

CEI Calc.

DO A 027832
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CEI2: THE CHEMICAL EXPOSURE INDEX CALCULATION SYSTEM		Work File Name
Reference: "Chemical Exposure Index Guide" - Second Edition, September-1993 Corporate Safety and Loss Prevention, The Dow Chemical Company		[AHCI cases.xls]CEI2
Plant or Project Name: <u>Solvents/EDC</u>	Prepared By: <u>Richard Rolts</u>	
Location: <u>LAD</u>	Date Prepared: <u>5/14/97</u>	
Plant Superintendent or Manager: <u>Don Taylor</u>	Reviewed By: <u>Buck Bailey</u>	
Site Review Representative: <u>Richard Rolts</u>	Date Reviewed: <u>5/30/97</u>	

I. CASE DATA	1	2	
Case Number			
Release Scenario	Liquid Release - Pipe/Vessel/Hose	Liquid Release - Pipe/Vessel/Hose	
Chemical Name	Hydrogen chloride	Hydrogen chloride	
Release Scenario Description	Nozzle failure on T-47	AHCI T/C Loading hose rupture	
EMERGENCY RESPONSE PLANNING			
Dow IHG (ppm)	-	-	
ACGIH TLV-TWA (ppm)	5	5	
STEL (ppm)	5	5	
ERPG-1 (ppm)	3	3	
ERPG-2 (ppm)	20	20	
ERPG-3 (ppm)	100	100	
PLANT DATA			
Total Quantity in Plant, (lb)	800000	800000	
Largest Single Containment, (lb)	800000	800000	
Pressure of Containment, (psig)	75	75	
DISTANCES TO (feet):			
1. Public	675	600	
2. Other in-company facility	375	375	
3. Non-company plant or business	975	975	
PHYSICAL PROPERTIES			
Operating Temperature of Liquid, Ts (°F)	-45.0	-45.0	
Molecular Weight, MW	36.5	36.5	
Normal Boiling Point of Liquid, Tb (°F)	-121.1	-121.1	
Vapor Pressure at Ts, Pvp (psia)	85.258	85.258	
Liquid Density at Ts, Rho (lb/ft3)	63.91	63.91	
Heat Capacity, Cp (Btu/lb°F)	0.231	0.231	
Heat of Vaporization, Hv (Btu/lb)	165.29	165.29	
II. AIRBORNE QUANTITY ESTIMATION			
Liquid System Inventory, (gal)	74000	100	
1. FROM A RELIEF DEVICE OR OTHER Input Release Rate (lb/min)			
2. FROM A GAS RELEASE Gauge Pressure, Pg (psig) Diameter of Hole, D (in)			
3. FROM A LIQUID RELEASE (PIPE/VESSEL, HOSE) Process Pipe/Vessel? or Hose? Diameter of Hole, D (in) Gauge Pressure, Pg (psig) Height of Liquid Above Release Point, 'h (ft) Diked area (ft2)	Pipe/Vessel 1.50 75.0 20.0 0	Hose 1.00 170.0 20.0 0	
4. FROM A LIQUID OVERFLOW/SPILL Filling or Unloading Rate (gpm) Diked area (ft2)			
CHEMICAL EXPOSURE INDEX			
Release Scenario	Liquid Release - Pipe/Vessel/Hose	Liquid Release - Pipe/Vessel/Hose	
Airborne Quantity, AQ (lb/min)	4022.4	144.1	
CEI	662	125	
Hazard Distance, HD-1 (feet)	32800	10610	
Hazard Distance, HD-2 (feet)	21708	4109	
Hazard Distance, HD-3 (feet)	9708	1838	

[CEI-2 System Ver-2.0 - 8/1/94]

