Contents

1.0 INTRODUCTION

1.1 Purpose

The purpose of this procedure is to outline the requirements to ensure compliance with:

A. 29 CFR 1910.119 paragraph (e) Process Hazard Analysis (PHA) of the OSHA Process Safety Management (PSM) regulation, Washington Administrative Code (WAC) 296-67 Process Hazard Analysis,

B. 40 CFR 68.67, the PHA requirements of the EPA Risk Management Program (RMP) rule, and

C. PSM-1070 Marathon Petroleum Company LP (MPC) Process Safety Management Standard.

D. RSP-1303, PSM/RMP Process Hazards Analysis

Conducting a PHA program per these guidelines will enable refinery personnel to effectively identify, evaluate, and control hazards which have the potential to affect personnel, property, or the environment.

1.2 Scope

This procedure establishes minimum requirements for conducting Process Hazard Analyses (PHA) at the Marathon Anacortes Refinery which meet the applicability standards as defined in OSHA PSM and EPA RMP regulations, and MPC policy PSM-1070.

This procedure applies to all initial (for new units) and revalidation PHAs (for existing units) as required by the OSHA PSM and EPA RMP regulations. It also applies to hazard reviews performed as a part of management of change, where the checklist evaluation from Appendix C in RSP-1307 identifies that the change is complex and requires a HAZOP. Hazard reviews for simple and intermediate changes performed as part of Management of Change (MOC) are detailed in Refining Standard Practice RSP-1307 "Management of change and Pre-Startup Safety Review" and are not part of the scope of this procedure.

This procedure is intended to be used in conjunction with the Anacortes Refinery PHA guidelines. This procedure is an overview of the PHA requirements and the detailed information for full compliance with RSP-1303 is found in these guidelines. The following sections of the PHA guidelines can be accessed from the PSM SharePoint library.

2.0 REFERENCES

2.1 Marathon Standards, Policies & Procedures

- GEN-1010, Risk Calibration Standard
- PSM-1070, Process Safety Management Standard
- PSM-5008, EPA Risk Management Plan
- RSP-1130-000, Emergency Eyewash and Shower Equipment Evaluation
- RSP-1131-000, Pressure Protection and Disposal
- RSP-1171-010, Emergency Isolation Valves (EIV)

- RSP-1172-020, Safety Instrumented Systems
- RSP-1173-010, DCS Alarm Management
- RSP-1300-015, PSM-Related Recommendation Management
- RSP-1301, PSM/RMP Employee Participation
- RSP-1302, PSM/RMP Process Safety Information (PSI)
- RSP-1303, PSM/RMP Process Hazards Analysis
- RSP-1307, PSM/RMP Management of Change and Pre-Startup Safety Review
- RSP-1308, PSM/RMP Mechanical Integrity
- RSP-1310, PSM/RMP Incident Investigation
- RSP-1314, PSM/RMP Building Siting
- RSP-1315-000, Layer of Protection Analysis (LOPA)
- RRD-1190-070, Materials Review for PHA Hydroprocessing Units
- RRD-1190-071, Materials Review for PHA Amine Treating Unit
- RRD-1190-072, Materials Review for PHA Catalytic Reformer
- RRD-1190-073, Materials Review for PHA CDU & VDU
- RRD-1190-074, Materials Review for PHA Delayed Coker Unit
- RRD-1190-075, Materials Review for PHA Fluid Catalytic Cracking and Light Ends Recovery
- RRD-1190-076, Materials Review for PHA Hydrofluoric Acid Alkylation
- RRD-1190-077, Materials Review for PHA SRU and TGU
- RRD-1190-078, Materials Review for PHA Sulfuric Acid Alkylation
- RRD-1190-200, Corrosion and Materials Diagram (CMD) Guidelines
- RRD-1190-201, Integrity Operating Window (IOW) and Corrosion Control Document (CCD) Guidelines
- RRD-1303-001, Instructions for Using the PHA Pro HAZOP Template
- RRD-1301-010, PHA Assessment Guide for HF Alkylation Units
- RRD-1303-011, PHA Assessment Guide for Delayed Coker Units
- RRD-1303-012, PHA Assessment Guide for Rose/SDA Units
- RRD-1303-014, PHA Assessment Guide for Isomerization Units
- RRD-1303-018, PHA Assessment Guide for Fuel Gas Systems
- RRD-1303-019, PHA Assessment Guide for Crude/Vacuum Units
- RRD-1303-021, PHA Assessment Guide for the GBR Toluene Disproportionation Unit
- RRD-1303-022, PHA Assessment Guide for Aromatic Extraction or Sulfolane Process

2.2 Government Regulations

- EPA 40 CFR 68.67, PHA requirements of the EPA Risk Management Program (RMP) rule
- EPA 555-B-04-001, EPA General Guidance on Risk Management Programs for Chemical Accident Prevention; March 2009
- OSHA 29 CFR 1910.119 Section (e), Process Hazard Analysis (PHA) of the OSHA Process Safety Management (PSM) regulation
- OSHA Instruction CPL 2-2.45A CH-1 9/94, OSHA Compliance Directive for PSM, dated September 13, 1994
- OSHA Instruction CPL-03-00-021, PSM Covered Chemical Facilities National Emphasis Program
- OSHA 3132, 2000 (Reprinted), Process Safety Management
- OSHA 3133, 1994 (Reprinted), Process Safety Management Guidelines for Compliance
- OSHA Standard Interpretations (2/1/2005), Documentation methods used to comply with the qualitative evaluation of a range of possible safety/health effects of "failure of controls" requirement of the PSM standard.
- OSHA Standard Interpretations (11/19/2001), Process hazard analysis facilitator's training requirements
- OSHA Standard Interpretations (01/22/1998), Steps for updating and revalidating a Process Hazard Analysis (PHA)
- Washington administrative code § 296-67-017, Process Hazard Analysis

