PR 1410 Working Group Meeting #7

JUNE 20, 2018

SCAQMD Headquarters

Diamond Bar, California

Agenda

- Summary of the April 28th Refinery Committee
- Status of Directions from the Refinery Committee to Staff
- Proposed Tier I Mitigation Measures
- Proposed Tier II+ Mitigation Measures

Summary of April 28th Refinery Committee Meeting

- More than 500 people attended
  - 5 speakers representing Torrance Refining Company (TORC), Valero, Torrance Refinery Action Alliance (TRAA), and two union representatives
  - Over 60 public comments
- SCAQMD staff proposed possible rule approaches:
  - Option A: Tier I+ mitigation in one year and phase-out of MHF in five years after rule adoption
  - Option B: Tier I/II+ mitigation in 2-3 years and phase-out of MHF in six years after rule adoption
    - If a technology assessment (within 2 years) concludes additional time for phase-out, phase-out of MHF no later than eight years after rule adoption
- Discussed health effects from exposure to HF and sulfuric acid

Status of Directions from the Refinery Committee to Staff

Directions from Refinery Committee

- Explore two implementation approaches to incorporate Tier I and II+ mitigation measures
  - Regulatory approach or
  - Memorandum of Understanding (MOU) or Agreement
- Pursue obtaining permission from Honeywell to release information on MHF technology to better inform the Board
- Provide information on events that can result in a large (consequential) release of MHF such as terrorism or natural disaster
- Provide additional information to prove MHF will not form a dense vapor cloud

Implementation Approach: Rule or Memorandum of Understanding

Revised 6/20/18

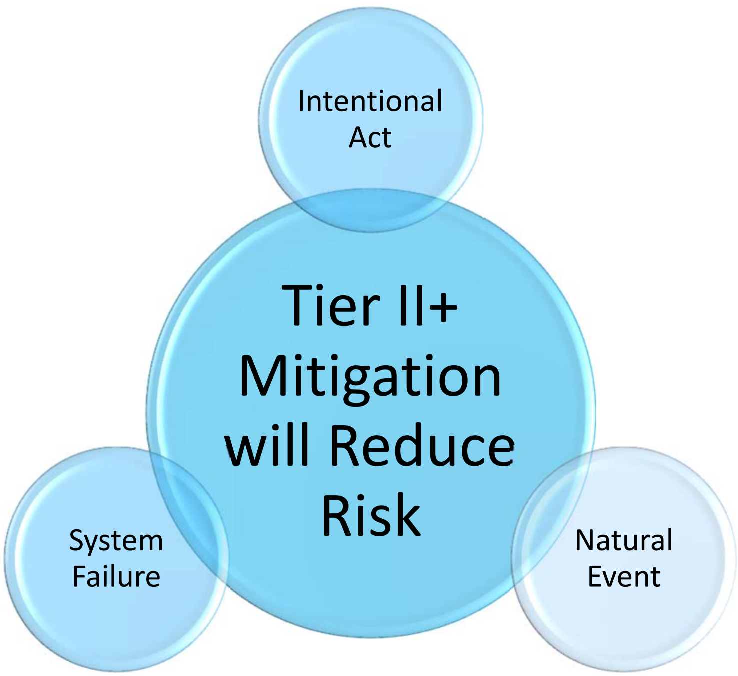
	Proposed Rule	Memorandum of Understanding
Public Process	Established public process: • Working Group Meetings • Stationary Source Committee, and • Public Hearing	• No established public process • Can incorporate public process
Approval	Adopted by Governing Board	Governing Board
Timeframe	4 to 6 months • 75-day public notice • Staff report • CEQA	Can be expedited • No public noticing required • No staff report required • Confirming CEQA
Compliance	• Enforcement and penalties • Option for Hearing Board, if needed	• Enforceable

Staff Approach

- Pursue Tier I and II+ mitigation through regulatory approach
  - Regulatory approach provides an established public process
  - Open to other approaches
- Staff exploring:
  - Phase-out – with consideration of economic impacts
  - Mechanisms to monitor progress in emerging alternative alkylation technologies
  - Concept of a mitigation fee
  - Laboratory or field testing for current percentage of additive in MHF