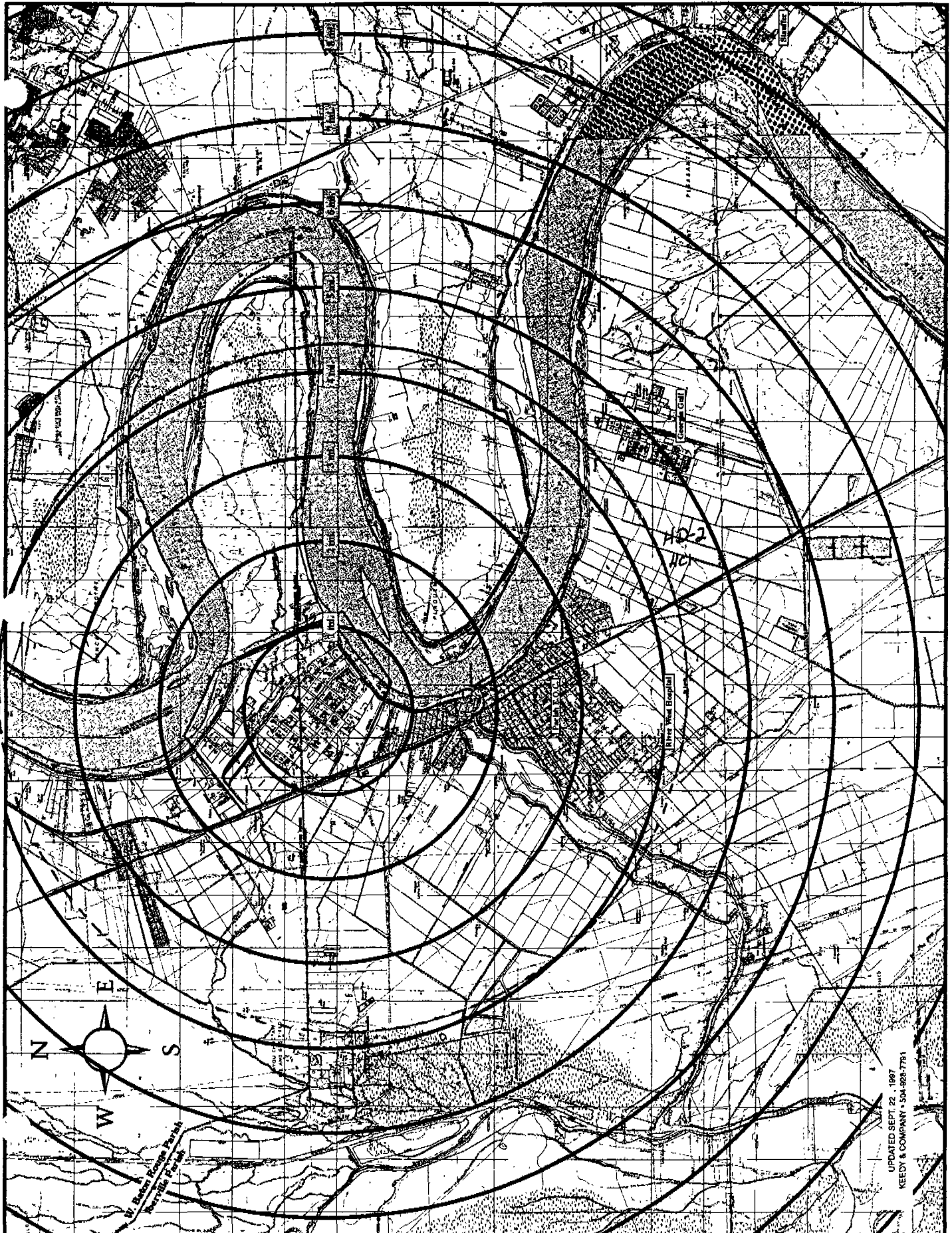
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CEI2 - INTERMEDIATE SUPPORTING CALCULATIONS		
Plant or Project Name: Solvents/EDC Location: LAD Prepared By: Richard Rolke Date Prepared: 5/14/97		
Case Number	1	2
Release Scenario	Liquid Release - Pipe/Vessel/Hose	Liquid Release - Pipe/Vessel/Hose
1. RELIEF DEVICE or OTHER CALCS.		
Input Release Rate (lb/min)	-	-
Time to Deplete System Inventory, (min)	-	-
Airborne Quantity for CEI, AQr (lb/min)	-	-
2. GAS RELEASE CALCS.		
Calculated Release Rate, (lb/min)	-	-
Time to Deplete System Inventory, (min)	-	-
Airborne Quantity for CEI, AQg (lb/min)	-	-
3. LIQUID RELEASE CALCS. (PIPE/VESSEL, HOSE)		
Step 1: Liquid Flow Rate Released		
Calculated Diameter to Use, Dcalc (in)	1.50	1.00
Calculated Liquid Release Rate, Lcalc (lb/min)	4022.4	2622.3
Time to Deplete System Inventory, (min)	132.6	0.3
Liquid Release Rate to Use, L (lb/min)	4022.4	144.1
Step 2: Total Liquid Released		
Calculated Total Liquid Release, WTcalc (lb)	60335.6	39335.2
System Inventory, WInv (lb)	533278.5	720.6
Total Liquid Release, WT (lb)	60335.6	720.6
Step 3: Fraction Flash		
Fraction Flash, Fv	0.106	0.106
Calculated Flash Rate, AQfcalc (lb/min)	2137.0	144.1
Time to Deplete System Inventory, (min)	249.5	5.0
Airborne Quantity by Flash to Use, AQf (lb/min)	2137.0	144.1
Step 4: Liquid Pool Size		
Mass of Liquid Entering Pool, Wp (lb)	28280.9	337.8
Calculated Liquid Pool Area, Ap calc (ft ²)	16000	191
Liquid Pool Area, Ap (ft ²)	16000	191
Step 5: Evaporation from Pool Surface		
