Martinez Refining Company
Spent Catalyst Release
November 24-25, 2022
Independent Safety Culture Assessment

Report prepared by

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Version 1

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I. Foreword

On the night of November 24-25, 2022, a large amount of catalyst was released from the Catalytic Cracking Unit (CCU) of Martinez Refining Company (MRC), part of the PBF Energy family of refineries. During the incident, a large amount of a solid material, called catalyst was released; it fell onto the City of Martinez, California, and surrounding areas. The Contra Costa [County] Health Hazards Materials Programs (CCHHMP) classified this incident as a Community Warning System (CWS) Level 2 or higher incident,[1] defined in the Contra Costa Industrial Safety Ordinance (ISO) as a Major Chemical Accident or Release (MCAR). [2]

After the incident, the MRC Oversight Committee was formed, which commissioned an independent incident investigation, a human health and ecological risk assessment, and this independent safety culture assessment. The Committee chose Scott Berger and Associates, LLC to perform the independent safety culture assessment. This report describes the results of this independent assessment.

Our assessment started with a review of an internal safety culture survey that had been conducted by MRC between November 2022 and April 2023. Following this review, we evaluated how MRC leadership developed, deployed, and enforced process safety management systems (PSMS) to establish a culture of process safety throughout the refinery. Our assessment included a review of MRC's PSMS documents plus interviews with MRC employees in leadership roles.

Our assessment protocol drew heavily on publications of the Center for Chemical Process Safety, most notably the following:

- *Process Safety Leadership from the Boardroom to the Frontline*, AIChE/Wiley, 2019
- Essential Practices for Creating, Strengthening, and Sustaining Process Safety Culture, AIChE/Wiley. 2018
- *Guidelines for Risk Based Process Safety*, AIChE/Wiley, 2007
- *Guidelines for Auditing Process Safety Management Systems, 2nd ed*, AIChE/Wiley, 2011

These publications, and CCPS publications in general, describe the best practices in managing and leading process safety and driving a strong culture of process safety.

Our assessment protocol also drew on Standards and Recommended Practices of the American Petroleum Institute (API), guidance documents provided by Contra Costa County, and our experience working with a wide range of domestic and international refining, chemical, and other relevant companies.

Assessment activities included reviewing MRC's process safety management system documents and interviewing MRC employees in leadership roles at the refinery leadership and subordinate levels. We

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[1] See https://www.cchealth.org/health-and-safety-information/hazmat-programs/community-warning-system.

[2] Contra Costa County. (2023). § 450-8.016. stationary source safety requirements., Chapter 450-8. risk management, division 450. hazardous materials and wastes, Title 4. health and safety, ordinance code, Contra Costa County. The State of California; Contra Costa County. http://www.contracostaco-ca.elaws.us/code/oc_title4_div450_ch450-8_sec450-8.016

sought to understand both the quality of MRC's management system element documents and the diligence of MRC's leadership in ensuring that these elements were executed professionally, faithfully, and on time.

We believe that the MRC employees we interviewed made true and accurate statements to the best of their abilities and volunteered honest opinions. We also believe that employees felt free to provide their input without retribution from management. We have confidence that both the identified strengths and the opportunities for improvement described in this report are accurate to the best of our knowledge of and experience in engineering and process safety. We also feel confident that our recommendations will help MRC drive improvement in the company's process safety culture.

II. Executive Summary

Between about 20:30 on November 24, 2022, and 04:00 on November 25, 2022, about 24 tons of spent catalyst was released from Catalytic Cracking Unit (CCU) of Martinez Refining Company (MRC) into the City of Martinez, California, and surrounding areas. The catalyst, a white powder, was found on resident's vehicles and trash cans and covering horizontal surfaces on the ground in neighborhoods to the southwest, west, and northwest of the refinery. Based on the quantity of catalyst released and the impact to the community, staff of the Contra Costa Health Hazardous Materials Programs (CCHHMP) identified this incident as a Community Warning System (CWS) Level 2 or higher incident.[3] As a result, CCHHMP determined that the incident was a Major Chemical Accident or Release (MCAR).

As required by the Contra Costa County Industrial Safety Ordinance, MRC established an Oversight Committee to investigate the incident. The Committee commissioned several independent studies, including this independent safety culture assessment. Scott Berger and Associates, LLC, a consultancy with expertise in best practices for process safety in chemical plants, refineries, and related facilities, was selected to perform this assessment.

The term "safety culture," as used here, specifically refers to the culture of process safety. Process safety addresses the policies, procedures, work activities, and oversight used to prevent release of hazardous materials from process equipment. Such releases can result in fires, explosions, toxic effects, and other potentially harmful impacts to people, the community, the environment, and the facility.

The broader term "Safety" encompasses process safety, occupational safety, vehicle safety, and other sub-disciplines. When many people hear the term "Safety", they are thinking of occupational safety, which addresses policies and activities that help prevent injury to workers as they carry out their job responsibilities. Some similarities between process safety and occupational safety do exist; however, the activities that organizations perform to accomplish each of them differ broadly, and it is possible for facilities to have broadly different cultures in these two areas. This assessment considered only the culture of process safety.

[3] See https://www.cchealth.org/health-and-safety-information/hazmat-programs/community-warning-system

Ultimately, the process safety culture of a company and facility depends on 1) the quality of the Process Safety Management System (PSMS) and 2) the rigor with which the company's leadership drives:

- execution of the PSMS;
- reduction of risk towards a level considered generally acceptable; and
- a focus on the elimination of process safety incidents, both site-wide and company-wide.

We found that MRC is performing well in all three of these high-level areas. At the more detailed level, MRC also performs well in areas such as pressure equipment integrity, interlock integrity, and emergency preparedness and response. We believe that MRC's high-level performance, coupled with the company's success in managing these elements, will serve as a good foundation for the improvement opportunities regarding management system elements as identified in this assessment.