2.3 Industry Standards

American Petroleum Institute (API)

- API RP 581, Risk-Based Inspection Methodology

Center for Chemical process Safety

- Center for Chemical Process Safety, Guidelines for Hazard Evaluation Procedures, American Institute for Chemical Engineers
- Center for Chemical Process Safety, Guidelines for Risk Based Process Safety, American Institute for Chemical Engineers
- Center for Chemical Process Safety, Revalidating Process Hazard Analyses, American Institute of Chemical Engineers

3.0 OSHA (PSM)/EPA (RMP) REFERENCES

Italicized text throughout this document indicates:

OSHA (PSM)/EPA (RMP) language [brackets indicate where EPA (RMP) language differs from OSHA (PSM) language]:

4.0 ROLES & RESPONSIBILITIES

4.1 Corporate Management

Following are the responsibilities of Corporate Management.

A. Communicates information that may impact the application of the PHA process, or policy scope.

B. Provides a periodic review of the PHA policy and coordinating revisions as necessary.

4.2 Refining Organization Management

Following are the responsibilities of the Refining Organization Management.

A. Establishes and updates the policy for the standard application of various PHA methodologies throughout Refining.

B. Implements, supports, and ensures compliance with the PHA policy.

C. Provides the necessary resources to effectively implement the PHA policy.

D. Maintains PHA Pro Template and Library.

E. Maintains RRD-1190-XXX for Materials Review.

F. Develops and maintains RRD-1303-XXX PHA Assessment Guides.

4.3 Refinery Site Management

Following are the responsibilities of the Refinery Site Management.

A. Ensures the PHA policy is implemented.

B. Dedicates resources necessary to conduct, review and approve PHAs that meet the requirements outlined in the policy.

C. Approves PHA recommendations and associated action plans are implemented on schedule.

D. Ensures that communication of recommendation status to affected personnel occurs.

4.4 Technical Service Managers

Following are the responsibilities of the Technical Service Managers.

A. Provides managerial oversight for the PHA element.

B. Maintains a working knowledge of the OSHA PHA element and RMP requirements, Corporate and Refining PSM standards/policies, and local site plans.

C. Reviews and approves the local PHA element site plan.

D. Addresses problems with the PHA standard and/or site plan identified during other PSM activities (audits, incident investigations, regulatory inspections, etc.).

E. Identifies roles and delegates responsibilities to ensure the PHA element components are effectively managed.

F. Reviews and approves the PHA study scope, methodology and team selection as proposed by the PHA Coordinator prior to the start of the study. The approval is

documented using the form in the corporate PHA standard RSP-1303 or a similar document.

G. Reviews and approves the PHA report.

H. Assures continuous improvement in the PHA element through metrics and management reviews.

I. Communicates PHA element issues and policy/standard practice changes with the Refinery Site Management and appropriate stakeholders at the site and within MPC .

4.5 Area Team Lead

Following are the responsibilities of the Area Team Lead.

A. Reviews the PHA recommendations before they are presented to refinery management.

4.6 PHA Coordinator

Following are the responsibilities of the PSM/PHA Coordinator.

A. Revises (with employee participation) the local PHA element site plan to maintain compliance with the relevant standards/policies.

B. Determines and documents a priority order for conducting PHAs and maintains a five-year rolling schedule for completing the PHAs.

C. Determines scope, methodology and format and identifies team members and facilitator for each study for approval by the Technical Service Manager.

D. Informs the appropriate Refining Process Technologists of upcoming PHAs and schedules the Process Technologist Kick-off Presentation.

E. Ensures that the minimum level of PSI, operating procedures, incident reports, and other pertinent information is available to the PHA team prior to the start of the PHA.

F. Serves as the main point of contact for any PHA study related communications.

G. Provides the facilitator necessary information, as well as the PHA Pro Template and Library prior to the start of the PHA meeting and ensures the facilitator and scribe are knowledgeable in the use of the template.

H. Ensures that training is provided to the PHA team at the beginning of the PHA.

I. Responsible for oversight of in-progress PHA studies and for day-to-day interface with the PHA facilitator to ensure compliance with local and MPC standards, and to drive consistency.

J. Reviews recommendations and involves appropriate technical resources in the review, ensures that the recommendations are presented to refinery site management.

K. Ensures that the final PHA report is generated, approved, issued, and archived.

L. Ensures that the PHA recommendations are entered into the tracking system. Periodically reviews the status of PHA recommendations and associated corrective actions and informs Refinery Site Management accordingly.

M. Tracks PHA metrics periodically.

4.7 PHA Facilitator

Following are the responsibilities of the PHA Facilitator.

A. Provides direction and administers the selected PHA methodology per MPC and site standards.

B. Executes all aspects of the PHA team meetings, ensures that appropriate resources are assembled, facilitates team meetings, remains impartial in the evaluation, and ensures proper documentation of team discussions.

C. Prepares the PHA report and list of recommendations.

4.8 PHA Team Members

Following are the responsibilities of the PHA Team Members.

A. Become familiar with the selected PHA methodology, generally through instruction at the beginning of the PHA.

B. Participate actively in discussion and contribute to identifying and evaluating hazards.

C. Provide experience and knowledge in various aspects of the design, operation and maintenance of the process being evaluated.

4.9 Technologist

Following are the responsibilities of the Process Technologist:

A. Maintains the PHA Assessment Guide (RRD-1303-XXX) for their technology which provides guidance on typical hazards for the unit and includes information on previous industry and MPC incidents. When a PHA Assessment Guide is not available for the unit, the process technologist shall provide a list of incidents for discussion by the PHA Team prior to the study.

