

**Louisiana Division
Consolidated Audit**

**Hazardous
Materials
Transportation
Review**

March 1991

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Dow U.S.A.

Louisiana Division
March 1991

The Dow Chemical Company
P.O. Box 150
Plaquemine, Louisiana 70765-0150

To: Plant Superintendent/Department Head

**SUBJECT: HAZARDOUS MATERIALS TRANSPORTATION
REVIEW (HMTR)**

The HMTR audit will be part of the Louisiana Division Consolidated Audit Process. The audit will be the responsibility of the Superintendent/Department Head.

The purpose of this audit is to provide an in-depth review of our Louisiana Division hazardous materials transportation practices of materials which, if released, could possibly cause injury to the public. The audit will be reviewing the chemicals shipped or received, including the plant's waste materials with a Hazardous Materials Transportation Index (HMTI) of 2, 3, or 4. (Does not include pipeline transportation).

You should begin your preparations by reviewing the attached program guidelines and developing or updating the HMT Indexes for your plants' various chemicals and potential loss of containment from worst case transportation scenario. You will need to complete and send a copy of the review package to the Audit Facilitator ten (10) calendar days prior to the audit.

A HMTR Audit Team is required for a HMTI of 2, 3, or 4. A U.S. Area Loss Prevention Representative will be required for a HMTI of 3, or 4. A HMTI of 1 requires a review by the Superintendent and his Manager only.

NOTE: Prompt response to the HMTI calculations is necessary. A 30 day pre-audit notification to the U.S. Area will be necessary for some materials. Contact Dean Smith at extension 8879 for U.S. Area Loss Prevention Representatives as audit team members (required for HMTI's of 3 or 4). Dean should also be contacted for a Functional Audit Team if the HMTI of materials is 2, 3, or 4.

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The list of contacts below can be used as additional resources.

Ind. Hygiene	Gary Meier	1809
Purchasing	Randy Normand	8481
Loss Prev.	Buck Bailey	1539
HMTI	Dean Smith	8879
CEI	Jim Gibson	8163
F&EI	Maurice Oubre	8953
Safety	Don Jones	6097

Attached are the "Guidelines for a Hazardous Materials Transportation Review ", including the Audit Instructions which give the details about what is needed to prepare for the audit and how the audit will be conducted. If there are any questions concerning the audit, please contact me at extension 8879.

Dean Smith
HMTR Functional Team Leader
Building 3302D
Ext. 8879

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**GUIDELINES FOR A
HAZARDOUS MATERIALS
TRANSPORTATION REVIEW**

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INTRODUCTION

This document is intended to aid in the set-up and execution of Hazardous Materials Transportation Review. Similar to Process Hazard Reviews currently conducted in Dow plants, the Hazardous Materials Transportation Review will address another area of safety - hazardous materials transportation practices.

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WHAT IS A HAZARDOUS MATERIALS TRANSPORTATION REVIEW?

The objective of a Hazardous Materials Transportation Review is to anticipate and prevent, through a complete evaluation of transportation modes and various chemical properties, incidents which may cause loss of containment of a chemical while being transported.

While each review will vary with the nature of the product and the transportation requirements, a general outline is as follows:

- * Review loading and securement procedures. Do not limit to Dow internal procedures, but include Dow carriers, customer procedures used to secure "empties" returned to Dow, and procedures used by third party personnel involved with swapping, tolling, or repacking operations performed for Dow.
- * Examine in-route procedures. Carefully review regulatory requirements, routing practices, emergency procedures, and other in-route procedures deemed important.
- * Consider materials of construction and appropriateness of design used for each distribution container or package.
- * Review unloading procedures, including product stewardship literature given to customers by Dow.

RESPONSIBILITIES

1. Prioritize the currently transported materials. Determine the combined or individual numbers derived from the C.E.I.-F.E.I. and Skin Ranking Grids (Appendices A - F). The final index obtained should help indicate the priority of the action to be taken.

Another important way to prioritize current materials is the choice of a worst case leak scenario. This may be challenged and changed several times before obtaining a realistic leak scenario which truly reflects the hazard potential of a particular distribution package or piece of equipment.

2. Ensure consistent and appropriate practices based on the properties of each material shipped from more than one site.

For example, the practices for shipping liquid chlorine should be consistent. (This does not necessarily mean equal.) The technology center can help serve this vital role.

When creating internal policies and guidelines, be sure they are essential for the safe transportation and storage of Dow's products and raw materials. Unnecessary policies and guidelines may restrict and impede the distribution of products to Dow customers and raw materials to Dow plants.

Keep in mind, once an operating discipline is established, it must be adhered to.

3. Develop pre-start up guidelines for transportation.

Before the decision is made to ship or receive a product or raw material not previously transported, a pre-start up review of the transportation system to be used should be given. This is similar to the pre-start up review of the plant producing the product.

PREPARING FOR A REVIEW

What Products and Raw Materials Should Be Reviewed?

Chemicals to be reviewed include:

- * All Dow products identified as having a Hazardous Materials Transportation Index of 2, 3, or 4 using Appendix A (Tables 1 and 2).
- * All raw materials or purchased chemicals identified as having an HMTI of 2, 3, or 4 using Appendix A (Tables 1 and 2).
- * All Dow products (1) terminalized or warehoused and shipped from a different location than where they were manufactured or (2) repackaged by others and shipped to a Dow customer.
- * Chemicals produced by other companies and shipped in Dow's name to Dow customers through swaps, tolls, and/or trades. (Appendix G)
- * All transported waste materials identified as having an HMTI of 2, 3, or 4 using Appendix A (Tables 1 and 2).

Worst Case Thinking

Product Review Team members should use "worst case" thinking in evaluating the safety of the transportation operation. An evaluation should then be made of the "worst case" scenario consequences.

For consistency, one should consider the following scenarios:

1. For bulk rail and bulk truck (including intermodal portable containers) - rollover and rupture of tank releasing entire contents.
2. For drum shipments - rollover of container and rupture of three drums. If a flammable material is involved, the ensuing fire would be expected to involve the entire contents of the container.
3. For cylinders - break off of the cylinder valve with material leaking from a 1" hole.