These opportunities for improvement are listed below. They correlate with cultural dimensions identified in MRC's November 2022 – April 2023 culture evaluation as being less than robust. Furthermore, the first two items on the list are directly linked to root causes identified in the independent investigation of the November 2022 catalyst release incident separately commissioned by the Oversight Committee.

- Tighten the policy for deviating from procedures, most notably the policy for use of manual control mode.
- Implement correct identification of root causes and improve the approach to making recommendations to better prevent repeat incidents.
- Set timely deadlines for correcting the process safety audit findings that have urgency.[4]
- Increase the rigor of several dimensions of the refinery's Asset Integrity program.

We recommend that MRC urgently address improvements in the first three areas. We also found that employees' reported feelings of confidence that they were working in a safe refinery--although not low--were not as high as workers and refinery leaders would like them to be.We believe that the recommendations made in this report, when implemented, will help MRC realize their GOAL ZERO[5] vision, which MRC describes as a "… *proactive safety approach [that] is designed to help us anticipate areas for improvement and execute preventative measures before incidents occur*.

III. Introduction

A. Objective

The objective was to perform an independent assessment of process safety culture of the MRC refinery. On behalf of the MRC Oversight Committee, CCHHMP hired Scott Berger and Associates, LLC, to conduct the assessment. Information about our team may be found in Appendix B. This report describes the findings of the independent safety culture assessment and offers recommendations for improving safety culture in the future.

[4] MRC's current audit resolution times reflect the regulatory requirement. However, certain findings should be corrected much sooner. For example, a finding related to a procedure should be addressed before the next use of the procedure.

[5] See https://martinezrefiningcompany.com/safety-culture/

B. Scope and Approach

As discussed in the book *Process Safety from the Boardroom to the Frontline*,[6] a publication of the Center for Chemical Process Safety (CCPS), the degree to which company and facility leadership drives the execution and improvement of process safety ultimately determines the company's and facility's culture of process safety.

This, and other CCPS publications, were used to form the protocol by which we conducted our assessments. Since 1985, CCPS has been advancing the technical, leadership, and culture practices of process safety with a vision of *A World Without Process Safety Incidents*.[7] While organizations such as the American Petroleum Institute (API) and the National Fire Protection Association (NFPA) establish standards that are minimum performance requirements, CCPS publications go well beyond these minimums, and are therefore a yardstick against which performance can be measured and improvement opportunities identified. The other publications included:

- Essential Practices for Creating, Strengthening, and Sustaining Process Safety Culture, AIChE/Wiley. 2018
- *Guidelines for Risk Based Process Safety*, AIChE/Wiley, 2007
- *Guidelines for Auditing Process Safety Management Systems, 2nd ed*, AIChE/Wiley, 2011

Therefore, the scope of this project included assessing all relevant elements of MRC's process safety management system (PSMS) refinery-wide, considering both the quality of each element and the way MRC's Refinery Leadership Team (RLT) put these elements into practice. We coupled this part of the assessment with a deep analysis of the regulatorily mandated[8] safety culture survey conducted by MRC between November 2022 and March 2023.

In forming our recommendations from this assessment, we sought actions that would make real improvements in MRC's process safety culture and performance, and that could be reasonably accomplished. Our recommendations were therefore guided by the "SMART" principle, by which recommendations should be Specific, Measurable, Aligned, Realistic, and Time-bound. Part of this involved discussing the recommendations from our first draft report with the MRC RLT. As a result, the recommendations we have made in this report are aligned with MRC's appropriate management systems and can be achieved by MRC within the recommended timeframe.

C. Report Format

Section IV of this report explains the connection between process safety culture and the way in which MRC defines and then drives its PSMS through its leadership. Section V provides a detailed analysis of MRC's 2022-23 process safety culture survey, highlighting areas of relative strength as well as areas that should be targeted for improvement. Section VI discusses the findings of our analysis of MRCs PSMS documents, key data, and the rigor with which the MRC Refinery Leadership Team (RLT) uses data to drive execution of the PSMS and to create a GOAL ZERO culture. Section VII summarizes SMART

[6] CCPS, *Process Safety Leadership from the Boardroom to the Frontline*, AIChE/Wiley, 2019. This book was prepared by our project team on behalf of CCPS with extensive inputs from a committee of experts with extensive experience in driving strong process safety performance and culture.

[7] See https://www.aiche.org/ccps

[8] MRC is required under the Contra Costa ISO, CalARP, and Cal/OSHA PSM regulations to perform periodic culture surveys. MRC's culture surveys are intended to meet the requirements of all three regulations.

recommendations based on our discussions with MRC. The Appendices describe our team experience and project responsibilities, provide a glossary of terms and acronyms. Subsequent versions of this report will summarize the resolution of comments received from the MRC Oversight Committee and the public.

IV. Background

In a presentation of how process safety culture is built and strengthened, the book *Process Safety Leadership from the Boardroom to the Frontline*[9] states:

> *Investigation of many process safety incidents have shown that cultural failures rival management system failures as leading causes. Similarly, when long term successes have been achieved, strong cultures of process safety excellence have been an integral factor.*
>
> *Just as leaders establish the overall corporate culture, they equally establish process safety culture… Much of that depends on how you [the leader] exercise Conduct of Operations and Operational Discipline.*

"Conduct of Operations" refers to how leaders specify clearly what needs to be done. This process starts with defining the policies and procedures of the PSMS and includes setting clear expectations that the work specified in these policies and procedures is carried out faithfully and professionally.

"Operational Discipline" refers to how everyone in the organization carries out their assigned roles. If leaders set clear expectations and verify that tasks are executed faithfully and professionally, the organization will follow; this dynamic is an essential part of a strong culture. As such, understanding the policies and procedures that MRC has established and how the RLT droves them has to be a key feature of a culture assessment.