B. During the kickoff of the unit PHA, the Process Technologist provides a brief overview of the process unit operation and key safety-related operational characteristics of the unit. Also included in the kick-off, the Technologist should share knowledge and expertise on inherent hazards of the process and review incidents at similar process units across MPC and the refining industry. If several units are reviewed in one PHA study, each unit must be covered during the introductory training.

C. Reviews the PHA team recommendations before they are presented to refinery management and provides expertise on the substance and feasibility of those recommendations.

D. After the PHA, the technologist should review PHA findings for any issues which may be relevant across Refining and, if necessary, develop recommendations for any findings appropriate for sharing at other sites and notify the Refining PHA Coordinator to disperse and track the recommendations. Where appropriate, the technologist should also update the PHA Assessment Guide with these findings.

5.0 PHA SCHEDULE

5.1 Regulatory Requirement for PHA Scheduling

(1)[a] The employer [owner or operator] shall perform an initial process hazard analysis (hazard evaluation) on processes covered by this standard [part]. The process hazard analysis shall be appropriate to the complexity of the process and shall identify, evaluate, and control the hazards involved in the process. Employers [The owner or operator] shall determine and document the priority order for conducting process hazard analyses based on a rationale which includes such considerations as extent of the process hazards, number of potentially affected employees, age of the process, and operating history of the process. The process hazard analysis shall be conducted as soon as possible, but not later than [June 21, 1999] the following schedule:
(i) No less than 25 percent of the initial process hazards analyses shall be completed by May 26, 1994.
(ii) No less than 50 percent of the initial process hazards analyses shall be completed by May 26, 1995.
(iii) No less than 75 percent of the initial process hazards analyses shall be completed by May 26, 1996.
(iv) All initial process hazards analyses shall be completed by May 26, 1997.
(v) Process hazards analyses completed after May 26, 1987, which meet the requirements of this paragraph are acceptable as initial process hazards analyses. These process hazard analyses shall be updated and revalidated, based on their completion date, in accordance with paragraph (e)(6) of this section.
[Process hazard analyses completed to comply with 29 CFR 1910.119(e) are acceptable as initial process hazard analyses. These process hazard analyses shall be updated and revalidated based on their completion date.]

5.2 PHA Schedule Requirements

The Marathon Anacortes Refinery, being a PSM/RMP regulated facility and/or process unit shall:

A. Develop a system to document the facility PHA schedule to ensure that revalidation analyses are completed before the five-year interval established by the prior PHA completion date. The completion date for a PHA is considered as the date of the last team meeting prior to presenting the recommendations to Refinery Site Management
B. Ensure PHAs for newly constructed facilities or process units are completed and recommendations are addressed prior to start-up. Also see refer to RSP-1303 for timing of PHAs on projects recommendations.

NOTE: Refer to Master-PHA-Schedule for the site PHA schedule located on the PSM SharePoint, on the PHA page

6.0 PHA OBJECTIVE ANALYSIS

(3)[c] The process hazard analysis shall address:

(i)[1] The hazards of the process.

(ii)[2] The identification of any previous incident which had a likely potential for catastrophic consequences in the workplace ["in the workplace" is omitted in RMP rule language];

(iii)[3] Engineering and administrative controls applicable to the hazards and their interrelationships such as appropriate application of detection methodologies to provide early warning of releases. (Acceptable detection methods might include process monitoring and control instrumentation with alarms, and detection hardware such as hydrocarbon sensors.);

(iv)[4] Consequences of failure of engineering and administrative controls;

(v)[5] Facility [stationary source] siting;

(vi)[6] Human factors; and

(vii)[7] A qualitative evaluation of a range of the possible safety and health effects of failure of controls on employees in the workplace ["on employees in the workplace" is omitted in RMP rule language]

6.1 PHA Description

A Process Hazard Analysis (PHA) is a key element of the Process Safety Management and Risk Management programs.

Definition: A PHA is an organized and systematic effort to identify and analyze the significance of hazards associated with the processing or handling of highly hazardous chemicals. A PHA provides information which will assist in making decisions for improving safety and reducing the consequences of unwanted or unplanned releases of hazardous chemicals. A PHA is directed toward analyzing potential causes and consequences of fires, explosions, releases of toxic or flammable chemicals and major spills of hazardous chemicals.

NOTE: The PHA focuses on equipment, instrumentation, utilities, human actions (routine and non-routine), and external factors that might impact the process. These considerations assist in determining the hazards and potential failure points or failure modes in a process.

6.2 Consideration for PHA Team

The PHA team must carefully evaluate applicable modes of operation. In many cases, risk of a catastrophic event is much greater during startup, shutdown, emergency events, upset conditions, maintenance activities, or other non-routine operations as compared to routine operation.

6.3 Consequences of Interest

During the PHA process, the PHA team identifies process safety concerns related to consequences of interest. Where existing safeguards against consequences of interest are not considered by the team to be adequate, a recommendation must be developed.

NOTE: Consequence and frequency of risk and risk tolerance as defined in the risk calibration standard (GEN-1010) is the guidance that the PHA team utilizes, including the risk matrix associated with the standard.

Consequences of Interest are events (e.g., flammable/toxic material releases, fires, and explosions; or a utility loss of containment) that could present serious dangers to workers or imminent and substantial endangerment to public health and the environment.

Consequences typically not considered for analysis under this section include:

A. Worker safety consequences (i.e., industrial safety and health concerns) not related to a release of flammable/toxic material, fire, or explosion.

B. Routine occupational hazards (e.g., employee slips or fall, or ergonomic issues),

C. Less significant environmental effects (e.g., small reportable spills or exceedance of an environmental permit), or

D. Operability problems that could lead to economic consequences (e.g., equipment damage without loss of primary containment, shutdowns, business interruptions, off-specification product, etc.).