NOTE: The suggested worst case scenarios should not preclude any scenarios that may be considered to be "worst case" by virtue of special chemical properties or equipment used. For example, drum quantities of easily polymerized material may heat up and result in an explosion.

However, unreliability of protection systems should not be allowed to be a cause of an accident. Regular documented testing of all elements of the protection systems is essential.

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HAZARDOUS MATERIALS TRANSPORTATION REVIEW AUDIT PREPARATION INSTRUCTIONS

These HMTR Audit Instructions are being sent to Louisiana Division plants/departments as an audit to be accomplished in the Consolidate Audit Process. You should start your preparations early and do a quality job on the Review Package.

A. Chemicals of Concern

The audit should review all chemicals shipped or received, including waste materials, with a Hazardous Materials Transportation Index (HMTI) of 2, 3 or 4. (An HMTI of 1 requires a review by the superintendent and his manager only.)
Note: Pipeline transportation practices are not a part of this audit.

B. Review Package

The Review Package requirements must be completed and sent to the Louisiana Division Auditing Facilitator at least 10 calendar days prior to the audit.

The Review Package should contain (for each chemical):

1. A copy of HMTR Audit Presentation, Page 7, Section I.
2. For chemicals involved in Swaps, Tolls, and Trades a completed Appendix G, Page 16.
3. A calculation of the HMTI with the associated CEI and F&EI data sheets or output from Lotus 1, 2, 3 programs. Also the dispersion data (for the quantities, distance, and conditions for the transportation worst case scenario) as per the CEI program instructions in the CEI Audit instructions.
4. A completed Physical Properties Sheet (see Appendix H, Page 17).

HMT Review Audit Instructions

5. A completed Chemical Properties Sheet (see Appendix H, Page 18).
6. A completed Health and Environmental Effects Sheet (see Appendix H, Page 19).
7. A completed Equipment Construction Sheet (see Appendix H, Page 20).
8. A completed Loading Procedures Sheet (see Appendix H, Page 23-25).
10. A completed Unloading Procedures Sheet (see Appendix H, Page 26-27).
11. A completed Outplant Contracts Sheet (see Appendix H, Page 28-29).
12. A completed "Inventory Practices of Full Tank Cars and/or Tank Trucks" (see Appendix H, Page 30).
13. A Transportation Equipment Data and Emergency Response (TEDER) sheet.
14. A list of the shipping quantities by mode and the specification of the containers (railcar, tank truck, drum, etc.) used.
15. Emergency response call reports and accident investigation reports documenting corrective actions.
16. A copy of special governmental regulations required for shipment, such as DOT exemptions.
17. Any business information as it pertains to the distribution operations (i.e., customer selectivity...Have we ever turned down shipping to anyone or with any carrier because they failed to follow safe practices?).

NOTE: This package should be used as the basis for the presentation which will be given to the Hazardous Materials Transportation Functional Audit Team on the day of the audit. The package will also be used by the HMTR Functional Audit Team to develop questions to be discussed during the review.

C. U.S. Area Representatives

The Functional Audit Team will invite appropriate Dow U.S. Area or Corporate representatives for reviews with HMTI's of 3 or 4 as needed. The plant will notify the Functional Audit Team Leader a minimum of 30 days in advance.

D. Plant Team

The Material Owner (Superintendent) is responsible to organize his Plant Team which as a group is responsible to complete the audit questionnaire and make the presentation to the HMTR Functional Audit Team.

E. The Audit

Plant Team Presentation/Discussion:

Your team should be prepared to lead a discussion with the Functional Audit Team which addresses each of the major areas of the questionnaire. Follow the attached Hazardous Material Transportation Review Audit Agenda.

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Hazardous Materials Transportation Review Calculations Using Lotus 1-2-3

A copy of the Lotus 1-2-3* program is included for your use in calculating the Chemical Exposure and Fire & Explosion Indexes and the Skin (Hazard) Ranking for the Hazardous Materials Transportation Review.

A sample spread sheet with data for 45,000 lbs. of acrylic acid is shown on the following page. The worse case scenario assumes the loss of the entire contents of the container.

The entire spread sheet is "write protected" except for the description of the product and container and the 11 pieces of input data (shown on the screen in the green column) required for the calculations.

The input data required is as follows:

1. The Dow EEPG concentration as shown in the CEI Audit instructions. (Note: If the EEPG value for your hazardous material is not available, use three times the TLV for the material).
2. The Material Factor as found in Appendix A of the F&EI Guide.
3. The NFPA Health Rating (Nh) as found in Appendix A of the F&EI Guide.
4. The NFPA Flammability Rating (Nf) as found in Appendix A of the F&EI Guide.
5. The Heat of Combustion (Hc) as found in Appendix A of the F&EI Guide.
6. The Molecular Weight of the hazardous material.
7. The Vapor Pressure in mm Hg at 25 degrees C.
8. Is the material thermally unstable below 100 degrees C. (That is, does a measurable exotherm [ARC or equivalent] take place below 100 degrees C.) Yes or No.
9. The physical state penalty. (Choose one from the three choices given).

10. The pressure in PSI in the shipping container at 50 degrees C.

11. The Dermal LD50 in mg/kg for skin exposure.

NOTE: The weight of material in the shipping container is fixed at 45,000 lbs.

Once the input data has been entered, press the F9 key to calculate the CEI, F&EI, and Skin Rank values, press ALT and P at the same time.

If there are any questions regarding this Lotus spread sheet, please call Dean Smith at Ext. 8879.