Process Safety Leadership also summarizes the role of an organization's leaders in process safety:

> *…unless you also fulfil your role in the PSMS with professionalism and drive your leaders, peers, and reporting structure to do the same, you will not achieve results. Driving the PSMS includes:*
>
> - *developing and understanding corporate risk criteria;*
> - *understanding your hazards and implementing a fully functioning set of barriers required to meet your company risk criteria;*
> - *executing the elements of the PSMS with rigor and professionalism to measure barrier performance and ensure barriers remain effective;*
> - *ensuring that your organization has the required competencies in the right places; and*
> - *verifying performance and driving continual improvement.*
>
> *Only then will you be able to create the disciplined process safety culture you need to achieve the desired results - zero process safety incidents.*

This speaks to the rest of the process safety culture assessment process, which involves evaluating:

[9] CCPS, 2019 (see above)

- the risk targets set by leadership and the rigor with which leaders strive to meet those targets;
- the rigor and pace with which the refinery closes action items related to gaps in process and management that are identified through activities such as incident investigations, audits, and process hazard analyses (PHAs); and
- the way leaders rive continuous improvement aimed at eliminating process safety incidents of all kinds.

V. MRC's Culture Survey

As required by the Contra Costa County Industrial Safety Ordinance, CalARP, and CalOSHA, MRC conducts culture surveys every four years. These surveys are developed collaboratively by MRC leadership and site representatives of the United Steelworkers, the union that represents MRC's hourly workforce.

The most recent culture survey was conducted between November 2022 and March 2023. The refinery sent the most recent survey to all approximately 560 employees and 250 contractors,[10] and received 485 responses, a response rate of about 60%. Results were tabulated and documented in April 2023. Many of the questions on this survey had been asked in previous surveys, but several new questions were added. It should be noted that some of the survey questions pertained to occupational safety topics. MRC tabulated average scores for each question and, from there, identified high- and low-scoring areas – indications of stronger and weaker areas of process safety culture.

MRC based their analysis on weighted-average scores. That is, they summed all of the non-blank responses (i.e., those with scores between 1 [low] and 10 [high]) and divided by the number of non-zero and non-blank responses. On this basis, MRC concluded that overall, their safety culture had taken a slight step backwards compared to their last survey performed in 2018. In discussions with MRC personnel, we came to understand that much of this decline was related to the sale of MRC from Shell to PBF in February 2020 along with the changes in operations that were required due to the distancing requirements imposed during the COVID-19 pandemic (March 2020 to June 2022). We agree that these factors were likely relevant. during the COVID-19 period. COVID-era limitations were generally lifted in June 2022, only five months before this survey began in November 2022. By now, nearly two years later, we expect that improvement has been realized in these areas. We recommend that MRC continue to drive improvements in these areas through their GOAL ZERO initiative.

The first five entries in Table 1 (see next page) summarizes the feedback received for the five survey questions that MRC identified had the lowest average cultural scores. The question number is included for MRC's reference only. We were able to reproduce MRCs calculations and we concur that these five questions do represent the lowest scores based on average ratings.

[10] See https://martinezrefiningcompany.com/

Table 1: Survey results indicating improvement needed

Entry #	Question #	The question result indicated:
1	18a	Excessive pressure to get work done from peers/co-workers
2	16	Low awareness of GOAL ZERO rewards and incentives
3	56	Inadequate staffing to allow involvement in process safety work activities
4	37	Inadequate staffing to avoid employee fatigue
5	29	Challenges accessing Industrial Hygiene (IH) monitoring reports.
6	55	Procedures, drawings, etc. not being timely updated
7	40	Incentives that do not encourage reporting unsafe conditions
8	4	Excessive pressure to get job done from supervisor or manager
9	51a	Preventive maintenance not carried out on time
10	36	Refinery not doing more for safety and process safety
11	15a	Negative repercussions after using Stop Work Authority

Entries 1 and 4 are potentially linked to the findings of the independent investigation of the November, 2022 catalyst release incident and are notable because the culture survey was in progress when the incident occurred. Entries 2 and 3 are believed to have been linked to Covid-era changes in operations and limitations placed on interpersonal connections and the transition of ownership from Shell to PBF. Finally, entry 5 is an occupational safety measure and therefore out of scope of this assessment.

We find that six additional survey questions scored differentially lower than the rest. Entry 9 corresponds to a finding from this culture assessment and will be discussed further in section VI. Entries 8 and 11 are consistent with findings from the independent investigation of the November 2022 catalyst release incident. Entries 6, 7, and 10 are believed to have been linked to Covid-era factors. We should expect to see significant improvement in all of the questions potentially impacted by Covid-era limitations, and a recommendation related to this is made in Section VII.

Figure 1 shows all weighted average scores, ranked from highest to lowest. The five questions with the lowest scores are color-coded with red diagonal stripes, while the next six lowest scores are color coded with green horizontal stripes. Collectively, the responses to these 11 survey questions stood out from the bulk survey data. These questions all had average scores of 6.8-7.3 out of 10--not necessarily bad scores, but they do stand out as weaker areas of culture.

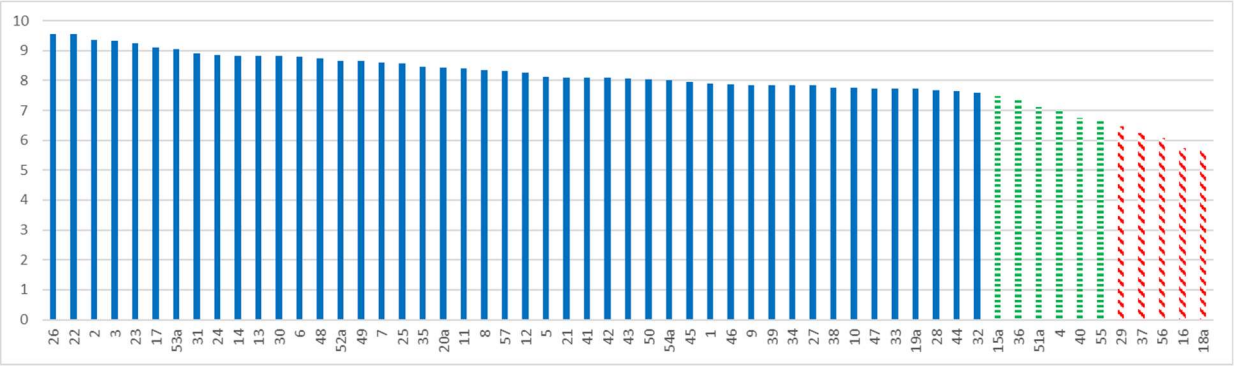

Figure 1: All weighted average culture survey scores, with next six lowest scores highlighted

The results of survey questions MRC identified as having the highest culture scores (greater than 9 out of 10) are summarized in Table 2.

