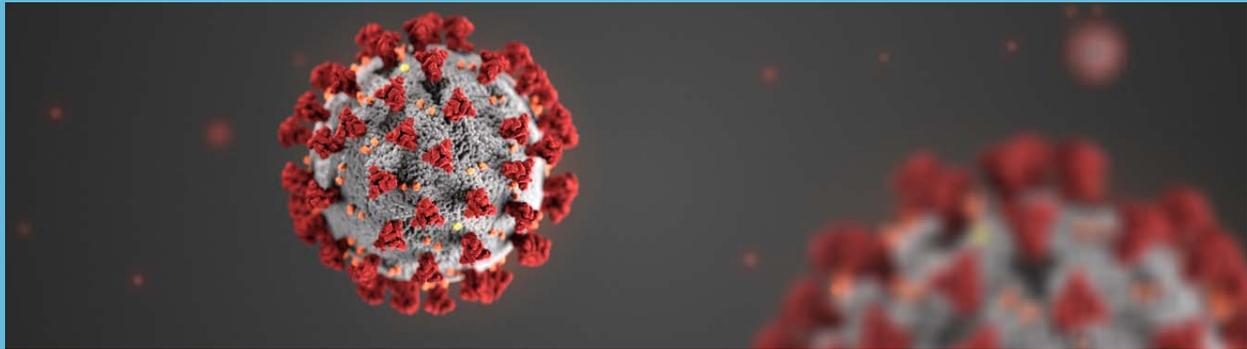


# CCPS Monograph:

## RISK BASED PROCESS SAFETY DURING DISRUPTIVE TIMES



*Graphic courtesy: Center for Disease Control*

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*INSIGHTS FOR MANAGING PROCESS SAFETY  
DURING AND FOLLOWING THE COVID-19  
PANDEMIC AND SIMILAR CRISES*

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## Executive Summary

This CCPS Monograph provides insights for managing Process Safety during and following the COVID-19 pandemic and similar crises. A CCPS task force has assembled this monograph based on their own experiences and expertise as well as input from CCPS member company representatives. The monograph is organized by the RBPS elements. Although human factors is not a RBPS elements, human factors is addressed in Process Safety Culture, Stakeholder Outreach, and Conduct of Operations. The following table identifies the insights offered in this document. Each insight is described in the monograph. The bold topics are viewed as those of highest importance.

<b>CCPS Risk Based Process Safety – with insights for disruptive times</b>		
<b>Commit to Process Safety</b>	<b>Process Safety Culture</b>	<b>Lead the crisis response</b> <b>Communicate often</b> <b>Compensate for impacts on human performance</b> <b>Build trust</b> <b>Maintain a sense of vulnerability amid the crisis</b>
	Compliance with Standards	Manage deferrals Continue to follow standards
	Process Safety Competency	Optimize on-line training Consider on-the-job learning opportunities Identify key resources
	Workforce Involvement	Engage creatively Minimize paper documentation
	Stakeholder Outreach	Communicate! Recognize support functions
<b>Understand Hazards and Risk</b>	Process Knowledge Management	Make information accessible
	Hazard Identification and Risk Analysis (HIRA)	Be flexible with HIRA Maintain control of risk decisions Evaluate effect of reduced staffing Manage increased cyber security risks
<b>Manage Risk</b>	Operating Procedures	Maintain procedures
	Safe Work Practices	Actively manage maintenance work Address new safety concerns Ensure smart devices are safe for use
	<b>Asset Integrity and Reliability</b>	<b>Use risk-based assessment</b> <b>Continue inspection, testing, and preventative maintenance</b>
	Contractor Management	Collaborate with contractors and integrate response plans
	Training & Performance Assurance	Continue basic safety training
	<b>Management of Change</b>	<b>Continue to manage change</b> <b>Recognize organizational change is key</b> <b>Anticipate organizational change</b>
	Operational Readiness	Make sure you are ready to operate
	Conduct of Operations	Maintain a sense of vulnerability Manage fatigue Focus on specific operational communications
	Emergency Management	Enact crisis management plans Maintain emergency response capability
<b>Learn from Experience</b>	Incident Investigation	Continue learning from incidents Conduct learning reviews
	Measurement and Metrics	Consider metrics specific to the crisis
	Auditing	Review audit schedule Consider remote audit capabilities
	Management Review & Continuous Improvement	Engage Management

## Introduction

This monograph is being written in early April 2020 as the COVID-19 is sweeping across the globe threatening health, lives, and businesses. We are all actively engaged to address these threats and adapt to a new way of life and work. Many organizations are providing advice for managing occupational safety and health aspects for response to the current crisis. This monograph focuses on insights for Process Safety during and following the pandemic. In the spirit of the Center for Chemical Process Safety (CCPS) Vision 20/20 “Responsible Collaboration”, CCPS is sharing ideas on how companies in our industry are adapting and leading, as these ideas may be useful to you.

