this diagram does not distinguish between existing and new piping or equipment.
- Sources used during non-emergency/malfunction/upset/contractual outage/customer constraint/maintenance flaring, such as during startup and shutdown, are as follows: PSA1 and Train 1 Hydrogen-Rich Knockout Drum (D-1240) (associated with Hydrogen Plant Train 1, S-4449); PSA2 and Train 2 Hydrogen-Rich Knockout Drum (D-2240) (associated with Hydrogen Plant Train 2, S-4450); and Hydrogen Recovery Unit (S-4451).
- All gases enter the flare header upstream of the flow meters and are measured.

The sources of vent and purge gases that could be flared are listed in Table 2-1.

Table 2-1 Hydrogen Plant Flare System Sources

BAAQMD Flare No.	Process Units
S-6021	*Sources flaring only during emergency upset, contractual constraint, customer outage, or maintenance conditions*: Relief valves in the feed gas separator drums Pressure Swing Adsorption 3 (Hydrogen Recovery Unit) area safety valves Relief valves in the feed gas pretreatment to the SMRs Relief valves in the hydrogen rich gas system downstream of the SMRs NG fuel relief protection SCR system relief protection PSA1 and PSA2 area safety valves Feed gas compressors Analyzer buildings 1 and 2 Oil removal skid
	Sources flaring in non-emergency events (e.g. start-up, shut-down): Hydrogen rich gas automatic vent before the PSA1 and PSA2 units. PSA1 and PSA2 startup flaring Hydrogen Recovery Unit startup flaring

2.2 Detailed Diagrams for Flaring Systems

A Piping & Instrumentation Diagram (P&ID) for the proposed Hydrogen Plant flare is located in Appendix B to this document.

A mechanical elevation drawing for the proposed Hydrogen Plant flare is located in Appendix C to this document. This diagram shows the knockout drum at the base of the flare, used for catching any condensibles that may be present. The normal operating level is below the inlet from the flare header.

2.3 Monitoring and Control Equipment

2.3.1 Flare Gas Flow Monitoring

As required by BAAQMD Regulation 12 Rule 11, Section 501, the proposed Hydrogen Plant flare will be equipped with a continuous flare vent gas flow meter. The properties of the flow meter used for this monitoring are shown in Table 2-2.

Water seals were considered in the design of the Hydrogen Plant since, if placed in the correct location, these could serve to differentiate low flow 'noise' from actual flow. However, water seals are not used at the Hydrogen Plant due the backpressure they exert which could negatively affect process operations. There are several Pressure Safety Valves (PSVs) that have low set pressures. Adding any more backpressure to the outlet of these PSV's was determined to not be a good safety practice.

Table 2-2 Flare System Flowmeters

Name & Location	*Make & Model*	*Type*	*Ranges*
Hydrogen Plant flare flowmeters Total of two, each installed between flare sub-header line and inlet to Hydrogen Plant Flare (S-6021).	GE GF868 Flare Gas Flowmeter (or equivalent)	gas ultrasonic flowmeter	0 to 275 fps (1) 0 to 60 psig 0 to 300 °F 2 to 120 Gram/mol

Note 1: Technical specification for flow meter minimum detectible gas velocity is 0.1 feet per second. The equivalent volumetric flow rate varies depending on pipe dimensions and vent gas physical properties. Additionally, due to large diameter pipe size, purging, and flow dynamics, low flow velocities do not necessarily indicate actual gas flow out the flare tip. Flowmeter is guaranteed to 275 feet per second.