Table 2: Significantly positive survey results

Entry #	Question #	The question result indicated:
1	26	HSE/Process Safety is everyone's responsibility
2	22	I take my HSE/Process Safety responsibility seriously
3	2	I have made sure every incident I'm aware of has been reported
4	3	I am encouraged to report incidents
5	23	I know my role in an emergency
6	17	I feel comfortable using stop-work authority
7	53a	I have not felt management pressure to bypass safety protocols

Entries 1 – 5 are consistent with positive findings from this culture assessment (see section VI). Entry 6 (comfort using stop-work authority) appears inconsistent with the independent investigation of the November 2022 catalyst release investigation, which found that work was not stopped or paused to reevaluate when appropriate. This may be related to a difference between the narrow California regulatory definition of Stop-Work Authority and the common, broader use of the term among process safety professionals. Additionally, our further analysis of MRC's culture survey data (see beginning on the next page) unveiled several questions that clarified that while workers felt comfortable using stop-work authority, some had experienced negative repercussions after having done so, and others felt pressure to get the job done from peers and management.

A focused discussion is presented in Section VI regarding entry 7 (bypassing safety protocols). Although our evaluations confirmed that MRC takes a rigorous approach to safety protocols related to Safety Integrity Layers (i.e. critical safeguards), we found that MRC's approach to deviating from Safe Operating Procedures should be more rigorous, especially in use of Manual modes of control when the Automatic of Cascade mode of control is called for. This concern was also identified in the independent investigation of the November 2022 catalyst release incident.

As Figure 1 shows, MRC found an average score of 8 out of 10 or greater for more than half of the survey questions. Indeed, an average score greater than 7.5 was given to all but the lowest-scoring questions. While this survey result appears to be positive, it is important to recognize a deficiency in using average scores when interpreting culture.

As described in Section IV, a strong process safety culture results from a metrics-focused drive, spearheaded by company and refinery leadership, to eliminate major (API Tier 1) and lesser (API Tier 2) incidents,[11] meet corporate risk criteria, and ensure the quality and execution of all PSMS elements. Therefore, in our evaluation, we sought to understand how the actions taken by MRC leadership and the policies, goals, and risk criteria that they implemented shaped the culture.

[11] API Recommended Practice 754, *Process Safety Performance Indicators for the Refining and Petrochemical Industries, 3rd edition*, 2021

In the strongest safety culture, survey scores should be uniformly high. That is, no segment of the workforce should give any question a low or mediocre rating or decline to respond to an appropriate question. With this in mind, we used a method called top-screening to analyze MRC's culture survey data. The top-screening method focuses only on positive responses. This approach differentiates survey questions with strengths in some parts of the refinery and weaknesses or "no responses" in others from those where there is strength across the refinery.

To understand how this works, consider a hypothetical survey consisting of two questions. Respondents answer each question with a rating from 1 to 10. The survey is sent to 10 individuals. For the first question, all the respondents gave a value of "8." For the second question, half of the respondents give an outstanding rating of "10" and the other half, a more mediocre rating of "6." By the weighted average approach (a common approach to data analysis), both questions received the same overall score, an average response of "8."

Using the top-screening method, however, we set a minimum score of "7" to be included in the overall calculation. We consider "7" a threshold positive score, and we consider any lower score to be either lukewarm or negative, including if the respondent chose not to answer. Next, we sum up only the scores that are equal to or greater than "7." For the first question, we sum all ten "8's" to obtain a total score of 80. For the second question, we neglect the five lukewarm responses of "6" and sum the remaining five scores to obtain a total score of only 50. This scoring method highlights the second question as an area where improvement should be given higher priority.

Figure 2 shows the results from applying the top-screening method to the MRC survey, using a rating of "7" as the cut-off figure.

Figure 2: Ranking of MRC Culture Survey Questions via the Top-Screen Method

The first thing that stands out, shown with black bars in the figure, is the difference in results between the two methods for question 42, "I often feel I am working in a safe refinery," and question 43, "I often have felt that we are working in a safe workplace." By the average score method, these questions rate an average of about 8 and are ranked close to other high-scoring questions. But when unfavorable or

blank responses are omitted, these two questions score well below the most favorable ones. Using the top screen method, we learn that although many employees felt that their workplace is safe, a notable number of workers felt otherwise.

The second thing that stands out is that there are 14 additional questions with scores quite close to the 11th – ranked question. Effectively, all of these questions are tied for 11th place, something not obvious from Figure 1. Table 3 summarizes the implication of all 25 questions starting with the lowest scoring.

