

CORPORATE REQUIREMENT

Dow's Corporate Environment, Health & Safety Requirements states:

"Each location shall have an appropriate and active program for reactive chemicals. Regular reviews of process reactive hazards shall be required for existing processes, new processes and whenever key personnel or a process is changed, as well as a thorough review of laboratory or pilot plant data prior to scale-up. References: Guidelines for a Reactive Chemical Program, Guidelines for Management of Change, and Loss Prevention Principle (LPP) 1.7"

The Reactive Chemicals Program shall be a "preventive program" which strives to ensure an understanding of the reactive chemicals hazards and knowledge of how to control them. This program applies to new, modified, or existing processes.

The keystone of Dow's "Reactive Chemicals Program" is the concept of "owner responsibility." Specifically, the "owner" of a material or process must obtain sufficient information to assure safe operation. These responsibilities include:

- Knowing the properties of the chemicals being used and their potential for uncontrolled reactions.
- Providing protection from the possibility of unexpected reactions with suitable procedures, protective devices, facility design, shielding or other lines of defense.
- Keeping quantities of reactive chemicals to a minimum.
- Obtaining reactive chemicals data on materials used in the process (including maintenance materials and materials of construction) and interpretation of that data in the context of the specific process conditions.
- Ensuring that any process change is reviewed by the location Reactive Chemicals Review Committee or Loss Prevention.
- Ensuring that when other persons or groups of people are involved in their area that they are aware of the hazards.
- Reporting all Reactive Chemicals Incidents to the location management and the Reactive Chemicals Committee within 48 hours.
- Ensuring appropriate reviews are conducted for all operations and functions.

Controlled copy found in VAX system
\$ SAFETY
Cpt. 18 Rx Chem

Controlled Copy on VAX
\$ SAFETY
Opt. 18 Rx Chem.

EXPECTATIONS/BEHAVIORS

The basis of Dow's Reactive Chemicals program is OWNER RESPONSIBILITY. The owner is defined as the Dow person directly responsible for the chemical material(s), process, system, and related operations. The owner is responsible for the safety of chemical handling, operating, and maintaining the process.

AREA MANUFACTURING/SERVICE EXCELLENCE TEAM

Expectation: Establish and reinforce culture and or process that eliminates Reactive Chemicals incidents. Uniform LAD Process

Behaviors:

1. Provide resources as required to implement process.
2. Audit and/or measure process effectiveness. (Coordinated by Safety Superintendent)
3. Provide positive and negative reinforcement.

TECHNOLOGY CENTER MANAGER/REPRESENTATIVE

Expectation: Be the repository of Reactive Chemicals data base.

Behaviors:

1. Establish/develop "Vital Reactive Chemicals Information" for the technology.
2. Collect, store, and distribute Reactive Chemicals Information specific to the technology or process.
3. In conjunction with plant superintendent, develop Reactive Chemicals training package for annual plant training and quarterly reviews (focus on "Vital Reactive Chemicals Information").
4. Involve appropriate knowledgeable people (e.g. sister plant superintendents and/or others identified by Technology Centers) in Reactive Chemicals reviews.
5. Communicate incidents that occur inside and outside of Dow that are pertinent to a plant. (This should be the responsibility of the Tech Center.)

Expectation: Understand in depth the Reactive Chemicals concerns/issues of the technology. Be a consultant for all chemical issues of the technology.

Behaviors:

1. Mandatory participation in audits/reviews. Provides input for structuring the reviews and assembling correct resources.
2. Answers Reactive Chemicals questions, relative to technology issues.

REACTIVE CHEMICALS COMMITTEE CHAIRMAN/COMMITTEE

Expectation: Manage Division review process efficiently.

Behaviors:

1. Insure that review schedules are based on severity potential.
2. Manage review schedules.
3. Check for deployment of critical knowledge within all levels.
4. Establish mix and number of people for proper review.
5. Report progress and goals periodically to SLT.
6. Develop agenda items.
7. Ensure formal review reports are sent out one week prior to review. Develop and maintain KPI's for Reactive Chemical process.

Expectation: Provide consultation for Reactive Chemicals issues.