Status of Request to Release Information on MHF Technology

Information on Events that Can Result in Consequential Release of MHF



- California has established seismic requirements
  - California Office of Emergency Services require refineries to conduct a review of external events every 3 to 5 years as part of the Risk Management Plan
  - California Building Code requires seismic retrofits
    - Newport-Inglewood and Palos Verdes fault zone traverse the South Bay
    - Requires structural integrity to withstand specific ground acceleration

Additional Information to Prove MHF Will Not Form a Dense Vapor Cloud

- Staff not aware of any further HF or MHF testing since the early 90's
- Addition testing would address uncertainties and assist in mitigation design
- Testing is expensive
  - Requires specific personnel, environment, and location that can handle the hazards of HF
  - Staff is researching costs of previous cost for previous testing of HF and MHF
- Estimated cost for a Quantitative Risk Analysis (QRA) which can quantify the potential impacts of a release of MHF is approximately $200,000
  - Quantitative Risk Analysis can help to better estimate the efficacy of specific mitigation measures

Mitigation

Background

- Objective is to require measures that can mitigate a large consequential release of MHF that could lead to off-site impacts
  - Existing mitigation can address small leaks
  - Larger leaks present additional challenges and existing mitigation is not sufficient
  - Provide greatest protection to the community in the event of a large consequential release of MHF
- MHF alone is not a solution to mitigate the hazards of HF
  - API 751 recognizes MHF as one of many mitigation measures to enhance safety and use of HF
  - Proposed mitigation will focus on improving the safety of workers and the community when using MHF

Guiding Principles for Mitigation Measures

- Multi-faceted approach to address large consequential release that can lead to off-site impacts
- Improve early detection of an MHF leak
- Decrease reaction time to activate mitigation measures
  - More passive mitigation
  - More automation
- Approaches to improve the reliability of mitigation measures
- Expeditious implementation schedule

Tier I Mitigation

Objectives of Tier I Mitigation

- Both refineries have existing mitigation measures in place
  - ❑ Tier I will require the same standards at each refinery
  - ❑ Use the best mitigation approach at each refinery as the standard
  - ❑ Some enhancements will be required at both refineries

General Overview of Tier I Mitigation

Enhance existing mitigation measures to improve early detection of MHF leak

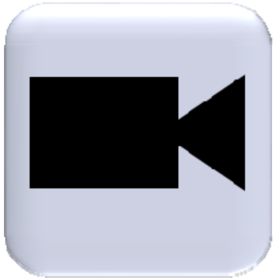
Early action enhancements and establishing requirements for base mitigation (API 751)

Provisions to ensure efficacy of all mitigation measures

Complete within 12 months

Tier I Mitigation

ENHANCEMENTS TO DETECTION OF MHF LEAKS



Key Elements to Improve Early Detection of MHF Leak (Tier I)

HF Point Sensors

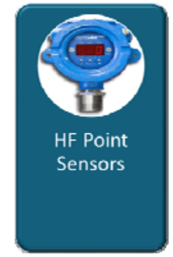
Open Path Monitors

Video Cameras and Control Room

HF Sensitive Paint

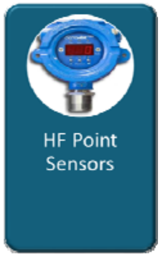
Early detection of MHF leak can improve the reaction time to mitigate a leak

HF Point Sensors

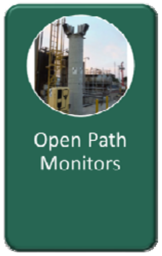


Function	• Detects HF at specific location • HF gas detection up to 10 ppm
Notifications	• 2 ppm internal • 6 ppm SCAQMD (informal agreement)
Existing configuration	• 27 point sensors at TORC • 33 point sensors at Valero
Current issues or limitations	• Low range of detection (0 – 10 ppm) • False alarm in high humidity conditions