Molecular Weight, MW	36.5	36.5
Characteristic Pool Temperature, T (°F)	-121.1	-121.1
Vapor Pressure at Ts, Pvp (psia)	95.258	95.258
Vapor Pressure at T, Pvp (psia)	14.700	14.700
Evaporation from Pool Surface, AQp (lb/min)	2408.4	35.9
Step 6: Total Airborne Quantity		
Calculated Airborne Rate, AQfcalc (lb/min)	4022.4	144.1
Time to Deplete System Inventory, (min)	132.6	5.0
Airborne Quantity for CEI, AQl (lb/min)	4022.4	144.1
4. LIQUID OVERFLOW/SPILL CALCS.		
Step 1: Liquid Flow Rate Released		
Calculated Liquid Release Rate, Lcalc (lb/min)	-	-
Time to Deplete System Inventory, (min)	-	-
Liquid Release Rate to Use, L (lb/min)	-	-
Step 2: Total Liquid Released		
Calculated Total Liquid Release, WTcalc (lb)	-	-
System Inventory, WInv (lb)	-	-
Total Liquid Release, WT (lb)	-	-
Step 3: Fraction Flash		
Fraction Flash, Fv	-	-
Calculated Flash Rate, AQfcalc (lb/min)	-	-
Time to Deplete System Inventory, (min)	-	-
Airborne Quantity by Flash to Use, AQf (lb/min)	-	-
Step 4: Liquid Pool Size		
Mass of Liquid Entering Pool, Wp (lb)	-	-
Calculated Liquid Pool Area, Ap calc (ft ²)	-	-
Liquid Pool Area, Ap (ft ²)	-	-
Step 5: Evaporation from Pool Surface		
Molecular Weight, MW	-	-
Characteristic Pool Temperature, T (°F)	-	-
Vapor Pressure at Ts, Pvp (psia)	-	-
Vapor Pressure at T, Pvp (psia)	-	-
Evaporation from Pool Surface, AQp (lb/min)	-	-
Step 6: Total Airborne Quantity		
Calculated Airborne Rate, AQfcalc (lb/min)	-	-
Time to Deplete System Inventory, (min)	-	-
Airborne Quantity for CEI, AQos (lb/min)	-	-