These types of consequences are outside the primary scope of the review. The team may choose to document such items if they are identified during team discussions, but the PHA does not strive to compile a complete list of these issues.

7.0 DEVELOPING RECOMMENDATIONS

In developing recommendations, the team leader should encourage the team to apply the concepts of inherently safe design to eliminate hazards rather than reduce the severity or likelihood of an event. However, application of inherently safe design is normally much more effective during process design than after the unit is built.

NOTE: Refer to RSP-1303 for further information on PHA recommendation requirements.

8.0 METHODOLOGY

8.1 Process Hazard Analysis Regulatory Requirements

(2)[b] The employer [owner or operator] shall use one or more of the following methodologies that are appropriate to determine and evaluate the hazards of the process being analyzed.

(i)[1] What-If;

(ii)[2] Checklist;

(iii)[3] What-If/Checklist;

(iv)[4] Hazard and Operability Study (HAZOP)

(v)[5] Failure Mode and Effects Analysis (FMEA);

(vi)[6] Fault Tree Analysis; or

(vii)[7] An appropriate equivalent methodology.

NOTE: Refer to RSP-1303 for further information on PHA methodology requirements.

8.2 Use of the HAZOP Method and Supplemental Reviews

The Hazard and Operability Study (HAZOP) methodology will be the principal method used for conducting PHAs on processes of significant size and complexity. The HAZOP method is a guideword stimulated, team-based brainstorming approach for identifying process safety concerns related to potential catastrophic incidents.

To help ensure more thorough consideration of human factors and facility siting issues, the HAZOP analysis will be supplemented by a checklist review of human factors and facility/stationary source siting issues.

NOTE: Refer to RSP-1303 for further information on these checklists, as well as links to the latest versions.

PHA methodologies other than the HAZOP method may be used for specific applications as approved by Technical Service Manager or designee. Alternative methodologies include but are not limited to the following:

- What-If/Checklists, and
- Failure modes and effects analysis (FMEA).

For guidance on re-do vs. updating/retrofitting of existing studies, refer to RSP-1303.

8.3 Concepts of the HAZOP Method

Basic concepts behind the HAZOP method are:

- Processes operate safely when operating at design conditions.
- When deviations from the process design conditions occur, hazards and operability problems may occur.
- Guidewords are used to assist the analysis team to systematically identify causes and evaluate the consequences of deviations from design conditions.
- Safeguards (i.e., engineering, and administrative controls) are considered in evaluating risk associated with a HAZOP scenario. Note: A list of generic safeguards, as found in Appendix B, should be included in the PHA report. This is to avoid the repetition in each node of safeguards applied generically across Refining.

For full information on PHA methodology refer to RSP-1303.

8.4 PHA Study Preparation

Thorough preparation is vital to the success of a PHA, and detailed preparation improves the efficiency and quality of the study.

In advance of the PHA, the PHA coordinator assembles and reviews the following information:

A. The report from the previous PHA,

B. List of previous PHA recommendations, including their status,

C. Complete and current Process Safety Information (PSI),

D. List of Process Safety Incidents (Category 2 and higher) since the last PHA study,

E. List of process-related Management of Change (MOC) modifications and status of implementation since the last PHA study, and

F. List of compliance audit findings since the last PHA and their status.

Based on this information, the PHA coordinator proposes the appropriate PHA approach (refresh vs. redo, RSP-1303), defines the scope and methodology of the study and proposes a team.

8.5 Scope of the PHA Study

(e)(3)(vii) [7] The PHA must address a qualitative evaluation of a range of the possible safety and health effects of failure of controls on employees in the workplace ["on employees in the workplace" omitted].

- A full PHA study typically contains two major components – the node-by-node review, which identifies causes, consequences and safeguards, and the review of checklists for specific global topics, such as human factors, facility siting, and materials review. Recommendations can be developed both during the node-by-node review and during the checklist review.
- The PHA Pro software should be used to document the node-by-node review and the checklist completion. The template and the library developed by Refining PSM PHA/LOPA Coordinator should be used for both the node-by-node review and the checklist completion.
- The scope will specify what equipment, procedures, and chemicals are to be included in the PHA. The PHA Facilitator will document the physical boundaries by 'noding' the P&IDs as per guidance on node identification in RSP-1303. Interconnecting piping, back to a PSM covered piece of equipment, should be included in noding to ensure all interplant piping, valves, deadlegs, etc. are included in the nodal analysis.

8.6 Node by Node Review

The node-by-node review covers the equipment identified in the scope. For each node, a list of deviations is used to guide the team in systematically considering departure from normal operation. The list of required deviations is included in RSP-1303. The list of deviations along with a listing of typical causes is also provided in the PHA Pro Library.

- The cause → consequence methodology is used for the HAZOP (i.e., the team identifies causes that could lead to the deviation and then determines the consequences). Causes are generally considered and documented in the node that the failure occurs. Consequences for a cause can occur anywhere in the unit and include impact to other units and off-site, if applicable. If causes outside the scope of the study with consequences inside the scope are identified, these should be included if not already covered in the PHA of the respective unit.
- Good Practice: When discussing inter-unit scenarios, representatives from the upstream or downstream unit should be included in the PHA team to provide expertise related to the upstream or downstream unit. Alternatively, a list of inter-unit scenarios can be maintained and the information on these inter-unit scenarios that were identified and/or analyzed by other PHAs made available to the team.
- Significant consequences of interest and their impact on safety and the environment (including off-site consequences) shall be considered. One cause can have multiple consequences and each consequence should be analyzed and documented separately since severity, frequency and safeguards may differ. Each consequence shall document impacts in both safety and environmental categories, but typically only the highest severity category needs to be analyzed. Documenting financial and reputation impact of a consequence is optional.
- If there are no credible causes or no consequences of interest identified for a cause, this needs to be documented in the PHA worksheets. Documentation by exception is not acceptable. If the same cause/consequence pair applies to multiple deviations or

multiple nodes, it should be documented only once in a node and deviation closely related to the failure, and then referenced to this specific cause/consequence pair when identified again in other deviations or nodes.