2.3.2 Other Flare Gas Continuous Recording Instruments

In accordance with BAAQMD Regulation 12, Rule 11, Section 502, the proposed Hydrogen Plant will be equipped with a gas chromatograph (GC) to determine the composition of the gas stream being flared. This gas chromatograph will be a Daniel-Emerson Model 590 (or equivalent), and there will be a Thermo-Fisher Scientific SOLA II (or equivalent) sulfur analyzer to perform Sulfur On-Line Analysis (SOLA). The GC will be utilized to monitor several process streams within the hydrogen facility, including the flare stream during a flaring event. Upon completion of an analysis, the GC receives the next sample stream in the sequence. This system will be designed such that in case of a flaring event involving at least 330 scfm of vent gas and lasting at least 15 minutes, the gas chromatograph and SOLA will automatically switch to continuous monitoring of the flare gas. The current sampling sequence of the GC will be interrupted and the flare stream sample will begin purging through the sampling system. Upon completion of the current stream analysis, the first flare gas sample is injected into the GC. Upon completion of the flare gas analysis, additional flare sample injections and analyses will be made until the flaring event is over. If the flow of the flare gas is determined to be more than 330 scfm, the GC and SOLA will continue to monitor the composition of the gas to the flare every 30 minutes at a minimum for the duration of the event.

One or more cylinders of calibration gas will be provided with the GC. The cylinders(s) contain the expected components present in the various sample streams at concentrations expected for the process stream.

In accordance with the GC vendor recommendations, the operator will flow calibration gas to the GC. Analyses will be made until the instrument response is deemed stable, indicating the sample system has equilibrated with the calibration gas. The concentration of the mixture will be calculated from the response factor settings in the GC. If the resulting concentrations agree within 5% of the known concentrations of the calibration cylinder, the GC is returned to sampling the process streams, and no further action is taken. If the concentrations do not agree within 5%, then the analyzer is calibrated by calculating new response factors from the known concentrations in the calibration standard and the new readings. These new response factors are entered into the GC and are used until the next calibration. The GC returns to analyzing the process streams as described above.

In the event that the GC is not functioning, there will be a sample take-off point after the sample 'pump' from the flare line. This sample composition can then be tested. All sampling points will be downstream of any inlet to the flare header and will be easily reachable by personnel during a flaring event. This manual sample will be taken every three hours until the flow rate of gas flared in a 15 minute period is continuously 330 scfm or less.

3.0 Past Reductions

Pursuant to the requirements of Regulation 12, Rule 12, Section 401.2, owner/operators are required to provide a description of the equipment, processes or procedures installed or implemented within the last five years to reduce flaring events. Since the proposed Hydrogen Plant flare has not been constructed, there are no actions that fall into this category.

4.0 Planned (Future) Reductions

Pursuant to the requirements of Regulation 12, Rule 12, Section 401.3, and 401.4.1 and 401.4.2 (feasible prevention measures) this section provides descriptions of any equipment, processes or procedures that the Hydrogen Plant plans to install or implement to eliminate or reduce flaring.

The proposed flare is designed to be constructed to meet the requirements set forth in EPA regulation 40 CFR 60.18 (General Control Device Requirements). Given the composition of the gases to be combusted in the proposed flare and the non-routine nature of its operation, there are no additional planned changes to the equipment, processes or procedures, beyond those described below, to eliminate or reduce flaring events at this time.

A primary means of reducing flaring of RPG in the Hydrogen Plant flare is the process line through which the plant can send the RPG back to the refinery's main header. The line can be utilized as Hydrogen Recovery Unit is started up until the hydrogen meets the purity specification, or in the event that the hydrogen reformer trains in the hydrogen facility are not running. When a PSA is started up, the required product purity is not reached immediately and some offgas is produced. The Hydrogen Recovery Unit tail gas process compressor outlet, which contains this offgas, can be diverted from the hydrogen train feed to the

Refinery. This is not a flare gas recovery compressor, but rather a process compressor whose outlet gas can be routed back to refinery's process. This return line will serve to limit any RPG flaring during Hydrogen Recovery Unit startup or operation of the Hydrogen Recovery Unit while the SMR trains are shut down.