Proposed Requirements for HF Point Sensors



- More sensors in and around MHF handling areas
  (fresh MHF storage, unloading, reactors/settlers, pumps, acid evacuation/transfer, etc.)
- Operate over a range of 0–20 ppm
- Minimal interference from humidity
- Periodic check & frequent calibration (every quarter at a minimum)
- Uninterruptible power supply
- Alarm notifications: 2 ppm internal, 6 ppm SCAQMD



HF Open-Path Monitors

Function

- Provides average HF concentration along a fixed path length
- Can be used to monitor perimeter where MHF used

Notifications

- 50 ppm-m and 75 ppm-m internal notifications

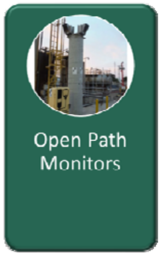
Existing configuration

- 4 sides perimeter monitoring at TORC around alkylation unit
- No open-path monitoring at Valero

Current issues or limitations

- Single-elevation will not capture leak at different elevation
- Possibly affected by steam plume and fog
- No SCAQMD notification requirements

Proposed Requirements for Open Path Monitors



- Along the perimeter of MHF alkylation unit and unloading zone
- Installation at multiple elevations (low and high elevations)
- Minimal interference from environmental conditions (glare, fog, etc.)
- Uninterruptible power supply
- Alarm notifications: 10 ppm-m internal, 20 ppm-m SCAQMD

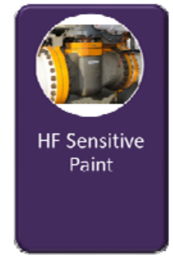
Video Cameras and Control Room

Function	• Early detection during release • Visual inspection of unit from remote location (control room) • Can be only visual in the event of a consequential release
Existing configuration	• 8 video cameras at TORC • 3 video cameras at Valero • Video monitors in control room (TORC and Valero)
Current issues or limitations	• Limited video monitors in control room • Outdated video quality and no night vision • Video cameras not dedicated to alkylation unit

Proposed Requirements for Video Cameras and Control Room

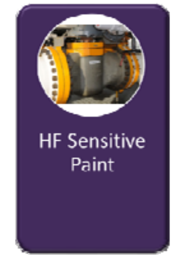
- Full HD video quality and night vision with remote pan/zoom, record/playback
- Retain recordings for one month
- Cover strategic portions of the unit (reactor, settlers, fresh MHF storage, and MHF unloading zone)
- One or more dedicated cameras to each portion of unit (e.g., must cover areas where water cannons used)
- Short distance from potential release location (e.g., settler)
- Consider glare from the sun, thermal load, and moisture
- Remote viewing in the control room
- Several screens dedicated to the alkylation unit and unloading area
- Minimum numbers of toggles per video

HF Paint



Function	• Detects HF leak at joints and unions • Very sensitive to low concentrations of HF • Easy visual inspection to locate and address small leaks
Existing configuration	• Coat all valves and flanges in area with high MHF concentration
Current issues or limitations	• Requires frequent re-application • More challenging to inspect under flange shrouds

Proposed Requirements for HF Paint



- Coat all valves and flanges in MHF service area, threaded fittings, compression fittings, pump seals, leak repair clamps, sample transportation containers, MHF-containing process connections, and vessels
- Paint must be durable to heat and sunlight
- Require frequent reapplication and inspection

Tier I Mitigation

EARLY ACTION ENHANCEMENTS AND ESTABLISHING REQUIREMENTS FOR BASE MITIGATION (API 751)

Early Action Enhancements and Establishing Requirements for Base Mitigation (API 751)

- American Petroleum Institute Recommended Practice 751 (API 751) – Safe Operation of Hydrofluoric Acid Alkylation Units
  - Includes "recommended practices" – viewed as industry standard
  - Both refineries follow most recommended practices in API 751
  - Tier I mitigation will make "recommended practices" mandatory and will add specificity and include some enhancements
- Tier II+ mitigation will include significant enhancements to existing systems (No Tier I water mitigation enhancements)

Early Action Enhancements and Establishing Requirements for Base Mitigation (API 751)