[CEI-2 System Ver-2.0 - 8/1/94]

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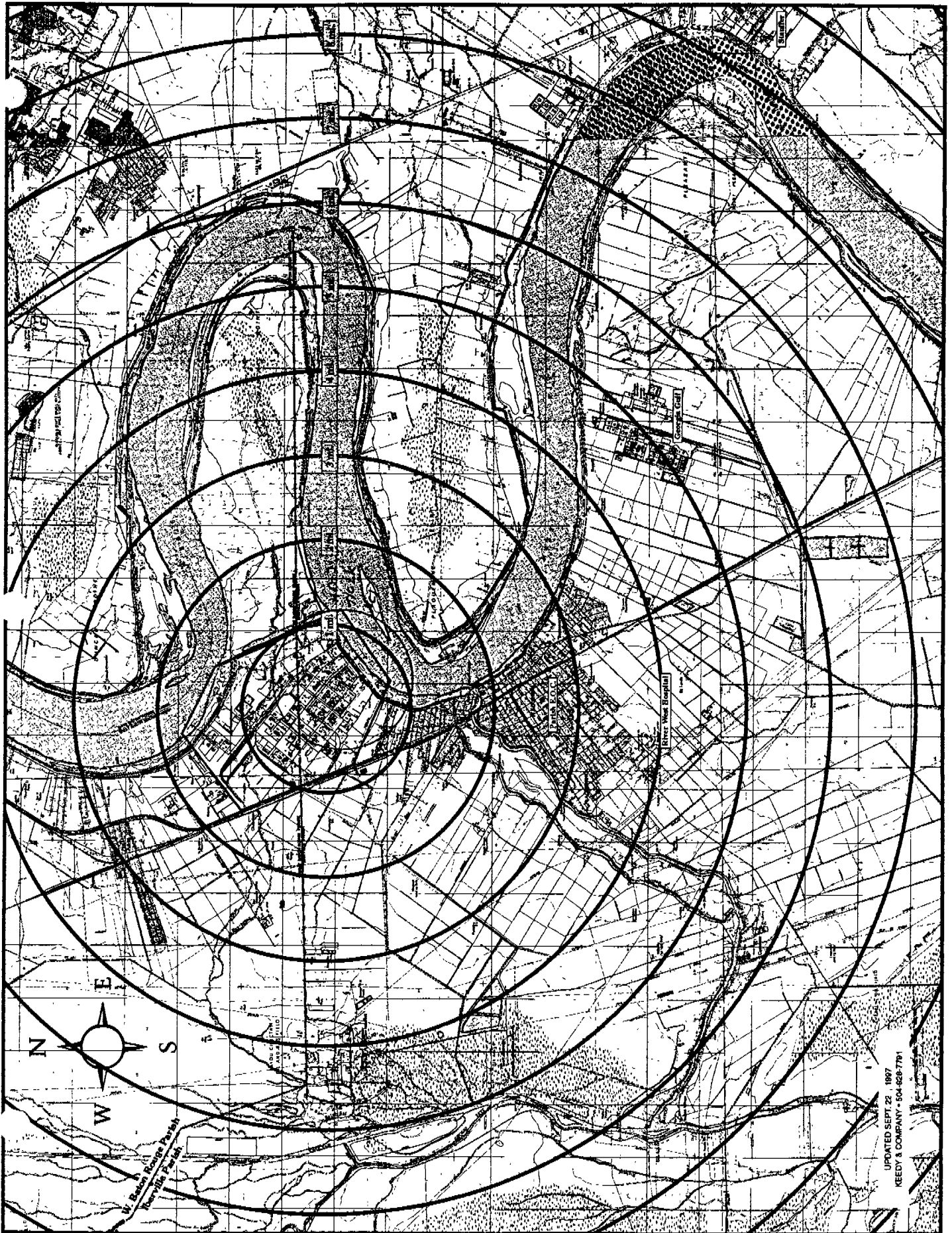
Anhydrous HCl
T-87 Nozzle Failure HD-2 4.1 miles



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AHCI LOADING HOSE FAILURE

HD-2 .8miles



UPDATED SEPT 22 1987
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Work File Name

[chlorine.xls]CEI2_TMP

Plant or Project Name:	<u>Solvents</u>	Prepared By:	<u>Richard Rolke</u>
Location:	<u>Piaquimine</u>	Date Prepared:	<u>5/8/97</u>
Plant Superintendent or Manager:	<u>Don Taylor</u>	Reviewed By:	<u>Buck Bailey</u>
Site Review Representative:	<u>Richard Rolke</u>	Date Reviewed:	<u>5/30/97</u>