Many of the non-hydrogen materials produced in the Steam Methane Reformers (SMRs) are used in production in other areas of the Hydrogen Plant. Offgas from the hydrogen purification units provides approximately 90% of the heat input to the furnaces. Steam is produced with waste heat recovery systems, and either recycled to the process or used for power production. Ammonia in the deaerator vent is sent to the furnace and is used to reduce ammonia required by the selective catalytic reduction (SCR) in the flue stack. This reuse of side products enables the hydrogen production facility to virtually eliminate flaring during normal operation. In addition, a large portion of the feedstock to the hydrogen production facility (over 30% by volume) is RPG, which allows the Refinery as a whole to prevent flaring by helping to maintain a balance in the refinery fuel system.

Since the Hydrogen Plant flaring generally occurs only during maintenance, upsets, shutdowns and the associated startups, increasing the reliability of the plant operation reduces flaring. As a result, the plant incorporates redundancy to eliminate single point failures that can bring down the entire facility. Bypass lines are used around most equipment and valves requiring regular minor maintenance. Examples of redundancy include dual redundant solenoids on several critical valves through the facility, two out of three voting, redundant transmitters and the use of three 50% rotating pieces of equipment. In addition, two electrical feeders go to the plant and two natural gas control valves are installed in parallel in the main natural gas feed to the plant. All of these designs decrease the frequency of unplanned shutdowns, which decreases flaring.

Significant volumes of gas must be flared at startup and shutdown. The reasons for not reusing the gas are described in section 5.2.1. Each startup and shutdown takes several hours. While the Refinery has made significant effort to minimize the time required for startup and shutdown, these processes are limited by the allowable rate of temperature change for the materials used to construct the plant. Of primary importance are the process integrity and personnel safety.

Measures considered that could reduce or eliminate flaring events during maintenance, upsets, startups and shutdowns include recovery of RPG to the Refinery or storage of RPG for future processing. Both of these options were rejected, primarily for safety reasons, as described in more detail below.

The Hydrogen Plant process compression system is able to send some of the RPG (after hydrogen is removed) back to the ~~Chevron~~ refinery's process in the event that Hydrogen Recovery Unit is operating while the reformers are down. This would typically only be done during startup of Hydrogen Recovery Unit, or when the hydrogen reformer trains are not operating. This process return line will serve to limit any RPG flaring through the flare during Hydrogen Recovery Unit startup or operation of Hydrogen Recovery Unit while the SMR trains are shut down. However, this option is only viable due to the large volumes of gas involved when the plant is operating. Use of the compression system is not a viable option for recovery of RPG such as that which might be flared during an upset event, which involves much smaller volumes of gas. The potential danger of drawing a vacuum in a flammable gas system far outweighs the benefit from preventing the flaring of a small amount of gas.

Storage of RPG for future processing was determined to be infeasible due to the high flammability of the gas that would be required to be stored. Combustion of flammable gases as they are produced, either in process equipment or in a flare system, is intrinsically safer than storage, as it minimizes the onsite inventory of combustible material. The minimization of on site storage of combustible gases also addresses Homeland Security concerns.

5.0 Prevention Measures

Pursuant to the requirements of Regulation 12, Rule 12, Section 401.4, this section discusses prevention measures, including feasibility and implementation schedule, to minimize flaring in the Hydrogen Plant. The proposed flare will be designed and constructed to meet the requirements of EPA regulation 40 CFR 60.18 and all conditions of the BAAQMD air permit. The proposed flare will be operated to minimize the duration of each flaring event and the resulting emissions. Work practices to achieve this goal include controlling exit velocity, ensuring adequate heat value of the combusted gases and maintaining smokeless operation. Detailed prevention measures are discussed in individual sections below.

5.1 Major Maintenance Activities

Pursuant to the requirements of Regulation 12, Rule 12, Section 401.4.1, this section discusses Hydrogen Plant maintenance and turnaround activities and outlines measures to minimize flaring during planned and unplanned maintenance activities. The section includes information on when flaring is likely to occur during maintenance activities, and a description of measures that can be used to perform these activities with a minimum of flaring. For purposes of this section, planned maintenance is interpreted as scheduled process unit turnarounds as well as more near-term shutdowns.