Rapid Acid Transfer

Physical Barriers

Remotely Operated Block Valves

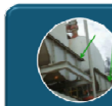
Tier I mitigation will make API 751 "recommended practices" mandatory

Rapid Acid Transfer

Function	• Quickly de-inventory MHF if substantial leak • One of the most effective mitigation measure
Existing configuration	• Pump driven at TORC (< 7 minutes) • Gravity system at Valero (< 10 minutes)
Current issues or limitations	• None identified at this time

Proposed Requirements for Rapid Acid Transfer

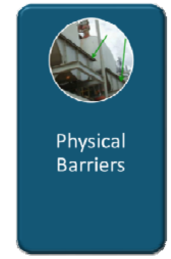
- De-inventory under 10 minutes
- Gravity or pump driven
  - Redundant power required if using pump
- Storage drum must be sufficient size to accommodate de-inventory



Physical Barriers

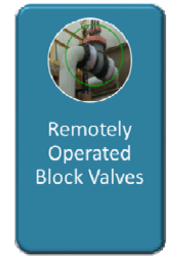
Function	• Breaks velocity of MHF release to prevent vaporization
Existing configuration	• Belly pans, blast wall, flange shrouds at TORC • Diffusors on acid coolers Valero
Current issues or limitations	• Belly pan does not cover entire unit • Blast wall only on three sides • No upper barriers

Proposed Requirements for Physical Barriers



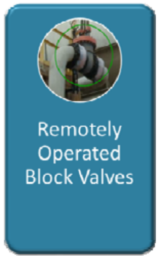
- Barriers on belly pan and acid circulation pump seals
- Shrouds on valves and flanges
- Researching efficacy of catch basin for valve and flange shrouds
- Further enhancements in Tier II+ mitigation

Remotely Operated Block Valves



Function	• Isolate MHF inventory in the event of an upset • Reduce magnitude of an MHF release
Existing configuration	• Remotely operated • Redundant power supply } TORC and Valero
Current issues or limitations	• None identified at this time

Proposed Requirements for Block Valves



- Remotely operated
- Redundant power supply
- Effective isolation of inventory with no overpressure

Tier I Mitigation

KEY ELEMENTS TO ENSURE EFFICACY OF MITIGATION MEASURES

Provisions to Ensure Efficacy of all Mitigation Measure

- Tier I mitigation will include provisions to ensure mitigation measures are:
  - ❑Implemented as intended
  - ❑Properly maintained

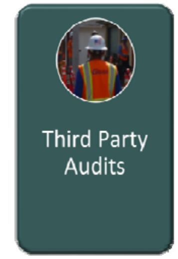
Key Elements to Ensure Efficacy of Mitigation Measures

Third Party Audits

Additive Concentration

Tier I will include provisions to ensure compliance

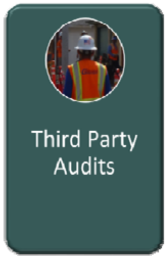
Revised
6/20/18



Third Party Audits

Function	• Ensures alkylation unit and mitigation systems are in optimal working condition
Existing configuration	• Periodic audits - TORC • Once every three years – Valero • Both facilities recently started auditing with a third party
Current issues or limitations	• No legal requirements for SCAQMD audits • No enforceable requirements for mitigation systems

Proposed Requirements for Third Party Audits



- Annual third party audits
- Copy of audits sent to SCAQMD and CalOSHA
  - Include status of equipment, specifically its safety and maintenance record, hazard risk potential, and overall operability of alkylation unit
- Checklist and electronic documentation (video recording, etc.)
- Tracking and resolution of deficiencies pursuant to audit findings

Additive Concentration

Additive Concentration

Function

- Reduces ability to form vapor cloud
- More MHF will fall to ground

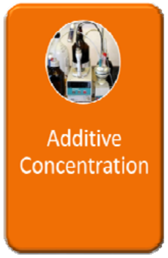
Existing configuration

- TORC ~ 7%
- Valero 6%

Current issues or limitations

- No testing to confirm current levels will not form vapor cloud
- No validation to confirm additive concentration