Table 3: Lowest Survey results that indicate improvement opportunities, by the top-screening method

Entry #	Question #	The question result indicated:
1	18a	Pressure to get the job done from peers/coworkers
2	55	*Insufficient encouragement to participate in Process Hazard Analyses and Corrosion Control Document revalidations.*
3	16	*Low awareness of GOAL ZERO FOCUS rewards and incentives program*
4	29	Challenges accessing Industrial Hygiene (IH) monitoring reports
5	56	*Inadequate staffing to allow involvement in process safety work activities*
6	40	*Procedures, drawings, etc. not being timely updated*
7	37	*Inadequate staffing to avoid employee fatigue*
8	4	*Incentives that do not encourage reporting unsafe conditions*
9	51a	Excessive pressure to get the job done from supervisor or manager
10	32	Preventive Maintenance not carried out on time
11	33	Incident investigations and reports improving HSE-PS performance
12	15a	Negative repercussions after using Stop Work Authority.
13	28	*Lack of knowledge of where to obtain needed process safety information*
14	19a	Pressure to take shortcuts from peers
15	10	Incident reporting system doesn't provide sufficient information needed to earn from incidents
16	34	Incident investigations more focused on blame than identifying management system gaps
17	36	Lack of comfort to use Stop Work Authority within work group
18	46	*Process safety (and Health, Safety, and Environment) not given sufficient priority in decision-making*
19	9	*Incident reporting system doesn't provide details quickly enough to prevent future incidents*
20	39	Insufficient training after changes have been made
21	50	*Unresolved process safety (and Health, Safety, and Environment) issues allowed to continue*
22	38	Insufficient refresher training after changes have been made
23	47	Insufficient knowledge of actions to take during process upset or emergency
24	41	*Permitting process involving contractors not sufficiently effective*
25	54a	Pressure to take shortcuts from other work groups' supervisors/managers

As described above, entry #4 pertains to occupational safety and is therefore out of scope for this assessment. Additionally, the entries shown in italic are believed to be related to the change in ownership from Shell to PBF, immediately followed by Covid-era restrictions on interpersonal connections.

Entries 12 and 17 pertaining to Stop Work Authority are consistent with a finding from the independent investigation of the November 2022 catalyst release incident. It is likely that entries 1 and 9 pertaining to pressure to get the job done also factor into reluctance to use Stop Work Authority.

Entries 20 and 22 pertaining to training and refresher training may also be linked to a finding from the independent investigation of the November 2022 catalyst release incident. During our onsite interviews, we found that MRC provides extensive training to personnel. It is possible that this survey result is also linked to Covid-era limitations

Entry 23 pertaining to knowledge of what to do in a process upset or emergency seems somewhat surprising. During our onsite interviews, we found that MRC has a very mature emergency planning, management, and response effort (see section VI). It is possible that emergency training was another casualty of Covid-era limitations.

The remaining entries are tied directly to improvement opportunities identified in this assessment. As discussed in Section VI of this report, these opportunities are related to:

- Incident investigation (entries 11, 15, and 16);
- Policy for operating controls in manual, and other procedure deviations (entries 14 and 25); and
- Elevating portions of the asset integrity management system to match the excellent approach to managing pressure equipment and interlocks.

The abovementioned questions 42 and 43, which suggested that worker confidence that they were working in a safe refinery, would be highly likely to improve if the results for all of the questions that scored lower are improved. In addition to the 25 questions just discussed, there are an additional 10 questions that score below questions 42 and 43. Table 4 summarizes these additional questions.

Table 4: Additional improvement opportunities, by the top-screening method

Entry #	Question #	The question result indicated:
1	1	*Insufficient awareness of GOAL ZERO hazard reporting tool*
2	27	*GOAL ZERO sessions have not improved process safety performance*
3	5	*Low acceptance/implementation of safety suggestions*
4	45	*Insufficient HSE performance of contractors*
5	44	*A feeling that the refinery isn't doing more for process safety*
6	21	*Process safety and HSE programs weren't valued*
7	20a	Pressure to bypass safety protocols from peers/coworkers
8	35	*Insufficient awareness and knowledge of process safety by individuals*
9	8	Insufficient learning from past incidents at facilities other than MRC
10	52a	Pressure to take shortcuts from direct supervisors/managers

The entries shown in italic are believed to be related to the change in ownership from Shell to PBF, immediately followed by Covid-era restrictions on interpersonal connections. Entries 9 and 10 are related to findings from this assessment in the areas of incident investigation and procedure deviations respectively.

VI. Findings From Onsite evaluations

As discussed in Section IV, the process safety culture of a company and facility depends on the quality of the PSMS and the rigor by which leadership drives:

- execution of the PSMS; reducing risk towards a level considered generally acceptable; and
- company and sitewide focus on elimination of process safety incidents.

We evaluated the elements of MRC's PSMS and the culture generated by the execution of this management system by reviewing the company's policies, standards and procedures. We also conducted interviews with the management system element owners and with the individuals who perform the management system activities. Finally, we reviewed both records of completion of the management system tasks, as well as metrics and incident reports.

A. Positive Findings

We found that MRC has commendable performance in all three of the high-level areas listed above. Examples of a strong process safety culture driven by the Refinery Leadership Team (RLT) and other refinery leadership include:

1. The RLT sets objectives with a regular cadence of management system reviews and monitors and acts on key metrics and investigation findings.

2. The RLT demonstrates their commitment to GOAL ZERO[12] which aims to drive:

> *"A culture where people deeply care about each other and our community. It is a personal and organizational commitment to be intolerant of injury, leaks or incidents that can impact our workers and the environment."* [Note: This program is being leveraged to the other refineries of the PBF Energy group].

3. MRC has many robust managements system elements in place, conducted with a high degree of efficacy, that are critically important to driving good process safety performance and the desired culture. Examples include:

- Pressure Equipment Integrity Program: The integrity processes defined by Recognized and Generally Accepted Good Engineering Practices (RAGAGEP) to ensure pressure equipment is designed, installed, operated, and maintained to be "fit for service". Note: MRC has been an active contributor to some of these RAGAGEP standards and has helped the industry improve in the areas of recognizing different types of failures on piping systems.

[12] See https://martinezrefiningcompany.com/safety-culture/.