5.1.1 When Flaring is Likely to Occur During Maintenance and Turnaround Activities

This section addresses maintenance and turnaround activities within the proposed Hydrogen Plant. The Hydrogen Plant has not yet been built, so a review of flaring that has occurred during planned maintenance activities during the past five years cannot be conducted. However, a reliability study has been conducted, which has led to the addition of some of the measures described above (e.g. dual solenoids).

Major maintenance activities take place during planned shutdowns. During a planned shutdown, equipment is generally purged with nitrogen to the flare. Different parts of the hydrogen production facility can be shutdown separately, ensuring the entire facility will not have to come down for maintenance at once. If the Refinery Process Gas purification system is to be shutdown, the RPG inlet streams can be sent directly as feed to the reformers. Each reformer train can be shut down separately from the other. The SMR trains are designed such that, in combination with the common equipment, they can each process the entire set of feedstocks. This ensures the refinery will not have to flare or dispose of these in a potentially hazardous way.

In addition, flaring of RPG may occur before or during maintenance in the following two scenarios:

1. In the event of a sudden malfunction or shutdown of the tail gas portion of one of the compressors located upstream of the Hydrogen Recovery Unit unit, independent of the

rest of the compressor, RPG could be vented to the flare for approximately one minute while the shutdown process occurs.

2. Isolation, depressurization, and inerting with nitrogen of the RPG piping system within the Hydrogen Plant prior to implementation of bypass of PSA system. This is a relatively small amount of piping that must be purged on shutdown in order to safely maintain the PSA. The gas is not compressed for reuse because the slight reuse benefits are far out-weighed by the risk of drawing oxygen in and creating a flammable atmosphere. This purge would take place through existing flare connections in the Hydrogen Recovery Unit.

Turnaround activities encompass startup and shutdown processes. Several procedures are in place that help reduce flaring. While flaring is unavoidable at startups and to a lesser extent at shutdowns, the startup procedure will be written such that each SMR will flare below 50% of design rates. Upon shutdown, though some flaring must take place to purge the system, the feedstock flow stops immediately and flaring generally stops within minutes. The Refinery's preventative maintenance plan prevents many potential problems and associated flaring events. The portion of this preventative maintenance plan covering systems at the Hydrogen Plant will be available at the plant site for District staff review upon request. Additionally, the Refinery has a computerized work order program that tracks frequency and methods used in maintenance activities. This history, as it relates to flaring events, will also be available for review at the plant site upon request.

5.1.2 Past Flaring due to Major Maintenance Activities

Since the Hydrogen Plant has not yet been constructed, there was no review of maintenance-related flaring during the 5 years before adoption of Regulation 12, Rule 12 (on July 20, 2005).

5.1.3 Measures to Minimize Flaring During Planned Maintenance

The greatest potential for further reductions in flaring is to update and improve existing operations and maintenance procedures. These flaring reduction measures satisfy safety and maintenance obligations. Minimizing flaring during planned maintenance activities while avoiding the more significant flaring associated with shutdown and startup minimizes the total flaring activity.

The following paragraphs describe practices that will be employed at the Hydrogen Plant to minimize future flaring during planned maintenance activities. These practices were made possible through a design philosophy of preventing shutdowns and therefore preventing as much flaring activity as possible.

Plant Feed Compression

The feed compression units have been designed as three 50% units. This means that if maintenance needs to be performed on a compressor machine, the other two can stay in operation without interrupting the hydrogen facility. Some flaring will be necessary while purging out the equipment to ensure personnel safety, but being able to perform maintenance while running the plant prevents the startup/shutdown flaring.