Proposed Requirements for Additive Concentration



- Require set concentration of additive
  - Settler: **8%**
  - Storage: 15%
- Proposing slightly higher additive concentration
  - Review of TORC additive concentration log for 2016 – 2017 shows additive concentration as high as 8.9%
- Measure acid/additive/water concentration twice daily
- Periodic third party verification of additive concentration

Tier II+ Mitigation

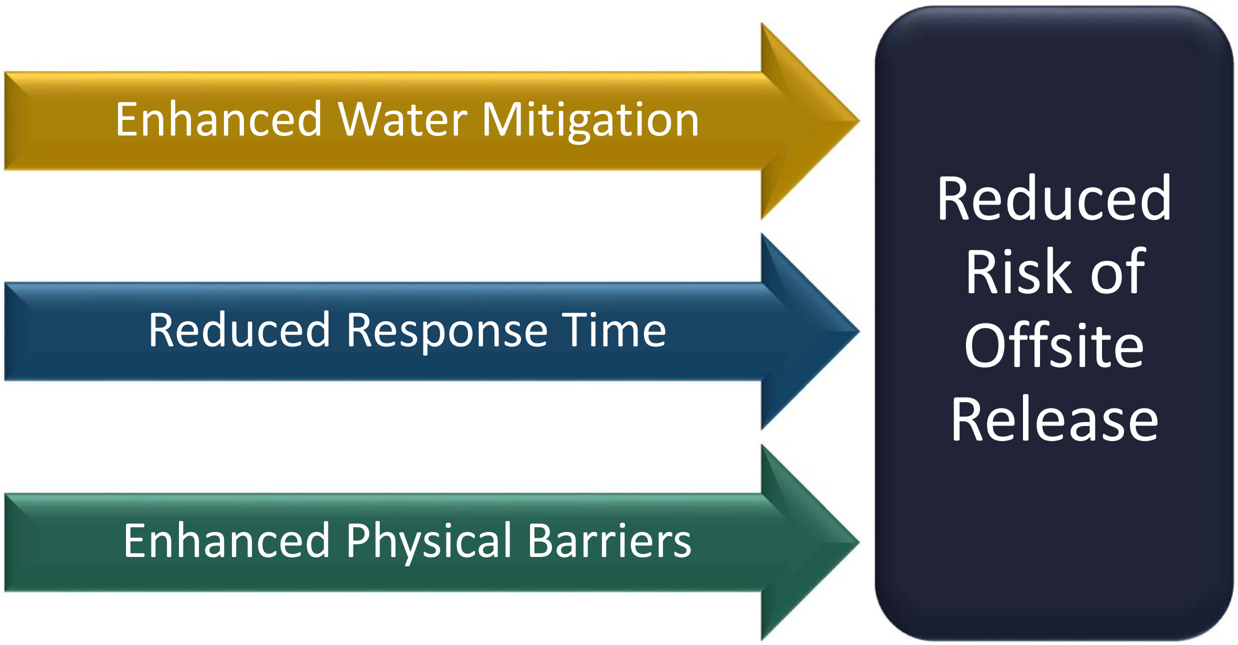
Background

- Mitigation assessment
  - Staff conducted a literature review of mitigation options for the release of hazardous chemicals
  - Contacted experts in the field
- Information presented will be incorporated into the design of Tier II+ mitigation
- Staff considering specific provisions and possibly a performance standard
- Presentation today does not include staff's recommendations for Tier II – will discuss at next Working Group Meeting

General Overview of Tier II+ Mitigation

- Substantial improvements to key mitigation elements:
  - Water
  - Physical barriers
- Require more passive mitigation and automation to existing mitigation
- Improve reliability of mitigation measures – power and water
- Considering a performance standard for Tier II+ mitigation
- Complete within 12 to 36 months

Key Elements of Tier II+ Mitigation



Water Mitigation

Importance of Water Mitigation

A well designed water mitigation system can be extremely effective

Once MHF leak occurs, water is key to prevent off-site release	Water acts as an effective measure to remove airborne MHF	Water dilutes the MHF and drives it to the ground