- Interlock Integrity Program: The integrity processes defined by RAGAGEP to ensure safety interlocks[13] are designed, installed, and maintained to be "fit for service".
- Process Hazard Assessment Processes and the use of MRC Risk Matrix: The process that MRC uses to identify and ensure implementation of the adequate number of sufficiently robust protection layers to meet the corporate risk criteria. This process exceeds regulatory requirements, defining situations where a greater number of protection layer can be implemented to mitigate risk. MRC has driven implementation of protection layers to put the facility in the broadly acceptable risk zone.
- Emergency Preparation and Response Capabilities: MRC's overall approach to emergency management includes (1) planning for possible emergencies, (2) providing resources to execute the plan, (3) practicing and continuously improving the plan, (4) training or informing employees, contractors, neighbors, and local authorities on what to do, how they will be notified, and how to report an emergency, and (5) effectively communicating with stakeholders in the event an incident does occur.
- Operating procedure development and procedure format: Operating procedures are written instructions that (1) list the steps for a given task and (2) describe the manner in which the steps are to be performed. Good procedures also describe the process, hazards, tools, protective equipment, and controls in sufficient detail that operators understand the hazards, can verify that controls are in place, and can confirm that the process responds in an expected manner. MRC's procedure development process is generally strong.
- Shift turnover and relief process: MRC uses a formalized process for shift turnover to ensure seamless communication, continuity, and awareness of safety-critical information and activities during transitions between shifts. Organizations that adhere to these principles can reduce the risk of incidents, enhance operational continuity, and foster a safety-conscious environment among personnel.

We believe that MRC's strong performance in these areas can serve as a good foundation for areas where MRC performs less well.

B. Opportunities to Improve

We have broken MRC's improvement opportunities into two groups. The first group includes high priority items that directly relate to and are highly leverageable to preventing future incidents. The second group includes continuous improvement opportunities.

High priority improvement opportunities

1. The MRC incident investigation process is not designed to be effective in preventing future incidents. There are two areas of improvement:
   - MRC's incident investigation does not properly define management system failures as root causes. Several of the investigations we reviewed (including MRC's November 2022 catalyst

[13] Devices such as switches that prevent a piece of equipment from operating when a hazard exists. See Glossary.

release incident) stopped at the direct cause for the failure, for example, operator error or equipment failure, without identifying the management systems that led to those error or failures. Speaking about the notion that operator error and equipment cause incidents, process safety pioneer Trevor Kletz said:

This is true in a sense. But it's not very helpful. It's a bit like saying "Falls are caused by gravity."

Correcting a human or mechanical failure may prevent that particular incident from happening again, but correcting a management system gap or failure prevents all of the incidents that the gap or failure could lead to. As described in the CCPS incident investigation guideline:

"Correcting only a causal factor is a simplistic approach that may prevent the identical incident from occurring again at the same location, but will not prevent similar incidents. Identifying and correcting the root causes should eliminate or substantially reduce the likelihood of recurrence of the incident and other similar incidents at the location. More importantly, the new knowledge and corrective methods resulting from the investigation may be shared for use throughout a company and possibly apply to an industry as a whole".[14]

- The process that MRC currently uses does not include a repetitive incident analysis of incident root causes. This analysis should be conducted as part of any incident investigation to help determine the scope of the corrective actions. This answers the question: should the corrective actions be exclusive to the specific equipment/situation, extended to the entire refinery unit, or applied across the entire refinery or company? We did observe one example where corrective measures from an investigation were applied across the entire refinery, and this should be done in all cases. As CCPS explains:

  "A thorough incident investigation identifies and addresses all of the causes of an incident, including the root causes. It also provides the mechanism for understanding the interaction and impact of management system failures. This analysis provides the means for fully addressing the incident, similar incidents, and even dissimilar incidents caused by the same root causes, throughout the facility, company, and industry. Addressing management system failures is the ultimate goal, yielding the maximum benefit from an incident investigation."[15]

  By revamping the investigation process to ensure all incident root causes are identified and fixed at the correct level within the company, MRC will be able to eliminate repeat incidents. By becoming a learning organization, MRC can accelerate progress towards eliminating Tier 1 and 2 Process Safety Events and High Potential Tier 3 Process Safety Events.

2. <u>The MRC PSMS does not address Process Control Systems "mode of control"</u>: In a refinery, many pieces of machinery are controlled by computers. Typical modes of computerized process

[14] CCPS, *Guidelines for Investigating Process Safety Incidents*, *3rd Edition*, AIChE/Wiley 2019
[15] Ibid

control include automatic, manual, and cascade modes. Automatic and cascade are the preferred modes of control. In these modes, the computer is monitoring process parameters on a continuous basis and controlling the process to pre-determined set points. Manual control is where the control loop is taken out of automatic or cascade control and the operator monitors the process and makes manual adjustments to the process to achieve the same predetermined control strategy. Manual mode is typically used to correct unusual process upsets that the computer cannot respond to adequately. The independent investigation of the November 24-25, 2022, incident determined that switching to manual mode, without close monitoring of the process as one of the root causes. As described in CCPS' safe automation guidelines:

> *There have been many high-profile Process Safety Incidents having process control systems in manual, e.g., March 2005 BP Texas City Explosion. Based on the authors' experience and interactions with chemical and refining company's process safety professionals, it is common for leading companies to establish rigorous processes to manage the risk from changes of mode of process control. This is important because: "Operator actions are subject to errors. These errors may be more likely than the dangerous failure of the automated equipment. When things go wrong, the operator may become overwhelmed and be unable to respond timely."* [16]

The improvement opportunity for MRC is to define a clear, time-bound Modes of Control policy with criteria for operating in manual. After operators gain immediate control of the situation that prompted putting the control system in manual, criteria should include the following:

- Assessment of the risk of continued operation in manual.
- Time triggers for performing this assessment (e.g., operating in manual for more than a specified length of time).
- When and how approval is obtained for continued manual operations.
- Documented plan for monitoring and controlling the process in manual.
- Contingency plan with action if the process exceeds operating limits defined by process safety alarms indicated in risk assessments.
- Plan for resolution to get the process control back in Automatic or Cascade mode.
- System allowing the RLT to monitor and enforce this policy

<u>Continuous improvement opportunities</u>

3. A review of recommendations/action items from process safety audits found action items related to updates to or development of procedures with an unreasonable amount of time to close these actions. We understand that MRC may have specified the timing for consistency with applicable regulatory requirements. Logically, however, procedural action items should be closed prior to the next use of the procedure. While the facility may be in legal compliance for closure of action items, a good process safety culture always drives procedures to be current and accurate, giving personnel the greatest chance of success in carrying out work

[16] CCPS, *Guidelines for Safe Automation of Chemical Processes, 2nd Edition, page 104, AIChE/Wiley,* 2016

activities. Additionally, procedures that aren't current and accurate can be one reason an operator may feel the need to put controls in Manual.