Each reciprocating feed compressor unit is made up of three process services: RPG compression, Hydrogen Recovery Unit Tail Gas compression, and Feed Gas compression. The capacities for each service in each unit are as follows:

RPG: 30 million standard cubic feet per day (MMscfd)

TG: 15 MMscfd
Feed: 54 MMscfd

The Refinery's preventative maintenance program will minimize possible flaring of small amounts of RPG that may leak from the compressor seals into the purge flow. The preventative maintenance program will ensure that seals are replaced on a schedule based on the vendor recommended lifetime and vendor guaranteed leakage rates.

Steam Methane Reformer Trains

During planned maintenance, the plant rate is decreased to the lowest possible level (generally near 30%) before the PSA loses efficiency. At this point there is brief flaring while the reforming train is brought down. The flammable feed gas is replaced with nitrogen to safely purge out the entire train and slowly cool equipment down.

Desulfurizer Catalyst Change

The desulfurization beds must be changed out on a regular basis. In order to do this while keeping the plant operating, two desulfurizer beds are installed in each hydrogen train. One vessel in each hydrogen train will be changed out approximately every six months. The changeout of the catalyst from a desulfurizer vessel involves the following steps: isolation from the process, depressurizing the vessel, inerting, changeout, and bringing the vessel online. During the changeout, the process gas that was going through the desulfurizer vessel is diverted to the other vessel instead of sending it to the flare. The beds can be safely isolated from the plant feed gas, and the small amount of hydrocarbon gas inside the vessel is purged to the flare. This allows the plant to keep operating and prevents frequent shutdowns with associated flaring. Each of the four desulfurizer vessels in the Hydrogen Plant contains less than 500 pounds (10,000 cubic feet) of gas at process temperature. The gas resulting from this purge has a high inert content and cannot be safely reused or routed to another part of the process.

PSA Units

The PSA units are designed such that if an automatic valve malfunctions or some other upset causes a vessel or two vessels to come out of service, the rest of the unit is still able to operate. The individual vessels may have to be isolated, depressurized, and inerted with nitrogen to the flare, but this design prevents a unit or even plant shutdown and the associated flaring.

To minimize the upset of the PSA from an automatic valve malfunction, the following three preventative measures will be implemented:

1. High cycle valves from an industry leading automatic valve supplier are used.
2. Logic is incorporated in the PSA control to only take the bed out of service that has the automatic valve malfunction. This minimizes the volume of increased tail gas.
3. Preventative maintenance is performed on the PSA automatic valves during planned turnarounds.