The backbone of the CCPS approach to process safety is Guidelines for Risk Based Process Safety (CCPS 2007). These RBPS guidelines are applicable at all times, including challenging times. In the current situation, the RBPS approach serves as a useful framework for providing these insights for managing process safety in a disruptive environment.

Quoting the RBPS book,

“The RBPS approach recognizes that all hazards and risks are not equal: consequently, it focuses more resources on higher hazards and risk. The main emphasis of the RBPS approach is to put just enough energy into each activity to meet the anticipated needs for that activity. In this way, limited company resources can be optimally apportioned to improve both facility safety performance and overall business performance.” (CCPS 2007)

“Risk based process safety criteria. Effective efforts to improve safety must be based upon:

- An understanding of the hazards and risks of the facilities and their operations.
- An understanding of the demand for and resources used in, process safety activities.
- An understanding of how process safety activities are influenced by the process safety culture within the organization.” (CCPS 2007)

## Approach

Consider these three points in light of the current pandemic.

- The process safety hazards and risks at our facilities should be managed to an acceptable level as before the pandemic started.
- Demand for process safety support resources will continue; however, the availability of those resources may be impacted.
- If we understand the process safety culture within the organization to include, or at least be impacted by, the cultural impact of the pandemic, then this has changed significantly.

The current challenge, then, is to address RBPS needs at our facilities taking into account the current global disruption and threats on process safety resources (services, people, materials, equipment, funds). Many of us are well into that challenge. CCPS has surveyed a number of member companies to collect insights on how they are adapting to the challenge. The insights shared are presented below using the RBPS framework. Managing human performance is challenging during a crisis. Human factors including anxiety, stress, fatigue, are addressed in Process Safety Culture, Stakeholder Outreach, and Conduct of Operations.

## Pillar: Commit to Process Safety

**Element 1 - Process Safety Culture:** A positive environment where employees at all levels are committed to process safety. This starts at the highest levels of the organization and is shared by all. Process safety leaders nurture this process.

- **Lead the crisis response.** Develop and execute Business Continuity Plans (BCP), in which sustaining process safety performance remains a key success factor. Establish response teams and structures to ensure that the evolving situation is managed carefully as changes are made to business processes and resource allocation. Create and sustain a culture of “collective mindfulness” in an environment with mental distractions, working remotely, and limited frontline staffing levels.
- **Communicate often.** During times of stress, employees are interested to hear what is changing, what is not changing, and how the company is doing. Communicate frequently and in a way that is easy for the employees to understand. Conduct town halls and team meetings via conference/ video calls, post on bulletin boards, conduct toolbox talks, use social media. Keep a sense of team cohesion during challenging times. Maintain a leadership presence in the field.
- **Compensate for impacts on human performance.** Humans can manage a given mental workload level. At times like these when that workload is increased, both due to work concerns and home issues, there is an increased likelihood of distraction and mistakes. Manage the workload to maintain performance, while being cognizant of work and home demands. Allow for breaks and alternate work schedules to compensate for distractions during the normal workday.
- **Build trust.** Treat everyone with respect, fairness, and honesty; characteristics that are important to building trust and communication in any organization. Build a psychologically safe environment. This enables employees to feel comfortable in raising concerns or bringing bad news. Recognize people for identifying failures and deficient systems to build a positive feedback loop with the workforce.
- **Maintain a sense of vulnerability amid the crisis.** In the shock to the organization and the distractions of the crisis, it is very easy to lose focus. Recognize that process safety risks continue to exist and the barriers that manage them may be compromised by the crisis.

**Element 2 - Compliance with Standards:** Applicable regulations, standards, codes, and other requirements issued by national, state/provincial, and local governments, consensus standards organizations, and the corporation. Interpretation and implementation of these requirements. Includes development activities for corporate, consensus, and governmental standards.