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SAMPLE OUTPUT FROM LOTUS 1-2-3 PROGRAM
HAZARDOUS MATERIALS TRANSPORTATION REVIEW
CEI, F&EI, AND SKIN RANK CALCULATIONS
(REVISED 5/14/90)

		TANK CAR STYRENE	
.....			
INPUT DATA			
.....			
EPPG CONCENTRATION PPM	200.00		• SUMMARY •
MATERIAL FACTOR (F&EI GUIDE)	24		• •
NFPA HEALTH RATING (Nh)	2		• CEI •
NFPA FLAMMABILITY RATING (Nf)	3		• 64.00 •
BTU'S PER MLBS	17.00		• •
MOLECULAR WEIGHT	104		• F&EI •
VAPOR PRESSURE MM HG @25 DEG C	7.00		• 142.22 •
THERMAL INSTABILITY DEG C	32		• •
PHYSICAL STATE PENALTY	1.00		• SKIN RAN •
VISCIOUS LIQUID ----- .70			• 0 •
LIQUID ----- 1.00			• •
COMPRESSED GAS ----- 1.20			
LIQUIFIED FLAM GAS --- 1.30			
LBS OF PRODUCT PER CONTAINER	150,000		
SHIPPING PRESSURE(PSI OF MATERIA)	5		
RELIEF VALVE SETTING (LBS)	75		
DERMAL LD50 FOR SKIN EXPOSURE	2.001		

		CALCULATED FACTORS	
.....			
CHEMICAL EXPOSURE INDEX RANKING		FIRE & EXLOSION INDEX RATING	
.....			
ACUTE HEALTH HAZARD FACTOR	21714.29	MATERIAL FACTOR	24 00
ACUTE HEALTH FACTOR SCALE #	1.00	GP BASE FACTOR	1 00
LBS VAPOR RELEASED IN 15 MIN.	893.55	HANDLING & TRANSFER FACTOR	0.95
VAPOR QUANTITY SCALE #	2.00	ACCESS FACTOR	0.35
DISTANCE SCALE #	4.00	SPILL CONTROL FACTOR	0 50
MOLECULAR WEIGHT SCALE #	4.00	F1-GENERAL PROCESS FACTOR	2.70
SHIPPING PRESSURE FACTOR	0.00	-----	-----
THERMAL INSTABILITY FACTOR	2.00	SP BASE FACTOR	1 00
PROCESS PENALTIES FACTOR	2.00	TOXIC MATERIALS FACTOR	0.40
PROCESS PENALTIES SCALE #	2.00	PROCESS OPERATION, PURGE FACT	0.30
CHEMICAL EXPOSURE INDEX	64.00	QUANTITY IN STORAGE FACTOR	0.40
CHEMICAL EXPOSURE SCALE #	1.00	IGNITION SOURCE FACTOR (FIRED HT	0.00
		OPERATING PRESSURE FACTOR	0.09
		F2-SPECIAL PROCESS HAZARDS FACT	2.19
.....			
SKIN RANKING	0.00	F3-UNIT HAZARD FACTOR (=F1 * F2)	5.93
		F&EI-FIRE & EXPLOSION INDEX	142.22
		FIRE & EXPLOSION RANKING	4

19-Sep-90

Hazardous Materials Transportation Review Audit Agenda

I. Overview Presentation to the Audit Team (45 minutes)

Note: Timing is approximate

1. Provide a list of all products and purchased materials as shown on plant cost sheets.
2. Review the hazardous materials to be covered in the audit, and the nature of the hazards (ie., flammable, reactive, toxic, etc.). Including the methods and modes of transportation.
3. Review any transportation incidents in the last two years.
4. Give the status of items agreed to be acted on by the plant from the previous HMTR audit.
5. Review your loader/unloader training program.
6. Based upon the answers given to the questions in the "Guidelines For A Hazardous Materials Transportation Review Process", discuss the major hazardous materials transportation concerns for the plant.
7. Review planned hazardous material transportation improvements.

II. HMTR Guidelines Questionnaire (45 minutes)

- A. Review the information provided in the HMTR questionnaire on an exception basis.

III. Documentation Audit and Facility Tour (30 minutes)

- A. Following the plant presentation, selected members of the Audit Team will examine the plant's loading/unloading areas and applicable documentation discussed during the audit. (Documentation should be readily available for the auditors). This will include:
 1. Documentation of DOT training;
 2. Examples of completed loading/unloading checksheets;
 3. Loading/unloading procedures.

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IV. Audit Report

- A. The HMT Functional Audit Team Leader will summarize the team's findings and furnish the Audit Facilitator a written audit report of their recommendations by Monday following audit week.**

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APPENDIX A

RELATIVE HAZARD RANKING

Dow products, products shipped by other companies to Dow customers in Dow's name, Dow-purchased raw materials, and transported Dow waste materials need to be ranked by using the Chemical Exposure Index (C.E.I.) calculations, the Fire and Explosion Index (F.E.I.) calculations and the effects of the chemical on skin contact.

The numerical ranking for skin is intended to indicate the relative risk from a single dermal exposure, such as might occur in a transportation accident, that could result in the absorption of acutely toxic or lethal amounts. It does not address skin burns or chronic absorption. The principal criterion used (See Table 1 below) is the actual or estimated animal dermal LD50. When there have been cases of human lethality from a single skin exposure, the chemical in question should be ranked in the highest category, regardless of the lower animal toxicity (eg. phenol).

TABLE 1

SKIN RANKING CRITERIA FOR HAZARDOUS MATERIALS

TRANSPORTATION REVIEW PURPOSES

<u>SKIN RANK</u>	<u>BASIS</u>
4	Dermal LD50 of < 200 mg/kg or lethal to humans
3	Dermal LD50 of 200-500 mg/kg
2	Dermal LD50 of 501-1000 mg/kg
1	Dermal LD50 of 1001-2000 mg/kg or single exposure judged acutely toxic
0	Dermal LD50 of >2000 mg/kg. Dermal single exposure judged not to be toxic, or no information available.

Once these indices are determined, they should be plotted on the C.E.I. - F.E.I. and Skin Ranking Grids shown in Table 2 to obtain a Hazardous Materials Transportation Index (HMTI).

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TABLE 2

HAZARDOUS MATERIAL TRANSPORTATION INDEX
CHEMICAL EXPOSURE INDEX - FIRE AND EXPLOSION INDEX -
SKIN RANKING GRIDS

CHEMICAL EXPOSURE INDEX (C.E.I.)	400+	1	1	1	4	4
	300-400	3	3	3	3	4
	100-299	2	2	2	3	4
	1-99	1	1	2	3	4
	0	0	1	2	3	4
		0	1-60	61-96	97-127	128+
		FIRE & EXPLOSION INDEX (F.E.I.)				