Pressure Relief

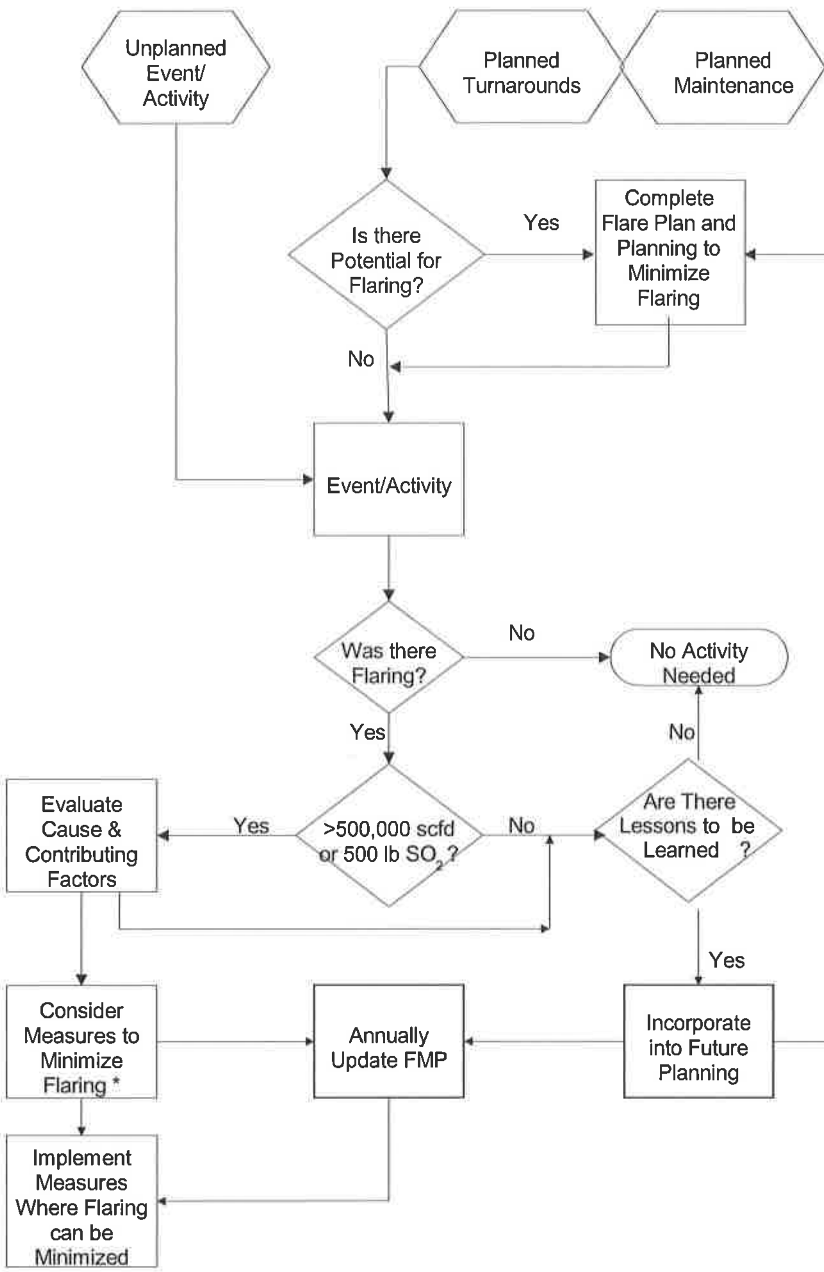
Maintenance, inspection and servicing of Pressure Relief Devices (PRDs) will be carried out according to all applicable federal, state and local regulations. This practice minimizes flaring by optimizing intervals for testing of PRDs and inspection. In addition, ensuring PRD reliability results in reduced leakage and therefore less likelihood for flaring.

Shutdown/Startup planning & Shutdown Procedures

A shutdown flare plan will be developed for each turnaround. The plan identifies possible sources of flaring and incorporates some choices of action for the turnaround that can minimize flaring. Each plan is unique to the planned activity for a particular turnaround. Specific actions planned for the turnaround depend on which parts of the unit are being brought down and which other units are also down at the same time.

A flowchart of the Hydrogen Plant's Flare Planning process is shown below, in Figure 5-1.

Figure 5-1 Flare Planning Process Flowchart



*If cause was recurrent equipment failure , consider adequacy of maintenance schedules and protocols .

5.1.4 Measures to Minimize Flaring During Unplanned Maintenance

There are occasions, primarily as a result of equipment malfunction, where a relatively immediate decision is made to shut down equipment, allowing little time for the kind of specific planning used for turnarounds and planned maintenance. In these cases, it is often not possible to make the same level of plant adjustments necessary to minimize flaring to the extent possible when a shutdown is planned far in advance.

The following are examples of upsets or malfunctions that could lead to flaring and unscheduled minor maintenance:

- Leaking Relief Valves or control valves
- Pressure Relief Valve malfunction
- Equipment overpressure or other cause for relieving relief valves
- Equipment Plugging resulting in local overpressure
- Loss of a utility (steam, cooling water, power)
- Loss of air fans or condensers

See 5.3 for additional detail regarding preventative maintenance procedures aimed at eliminating the occurrence of upsets and malfunctions.