Behaviors:

1. Produce and distribute a Reactive Chemicals manual for the LAD.
2. Participate in Reactive Chemicals incident investigations.

DO 072102
CONFIDENTIAL

3. Provide capital project concurrence that involves chemical reactivity or process changes.
4. Answer Reactive Chemicals Questions.
5. Communicate local incidents and the lessons learned.
6. Procure resources needed to meet Reactive Chemicals testing needs.
7. Coordinate sharing of Reactive Chemicals learning experiences within the division.
8. When applicable, communicate pertinent information with other plants/departments with similar unit operations.

PLANT SUPERINTENDENT

Expectation: The plant superintendent will assume ownership and accountability for the Reactive Chemicals process. A sustainable culture will result that eliminates Reactive Chemicals incidents.

Behaviors:

1. Provide leadership to insure proper emphasis of the Reactive Chemicals process in the plant.
2. Insure that adequate resources are available for Reactive Chemicals process. (Training Module in place for his/her department)
3. Insure that Reactive Chemicals process fulfills the requirements of Operating Discipline.
 - MOC - Proper review, approval and documentation of changes.
 - Process Technology Documentation - Availability of R&D reports, documented process chemistry, experts/resources listed, process description, piping specs, P&ID's, M&EB's, product, raw material specifications, design criteria, safe operating ranges, materials of construction, instrument specs, design basis for safety systems, learning experiences and incidents, (some of this from tech center), worst case scenarios, potential energy.
 - Training - Adequate training modules with proficiency demonstration and documentation, defined refresher frequencies.
 - Safety Process - PHA's (risk analysis) as appropriate, communication system, three year reviews and incident investigations, measurement of progress toward goals, contractor communications, system for tracking follow up action.
 - Process Risk Management - operability of control systems, critical instruments systems, drills.
 - Operating Procedures - Reactive Chemicals material included in appropriate procedures, procedural requirement, maintenance procedures.
 - Process Control - Reactive Chemicals concerns and included in control strategy.
 - Process Information - Adequate Alarm system.
 - Policies and Procedures - Procedures for identifying and tracking raw materials, inspecting handling storage, and packaging equipment.
 - Environmental - Procedures include Reactive Chemicals concerns for wastes.

Expectation: Each plant superintendent will have a thorough knowledge of the his/her area of responsibility.

Behaviors:

1. Demonstrate his/her knowledge by completing the Reactive Chemicals IPT module for the plant, by conducting the new superintendent review, and by taking an active part in all other Reactive Chemicals reviews. The knowledge obtained by the superintendent will include:
 - Knowledge of the "Vital Reactive Chemicals Information" for his/her processes.
 - Knowledge of the Reactive Chemicals Control Systems. (Hardware, software, procedures) for his/her processes.
 - Knowledge of the material contained in the plant's annual training.

- Knowledge of the location of test data for "non-vital reactive chemicals information" issues.
- 3. Deliver packet of information for Reactive Chemicals review two weeks prior to review, or the review is delayed.

PRODUCTION SUPERVISOR

Expectation: Each production supervisor will have a thorough knowledge of the Reactive Chemicals potential in his/her area of responsibility.

Behaviors:

1. Demonstrate his/her knowledge by completing the Reactive Chemicals IPT module for the plant.
2. The knowledge obtained by the production supervisor will include:
 - Knowledge of the "Vital Reactive Chemicals Information" for his/her processes.
 - Knowledge of the Reactive Chemicals Control Systems. (Hardware, software, procedures) for his/her processes.
 - Knowledge of the material contained in the plant's annual training.
 - Knowledge of the location of test data for "non-vital reactive chemicals information" issues.

Expectation: The production supervisor will implement the Reactive Chemicals process within his/her plant.

Behaviors:

1. Implement the Reactive Chemicals process in the plant.
2. Participate in plant Reactive Chemicals reviews.
3. Insure that all reports are adequately trained in Reactive Chemicals issues.
4. Assess Reactive Chemicals impact of moderate plant changes (procedures, software, hardware, raw materials, etc.) through the MOC process and assures they are adequately addressed.

PLANT ENGINEER

Expectation: Each plant engineer will have a thorough knowledge of the Reactive Chemicals potential in his/her area of responsibility.