8.7 Standalone Studies

The following list of stand-alone evaluations are outside the scope of the PHA study. These evaluations are completed according to its respective RSP/RRD as indicated. Documentation from each study or analysis should be made available to the PHA Team for reference during the PHA study.

A. Plant-wide Flare/Relief System Study per RSP-1131-000

B. Building/Facility Siting Analysis per RSP-1314

C. Emergency Isolation Valve (EIV) Evaluations per RSP-1171-010

D. EPA Risk Management Plan (RMP) per PSM-5008

E. Alarm Rationalization RSP-1173-010

F. SRS Revalidations per RSP-1172-020 at: http://cbgrs20/red/copyout.aspx?lib_no=32&doc_no=358

G. Integrity Operating Windows (IOW), Corrosion Control Documents (CCD) and Materials Degradation Hazard Reviews (DMHR) per RRD-1190-200 and RRD-1190-201

H. Emergency Eyewash and Shower Equipment Evaluation per RSP-1130-000

8.8 Review of Incidents or other Hazard Information

(3)[c] The process hazard analysis shall address: […] (ii)[2] The identification of any previous incident which had a likely potential for catastrophic consequences in the workplace ["in the workplace" is omitted in RMP rule language];

Previous Incidents from various sources are a good source for identifying what process equipment malfunctions or human errors could occur within the process that may lead to accidental releases. Previous incidents that resulted in, or could reasonably have resulted in, a major uncontrolled release of a highly hazardous chemical including fire/explosion events, shall be reviewed by the PHA Team. It is helpful to have information on the root causes of the incident (if available) since this will allow the team to review if they are at risk for a similar incident and what can be done to protect against a reoccurrence.

8.8.1 Considerations for Chemical Compatibility

During HAZOP reviews the PHA must evaluate each new chemical or catalyst, or those introduced during the previous 5-year cycle. Considerations must include consulting the Anacortes Refinery chemical compatibility data as it applies to the chemicals under study. The team must determine if any incompatibility could have been introduced as part of any of these change and address any consequence determined in these reviews.

PHA teams must consider the hazards of mixing incompatible substances, which can result in dangerous and sometimes violent reactions, which could result in process safety exposures (pressure and temperature excursions) or personal injuries such as burns and poisoning.

The team shall also consult the appropriate Safety Data Sheets (SDS) for stability and incompatibility information for each of the materials in the processes under evaluation, by using the designated guideword related to incompatibility/mixing, etc.

This must be evaluated in each HAZOP node, during the PHA.

Where materials are found to be incompatible, the PHA team must evaluate whether recommendations for additional safeguards are required and make these recommendations where necessary.

This Anacortes Refinery's site chemical compatibility data is found for each process unit on the Anacortes Refinery's SharePoint in EDOCs. Tables are available on EDOCs by searching for document number A40A125. These tables are in excel format and each unit has an assigned tab.

SDS information is also found on the Anacortes Refinery's SharePoint site on the refinery main page and the link "Safety Data Sheet (MSDS online Search)"

8.8.2 MOC Hazard Evaluation for Chemical Compatibility

MOC Hazard evaluation teams (MOCPT) must also consider the hazards of mixing incompatible substances, where applicable, which can result in dangerous and sometimes violent reactions, process safety exposures (pressure and temperature excursions) or personal injuries such as burns and poisoning. Refer to R-12-006 site MOC policy for guidance in MOC hazard evaluations.

8.9 Management of Change (MOC) Modifications

Process units may be modified over time for various reasons (technology improvements, optimization, etc.). Although MOC is intended to maintain the integrity of original safety features designed into the process and to ensure that any new hazards are properly managed, potentially hazardous interactions may have been introduced to the process unit after numerous process changes.

NOTE: The likelihood that hazards exist due to unidentified interactions increases with the number of process modifications.

During the initial study preparation, the PHA Coordinator assembles a list of all process related MOC's on the unit under study since the previous PHA. If a large number of MOCs have been completed since the previous PHA, redoing the PHA may be more cost-effective than updating the PHA documentation to incorporate each MOC. (Refer to RSP-1303 for more details on selecting the appropriate PHA approach).

When performing a re-do (either from the previous study file or from scratch), the entire unit is reviewed "as is", and the potential impact of all modifications is covered by this review. Thus, for a re-do, a review of MOCs completed since the previous PHA is not necessary (unless required by local regulations or defined in the site's PHA procedure). The PHA coordinator may choose to include a review of selected MOCs in the scope of the PHA if desired.

When performing a re-fresh of the previous PHA, all process related MOC's shall be reviewed by the team as described in RSP-1303.

8.10 Human Factors

Consideration of human factors during a PHA includes such items as potential human error causes of accidents, examining the location of and access to critical safety instruments, alarms, and equipment, and how procedures and training are used by operators and maintenance personnel.

Refer to RSP-1030 for details on Human Factors checklist.

8.11 Facility Siting Review

Consideration of facility siting during a PHA includes such items as:

A. The location of potential release points relative to ignition sources.

B. The location of process equipment relative to population centers (e.g., office buildings, labs, maintenance shops, etc.).