- **Manage deferrals.** Gain approval for deferrals, with documented risk analysis, for any regulatory required studies such as PHA, PSM audit, etc.
- **Continue to follow standards.** Sites should be in core operating mode during such challenging times, and so new construction is unlikely, however, it should still follow codes and standards, including internal standards. Standards include many industry learnings from incidents that are always relevant, regardless of the business environment. US OSHA has recently published the "2020 Guidance on Preparing Workplaces for COVID-19" <https://www.osha.gov/Publications/OSHA3990.pdf> for employers to meet the Act's General Duty Clause in relation to this Pandemic.

**Element 3 - Process Safety Competency:** Skills and resources that the company needs to have in the right places to manage its process hazards. Verification that the company collectively has these skills and resources. Application of this information in succession planning and management of organizational change.

- **Optimize on-line training.** Given the current resource demands, deferring face-to-face training may be appropriate. Increase on-line training for those who have the time to do so. Employees can also work toward professional certifications including the CCPS Process Safety Certification (see this link: <https://www.aiche.org/ccps/resources/certified-process-safety-professional>). Those with certifications can catch up on CEU/ PDH hours required to maintain them. For a limited time, AIChE has made many courses free. Follow this link: <https://www.aiche.org/COVID-19#panels-pane-collapsible-boxes-collapsible-boxes>
- **Consider on-the-job learning opportunities.** Formal training provides only a fraction of learning. On-the-job learning is the largest and most impactful learning opportunity. During times like these there are special projects, response teams, and step-up roles which provide great learning and development opportunities.

- **Identify key resources.** Identify backups for key technical resources / critical subject matter experts (SMEs) who may be unavailable. Identifying key remote technical resources reminds staff of the expert technical resources that are still available who have the experience needed to resolve issues quickly and safely.

**Element 4 - Workforce Involvement:** Broad involvement of operating and maintenance personnel in process safety activities, to make sure that lessons learned by the people closest to the process are considered and addressed.

- **Engage creatively.** Involve the workforce in different ways, as many are working remotely. Consider a daily "morning coffee" or "water cooler" group call to maintain comradery and team work. Solicit suggestions from the workforce on how to improve workforce involvement remotely and to aid with current organizational issues.
- **Minimize paper documentation.** Involve workforce remotely through electronic documentation. Manage shift handover electronically to minimize contact. Utilize online logbooks accessible from remote locations.

**Element 5 - Stakeholder Outreach:** Activities with the community to help outside responders and the public to understand the plant's hazards and potential emergency scenarios and how to address these scenarios.

- **Communicate!** Stakeholders include employees, suppliers and customers, regulators, contractors, and the community. Communicate via website updates, emails, telephone calls, and through social media. Communicate with the supply chain regarding what is no longer needed and what will be needed in greater quantities or faster. Make customers aware of any changes in the availability and delivery schedule. Ensure the public that safety and the environment is still the company's primary concern and address any misinformation that may be communicated on social media.
- **Recognize support functions.** Provide extra support to internal stakeholders from HSE, HR, and purchasing, whose role may change to adapt to the crisis to support Operations effectively. Evaluate what can be deferred during this core operating mode (e.g. new hire onsite interviews). Shift responsibilities from those who are overloaded to those who now have more time.

## Pillar: Understand Hazards and Risk

**Element 6 - Process Knowledge Management:** The assembly and management of all information needed to perform process safety activities. Verification of the accuracy of this information. Confirmation that this information is correct and up to date. This information must be readily available to those who need it to safely perform their jobs.

- **Make information accessible.** Provide remote access to the process knowledge stewards, so they can remain as owners and experts for this knowledge. Address challenges of access to documents that are not online and prioritize the need to convert key documents to an accessible electronic form.

**Element 7 - Hazard Identification and Risk Analysis (HIRA):** Identification of Process Safety hazards and their potential consequences. Definition of the risk posed by these hazard scenarios. Recommendations to reduce or eliminate hazards, reduce potential consequences, reduce frequency of occurrence. Analysis may be qualitative or quantitative depending on the level of risk.