Behaviors:

1. Demonstrate his/her knowledge by completing the Reactive Chemicals IPT module for the plant.
2. The knowledge obtained by the plant engineer will include:
 - Knowledge of the "Vital Reactive Chemicals Information" for his/her processes.
 - Knowledge of the Reactive Chemicals Control Systems. (Hardware, software, procedures) for his/her processes.
 - Knowledge of the material contained in the plant's annual training.
 - Knowledge of the location of test data for "non-vital reactive chemicals information" issues.

Expectation: The plant engineer will assist in implementing the Reactive Chemicals process within his/her area.

Behaviors:

1. Assist in training others in the Reactive Chemicals issues in their area of responsibility.
2. Participate in plant Reactive Chemicals reviews and adequately address issue identified in the review.
3. Assess Reactive Chemicals impact of plant changes (procedures, software, hardware, raw materials, etc.) in their area of responsibility through the MOC process and assure they are adequately addressed before implementation.
4. Update the Reactive Chemical IPT training module for their area of responsibility as new knowledge/experience is available.
5. Coordinate any Reactive Chemicals testing requirements.

OPERATIONS SUPERVISOR

Expectation: Obtains a working knowledge of Reactive Chemicals that will allow them to raise a "red flag" to new/changing situations.

Behaviors:

1. Successfully complete the IPT Reactive Chemicals training module.
2. Understand the worst case scenarios ("Vital Reactive Chemicals Information") and lines of defense that exist in the plant.
3. Participate in Reactive Chemicals reviews.
4. Review minor changes for Reactive Chemicals impact.
5. Intervene to stop incidents before they develop.

Expectation: Develop operators to understand complexities of Reactive Chemicals concerns for the process/plant.

Behaviors:

1. Reinforce operator behaviors related to understanding Reactive Chemicals issues. Reinforce operator intervention on Reactive Chemicals issues. Reinforce usage of operating discipline (especially following procedures).
2. Be involved in Reactive Chemicals incident investigations when available (to improve Reactive Chemicals comprehension).

Expectation: Ensure that proper deployment of training is given to all operators.

Behaviors:

1. Complete all required Reactive Chemicals training.
2. Participate in quarterly (regularly scheduled) interactive Reactive Chemicals training with operators.

OPERATOR

Expectation: All operators are properly trained in the Reactive Chemicals area. They sufficiently understand the complexities of Reactive Chemical concerns for their process/plant, allowing them to raise a "red flag" to new/changing situations.

Behaviors:

1. Successfully complete the IPT Reactive Chemicals training module.
2. Complete all required Reactive Chemicals training.
3. Participate in quarterly (regularly scheduled) interactive Reactive Chemicals training.
4. Pass minimum expectations for their particular job.
5. Be involved in Reactive Chemical incident investigations, when available (to improve Reactive Chemical comprehension).
6. Intervene to stop incidents before they develop.
7. Understand the worst case scenarios ("Vital Reactive Chemicals Information") and lines of defense that exist in the plant.
8. Participate in Reactive Chemical reviews (checking for deployment of knowledge), when available.
9. Utilize MOC and other appropriate operating discipline sections in all aspects of the job.

Controlled Copy on VAX
\$ SAFETY
Opt. 18 RXchem.

THE REACTIVE CHEMICALS REVIEW PROCESS

(-----

THE REACTIVE CHEMICALS THOUGHT PROCESS

The thought process, shown below, addresses areas that need to be examined in preparation for the Process Review. The focus of reactive chemicals concerns can be quite different for the various functions. Therefore, it is necessary that each group anticipating a review, consider the impact of potential hazardous reactive chemicals situations. This thought process is appropriate for process changes, project reviews, mini reviews, consolidated audits, and all aspects of the management of reactive chemicals.

The significance of the twelve areas outlined below will vary from one operation to another. Use these areas as a checklist to provoke questions about your process. Include in your package your responses to these issues. They are designed to cause you to think about the potential energy of your system and the conditions of its release.

The thought process is one of stimulation: It should assist your group's continuous improvement of its reactive chemicals awareness.

1. Review the entire Louisiana Division Reactive Chemicals Program Manual. (Safety Menu on the VAX)
2. Review the status of action items from the prior audit or review.