0	1	2	3	4
EFFECTS ON SKIN				

The purpose for calculating the HMTI Index is to determine:

- * Priority of product review
- * Level of management involvement in the reviews

When calculating the C.E.I. in a transportation environment, the shortest distance (1,000 feet) from the point of release should be used. This is done because it is impossible to determine the point where loss of containment during transportation may occur.

Appendices B, C and D illustrate typical calculations for the Dow-produced products Ethylene Oxide and Liquid Chlorine.

Appendix E illustrates a typical calculation for a Dow-purchased raw material, Methacrylonitrile.

Appendix F places all of the above chemicals in the C.E.I.-F.E.I. and Skin Ranking Grids.

Table 3 will indicate the action to be followed based on the ranking grid number of the chemicals.

TABLE 3
TYPICAL REVIEW LEVELS

This table illustrates various review levels. The superintendent should be present for all different levels of the review.

<u>Ranking Grid No.</u>	<u>Review Committee</u>
1	Superintendent + Manager
2	Division Review Committee
3 & 4	Division Review Committee + Area Rep.

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APPENDIX B

CHEMICAL EXPOSURE INDEX

Complete the following Table (See Note 1) by filling in and multiplying the appropriate Risk Factor Scale numbers for each of the major Risk areas as identified in the following formula:

$$\begin{array}{ccccccc}
 \boxed{\text{I.}} & \times & \boxed{\text{II.}} & \times & \boxed{\text{III.}} & \times & \boxed{\text{IV.}} & \times & \boxed{\text{V.}} & = & \boxed{\text{VI.}} \\
 \text{Acute Human} & & \text{Vapor} & & \text{Distance} & & \text{Molecular} & & \text{Process} & & \text{Chemical} \\
 \text{Hazard} & & \text{Quantity} & & \text{(Remoteness)} & & \text{Weight} & & \text{Parameters} & & \text{Exposure} \\
 \text{Scale} & & \text{Scale} & & \text{Scale} & & \text{Scale} & & \text{Scale} & & \text{Index} \\
 \text{No.} & & \text{No.} & & \text{No.} & & \text{No.} & & \text{No.} & &
 \end{array}$$

Identification of Containment Vessels
being evaluated:

Name or Number (See Notes 2 & 3)

Source #1 Tank Car Rupture of
Ethylene Oxide

Source #2 (if needed) _____

I.	II.	III.	IV.	V.	VI. (CEI)
3	4	4	3	2	288

* NOTE 1 - The distance scale number in Column III for chemicals in a transportation environment will always be less than 1,000 feet.

NOTE 2 - Only different sources of the same chemical should be evaluated on this sheet. Use a separate Chemical Exposure Index for every different chemical.

NOTE 3 - Use additional sheets if additional sources with differing potential impact are present.

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FIRE AND EXPLOSION INDEX



LOCATION ETHYLENE OXIDE DATE _____
TANK CAR IN ROUTE

PLANT _____ PROCESS UNIT _____ EVALUATED BY _____ REVIEWED BY _____

MATERIALS AND PROCESS

MATERIALS IN PROCESS UNIT _____

STATE OF OPERATION

☐ START-UP ☐ SHUT-DOWN ☒ NORMAL OPERATION

BASIC MATERIAL(S) FOR MATERIAL FACTOR _____

MATERIAL FACTOR (SEE TABLE I OR APPENDICES A OR B) Note requirements when unit temperature over 140°F _____

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1. GENERAL PROCESS HAZARDS

	PENALTY	PENALTY USED
BASE FACTOR _____	1.00	1.00
A. EXOTHERMIC CHEMICAL REACTIONS (FACTOR 30 to 1.25)		
B. ENDOTHERMIC PROCESSES (FACTOR 20 to .40)		
C. MATERIAL HANDLING & TRANSFER (FACTOR 25 to 1.05)		.85
D. ENCLOSED OR INDOOR PROCESS UNITS (FACTOR 25 to .25)		
E. ACCESS _____	.25	.35
F. DRAINAGE AND SPILL CONTROL (FACTOR 25 to .50) _____ 2.48		.50
GENERAL PROCESS HAZARDS FACTOR (F ₁) _____		2.70

2. SPECIAL PROCESS HAZARDS

BASE FACTOR _____	1.00	1.00
A. TOXIC MATERIAL(S) (FACTOR 0.20 to 0.80)		.40
B. SUB-ATMOSPHERIC PRESSURE (< 500 mm Hg)	.50	
C. OPERATION IN OR NEAR FLAMMABLE RANGE ☐ INERTED ☐ NOT INERTED		
1. TANK FARMS STORAGE FLAMMABLE LIQUIDS	.50	
2. PROCESS UPSET OR PURGE FAILURE	.20	.50
3. ALWAYS IN FLAMMABLE RANGE	.90	
D. DUST EXPLOSION (FACTOR 25 to 2.00) (SEE TABLE III)		
E. PRESSURE (SEE FIGURE 2) OPERATING PRESSURE _____ PSIG RELIEF SETTING _____ PSIG		
F. LOW TEMPERATURE (FACTOR 20 to .30)		
G. QUANTITY OF FLAMMABLE/UNSTABLE MATERIAL: QUANTITY _____ GAL. H ₂ O _____ STUB		
1. LIQUIDS, GASES AND REACTIVE MATERIALS IN PROCESS (SEE FIG. 3)		
2. LIQUIDS OR GASES IN STORAGE (SEE FIG. 4)		.50
3. COMBUSTIBLE SOLIDS IN STORAGE, DUST IN PROCESS (SEE FIG. 5)		
H. CORROSION AND EROSION (FACTOR .10 to .75)		
I. LEAKAGE - JOINTS AND PACKING (FACTOR 10 to 1.50)		
J. USE OF FIRED HEATERS (SEE FIG. 6)		
K. HOT OIL HEAT EXCHANGE SYSTEM (FACTOR 15 to 1.15) (SEE TABLE III)		
L. ROTATING EQUIPMENT	.50	