C. The location of process equipment relative to adjacent units and the potential external impact when listed as a cause of loss of containment. Potential hazards and consequences can then be identified (e.g., fire, explosion, toxic exposure, etc.) associated with the release, and then qualitatively evaluated (e.g., small/medium/ large release, onsite or offsite impacts, etc.).

NOTE: For the purposes of this document, the phrase "Facility Siting" also includes Stationary Source Siting as required by RMP regulations.

The facility siting review should focus on the specific process under review staying within the geographical boundaries of the unit, but may also include refinery wide systems (e.g., firewater, emergency response, etc.).

8.12 Materials Review (Damage Mechanism Review)

Specific Materials Review Checklists have been developed for several typical refining process units to assist in a damage mechanism review and identify potential issues related to materials of construction and operating windows. These checklists and further background information on degradation processes are summarized in several unit-specific Refining Reference Documents (RRDs).

If a unit specific RRD with a checklist is available, the checklist shall be completed in conjunction with the PHA. The PHA team shall review the checklist and the answers and create follow-up recommendations as needed. RSP-1303 contains a list of available unit-specific materials review documents, describes their content, and explains how the PHA team should complete the review.

Recommendations from the Materials Review Checklist shall be included with the PHA recommendations. It is strongly recommended to document the review of the Materials Review Checklist within the PHA Pro software, so that team comments and recommendations from the review are automatically captured and included with the PHA documentation. If the review is done outside the PHA software, recommendations shall be transferred manually into the PHA software or the PHA report.

8.13 Mechanical Integrity (MI) Covered Equipment

During the PHA, the team should have a list of MI covered equipment and instruments available, and preferentially use these when selecting safeguards. Non-MI covered equipment and instruments can also be used as safeguards where appropriate.

Section 2.3(a) of RSP-1308 and Appendix J of PSM-1070 provide guidance that equipment which is a cause of or a safeguard for a catastrophic release due to functional or mechanical failure be included in the MI program. However, it is NOT required that ALL causes and safeguards used in the PHA are included in the MI program. Identification of MI covered equipment for existing units is done per the guidelines in RSP-1308 (specifically Section 2.3(b)) outside the PHA.

8.14 Evaluation of Off-Site Impacts

To perform a qualitative evaluation of the range of possible safety and health effects of failure of engineering and administrative controls, the PHA shall discuss consequences related to the release of highly hazardous chemicals. Units covered by the RMP rule must also rate consequences that might affect the public and the environment. Such events shall consider a range of onsite as well as offsite impacts (i.e., impacts to the public or the environment as defined by EPA's RMP regulation). Offsite impacts identified in the node-by node review are documented through the off-site impact rating for each consequence (refer to RSP-1303).

8.15 Development of Recommendations

When the PHA team determines that the existing safeguards against a consequence of interest are not adequate or when a checklist item identifies a deficiency, the team shall create a recommendation to address the deficiency.

Recommendations related to "preventing or minimizing the consequences of catastrophic releases of toxic, reactive, flammable or explosive chemicals are classified as "process-safety recommendations". For these recommendations, a pre-recommendation and post-recommendation risk rank is assigned to each recommendation. For recommendations from the node-by-node review, the risk rank from the HAZOP scenario is used as the pre-recommendation risk rank. For checklist items, the team will determine the severity and frequency of a potential consequence. Risk rank response criteria from GEN-1010 (Table 5) shall be applied to the PHA recommendation based on the pre-recommendation risk rank. All process-safety recommendations shall be documented in the PHA report.

8.16 Previous Recommendations

Process Safety recommendations from the previous PHA shall be reviewed and the review documented. Closed recommendations should be reviewed for proper closure. Open recommendations may be modified, expanded or cancelled, if appropriate (refer to RSP-1300-015 for modifying or rejecting existing process safety recommendations). Any changes to existing recommendations proposed by the PHA Team shall be incorporated into the list of current PHA recommendations.

Other open, process-related recommendations for the unit under study should be considered by the PHA Team to ensure that they are consistent with the PHA conclusions and that the PHA does not create duplicate recommendations.

8.17 PHA Report

The PHA Facilitator is responsible for documenting the results of the PHA study. The PHA Coordinator assists the Facilitator in reviewing the study documentation and preparing the PHA report for review by Technical Service Manager. The report shall be approved no later than 120 days after the last team meeting.

9.0 TEAM REQUIREMENTS AND COMPOSITION

9.1 Regulatory Requirements Analysis

(4)[d] The process hazard analysis shall be performed by a team with expertise in engineering and process operations, and the team shall include at least one employee who has experience and knowledge specific to the process being evaluated. Also, one member of the team must be knowledgeable in the specific process hazard analysis methodology being used.

9.2 Team Requirements and Roles

In keeping with these basic team requirements, full-time/part-time members shall be assigned to the PHA team at a minimum per the requirements of RSP-1303.

9.3 Team Member Selection

A team of knowledgeable, multi-disciplinary members shall be selected so that a balanced approach to identifying process hazards is achieved.

- Refer to RSP-1303 for information on study preparation, scope, execution and PSI requirements, and all other elements for the study.
- Refer to RSP-1303 for further information on PHA team composition.
- Refer to RSP-1303 for a study approval form.

10.0 MANAGEMENT OF RECOMMENDATIONS

10.1 Regulatory Requirements Recommendations

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

10.2 Recommendation System

The PSM Rule requires a documented, integrated system for managing and monitoring recommendations. Recommendations must be addressed and documented in a timely manner. Implementation schedules for corrective actions must be tracked. Finally, the system must ensure that all affected operating and maintenance personnel and other affected employees are notified of planned actions.

NOTE: All Refinery Site Management decisions must be documented, and a system must be utilized to track implementation of corrective actions to be made.

NOTE: Refer to RSP-1303 for further information on PHA recommendation requirements.