- **Be flexible with HIRA.** Consider three ways to manage HIRA (HAZOP, PHA, LOPA, etc).
  - 1) Revalidation of HIRA uses much less resources than re-doing them.
  - 2) Defer the HIRA of the lower-risk units until resources are available again.
  - 3) Conduct the HIRA using remote technology. Best practices include using video conference programs for separate sharing of P&ID and for study worksheets. Send the P&IDs electronically to participants prior to the meeting. Have good hardware and resolve communication issues early. If the HIRA cannot be conducted effectively, then it should be deferred, with appropriate approvals.
- **Maintain control of risk decisions.** During a crisis, employees will strive to respond quickly to current needs, sometimes with more discretion than during normal operating period. Make sure that decision authority impacting major risks are retained at the appropriate level in the organization. This includes allocation of personnel and financial resources supporting the barriers protecting against major accident risks.
- **Manage risks related to staffing levels.** Evaluate the effect of the reduced staffing or changing staffing configuration on the administrative controls that are credited in the HIRA.

- **Manage cyber security risks.** With much of the face to face communications being replaced with virtual communications, address cybersecurity with regard to use of VPN and remote access to files. Ensure barriers against cyber security threats are in place and monitored.

Pillar: Manage Risk presented on the next page

## Pillar: Manage Risk

**Element 8 - Operating Procedures:** Written instructions for a manufacturing operation that describes how the operation is to be carried out safely, explaining the consequences of deviation from procedures, describing key safeguards, and addressing special situations and emergencies.

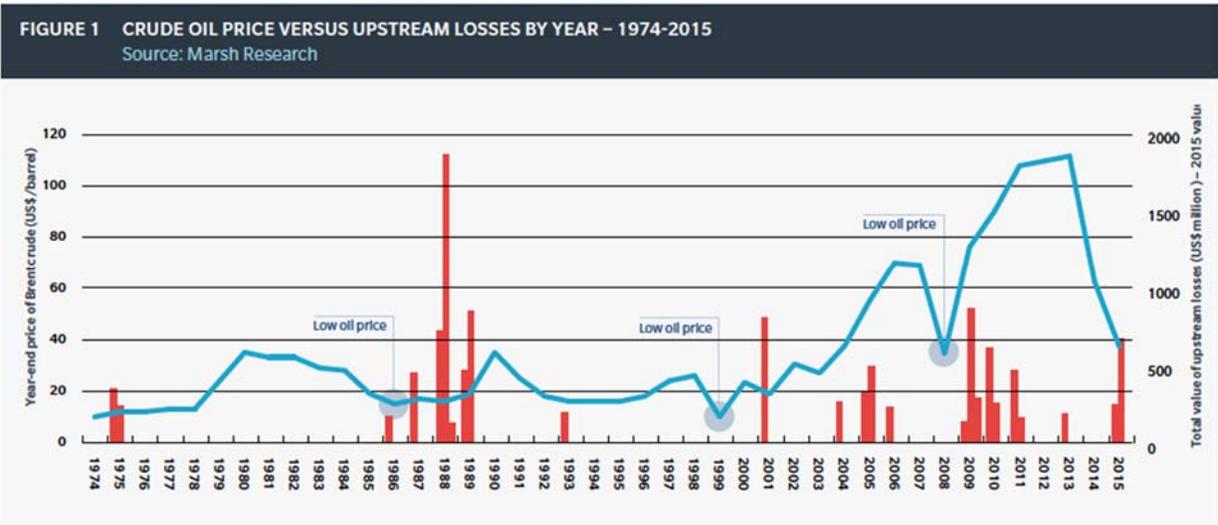
- **Maintain procedures.** Some staff may see a downturn in workload and have time to update or revalidate procedures. Provide remote access to procedures and supporting documents. Include the workforce in the review, utilizing operators who are off shift or working remotely. Designate SMEs on-call who can be contacted for support as procedures are being executed.

**Element 9 - Safe Work Practices:** Procedures to safely maintain and repair equipment such as permits-to-work, line breaking, and hot work permits.