SPECIAL PROCESS HAZARDS FACTOR (F₂) _____

2.00

UNIT HAZARD FACTOR (F₃ = F₁ × F₂) _____

5.40

FIRE AND EXPLOSION INDEX (F₄ = MF × F₃ × E₁) _____

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APPENDIX D

CHEMICAL EXPOSURE INDEX

Complete the following Table (See Note 1) by filling in and multiplying the appropriate Risk Factor Scale numbers for each of the major Risk areas as identified in the following formula:

$$\begin{array}{ccccccc}
 \boxed{\text{I.}} & \times & \boxed{\text{II.}} & \times & \boxed{\text{III.}} & \times & \boxed{\text{IV.}} & \times & \boxed{\text{V.}} & = & \boxed{\text{VI.}} \\
 \text{Acute} & & \text{Vapor} & & \text{Distance} & & \text{Molecular} & & \text{Process} & & \text{Chemical} \\
 \text{Hazard} & & \text{Quantity} & & \text{(Remoteness)} & & \text{Weight} & & \text{Parameters} & & \text{Exposure} \\
 \text{Scale} & & \text{Scale} & & \text{Scale} & & \text{Scale} & & \text{Scale} & & \text{Index} \\
 \text{No.} & & \text{No.} & & \text{No.} & & \text{No.} & & \text{No.} & &
 \end{array}$$

Identification of Containment Vessels
being evaluated:

Name or Number (See Notes 2 & 3)

Source #1 Tank Car Rupture of
Liquid Chlorine

Source #2 (if needed) _____

I.	II.	III.	IV.	V.	VI. (CED)
4	4	4	4	2	512

* NOTE 1 - The distance scale number in Column III for chemicals in a transportation environment will always be less than 1,000 feet.

NOTE 2 - Only different sources of the same chemical should be evaluated on this sheet. Use a separate Chemical Exposure Index for every different chemical.

NOTE 3 - Use additional sheets if additional sources with differing potential impact are present.

APPENDIX E

CHEMICAL EXPOSURE INDEX

Complete the following Table (See Note 1) by filling in and multiplying the appropriate Risk Factor Scale numbers for each of the major Risk areas as identified in the following formula:

$$\begin{array}{ccccccc}
 \boxed{\text{I.}} & \times & \boxed{\text{II.}} & \times & \boxed{\text{III.}} & \times & \boxed{\text{IV.}} & \times & \boxed{\text{V.}} & = & \boxed{\text{VI.}} \\
 \text{Acute} & & \text{Vapor} & & \text{Distance} & & \text{Molecular} & & \text{Process} & & \text{Chemical} \\
 \text{Hazard} & & \text{Quantity} & & \text{(Removal)} & & \text{Weight} & & \text{Parameters} & & \text{Exposure} \\
 \text{Scale} & & \text{Scale} & & \text{Scale} & & \text{Scale} & & \text{Scale} & & \text{Index} \\
 \text{No.} & & \text{No.} & & \text{No.} & & \text{No.} & & \text{No.} & &
 \end{array}$$

Identification of Containment Vessels
being evaluated:

Name or Number (See Notes 2 & 3)

Source #1 ISO Container Tank
Car Rupture of
Methacrylonitrile
(MAN)

Source #2 (if needed) _____

I.	II.	III.	IV.	V.	VI. (CEI)
3	3	4	4	2	288

* NOTE 1 - The distance scale number in Column III for chemicals in a transportation environment will always be less than 1,000 feet.

NOTE 2 - Only different sources of the same chemical should be evaluated on this sheet. Use a separate Chemical Exposure Index for every different chemical.

NOTE 3 - Use additional sheets if additional sources with differing potential impact are present.

APPENDIX F

HAZARDOUS MATERIAL TRANSPORTATION INDEX

Chemical Exposure Index -
Fire and Explosion Index - Skin Ranking Grids

CHEMICAL EXPOSURE
INDEX (C.E.I.)

400+	C1 ₂	4	4	4	4
300-400	3	3	3	3	4
100-299	2	2	2	3	E.O.
1-99	1	1	2	3	4
0	0	1	2	3	4
	0	1-60	61-96	97-127	128+

FIRE & EXPLOSION INDEX (F.E.I.)

0	1	2	3	MAX
---	---	---	---	-----

EFFECTS ON SKIN

FIRE AND EXPLOSION INDEX



LOCATION ETHYLENE OXIDE DATE _____
TANK CAR IN ROUTE

PLANT _____ PROCESS UNIT _____ EVALUATED BY _____ REVIEWED BY _____

MATERIALS AND PROCESS

MATERIALS IN PROCESS UNIT _____

STATE OF OPERATION
☐ STARTUP ☐ SHUT-DOWN ☒ NORMAL OPERATION

BASIC MATERIAL(S) FOR MATERIAL FACTOR _____

MATERIAL FACTOR (SEE TABLE I OR APPENDICES A OR B) Note requirements when unit temperature over 140°F _____

20

1. GENERAL PROCESS HAZARDS

	PENALTY	PENALTY USED
BASE FACTOR _____	1.00	1.00
A. EXOTHERMIC CHEMICAL REACTIONS (FACTOR 30 to 1.25)		
B. ENDOTHERMIC PROCESSES (FACTOR 20 to .40)		
C. MATERIAL HANDLING & TRANSFER (FACTOR 25 to 1.05)		.85
D. ENCLOSED OR INDOOR PROCESS UNITS (FACTOR 25 to .70)		
E. ACCESS	.25	.35
F. DRAINAGE AND SPILL CONTROL (FACTOR 25 to .50) _____ 2.25		.50
GENERAL PROCESS HAZARDS FACTOR (F ₁) _____		2.70