(Describe the PROCESS CHEMISTRY; the following areas should be addressed:

HEATS OF REACTION: [Calculate maximum temperature rise(s) from reactive chemicals data.] Even though this represents an important part of the process knowledge, they are often left out, incorrect, or not known. Heats of reaction are basic data required for worst case scenarios. Include the data for delta Heat of reaction in the process flow sheet display of Reactive Chemicals data and in the chemistry for the principle reactions. Use consistent units throughout; do not mix joules/gm, BTU/lb mole, BTU/lb, kcal/mole.

INDEX FLOW SHEETS WITH TEST DATA: Develop a schematic or block diagram (an index flow sheet works well here) showing flows of chemicals and key process steps. Show the points where reactive chemicals testing has been done. List the tests and the data as a summary, giving Exotherm onset temperature, maximum temperature and total energy. The operating and maximum temperatures should also be shown on the diagram so that they may be compared with the reactive chemicals data. Not all tests will be shown on the process flow sheet, e.g., sawdust and chemicals.

POTENTIAL ENERGY: The potential energy available from mechanical sources (such as pressure) and from chemical sources must be evaluated. The potential chemical energy is considered to be the worst case recombination of the atoms present to release the maximum amount of energy. This is normally a conservative assessment but follows the evaluation of potential hazards in the event of safety precautions do not perform appropriately. This potential chemical energy is often evaluated using computer programs such as CHETAH or AUISE.

RAW MATERIAL IDENTIFICATION: Describe how confirmation of chemical identity is accomplished, such as lab chemical analysis procedures used. Consider the source of materials and likelihood of receiving "look-alike" chemicals from

supplier.

MATERIAL BALANCE: The index flow sheet will yield sufficient detail. This information is used to determine areas of need for reactive chemicals information.

WASTE DISPOSAL: Describe the fate of waste generated during the process. Include absorbents used to handle spills, the testing performed to determine suitability, and procedures used to dispose of all waste materials, including temporary in-block storage procedures. Describe the venting and header system(s) that connect the process overheads to prevent incompatible mixing.

MATERIALS OF CONSTRUCTION: Outline procedures for maintaining integrity of materials of construction supplies. Describe confirmation of identity, if appropriate.

4. Describe the **PROCESS CONDITIONS**, highlighting the main process(es). Pay particular attention to the following areas of concern:

Side reactions, including impact of water, ambient temperature extremes
Catalysts, desired and undesired
Inhibitors
Relief devices
Raw materials storage

Compare the reactive chemicals test results with the unit's process condition, i.e., compare temperatures and extremes to onset temperature of the thermal event. Are any chemicals scenarios apparent?
Be prepared to discuss.

5. Review the **RAW MATERIALS** and **PRODUCTS** for Reactive Chemicals data on storage of these materials. Describe any information, relating to storage needs of the product, that the customer should be made aware. Has the appropriate data been obtained for product made in commercial quantities?
6. Review status of the **COMPATIBILITY CHART**; revise to reflect changes in the process. Existing charts will be audited for completeness and relevance of the data. If a new chart is needed, contact Reactive Chemicals Testing for assistance. Use the computer program **CHEMPAT** to generate the compatibility chart.
7. Describe the **MANAGEMENT OF CHANGE PROCESS** system in place for the process under review.
8. Review the **TRAINING** programs for Reactive Chemicals that are used in the block. Describe the training modules and the worst case scenarios drills used to train personnel.
9. The **HAZOP** (Hazard and Operability) study is a flexible technique for process safety and reliability analysis. Describe any HAZOP analyses, or other hazard evaluation processes, that have been performed, or are planned.
10. Review, and include in the package, **WORST CASE SCENARIOS** for the process. Consider the plant's **INCIDENT HISTORY**. Use the HAZOP approach, where appropriate, to review the following areas:

CHEMICALS - process and those not directly involved in manufacture. In particular, review the presence of heels, the impact of low/high flow rates and backflow, the presence and/or absence of catalyst and

inhibitors, the potential for peroxide formation, and the effect of variation in composition.