I. CASE DATA		1	2
Case Number		Liquid Release - Pipe/Vessel/Hose	Gas Release
Release Scenario			
Chemical Name		Chlorine	Chlorine
Release Scenario Description		C-810 Bottoms Line	12" Line to R-1D
EMERGENCY RESPONSE PLANNING			
Dow IHG (ppm)		-	-
ACGIH TLV-TWA (ppm)		-	-
STEL (ppm)		-	-
ERPG-1 (ppm)		1	1
ERPG-2 (ppm)		3	3
ERPG-3 (ppm)		20	20
PLANT DATA			
Total Quantity in Plant, (lb)		1000	200
Largest Single Containment, (lb)		1000	200
Pressure of Containment, (psig)		11	66
DISTANCES TO (feet):			
1. Public		875	800
2. Other in-company facility		375	150
3. Non-company plant or business		975	825
PHYSICAL PROPERTIES			
Operating Temperature of Liquid, Ts (°F)		3.0	75.0
Molecular Weight, MW		70.9	70.9
Normal Boiling Point of Liquid, Tb (°F)		-29.3	-29.3
Vapor Pressure at Ta, Pvap (psia)		27.525	100.438
Liquid Density at Ta, Rho (lb/ft³)		94.71	87.87
Heat Capacity, Cp (Btu/lb°F)		0.219	0.236
Heat of Vaporization, Hv (Btu/lb)		118.94	108.61
II. AIRBORNE QUANTITY ESTIMATION			
Liquid System Inventory, (gal)		80	20
1. FROM A RELIEF DEVICE or OTHER Input Release Rate (lb/min)			
2. FROM A GAS RELEASE			
Gauge Pressure, Pg (psig)			65.0
Diameter of Hole, D (in)			2.40
3. FROM A LIQUID RELEASE (PIPE/VESSEL, HOSE)			
Process Pipe/Vessel? or Hose?		Pipe/Vessel	
Diameter of Hole, D (in)		2.00	
Gauge Pressure, Pg (psig)		11.0	
Height of Liquid Above Release Point, h (ft)		3.6	
Diked area (ft²)		19400	
4. FROM A LIQUID OVERFLOW/SPILL			
Filling or Unloading Rate (gpm)			
Diked area (ft²)			
CHEMICAL EXPOSURE INDEX			
Release Scenario		Liquid Release - Pipe/Vessel/Hose	Gas Release
Airborne Quantity, AQ (lb/min)		202.6	46.9
CEI		275	132
Hazard Distance, HD-1 (feet)		15622	7515
Hazard Distance, HD-2 (feet)		9019	4339
Hazard Distance, HD-3 (feet)		3493	1680

[CEI-2 System Ver-2.0 - 8/1/94]