4. Interviews with leadership indicates that the asset integrity processes for electrical and rotating equipment integrity are being "revitalized." There is an opportunity to leverage the strong, positive approach the RLT uses for monitoring the pressure equipment integrity and interlock integrity programs performance to achieve similar performance for other asset integrity processes. This should include communication with the RLT when metrics show needed improvement or that assistance from the RLT is needed in focusing the organization on these activities or overcoming roadblocks.

5. Many of the less favorable survey responses appear to have been linked to restrictions imposed between March 2020 and June 2022 due to the COVID-19 pandemic. Distancing requirements made it difficult for leaders and workers to engage directly with each other while focusing work efforts on the most basic individual tasks. Also, the implementation of COVID restrictions coincided with sale of the refinery by Shell to PBF, making it more difficult to address worker concerns related to the transition. The MRC culture survey identified these factors as reasons why culture scores had regressed compared to the prior culture survey. Based on our interviews with employees and leadership, we understand that engagement has improved significantly in the last one + years since the 2023 culture survey, but this was not directly measured. The Contra Costa ISO, CalARP, and CalOSHA require performing the culture survey every four years. However, since engagement is so critical to MRC's GOAL ZERO, we believe it is important for MRC to confirm the general impression that this dimension of culture has improved.

VII. Recommendations

Except as noted, these recommendations and the timing for their resolution have been discussed with MRC to ensure that the management systems have been specified accurately and that the action and timing are reasonable and achievable.

A. Improve the process of incident investigation:

1. Upgrade the incident and high potential near-miss investigation processes used by MRC to ensure that investigations do not stop with human errors and equipment failures, and instead continue on to identify gaps and weaknesses in the relevant PSMS elements (i.e., Root Causes).

2. Train MRC investigators based on the improved incident and near-miss investigation approach and ensure that that investigation teams can begin using the new approach as of the completion date below.

3. Establish a program of repetitive incident analysis that evaluates completed incident investigations to specifically identify <u>all</u> barrier failures, their direct causes, and each barrier failure root cause (management system failure). From there, identify all barrier failure causes

and their root causes that have been seen historically in other incidents in the refinery so that appropriate corrective measures to the management system can be implemented.

Timing: We recommend that items A.1 and A.2 are complete by August 31, 2024. We recommend that the program of item A.3 should begin August 31, 2024, with retroactive analysis of the past ten years of investigations completed by August 31, 2025. MRC agrees with the scope of this recommendation but has asked for time to evaluate whether the timing can be met, to be determined in time for Draft 2 of this report.

B. Establish and enforce clear expectations for operation of the process control system in manual mode and other deviations from procedures.

1. Establish a new procedure (or modify an existing one) that sets clear limits (situational and time) on changing the control mode of one or more process control loops from automatic to manual control mode or from cascade to either automatic or manual control mode such that if these limits are to be exceeded, there will be a professional review and approval of the deviation, and if appropriate, referral to the Temporary Management of Change process.

2. Additionally, expand the above-recommended procedure (or other relevant procedures) to include all procedure deviations. If there is a need to deviate from procedures, the procedure should require a professional review and approval of the deviation and, if appropriate, referral to the Emergency, Temporary, or Permanent Management of Change process.

3. Establish metrics and tracking system for these deviations and include reviews in regular RLT cadence of reviews.

Timing: Complete development and roll-out by December 31, 2024.

C. Set appropriate completion dates for audit action items related to procedures.

1. Establish due dates for action items requiring material changes to procedures to ensure that such changes are implemented before the next use. It is understood that the regulatorily-defined due date is commonly 18-months, and it may be necessary to have an internal due date as well as a regulatory due date associated with the action item.

2. Immediately resolve any existing material action items with a due date extending beyond one month after the above change.

Timing: Change policy by July 31, 2024; resolve then-pending action items before next use of the relevant procedure.

D. Ensure that oversight is provided of all Inspection, Testing, and Preventive Maintenance (ITPM) asset integrity items not currently overseen by the RLT.

1. Establish appropriate leading metrics for asset integrity items not currently overseen by the RLT, for example, electrical equipment and rotating equipment.

2. Establish a process by which an appropriate functional leader tracks performance and either corrects issues or escalates them to RLT for resolution.

Timing: Complete December 31, 2024.

E. Conduct the next culture survey ahead of schedule.

1. In order to confirm that survey impacts attributed to COVID-era limitations have been resolved, include these items in the next state and ISO-required interim culture assessment.

Timing: Complete September 30, 2025.

Appendix A. Process Safety Culture Team Makeup

The independent investigation team included Scott Berger, President of Scott Berger and Associates, LLC, as project manager, working with Kenan Stevick, President of KPS Process Safety, Inc., (under subcontract) as study leader.

Scott Berger, CCPSC has forty-five years of experience in process safety, environment, health, and safety (EHS) management, chemical engineering, chemical manufacturing, process engineering, and human factors. From 2001 to 2015 he served as Executive Director of CCPS. Since 2015 he has worked as a consultant in process safety, focusing on process safety leadership, process safety management systems, training for basic process safety competency, incident investigation, and litigation support. He is the co-author of three books on process safety for the Center for Chemical Process Safety (CCPS), *Driving Process Safety Improvement from Investigated Incidents (2021), Process Safety Leadership from the Boardroom to the Frontline* (2019) (with Kenan Stevick), and *Essential Practices for Creating, Strengthening, and Sustaining Process Safety Culture* (2018).