2. SPECIAL PROCESS HAZARDS

BASE FACTOR _____	1.00	1.00
A. TOXIC MATERIAL(S) (FACTOR 0.20 to 0.80)		.40
B. SUB-ATMOSPHERIC PRESSURE (< 500 mm Hg)	.50	
C. OPERATION IN OR NEAR FLAMMABLE RANGE ☐ INERTED ☐ NOT INERTED		
1. TANK FARMS STORAGE FLAMMABLE LIQUIDS	.50	
2. PROCESS UPSET OR PURGE FAILURE	.20	.30
3. ALWAYS IN FLAMMABLE RANGE	.50	
D. DUST EXPLOSION (FACTOR 25 to 2.00) (SEE TABLE IV)		
E. PRESSURE (SEE FIGURE 2) OPERATING PRESSURE _____ PSIG RELIEF SETTING _____ PSIG		
F. LOW TEMPERATURE (FACTOR 20 to .30)		
G. QUANTITY OF FLAMMABLE/UNSTABLE MATERIAL: QUANTITY _____ LB., M ₂ = _____ STUB		
1. LIQUIDS, GASES AND REACTIVE MATERIALS IN PROCESS (SEE FIG. 3)		
2. LIQUIDS OR GASES IN STORAGE (SEE FIG. 4)		.50
3. COMBUSTIBLE SOLIDS IN STORAGE, DUST IN PROCESS (SEE FIG. 5)		
H. CORROSION AND EROSION (FACTOR .10 to .75)		
I. LEAKAGE — JOINTS AND PACKING (FACTOR 10 to 1.50)		
J. USE OF FIRED HEATERS (SEE FIG. 6)		
K. HOT OIL HEAT EXCHANGE SYSTEM (FACTOR 15 to 1.15) (SEE TABLE III)		
L. ROTATING EQUIPMENT	.50	

SPECIAL PROCESS HAZARDS FACTOR (F₂) _____

2.00

UNIT HAZARD FACTOR (F₃ = F₁ × F₂) _____

5.40

FIRE AND EXPLOSION INDEX (F₄ = MF × F₃ × E₁) _____

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APPENDIX D

CHEMICAL EXPOSURE INDEX

Complete the following Table (See Note 1) by filling in and multiplying the appropriate Risk Factor Scale numbers for each of the major Risk areas as identified in the following formula:

$$\begin{array}{ccccccc}
 \boxed{\text{I.}} & \times & \boxed{\text{II.}} & \times & \boxed{\text{III.}} & \times & \boxed{\text{IV.}} & \times & \boxed{\text{V.}} & = & \boxed{\text{VI.}} \\
 \text{Acute} & & \text{Vapor} & & \text{Distance} & & \text{Molecular} & & \text{Process} & & \text{Chemical} \\
 \text{Hazard} & & \text{Quantity} & & \text{Remoteness} & & \text{Weight} & & \text{Parameters} & & \text{Exposure} \\
 \text{Scale} & & \text{Scale} & & \text{Scale} & & \text{Scale} & & \text{Scale} & & \text{Index} \\
 \text{No.} & & \text{No.} & & \text{No.} & & \text{No.} & & \text{No.} & &
 \end{array}$$

Identification of Containment Vessels
being evaluated:

Name or Number (See Notes 2 & 3)

Source #1 Tank Car Rupture of
Liquid Chlorine

Source #2 (if needed) _____

I.	II.	III.	IV.	V.	VI. (CED)
4	4	4	4	2	512

* NOTE 1 - The distance scale number in Column III for chemicals in a transportation environment will always be less than 1,000 feet.

NOTE 2 - Only different sources of the same chemical should be evaluated on this sheet. Use a separate Chemical Exposure Index for every different chemical.

NOTE 3 - Use additional sheets if additional sources with differing potential impact are present.

APPENDIX E

CHEMICAL EXPOSURE INDEX

Complete the following Table (See Note 1) by filling in and multiplying the appropriate Risk Factor Scale numbers for each of the major Risk areas as identified in the following formula:

$$\begin{array}{ccccccc}
 \boxed{\text{I.}} & \times & \boxed{\text{II.}} & \times & \boxed{\text{III.}} & \times & \boxed{\text{IV.}} & \times & \boxed{\text{V.}} & = & \boxed{\text{VI.}} \\
 \text{Acute} & & \text{Vapor} & & \text{Distance} & & \text{Molecular} & & \text{Process} & & \text{Chemical} \\
 \text{Hazard} & & \text{Quantity} & & \text{(Reference)} & & \text{Weight} & & \text{Parameters} & & \text{Exposure} \\
 \text{Scale} & & \text{Scale} & & \text{Scale} & & \text{Scale} & & \text{Scale} & & \text{Index} \\
 \text{No.} & & \text{No.} & & \text{No.} & & \text{No.} & & \text{No.} & &
 \end{array}$$

Identification of Containment Vessels
being evaluated:

Name or Number (See Notes 2 & 3)

Source #1 ISO Container Tank
Car Rupture of
Methacrylonitrile
(MAN)

Source #2 (if needed) _____

I.	II.	III.	IV.	V.	VI. (Calc.)
3	3	4	4	2	288

NOTE 1 - The distance scale number in Column III for chemicals in a transportation environment will always be less than 1,000 feet.

NOTE 2 - Only different sources of the same chemical should be evaluated on this sheet. Use a separate Chemical Exposure Index for every different chemical.

NOTE 3 - Use additional sheets if additional sources with differing potential impact are present.

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APPENDIX F

HAZARDOUS MATERIAL TRANSPORTATION INDEX

Chemical Exposure Index -
Fire and Explosion Index - Skin Ranking Grids

CHEMICAL EXPOSURE
INDEX (C.E.I.)

400+	Cl ₂	4	4	4	4
300-400	3	3	3	3	4
100-299	2	2	2	3	E.O.
1-99	1	1	2	3	4
0	0	1	2	3	4
	0	1-50	61-96	97-127	128+

FIRE & EXPLOSION INDEX (F.E.I.)

0	1	2	3	MAX
---	---	---	---	-----

EFFECTS ON SKIN

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APPENDIX G

SWAPS - TOLLS - TRADES

Suggested items to consider on swaps, tolls, trades and use of third party shipping containers, rail cars, storage tanks, etc.

1. Is your product involved in swaps, tolls, or trades?

Yes ☐ No ☐

2. If no, do not answer the following questions.

3. If yes, who is responsible for making the swaps, tolls, or trades agreements? _____

4. Does your plant have any input into the transportation practices for this product? Consider:

Specifications for equipment

Yes ☐ No ☐

Securement training and procedures for loading personnel

Yes ☐ No ☐

Difference in quality which could result in customer problems, such as reactivity

Yes ☐ No ☐

5. Do non-Dow shippers load on heels?

Yes ☐ No ☐

6. Do non-Dow shippers load through dedicated piping/equipment when it is critical to do so?

Yes ☐ No ☐

7. Do non-Dow shippers load through cross header systems (possible contaminates)?

Yes ☐ No ☐

8. Are similarities and/or differences between Dow and other non-Dow shippers documented?

Yes ☐ No ☐

APPENDIX H

Hazardous Materials Transportation

Review Questionnaire (Not Inclusive)

The following is a list of items to consider when preparing a review. It is by no means all inclusive. The Product Review Team is encouraged to modify and expand the list to best suit their individual needs.