11.0 MANAGEMENT OF RECOMMENDATIONS AND TEAM SUGGESTIONS NOT RELATED TO PROCESS SAFETY

If safety suggestions were recorded by the team to address a deficiency not related to process safety (i.e., not related to "preventing or minimizing the consequences of catastrophic releases of toxic, reactive, flammable, or explosive chemicals"), these will be compiled, included in the PHA report, and tracked using the site's system for the management of safety suggestions, separate from the PHA recommendations. They do not need to be risk-ranked or reviewed by the Refinery Site Management team.

Improvement ideas brought up by the team will be compiled into a list and provided to the area team lead at the end of the study. Each site may determine a method to communicate and address (if justified) these items. They are not included in the PHA report and managed separately from the PHA recommendations.

12.0 PROCESS HAZARD ANALYSIS REVALIDATION

12.1 Regulatory Requirements

(6)[f] At least every five (5) years after the completion of the initial process hazard analysis, the process hazard analysis shall be updated and revalidated by a team meeting the requirements in paragraph (e)(4)[d] of this section, to assure that the process hazard analysis is consistent with the current process. [Updated and revalidated process hazard analyses completed to comply with 29 CFR 1910.119(e) are acceptable to meet the requirements of this paragraph.]

12.2 Study Revalidation Options

The PSM regulation requires that an initial PHA be performed for new processes prior to the introduction of highly hazardous chemicals. For existing processes, the PHA must be revalidated at least every five years.

NOTE: Refer to RSP-1303 for further information on PHA revalidation requirements.

NOTE: A PHA redo should occur no later than the third cycle of the previous full PHA.

A. Redo based on the previous study: Use the previous PHA documentation as a starting point, and review all nodes and deviations, validate each scenario using current PSI and identify additional causes or consequences as found by the team. It is recommended to remove the severities and frequencies assigned during the previous PHA in order to encourage the PHA team to think through the scenarios. Additional information, such as the consequence description may need to be removed, if necessary, to keep the team engaged. Advantages of starting from the previous PHA documentation are that previously identified scenarios are not overlooked in the new study and time requirements for thorough documentation are reduced. Nodes should be defined the same way as for the previous PHA. All associated reviews (such as incidents and previous recommendations) shall be completed and the checklists from the previous study shall be reviewed and updated as needed. A review of MOCs is not required since the unit is evaluated "as is".

B. Redo from a "blank sheet": Start from a blank study file and develop each scenario "from scratch" using the current PSI. This approach to a redo should be selected if the previous study was of poor quality or not well documented. Also, if there were significant changes to unit that would invalidate large sections of the previous PHA or if the previous noding is redone, a "fresh start" is generally more efficient than starting the redo from the previous study file. All checklists and associated reviews (such as incidents and previous recommendations) shall be completed. A review of MOCs is not required since the unit is evaluated "as is".

C. Refresh (Update): A Refresh of an existing PHA focuses only on those part of the process that were impacted by an MOC since the previous PHA. Rather than reviewing the entire PHA, the MOCs and their impact on the hazards of the process are reviewed by the team and documented. A refresh cannot be used for the first PHA following the start-up of a new unit. More guidance on what to include in a refresh is provided in RSP-1303

13.0 HAZOPS PERFORMED FOR A COMPLEX MOC

13.1 Definition of a Complex Change

This section does not apply to the initial PHA for a new unit or to the 5-year PHA. It only covers HAZOPs performed as part of an MOC for complex changes. The complexity of a change is determined by the answers to the checklist in Appendix C of RSP-1307.

NOTE: Refer to RSP-1303 for further information on HAZOPs for Complex MOCs requirements.

13.2 Timing within the Project Lifecycle

It is recommended that projects perform a HAZOP early in the project, when changes are easier to make, and inherently safer design concepts can be incorporated. These early HAZOPs do not have to conform to all the requirements in this RSP, since the changes only exist on paper at this time. The final project HAZOP will provide the assurance that all hazards have been addressed before start-up and will also provide the documentation necessary for compliance with regulatory requirements. It is good practice to follow the full HAZOP methodology for early HAZOPs in order to minimize new discoveries at the final project HAZOP.

Guidelines for PHA activities in early project phases:

A. Feasibility Phase: HAZID (HAZard IDentification) or What-If at the PFD level, with focus on hazard identification and inherently safer design opportunities.

B. Definition Phase: HAZOP (preferred) or What-if when P&ID's are IFD (Issued for Design). It is common that not all PSI (such as relief valve sizing calculations, etc.) is available in this phase. PHAs for newly constructed facilities covered process(es) shall be completed with sufficient lead time prior to final construction of the covered process to allow proper time to resolve the recommendations from the PHA.

The final project HAZOP should be performed after the design and the P&IDs have been finalized (typically IFC – Issued for Construction) but before start-up of the unit. The HAZOP should not be combined with other project reviews, such as P&ID reviews. This HAZOP shall follow the requirements in this standard and local site standards.

If changes are made to the project after the final project PHA is completed, they shall be documented in a change log and reviewed periodically. The review will determine if an update of the final Project PHA for the changes is required. All changes after the final project PHA shall be reviewed prior to startup.

NOTE: Refer to RSP-1303 for further information on HAZOPs for project requirements.

14.0 RECORDS RETENTION

14.1 Process Hazard Analysis Record Regulatory Requirements

(7)[g] Employers [The owner or operator] shall retain process hazards analyses and updates or revalidations for each process covered by this section, as well as the documented resolution of recommendations described in paragraph (e)(5) [e] of this section for the life of the process.

14.2 Retaining Records

Each PHA report and the documentation on the resolution of the recommendations resulting from each PHA must be retained for the life of the process as mandated by regulation. The final PHA report must be electronically archived for permanent retention.