EQUIPMENT - performance deviations. In particular, review the impact of failure in high cells, relief systems, agitators, static mixers, exchangers, pumps, scrubbers, critical instruments. Review the possibilities of too high or too low pressure, temperature, and/or flow

UTILITIES - total and partial loss; include pipeline sources of raw materials.

STARTUP/SHUTDOWN/TURNAROUND - Review special concerns and scenarios. Show calculations to support your worst case scenarios, for example adiabatic temperature rise.

Review your AREAS OF CONCERN; be prepared to discuss these as an integral part of the review process.

11. Review LINES OF DEFENSE in light of the worst case scenarios described in the previous section. Lines of defense are provided by integration of the following types of activities into the plant's operations:

- Training
- Monitoring equipment
- Alternate strategies in the program code
- Instrumentation, such as on-line analytical or critical instruments
- Raw material analysis and confirmation
- Material handling procedures

Include in the package WORST CASE SCENARIOS and describe the LINES OF DEFENSE set up to handle the situation. Stress the interpretation of your answer(s). Use HAZOP and/or incident histories as a source of scenarios.

12. Use the "Review of Reactive Chemicals Concerns" to think through the state of the plant's program in the areas addressed in the document. That section is not a questionnaire to be answered in a 'yes/no' mode. Rather, the intention of it is to stimulate (re-)examination of areas of the process that have the potential for an incident. It is also a tool to assist in review preparation. Include your written comments and observations to "Review of Reactive Chemicals Concerns" in the review package.

STRATEGY FOR REACTIVE CHEMICALS REVIEWS

All reactive chemicals reviews are comprised of these major steps:

- Reactive chemicals thought process.
- Review of reactive chemicals data for relevance and integrity.
- Preparation and delivery of package to Reactive Chemicals team members who will attend the audit or review.
- Formal presentation of review package.
- Discussion of reactive chemicals concerns.
- Recommendations letter, action plan response, implementation of findings.

The nature and extent of each section is determined by the particular review.

Other sections of this manual provide overviews and details of the Reactive Chemicals thought process, how the review will be conducted, and what follow-up actions may be taken.

TYPES OF REACTIVE CHEMICALS REVIEWS

Safety and Loss Prevention Standard S-315, Reactive Chemicals, outlines several situations where a reactive chemicals review is required. These situations are covered by the following review types:

CONSOLIDATED AUDIT/THREE-YEAR PROCESS REVIEW

The reactive chemicals consolidated audit is a part of the consolidated audit procedure for production plants. The reactive chemicals audit usually occurs during the morning of the third day of the consolidated audit. Operations outside the scope of the consolidated audit system also have three-year process reviews. These include research groups, pilot plants, TS&D, and some utility groups.

Focus of the periodic Reactive Chemicals review will be:

- To ensure adequacy of training and deployment of understanding
 - To ensure proper depth and breadth of Reactive Chemicals Operating Discipline
1. To insure that sufficient emphasis is placed upon the periodic Reactive Chemicals audit, the Reactive Chemicals Committee shall set a specific audit frequency for each department, with SLT approval. The review frequency should be a minimum of three years.
 2. Plant staff should participate, where appropriate as determined by the superintendent, in the review process.
 - Check for deployment of understanding and adequacy of training:
 - Review procedures for Reactive Chemicals concerns
 - Review IPT tests for Reactive Chemicals concerns
 - Conduct personal interviews with all levels of plant staff
 - Pose "what if" scenarios to check for correct responses
 - Review training records
 4. Check for Reactive Chemicals Operating Discipline:
 - Prevention and mitigation of key scenarios
 - Controls
 - Alarms
 - Procedures
 - Information and data agree with Tech Center recommendations
 5. Plant superintendent will ensure that follow-up activity is done in a timely fashion.

NEW SUPERINTENDENT REVIEW

The new superintendent review occurs within three months of that individual's appointment. The intention of this review is to determine the familiarity the new superintendent has with the reactive chemicals concerns and issues of the unit. The review also provides the superintendent with the opportunity to revise the reactive chemicals data relevant to the unit. Prior to superintendent "completing" the Reactive Chemicals IPT for his/her plant, Tech Center Manager will co-sign level three MOC's.