I. PHYSICAL PROPERTIES

1. Molecular Weight -
2. Odor -
3. Appearance -
4. Color -
5. Chemical Formula -
6. Solubility: In Water, Others -
7. Boiling Point -
8. Freezing Point -
9. Flash Point (Method) -
10. Flammable Limits -
11. Autoignition Temperature -
12. Density of Material -
13. Vapor Pressure - mm Hg at 20 C -
14. Explosive Limits -
15. Heats of Reaction -

**HAZARDOUS MATERIALS TRANSPORTATION
REVIEW QUESTIONNAIRE**

II. CHEMICAL PROPERTIES

1. Chemical composition if the material is formulated or not pure.

2. Do you have ARC run on material?

Yes ☐ No ☐

3. Does material react with water?

Yes ☐ No ☐

What are products? _____

4. Does material undergo autodecomposition?

Yes ☐ No ☐

5. Are the potential reactive chemical consequences of pH, water, rust, light, promoters and other possible containments known?

Yes ☐ No ☐

6. Does material polymerize?

Yes ☐ No ☐

7. If material freezes, will inhibitor separate?

Yes ☐ No ☐

8. What are the products of oxidation (fire)?

* 9. List some of the main transportation related reactive chemical concerns, in order of magnitude or priority.

* Answer question 9 even if an MSD sheet is supplied.

HAZARDOUS MATERIALS TRANSPORTATION

REVIEW QUESTIONNAIRE

III. HEALTH AND ENVIRONMENTAL EFFECTS

1. What is acute toxicity of the materials?

- Inhalation (LC50 in ppm) _____

- Dermal (LD50 in mg/kg) _____

- Oral (LD50 in mg/kg) _____

2. Are potential health effects reversible?

Yes ☐ No ☐

3. Can people readily escape contaminated areas?

Yes ☐ No ☐

4. What is effect on aquatic life? _____

5. Does material biodegrade?

Yes ☐ No ☐

6. Would a spill cause long-term groundwater toxicity problems?

Yes ☐ No ☐

7. Does material exhibit any warning properties?

Yes ☐ No ☐

8. Is material corrosive to skin?

Yes ☐ No ☐

9. Has recommended protective equipment been tested?

Yes ☐ No ☐

10. Please Submit -

-- A Material Safety Data Sheet (MSDS)

-- A Transportation Equipment Data-Emergency Response Sheet
(TEDER)

HAZARDOUS MATERIALS TRANSPORTATION

REVIEW QUESTIONNAIRE

IV. EQUIPMENT CONSTRUCTION

1. Is this product corrosive to the material of construction of the shipping container?

Yes ☐ No ☐

2. Are specific materials of construction required to be used or to be avoided?

Yes ☐ No ☐

3. Are materials of construction concerns communicated to the customer or supplier (eg. aluminum not acceptable for PDC)?

Yes ☐ No ☐

4. How do you assure the proper material of construction is being used?

5. Does this product require insulation against extreme heat or cold conditions?

Yes ☐ No ☐

If yes, how do you assure that insulated equipment is used?

6. What are the minimum equipment specifications for this product for the modes of transportation used (for DOT, IMO, etc.)?

7. What are the preferred specifications for this product for the modes of transportation used?

Which are used?

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HAZARDOUS MATERIALS TRANSPORTATION

REVIEW QUESTIONNAIRE

V. LOADING PROCEDURES

1. Is material of construction verified before loading?
Yes ☐ No ☐
2. Is material to be loaded in dedicated tank or shipping containers?
Yes ☐ No ☐
3. Are hoses dedicated to this material?
Yes ☐ No ☐
4. Is there a potential for cross contamination in the loading process?
Yes ☐ No ☐
5. Who/How are checks for the cleanliness and integrity of tank cars, trucks, drums, or other containers made before loading?

Are there written procedures, checklists and training available?

Yes ☐ No ☐

Are heels analyzed?

Yes ☐ No ☐

6. Are dew-point checks needed for this product prior to loading?

Yes ☐ No ☐

7. Who is responsible for the general safety conditions of tank cars, trucks, drums, or other containers (leaking valves, brakes, tires, gaskets, floor surface in trailers, damage, mixed shipment product mix, etc.)? _____

How are inspections made? _____

8. Are drivers involved in loading this product in your plant?

Yes ☐ No ☐

9. If so, do drivers have training in what to do in case of emergency in the plant?
Yes ☐ No ☐
10. Do drivers that load products have training on how to properly secure the shipping container?
Yes ☐ No ☐
11. How do you assure that trucks, rail cars, and containers are properly labeled and placarded for the hazard?

12. How do you assure that trucks, rail cars, containers, and marine vessels are properly secured after loading? _____

13. Are loading procedures current?
Yes ☐ No ☐
Written by whom? _____
Reviewed/Approved by whom? _____
14. What specific personal protective equipment is required for loading this product? _____
15. Have loaders received DOT training within the last two years?
Yes ☐ No ☐
16. What measures are used to assure container is not overloaded?

17. Is the vapor space prevented from passing through a flammable envelope during loading?
Yes ☐ No ☐
Is inert padding/purging required?
Yes ☐ No ☐

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HAZARDOUS MATERIALS TRANSPORTATION

REVIEW QUESTIONNAIRE

VI. IN ROUTE PROCEDURES

1. What is the driver selection process used by the carrier?
-

2. Are TEDER and MSD sheets available?

Yes [] No []

3. Is there a specific packet for handling precautions given to the driver?

Yes [] No []

4. Do you require drivers to have the same personal protective equipment as your loaders?

Yes [] No []

5. What is the worst case reasonable situation that could occur?
-

Have you conducted simulated loss of containment "What If" scenarios with people (including carriers) who can contribute to an emergency plan?