Current Water Mitigation Systems

Pump Deluge

- Effective for small leaks
- Water volume too low to address large leak

Water Cannon

- Large volume of water more effective on large leak
- Time delay to activate and direct water toward leak

Water Spray Curtain

- Effective for small, low velocity leak
- Large, high velocity leak would breach curtain
- Not protective against leak above water level

Finding on the Effectiveness of MHF Water Mitigation

- Staff conducted a literate review of the effectiveness of water mitigation on toxic releases
- Found three relevant studies that will guide Tier II+ mitigation development
- Interested in other resources, studies, or data
- Key findings:
  - Water to HF ratio critical
  - Most existing systems can mitigate small, low velocity leaks but are insufficient against consequential leaks
  - Need multiple layers of vertical water curtains with larger perimeter

First Study - Water Mitigation

- Water Spray mitigation of hydrofluoric acid releases[1]
  - 1990 study examined the effect of water spay on mitigating HF cloud
  - Based on Hawk test - small, bench scale laboratory tests followed by larger flow chamber tests
- Key Findings
  - HF removal efficiency increases with:
    - Smaller water spray droplet size (e.g., 160 μm droplets)
    - Narrow nozzle spacing
    - Increased water ratio of 40:1 or higher
    - Spray headers at the higher level than acid release elevation
    - Water monitors directly aimed at the release point in narrow angle from short distance

1. *Schatz and Koopman (1990) J. Loss Prev. Process Ind., 3(2), 222-233.*

Second Study – CQRA

- The Use of Comparative Quantitative Risk Analysis (CQRA) in Evaluating Proposed Hydrogen Fluoride Mitigation Systems[2]
  - CQRA is a technique for evaluating the effectiveness of proposed risk reduction strategies
  - Compared risk to the public posed by different release parameters and mitigation systems
- Key Findings
  - Timing is critical for large releases of HF in a short period of time
  - Activation time for leaks and punctures not as critical as for ruptures and large holes
  - Most effective systems evaluated in specific CQRA:
    - Rapid acid dump (most effective)
    - Remotely controlled water cannons
    - Water curtain (least effective)

2. Quest Consultants Inc. (1998)

Second Study – CQRA (cont.)

HF Removal Efficiencies for Releases from Reactor/Riser Leg with Water Curtain in Operation

Hole Size	Total Airborne Mass Release Rate [Hydrocarbon and HF] (kg/sec)	Airborne HF Mass Release Rate (kg/sec)	Water Curtain Activation Time (min)	Water Curtain Mass Rate (kg/sec)	Water/HF Mass Ratio	Modified Airborne HF Mass Release Rate (kg/sec)	Percent Reduction in Airborne HF Mass Release Rate (%)
6-inch	330.0	260.0	1	100	0.38	260.0	0.0
1-inch	10.0	8.0	1	100	12.5	5.6	30.0
1/4-inch	0.7	0.5	3	100	200.0	0.08	84.0

HF Removal Efficiencies for Releases from Reactor/Riser Leg with Water Curtain and Water Monitors in Operation

Hole Size	Total Airborne Mass Release Rate [Hydrocarbon and HF] (kg/sec)	Airborne HF Mass Release Rate (kg/sec)	Water Monitor Activation Time* (min)	Total Water Mass Rate** [Curtain + Monitor] (kg/sec)	Total Water/HF Mass Ratio [Water Curtain + Water Monitor]	Modified Airborne HF Mass Release Rate (kg/sec)	Percent Reduction in Airborne HF Mass Release Rate (%)
6-inch	330.0	260.0	2	183.3	0.71	260.0	0.0
1-inch	10.0	8.0	2	183.3	22.9	4.2	47.0
1/4-inch	0.7	0.5	4	183.3	366.0	0.08	84.0

* Activation time for remote monitors increased one minute to allow for rotating monitor to "hit" release location.
** Assumes only one of the four monitors (83.3 kg/sec) is fully effective in mitigating a release.