NOTE: Refer to RSP-1303 for further information on PHA record retention requirements.

14.3 PHA Metrics Tracking

The PHA coordinator shall track metrics for each completed PHA, including:

A. Study duration (number of meeting days and time from start to finish),

B. Number of nodes,

C. Number of process safety recommendations made by the team and number of process safety recommendations approved by the management review.

D. Number of safety suggestions

E. Days between last team meeting and management review of recommendations

15.0 SKILLS AND TRAINING

15.1 Training

- PHA Coordinators, designees or nominated personnel within an organization shall have appropriate knowledge on how to input and utilize an electronic database for tracking PHA recommendations and corrective actions.
- All applicable employees shall have appropriate knowledge on how to view and adequately close assigned action items or findings from PHAs in an electronic database.
- The PHA Facilitators must have received formalized training in the application and execution of the PHA methodology and the risk evaluation tool.
- PHA Team Members must receive instruction in hazards recognition and corresponding use of the PHA methodology, generally provided by the PHA Facilitator. This training needs to include risk calibration training (i.e., a review of

severities assigned to typical consequences). PHA team orientation should include the concepts of inherent safety to eliminate rather than prevent or mitigate hazards leading to consequences of interest.

NOTE: Refer to RSP-1303 for further information on PHA skills and training requirements.

16.0 REVIEW AND REVISION HISTORY

Revision #	Preparer	Date	Description
0	Terry Hering	6/20/2022	Completely rewritten to provide an outline only of the PHA process (previous version was a copy of the corporate standard RSP-1303) per recommendations from the 2021 PSM Compliance and Collaborative Audits. Voided SRA Forms. PS-04 Edited – All edits contained within this document. Reformatted and Numbered per Document Control Policy, R-63-001.
1	Terry Hering	1/3/2024	Update section 7.8.1/7.8.2 for considerations required for PHAs to review chemical composition or catalyst changes or introduce new chemicals and consult of SDSs and new site chemical compatibility tables. Edit to the PSM coverage for tank farm in Attachment 1.

17.0 ATTACHMENT 1 – PSM COVERAGE

PSM Coverage Per OSHA 29 CFR 1910.119			
Unit		Covered Process	Rationale (OSHA)
1.	Crude Unit/CCU Feed Diversion	YES	> 10,000 LB flammables
2.	Vacuum Flasher/Fuel Oil and Asphalt Blending	YES	> 10,000 LB flammables
3.	Deasphalter	NO	Removed from service
4.	Cat Gasoline Splitter	YES	> 10,000 LB flammables
5.	Distillate Hydrotreater	YES	> 10,000 LB flammables
6.	Clean Fuel Hydrotreater	YES	> 10,000 LB flammables
7.	Naphtha Hydrotreater	YES	> 10,000 LB flammables
8.	Cat. Reformer	YES	> 10,000 LB flammables
9.	Fuel Gas Blender	YES	> 10,000 LB flammables
10.	Propane/Butane Tank Car & Truck Racks	YES	> 10,000 LB flammables
11.	Propane/Butane Storage	YES	>10,000 LB flammables
12.	Gasoline Blender	YES	PSM regulated covered process due to connectivity to other covered processes
13.	Gasoline Truck Rack	NO	< 10,000 LB flammables
14.	Diesel Truck Rack	NO	NOT COVERED
15.	Tank Farm Tankage, including Atmospheric storage tanks containing Flammable or Toxic Chemicals	YES	PSM covered on a voluntary basis
16.	Wharf	NO	NOT COVERED
17.	Jet Fuel Treater	YES	> 10,000 LB flammables
18.	ROSE	YES	> 10,000 LB flammables
19.	CCU Feed System, Reactor/Regenerator	YES	> 10,000 LB flammables
20.	CO Boilers/Flue Gas Scrubber	NO	PSM regulated covered process due to connectivity to other covered processes
21.	Sour Water Strippers	YES	PSM covered on a voluntary basis (<H2S TQs)
22.	CCU Fractionators	YES	> 10,000 LB flammables
23.	Gas Recovery Unit	YES	> 10,000 LB flammables
24.	Dry Gas Treater	YES	Part of H2S Recovery
25.	C3/C4 Treater	YES	> 10,000 LB flammables
26.	SR C4 Treater	YES	> 10,000 LB flammables
27.	Caustic Regenerator	NO	PSM regulated covered process due to connectivity to other covered processes
28.	CCU Gasoline Treaters	YES	> 10,000 LB flammables
29.	H2S Recovery (Amine I and II Systems)	YES	> 1500 LB H2S
30.	Alkylation (incl. spheres)	YES	> 10,000 LB flammables
31.	Butane Isomerization	YES	> 10,000 LB flammables
32.	Flare System	YES	> 10,000 LB flammables
33.	Cooling Water Towers	NO	NOT COVERED
34.	Utilities Fuel Oil Storage	NO	Removed from service
35.	Utilities Boilers	YES	PSM regulated covered process due to connectivity to other covered processes
36.	SHU (Selective Hydrogenation Unit)	YES	> 10,000 LB flammables
37.	Hot Dropout System	N/A	Removed from service

PSM Coverage Per OSHA 29 CFR 1910.119			
Unit		Covered Process	Rationale (OSHA)
38.	Vehicle Refueling Tanks	NO	NOT COVERED
39.	Buildings, Shops, Contract areas	NO	NOT COVERED
40.	BSU (Benzene Saturation Unit)	YES	> 10,000 LB flammables
41.	Pentane Isomerization	YES	> 10,000 LB flammables
42.	Waste-Water Treatment Plant (WWTP)	YES	PSM covered on a voluntary basis