- **Actively manage maintenance work.** Limit maintenance to safety critical equipment maintenance and essential repairs required to ensure reliability and safety. Defer high-hazard work to minimize risk of emergency. Maintain vigilance for the site's safe work, hot work, and other permit processes (e.g. equipment / safety systems.) Create a call out procedure for critical maintenance.
- **Address new safety concerns.** The crisis may introduce new concerns and associated safe work practices such as social distancing, proper hygiene, and PPE use, which should be incorporated into existing operating and maintenance procedures. This may require new approaches to doing work such as building a scaffold or repairing a pump where two people work in close proximity.
- **Ensure smart devices are safe for use.** There may be a challenge of limited personnel onsite which might encourage the use of smart devices and cameras to provide "eyes" in the field. Ensure these devices are managed by the hot work policy and/or are intrinsically safe.

**Element 10 - Asset Integrity and Reliability:** Activities to ensure that important equipment remains suitable for its intended purpose throughout its service. Includes proper selection of materials of construction; inspection, testing, and preventative maintenance; and design for maintainability.

- **Use Risk-Based Assessment.** Use risk-based inspection programs to prioritize preventative maintenance activities. Use Management of Change to assess the risk and manage any inspections that are deferred. Follow-up after the crisis to perform any inspections that were deferred.
- **Continue inspection, testing and preventive maintenance.** Reducing ITPM may be appropriate; however, reduction or elimination of maintenance activities will have a long-term impact if not properly managed. Pay critical attention to across the board budget cuts associated with asset integrity activities. Reductions should be focused on specific equipment and the risk assessed, long-term consequences examined, and managed using the MOC process. Deferrals, and their impacts, may continue after the crisis has ended. The graph below shows after each time oil price fell; process safety incidents increased. This is likely a result of a reduction in asset integrity spending during periods of low oil price in order to reduce expenditures. This is a lesson to learn.



Courtesy: *Marsh 100 Largest Losses 1974 - 2015*, Marsh & McLennan, 2016

**Element 11 - Contractor Management:** Practices to ensure that contract workers can perform their jobs safely, and that contracted services do not add to or increase facility operational risks

- **Collaborate with contractors and integrate response plans.** Maintain clear and frequent communications with both resident and non-resident contractors. Share resources with neighboring sites where appropriate to perform critical work. Maintain the proper level of safety awareness training for contractors, who may be new to the site, despite the operational disruption. Integrate response plans to support an effective response.

**Element 12 - Training and Performance Assurance:** Practical instruction in job and task requirements and methods for operation and maintenance workers, supervisors, engineers, leaders, and process safety professionals. Verification that the trained skills are being practiced proficiently.

- **Continue basic safety training.** Provide basic safety, including process safety, and job training for new employees and contractors as they come on site.

**Element 13 - Management of Change:** Process of reviewing and authorizing proposed changes to facility design, operations, organization, or activities prior to implementing them, and that the process safety information is updated accordingly.

- **Continue to manage change.** Most incidents have a management of change factor amongst the causes. Consider whether or not the change is a priority at this time. Be proactive in understanding the short-term and long-term implications of decisions. Minimize team time at risk while ensuring change is properly reviewed.
- **Recognize organizational change is key.** Manage the organizational change carefully and understand risks. Make sure that as people move, leave, step-up, it is clear who is in charge. Watch for the small, but important, tasks that can easily be overlooked. Verify personnel competencies as people move into new assignments/roles. Leaders should plan for the longer term and consider the organizational changes, and their impact, through the recovery stage and into normal operations.

- **Anticipate organizational change.** Anticipate employees being on sick-leave or unavailable due to 'self-isolation' and identify back-ups for key roles. Consider how people in self-isolation can work remotely on other tasks to take the workload off those that are at the job site.

**Element 14 - Operational Readiness:** Evaluation of the process before start-up or restart to ensure the process can be safely started. Applies to restart of facilities after being shut down or idled as well as after process changes and maintenance. Also applies to start-up of new facilities.

- **Make sure you are ready to operate.** Perform operational readiness checks with the competent personnel prior to startup of units that are shut down. Minimize team time at risk while ensuring PSSRs are fully completed. Ensure completion of actions identified during the readiness review. While the majority of the team may be working remotely, a core team must be onsite to conduct the review.