Occasionally, a major malfunction can cause the hydrogen-purifying PSA to shut down. In this case the plant quickly reduces operation to 40% rates and allows the SMR to continue operating. During this unplanned maintenance situation, flaring will be minimized through evaluation of the anticipated volume of flaring associated with conducting repairs while the system is online versus shutting down the entire plant. The SMR would continue to run if it was determined that the volumes of flaring during the shutdown and startup would exceed those resulting from the repair duration.

Major process upsets from feedstock changes are unavoidable, whether due to changes in gas composition or sudden changes in flow rates. In order to minimize flaring on these occasions, the Hydrogen Plant inlet compression system has a significant amount of flexibility, for example, recirculation valves and unloading steps help control upset flow conditions.

Equipment failures that result in equipment overpressure, typically leading to relief valves opening to the flare system, are classified as emergencies. Emergency flaring events are severe instances of upsets or malfunction and have the same set of basic causes.

There are many potential other causes of flaring which cannot be eliminated, despite careful planning and system design to minimize the risk of their occurring. Some examples of these types of other causes include:

- Acts of God
- Terrorism

5.2 Gas Quality and/or Quantity Issues

Pursuant to the requirements of Regulation 12, Rule 12, Section 401.4.2, this section provides a description and evaluation of prevention measures for flaring that may reasonably be expected to occur due to issues of gas quantity or quality. The section includes information on when flaring is likely to occur.

RPG may, under rare circumstances, be flared in the Hydrogen Plant flare. RPG is a mixture of natural gas and sweetened process gas from several process units. The following composition and characteristics are approximately typical of RPG:

Component	Mole %
Hydrogen	62.1
Methane	15.3
Ethane	10.0
Propane	6.4
C4+	1.9
Nitrogen	4.0
Water	0.3

High heating value	756 Btu/SCF
Low heating value	676 Btu/SCF
Specific gravity	0.40
H2S content	30 ppm avg., 150 ppm max

The quantity and quality of the fuel gas will vary depending on the type of crude oil being processed by the Refinery, the severity of operations, and the relative contributions from the various process units at any one time. Under normal operating conditions, there is no vent gas flow expected to be sent to the flare.

Maintaining the correct RPG composition is critical to the refinery operations from an efficiency and safety perspective. However, upsets may occur. In the event that the refinery process stream composition deviates significantly from specifications to the extent that the Hydrogen Plant is no longer able to process the RPG streams, the battery limit control valves ramp closed to prevent the RPG streams from entering the Hydrogen Plant. While the valves close (on the order of one minute), the Hydrogen Plant feed compressors can recirculate the gas in the compressor loop. This compression system flexibility will serve to limit any RPG flaring through the Hydrogen Plant flare.

The facility is designed to be able to handle natural gas containing 1.4% by volume of nitrogen. The actual nitrogen composition in the natural gas is normally less than 1% by volume. Concentrations above 1.4% nitrogen may lead to a loss of hydrogen purity in the output from PSA1 and/or PSA2. The Hydrogen Recovery Unit will not be affected by the nitrogen concentration in the natural gas. If a loss of hydrogen product purity occurs, it may lead to a flaring event as defined by Regulation 12-12-208. The nitrogen content in the natural gas is monitored by a GC upon entering the Hydrogen Plant, and if detected in time, adjustments to PSA1 and PSA2 may be able to be made to avert the loss of hydrogen purity. It should be noted that as both SMRs associated with PSA1 and PSA2 require natural gas in order to operate, the high nitrogen natural gas must be used to avoid a PSA unit shutdown. Since shutting down either PSA unit will produce more flaring, this is not considered an acceptable alternative.

High nitrogen in the RPG feedstock could cause a loss of hydrogen purity from Hydrogen Recovery Unit. The nitrogen in the RPG feedstock is also monitored by a GC and may be kept upstream of the Hydrogen Plant if the nitrogen content goes above 3.25% by volume. The nitrogen in the RPG feedstock is typically less than 1% by volume.