Yes [] No []

6. Have you determined what evacuation plans would be recommended in case of an emergency?

Yes [] No []

NOTE: Utilize the dispersion data (for the quantities, distance, and conditions for the transportation worst case scenario) as per the CEI program instructions in the CEI audit. Information to be provided to emergency responders should be consistent with current DOT Emergency Response Guidebook recommendations for specifically named chemicals.

7. Is specialized equipment and/or a procedure required to respond to a leak of this product?

Yes [] No []

Is it available?

Yes ☐ No ☐

Where? _____

8. Is there a maximum time a product can remain in a shipping container before it is unloaded (e.g. anhydrous HCl)?

Yes ☐ No ☐

9. Should this product require special transportation modes and routes?

Yes ☐ No ☐

Why/Why not? _____

10. Are local, state, or federal special permits or approvals required (eg. Dot exemptions)?

Yes ☐ No ☐

11. What regulatory requirements are applicable (DOT, U.S. Coast Guard, IMO (International Marine), IATA (air)?

12. Do you place any restrictions on the carrier (ie, daylight movement only, special routes, or weather restrictions)?

Yes ☐ No ☐

13. Who will be the "knowledgeable" Dow contacts in an emergency response (E/R) situation? _____

14. Does this product require special training for Dow's E/R Teams and medical personnel?

Yes ☐ No ☐

If yes, what is the frequency of training? _____

15. Does there need to be a definition of geographical responsibility on what E/R Team reacts to an emergency (ie. related to question 14)? This could be U.S., overseas, etc.

Yes ☐ No ☐

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16. Do drivers have training in what to do in case of emergency?

Yes ☐ No ☐

Who provides the training? _____

17. Has a Driver Performance Evaluation Program been established?

Yes ☐ No ☐

18. What are the carrier policies regarding highway emergencies? (Dow recommends a first call to CHEMTREC be included in the emergency plan.)

19. Do you audit carrier performance relative to the transportation of your products?

Yes ☐ No ☐

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**HAZARDOUS MATERIALS TRANSPORTATION
REVIEW QUESTIONNAIRE**

VII. UNLOADING PROCEDURES

1. Is material unloaded by driver or local operating personnel?

Are they trained in the procedures?

Yes ☐ No ☐

Does this include emergency procedures in case of hose failures, gaskets, etc.?

Yes ☐ No ☐

Who conducts the training and how often? _____

Is the training documented?

Yes ☐ No ☐

2. Are unloading procedures current?

Yes ☐ No ☐

Written by whom? _____

Reviewed and approved by whom? _____

3. Have procedures been established and customers informed to ensure proper securement of the shipping container, rail car, truck, vessel or drums after unloading?

Yes ☐ No ☐

4. Should car, truck, or marine vessel be inerted as it is emptied?

Yes ☐ No ☐

5. Is the vapor space prevented from passing through a flammable envelope during unloading?

Yes ☐ No ☐

6. Is sampling/analysis required prior to unloading?

Yes ☐ No ☐

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7. Are unloading areas equipped with the required safety equipment (ie, suitable fire extinguishing, equipment, spill basins, etc.)?

Yes ☐ No ☐

8. Are unloading operations "attended" throughout the entire period of unloading?

Yes ☐ No ☐

Is the "attendance" by people, electronic devices, or both:

For rail cars: _____

For tank trucks: _____

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HAZARDOUS MATERIALS TRANSPORTATION

REVIEW QUESTIONNAIRE

VIII. OUTPLANT CONTRACTS (TERMINALS - WAREHOUSES - REPACKAGERS)

Items to consider on use of off-site contracted services and operation:

1. Are facilities covered by Standard Dow Contract (i.e. approved by U.S. Area or Division Terminal's Focal Point)?

Yes ☐ No ☐

Is there a current Contractual Exhibit B or Dow Operating Procedures in existence for the location?

Yes ☐ No ☐

2. Have facilities been audited and approved by U.S. Area Terminal's Focal Point or representative?

Yes ☐ No ☐

3. Is surrounding area free of residential or public facilities, i.e., hospitals, schools, etc.?

Yes ☐ No ☐

What is approximate distance to nearest public facility and the corresponding highest CEI number? _____

What is approximate distance to nearest residence and the corresponding highest CEI number? _____

4. Are contract facilities covered by Dow Technology Center Audits and/or QAC Reviews?

Yes ☐ No ☐

5. Are products positively identified prior to loading or off-loading?

Yes ☐ No ☐

How is product quality monitored/maintained? _____

6. Have contract facility employees been trained in proper handling of Dow products with regard to Safety, Industrial Hygiene, Environmental, proper packaging (materials of construction), securement, etc.?

Yes ☐ No ☐

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7. Are appropriate blocking and bracing procedures available to cover loading of packaged goods?

Yes [] No []

8. Does facility have a formal emergency plan?

Yes [] No []

Ability to prevent run-off water in case of a fire?

Yes [] No []

Resource and Information:

G. R. Mutscher - U.S. Area Warehousing/Terminals Focal Point
2020 WHDC
Midland, Michigan Phone (517) 636-5841

Ernie Wall - Louisiana Division Terminals Focal Point
Building 3302D
Plaquemine, Louisiana Phone (504) 389-6497

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HAZARDOUS MATERIALS TRANSPORTATION

REVIEW QUESTIONNAIRE

IX. INVENTORY PRACTICES OF FULL CONTAINERS

1. Is there a policy setting the maximum number of containers (rail car, trucks, drums, etc.) or quantity of material that can be stored at one location?

Yes ☐ No ☐

Should there be?

Yes ☐ No ☐

2. Is it necessary to know the location, as well as types, of chemicals being inventoried side-by-side while inside Dow?

Yes ☐ No ☐

3. Are inhibitor levels or other time dependent variables monitored for chemicals in storage in shipping containers?

Yes ☐ No ☐

How? _____

4. Have adequate safety-loss prevention and environmental principals (ie. fire monitors, flammable detectors, spill containment, CEI & F & EI calculations) been considered for your materials?

Yes ☐ No ☐

5. Is reconfirmation of securement done prior to shipment?

Yes ☐ No ☐

6. Have emergency procedures, including hurricanes, freezing weather, etc. been developed for your materials in storage in shipping containers?

Yes ☐ No ☐

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