Berger is a CCPS-certified process safety professional (CCPSC), a Fellow of the American Institute of Chemical Engineers, and a Fellow of the Center for Chemical Process Safety.

Kenan Stevick has 42 years of chemical industry experience in process safety, manufacturing, project management and EHS management. Since 2016 he has worked as a consultant in process safety with a focus on process safety governance and leadership, process safety management systems, improving process safety performance, training for basic process safety competency, incident investigation, and litigation support. During this period, he co-authored (with Scott Berger) the Center for Chemical Process Safety (CCPS) book *Process Safety Leadership from the Boardroom to the Frontline* (With Scott Berger).

From 1981 to 2015, Kenan worked for the Dow Chemical company. From 2010 to 2015 he served as the Chief Process Safety Engineer and Global Director of Process Safety. In this role, he worked closely with Dow senior executives and the Board of Directors to lead Dow's process safety improvement efforts. During this time Dow improved their Tier 1 and Tier 2 Process Safety Incident rate performance by approximately 85%.

Stevick's earlier career involved assignments leading Dow's process safety, reactive chemicals, mechanical integrity, and dust explosion prevention competencies, managing medium-sized manufacturing facilities, managing EHS for a large business unit, and a range of engineering and supervisory positions in manufacturing.

He holds a BSChE from Michigan Technological University and has been recognized as a CCPS Fellow.

Appendix B. Glossary of Terms and Acronyms

Term	Definition
AIChE	American Institute of Chemical Engineers.
API	American Petroleum Institute; a trade and standards organization supporting the petroleum industry.
Asset integrity Management System	A management system for ensuring the integrity of all equipment and piping throughout their lifecycles so that they will perform their intended function.
Automatic (Auto)	A control mode where a component (e.g., a valve) is automatically adjusted to maintain a process parameter (e.g., a level) at a set value.
CalARP	California Accidental Release Program. A regulation of the state Environmental Protection Agency that aims to prevent accidental release of extremely hazardous materials. Please see https://calepa.ca.gov/california-accidental-release-prevention.
Cal/OSHA PSM	Regulations of the California Division of Occupational Safety and Health, Process Safety Management (PSM) unit. State regulations aimed at preventing catastrophic explosions, fires, and releases of dangerous chemicals. Please see https://www.dir.ca.gov/dosh/psm-unit.html.
Cascade	A control mode in which a controller set point is obtained based on some other process variable or condition.
CCHHMP	Contra Costa Health Hazards Materials Programs.
CCPS	Center for Chemical Process Safety, a global technical organization operated by AIChE that supports the petroleum, chemical, and related industries with guidance and training for managing process safety.
CCU	Catalytic Cracking Unit, a grouping of refinery equipment that converts (cracks) high molecular weight hydrocarbons into hydrocarbons with lower molecular weight.
Conduct of Operations	An element of the Process Safety Management System described in CCPS, *Guidelines for Risk Based Process Safety*, AIChE/Wiley(2007). How leaders define the policies and procedures of the process safety management system and then ensure they are carried out faithfully and professionally.
CWS	Community Warning System, an all-hazards community notification system of Contra Costa County intended to alert residents about any potential health hazards and emergencies that may be occurring.
GOAL ZERO	An MRC program aimed at maintaining a culture in which employees and contractors deeply care about each other, working safely, the environment, and refinery neighbors in order to prevent all injuries, incidents, and

Term	Definition
	community impacts. See https://martinezrefiningcompany.com/safety-culture/.
Human factors	The way that people interact with equipment, controls, and their work environment.
Incident investigation	A systematic process to determine the root causes of an incident and develop recommendations that address these causes to help prevent or mitigate future incidents.
Interlock	A protective response initiated by an out-of-limit process condition. For example, a device or software that will not allow one piece of equipment to function unless another part is functioning; or a switch that prevents a piece of equipment from functioning when a hazard exists.
ITPM	Inspection, testing, and preventive maintenance, that is, tasks associated with the refinery asset integrity management system,
ISO	The Industrial Safety Ordinance of Contra Costa County.
Management system	Policies, procedures, and standards that describe how specific functions are to be carried out, how performance is verified, and how performance is improved.
Manual	A control mode in which control devices (e.g., valves) respond only to operator input.
MCAR	Major Chemical Accident or Release, as defined by CCHHMP.
Mechanical integrity	See asset integrity.
MRC	Martinez Refining Company, a unit of PBF Energy.
Operating procedures	Written, step-by-step instructions and information necessary to operate equipment, compiled in one document that includes operating instructions, process descriptions, operating limits, chemical hazards, and safety equipment requirements.
Operational discipline	The way each person in the organization carries out their assigned roles faithfully and professionally. Both a driver and a result of good Conduct of Operations.
Operator	An individual who is trained and qualified to operate a process or some portion of a process.
PHA	Process Hazard Analysis, a study in which process hazards are identified and a wide range of deviation scenarios are analyzed to determine if the unit's safeguards are adequate.
PSMS	Process Safety Management System. Policies, procedures, and standards that describe how specific process safety functions are to be carried out, how performance is to be verified, and how performance is to be improved.

Term	Definition
RAGAGEP	Recognized and Generally Accepted Good Engineering Practices. See https://www.aiche.org/ccps/resources/glossary.
RLT	MRC's Refinery Leadership Team.
Root causes	Gaps in Process Safety Management Systems, including human factors.
Safety Integrity Layers	Critical interlocks, relief devices, and other layers of protection that facilities rely on to reduce risk and meet risk criteria.
SMART	Recommendations that are Specific, Measurable, Aligned, Realistic, and Time-bound.
Tier 1, Tier 2	Classification of process safety incidents based on their severity, according to API Recommended Practice 754. Tier 1 incidents are of the greatest severity with regard to impacts to people, the community, the environment, and process facilities. Tier 2 incidents are of lower severity.

Appendix C: Resolution of MRC Oversight Committee Comments

[Pending version 2 of the report]

Appendix D: Responses to Community Comments

[Pending version 2 of the report]