2. *Quest Consultants Inc. (1998)*

Third Study –Water Curtain

- Effectiveness of Water Sprays in Mitigation Toxic Release[3]
  - Evaluated the effect of water curtains to mitigate high pressure leaks
- Key Findings
  - Small, low-velocity MHF release:
    - Water curtains are effective (3–5 m/s releases)
    - Water curtains close to leak effective for small continuous release (< 1/8-inch puncture)
  - Large, high-velocity MHF release:
    - Water curtains close to the release point ineffective due to inadequate gas-liquid contact
    - Much larger water curtain perimeter with multiple rows of spray nozzles (> 15 – 30 meters) needed
      - ✓ Velocity of the jet must decrease to effectively remove MHF with water
    - Larger perimeter results in greater dispersion of the MHF, upper barrier needed to prevent MHF from expanding above water spray
    - Placing barriers on three sides of the pressurized tank could reduce footprint and number of spray nozzles

3. Mukherjee et al. (2018) Process Safety Progress, 37(2), 256-262.

Summary of Findings from Studies on Water Mitigation

Timing is critical to identify location of release, and activate the appropriate mitigation

(acid evacuation, water curtain, water cannon, etc.)

One water spray curtain layer is effective to rainout low velocity, small volume release

ping pong ball hits water wall and drops down

but not high velocity, large volume release

softball breaches water wall

Water to MHF ratio critical -

must design system with adequate water supply to suppress large volume of MHF

Considerations in Designing Tier II+ Water Mitigation

- Automate water mitigation system(s) upon threshold detection
- Require a combination of water cannons and water spray curtains
  - ❑ Multiple water cannons in narrow setting (high water momentum)
  - ❑ Multiple layers of water curtains
  - ❑ Large perimeter for final water curtain layer (15 – 30 m from unit)
  - ❑ Vertical or horizontal water spray configuration
  - ❑ Specific water nozzle sizes and spacing and elevation
  - ❑ Increase ratio of water to HF (e.g., 60:1[1])
  - ❑ Specify number of sensors around critical equipment

1. *Koopman (2016) HF Dispersion – Model Development, Field Experiments, and Real-World Application presentation*

Physical Barriers

Importance of Physical Barriers

Well designed system can block the spread of vapor cloud

Break the velocity of the MHF release	Protect unit from falling objects or projectiles

Lessons Learned About the Design of Physical Barriers

- HF Release at Marathon Petroleum Corporation, Texas City in 1987
  - Crane dropped heater which seared two lines at *top* of HF setter tank
  - Vapors emitted under pressure for over 2 hours
- Demonstrates a breach at the top of the settler would release MHF
  - Belly pans, instead of full enclosures, justified because they cover the up to the height of the MHF in the settler
  - Isobutane at the top of the settler thought to keep MHF from escaping and causing an autorefrigeration effect that cools the MHF and reduces the release
  - Modeling of the 1987 release demonstrated the 'autorefrigeration' effect did not reflect the actual extent of the release*

** Source: Woodward (1998), Process Safety Progress, 17(3), 213-218*

Considerations in Designing Tier II+ Physical Barriers

- Barriers to area with high volume and concentration of MHF (e.g. settler tanks, acid storage)
  - Three sides and rooftop barrier
    - Barriers break the velocity of a high velocity release
    - Barriers to include integrated layers of water curtains
    - Rooftop barrier to prevent release from expanding above water level
    - Barrier on three sides could reduce the number of water nozzles
      - ✓ Release would be blocked from dispersing in all but one direction
      - ✓ Water curtains would not be as vulnerable to the effect of winds

Next Steps

Schedule

Activity	Current Target Date
Working Group Meeting #8	July 2018
Release of CEQA Notice of Preparation/Initial Study	July 2018
Release of preliminary draft rule language	July 2018
SCAQMD Refinery Committee Meeting #3	August/September 2018
Release of CEQA Draft EIR	TBD
Governing Board consideration of PR 1410	December 2018

NOTE: Additional Working Group meetings as needed

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