New Superintendent Review Process

Focus of the New Superintendent Review will be to ensure that the new superintendent demonstrates sufficient knowledge base of Reactive chemicals for his/her operating unit.

1. Business manufacturing leader will be invited.
2. Superintendent will demonstrate satisfactory knowledge of the behavioral

items listed in the superintendent expectations and behaviors section of this manual.

3. Co-Chairman and superintendent's manager or coach will determine the follow-up action required, if any (i.e., satisfactory, further specific review follow-up required, etc.).
4. Superintendent shall present the review.
5. Area engineers and operations supervisors shall attend, where possible, to increase their Reactive Chemicals awareness

CAPITAL AUTHORIZATION REVIEW

This is a review of any capital authorization project that may have reactive chemicals concerns. Committee co-chairperson should be contacted a few weeks before the review to allow time for completion of any reactive chemicals testing that may be necessary.

PHASE III PACKAGE REVIEW

Major projects are reviewed at several points during the preparation of the package. During the earlier reviews, the overall reactive chemicals concerns should be determined and appropriate test data collected. Generally, by the time the Phase III review is conducted, the project has reached a stage where sufficient engineering is complete for the process to be well defined. The Phase III review generally covers more details of the project.

MANAGEMENT OF CHANGE REVIEW

This review is conducted before any significant change is made in the process which may affect its chemical reactivity (pressure, temperature, catalyst, materials of construction, raw materials, etc.). Project Review: Plant superintendent will coordinate with Reactive Chemicals Committee and Technology Center to determine magnitude of review needed for the specific project in question.

REACTIVE CHEMICALS INCIDENT INVESTIGATION

In the event of a reactive chemicals incident, the investigation should be conducted as soon as possible after the incident is under control. Members of the Reactive Chemicals Committee should be involved in all aspects of the incident investigation. Notify a Reactive Chemicals committee co-chairperson after an incident has occurred.

WASTE HANDLING REVIEW

This review is conducted before any significant change is made in how a chemical waste is handled from when it is generated until its final disposal.

REACTIVE CHEMICALS REVIEW AGENDA

The reactive chemicals review meeting will comprise of the major steps, described below. The emphasis level and attention placed on each step will vary for each type of review. Prepare a presentation to cover the package submitted to the Review Team four weeks prior to the review meeting. A general outline of the presentation is given below; the exact nature of the presentation will depend on input from the plant's Reactive Chemicals committee consultant as to what areas of the Reactive Chemicals program should be emphasized. Remember, the audit team will have already reviewed the package and does not need to have a verbatim presentation of it at the audit meeting.

- A. PROCESS CHEMISTRY: Summarize the contents of the package pertaining to the process.
- B. LETTER OF RECOMMENDATIONS: Review status from the previous review (or

audit), thereby completing that correspondence.

- C. SCENARIOS & LINES OF DEFENSE: Review past incidents in the technology (brief descriptions only); present at least two worst case reactive chemicals scenarios derived from HAZOP or other hazard identification procedures for your process; present your lines of defense as reviewed in the package.
- D. CONTINUOUS IMPROVEMENT ITEMS: Discuss items and/or areas for improvement that have emerged during the preparation for the review.
- E. QUESTIONNAIRE BY EXCEPTION: results of your review of the process using the "Reactive Chemicals Questionnaire ". This is not a question and answer session, but a forum for discussing your thoughts on plant reactive chemicals concerns stimulated by this document.
- F. PRE-REVIEW RESPONSES: Discuss the responses from the Committee arising from the pre-audit review of your package. Cover those items that have not been referred to in A through E, as requested by the Committee during the review.

POST REVIEW ACTIONS

A Committee co-chairperson will send a letter of recommendations to appropriate individuals. A copy of this letter is also sent to the plant superintendent and major manager. A response to the letter is required within 60 days of receipt of the recommendations letter for a consolidated audit and within 30 days for other reviews. The response should address each recommendation indicating actions that will be taken, and a timetable for completion of those actions. Since these are recommendations, rather than requirements to act on, it is not required that the respondent take the recommended action noted in the letter. However, it is required that a response is given to each recommendation. If a recommendation is not followed, give the rationale for not following the recommendation. Often alternative actions are appropriate.

[EOB]