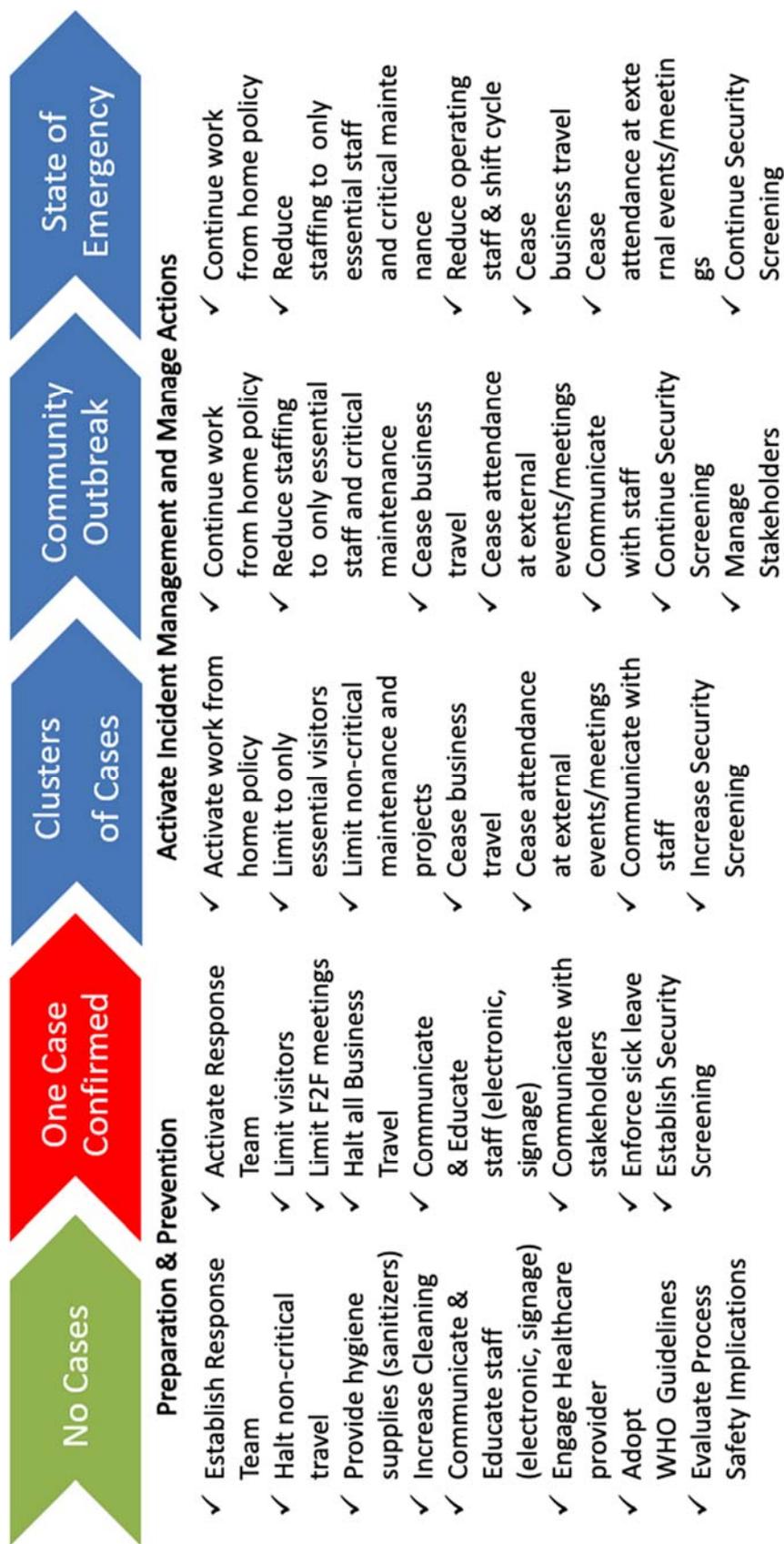
**Element 15 - Conduct of Operations:** Means by which management and operational tasks required for process safety are carried out in a deliberate, faithful, and structured manner. Managers ensure workers carry out the required tasks and prevent deviations from expected performance.

- **Maintain a sense of vulnerability.** Pay particular attention to non-routine operations as these require more attention – which may be a challenge due to increased workload, fatigue, and distraction due to the crisis. These non-routine operations could include catalyst changeout, changeover to a different product slate, or a turndown in throughput. Focus on changes that can take the process out of its safe operating envelope. Leaders should reinforce maintaining this sense of vulnerability through their communications.
- **Manage fatigue.** Address fatigue due to personal situations, reduced staffing, changing shift cycles, and increased responsibility. Build schedules that include rotation of personnel to avoid burn out and fatigue due to work.
- **Focus on specific operational communications.** Specific activities such as shift change, shift instructions, and shift meetings take on additional importance given the many changes during the crisis. Communicate clearly. Make sure equipment and maintenance status is clear for the next shift.