The loss of hydrogen purity due to either high nitrogen in the natural gas or high nitrogen in the RPG feedstock is not anticipated to be a frequent occurrence. It is estimated that a flaring event due to high nitrogen could occur less than once per year. Each flaring event would likely be less than 2 hours in duration.

5.2.1 Options for Recovery, Treatment and Use

Regulation 12, Rule 12, Section 401.4, requires consideration of the feasibility of further reducing flaring through additional recovery, treatment, and/or storage of relief gas header gases, or through other means to use the recovered gases.

While flare gas recovery is a significant benefit to operation of the refinery, the system is not practical within the Hydrogen Plant. As shown by the information below on the composition and characteristics typical of PSA1 and PSA2 inlet gas during startup, the heating value of this gas is extremely low and there is a high percentage of inert gas. The gas is flammable, so use for purging is not possible. The ability to use this gas for fuel is very low based on the heating value – most burners are not designed for gas of this composition.

As stated before, the Hydrogen Plant has virtually no flaring unless the plant is starting up, shutting down, or performing maintenance. Combustion of flammable gases as they are produced, either in process equipment or in a flare system, is intrinsically safer than storage, as it minimizes the onsite inventory of combustible material. The minimization of on site storage of combustible gases also addresses Homeland Security concerns and the potential for damage from an earthquake.

The design basis for the flare is 125,000 scfm, which represents 50% of the typical PSA1 and PSA2 feed flowrate. The following composition and characteristics are typical of PSA inlet gas that may be flared during startup:

Component	Mole %
Hydrogen	72
Methane	6
CO	4
CO2	16
Nitrogen	2
Water	~0

High heating value	310 Btu/SCF
Low heating value	270 Btu/SCF
H2S content	~0 ppm

5.2.2 Minimizing Sulfur Emissions from Flaring

The gases that will most frequently be flared (see above in 5.2.1) in the proposed Hydrogen Plant flare have very low sulfur content. The gases will be passed through multiple sulfur removal units prior to flaring except during rare occasions of RPG flaring, as previously mentioned.

5.3 Recurrent Failure

Pursuant to Regulation 12, Rule 12, Section 401.4.3, this section considers prevention measures for flaring caused by the recurrent failure of air pollution control equipment, process equipment, or a process to operate in a normal or usual manner. A failure is recurrent if it occurs more than twice during any five year period as a result of the same cause as identified by cause investigations conducted pursuant to the requirements of Regulation 12, Rule 12, Section 406 (i.e., after July 20, 2005).

The Hydrogen Plant will have in place a preventative maintenance program that is consistent with recognized industry standards and recommended practices. This program includes procedures and policies to maintain the reliability of equipment so that equipment failures and other types of process upsets are minimized or eliminated. When equipment or systems do fail and impact operations (or cause significant flaring), investigations are conducted to identify the cause of the failure and implement suitable corrective actions.

Appendix A – Simplified Flow Diagram
New Hydrogen Plant Flare

This section included in Trade Secret Transmittal Submitted under separate cover

Trade Secret Information

Appendices A through D to this FMP Project-Specific Update contain confidential business information and are trade secrets of Chevron Products Company, a division of Chevron U.S.A. Inc., as defined by the California Public Records Act, Government Code Section 6254.7 et seq., and 40 CFR Part 2, Subpart B, 18 USC 1905 and 5 USC 552(b)(4). This response is protected from public disclosure under California law, including Government Code Section § 6254.7, and the District's procedures in Section 11 of the District's Administrative Code. Because of the sensitive and competitive nature of the information, Chevron Products Company requests that the BAAQMD afford the information Confidential Business Information treatment indefinitely.

Appendix B – Flare P&IDs
New Hydrogen Plant Flare

This section included in Trade Secret Transmittal,

Submitted under separate cover.

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Appendix C – Flare Elevation Drawings
New Hydrogen Plant Flare

This section included in Trade Secret Transmittal, Submitted under separate cover.

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Appendix D – Simplified Block Flow Diagram
New Hydrogen Plant

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