**Element 16 - Emergency Management:** Plans for possible emergencies that define actions in an emergency, resources to execute those actions, practice drills, continuous improvement, training or informing employees, contractors, neighbors, and local authorities, and communications with stakeholders in the event an incident does occur.

- **Enact crisis management plans.** Many companies surveyed had a pandemic on their risk matrix and had crisis management plans to address this. Update the plans as new threats and means to address those threats are identified. An emergency response overview is provided in the following graphic.
- **Maintain emergency response capability.** Ensure that the minimum number of response personnel are available for emergency response. Coordinate with mutual aid groups to supplement response staffing and coordinate response capabilities. Coordinate emergency equipment procurement and distribution at a corporate level. Consider the challenges of team assignments keeping in mind the need to self-isolate due to exposure or illness.

Graphic on following page



CCPS member company generalized response framework

## Pillar: Learn from Experience

**Element 17 - Incident Investigation:** Process of reporting, tracking, and investigating incidents and near-misses to identify root causes, taking corrective actions, evaluating incident trends, and communicating lessons learned.

- **Continue learning from similar incidents.** Other organizational failures or disasters provide important lessons. Flixborough, LaPorte, and Longford all had elements where Operations did not utilize expertise and technical resources. In a pandemic or crisis where support staff is working remotely, it is critical to maintain communication to manage normal and abnormal situations.
- **Conduct learning reviews.** Share incident reports or external industry alerts (e.g., Process Safety Beacon) virtually across the site(s) and proactively identify potentially similar deficiencies, to spot issues in advance. Consider how could this event happen and what corrective actions are needed before the incident occurs.

**Element 18 - Measurement and Metrics:** Leading and lagging indicators of process safety performance, including incident and near-miss rates as well as metrics that show how well key process safety elements are being performed. This information is used to drive improvement in Process Safety.

- **Consider metrics specific to the crisis.** It is important to maintain/update metrics during the crisis. Much of the data collected for metrics is usually available through online systems. It may be appropriate to create new metrics for use during the crisis such as performance of IT systems supporting remote working, or participation in group telecoms to boost comradery.

**Element 19 - Auditing:** Periodic critical review of process safety management system performance by auditors not assigned to the site to identify gaps in performance and identify improvement opportunities, and track closure of these gaps to completion.

- **Review Audit schedule.** During the crisis may not be an appropriate time to bring additional people on site and potentially distract busy staff. Manage deferrals of internal and regulatory audits. Although audits may be deferred, continue to self-verify that work is done correctly and safely.

- **Consider remote audit opportunities.** Consider the opportunity to conduct some portion of audits during this time, such as review of incidents, procedures, process knowledge documents, and other online information. Continue the onsite portion of the audit after the crisis, when personnel availability is improved.

**Element 20 - Management Review and Continuous Improvement:** The practice of managers at all levels of setting process safety expectations and goals with their staff and reviewing performance and progress towards those goals. May take place in a staff or “leadership team” meeting or one-on-one. May be facilitated by process safety lead but is owned by the line manager.

- **Engage Management.** Leadership must maintain a process safety focus. Meet regularly with management and leadership to ensure the communication of new expectations and safe conduct of operations during this time. Team cohesivity is important during times of isolation and uncertainty.

## References

CCPS 2007. Guidelines for Risk Based Process Safety, Center for Chemical Process Safety, American Institute of Chemical Engineers, New York, NY, 2007.

This monograph was created by a sub-committee of CCPS members with oversight by Dr. Anil Gokhale, Director, CCPS Projects. The team was initiated by Ramesh Harrylal, The National Gas Company of Trinidad and Tobago Ltd. and included Jerry Forest, Celanese; Elliot Wolf, Chemours; Jennifer Bitz, CCPS; and Cheryl Grounds, CCPS. It is made available for use with no legal obligations or assumptions (i.e. Use at your own risk). This monograph was reviewed by Louisa Nara, CCPS Global Technical Director. Corrections, updates, additions, and recommendations should be sent to Dr. Gokhale at [anilg@aiiche.org](mailto:anilg@aiiche.org).

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