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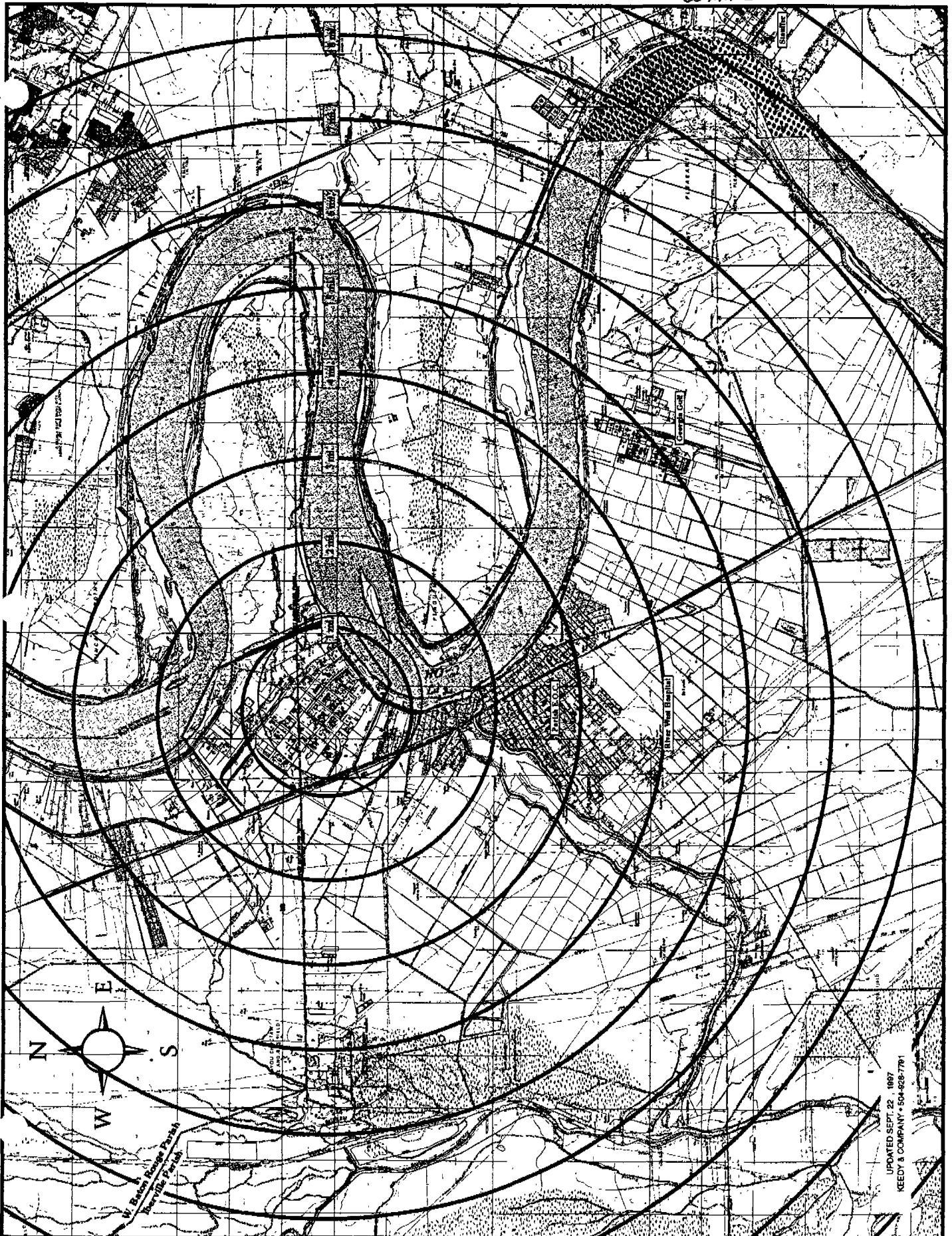
CEI2 - INTERMEDIATE SUPPORTING CALCULATIONS		
Plant or Project Name: ?		
Location: ?		
Prepared By: MUKUND PATEL		
Date Prepared: 7/24/94		
Case Number	1	2
Release Scenario	Liquid Release - Pipe/Vessel/Hose	Gas Release
1. RELIEF DEVICE or OTHER CALCS.		
Input Release Rate (lb/min)	-	-
Time to Deplete System Inventory, (min)	-	-
Airborne Quantity for CEI, AQr (lb/min)	-	-
2. GAS RELEASE CALCS.		
Calculated Release Rate, (lb/min)	-	627.5
Time to Deplete System Inventory, (min)	-	0.4
Airborne Quantity for CEI, AQg (lb/min)	-	46.9
3. LIQUID RELEASE CALCS. (PIPE/VESSEL, HOSE)		
Step 1: Liquid Flow Rate Released		
Calculated Diameter to Use, Dcalc (in)	2.00	-
Calculated Liquid Release Rate, Lcalc (lb/min)	3816.4	-
Time to Deplete System Inventory, (min)	0.3	-
Liquid Release Rate to Use, L (lb/min)	202.6	-
Step 2: Total Liquid Released		
Calculated Total Liquid Release, WTcalc (lb)	57230.8	-
System Inventory, WInvt (lb)	1012.8	-
Total Liquid Release, WT (lb)	1012.8	-
Step 3: Fraction Flashed		
Fraction Flashed, Fv	0.060	-
Calculated Flash Rate, AQfcalc (lb/min)	202.6	-
Time to Deplete System Inventory, (min)	5.0	-
Airborne Quantity by Flash to Use, AQf (lb/min)	202.6	-
Step 4: Liquid Pool Size		
Mass of Liquid Entering Pool, Wp (lb)	711.3	-
Calculated Liquid Pool Area, Ap calc (ft2)	229	-
Liquid Pool Area, Ap (ft2)	229	-
Step 5: Evaporation from Pool Surface		
Molecular Weight, MW	70.9	-
Characteristic Pool Temperature, T (°F)	-29.3	-
Vapor Pressure at Ts, Pvp (psia)	27.525	-
Vapor Pressure at T, Pvp (psia)	14.700	-
Evaporation from Pool Surface, AQp (lb/min)	65.2	-
Step 6: Total Airborne Quantity		
Calculated Airborne Rate, AQlcalc (lb/min)	202.6	-
Time to Deplete System Inventory, (min)	5.0	-
Airborne Quantity for CEI, AQI (lb/min)	202.6	-
4. LIQUID OVERFLOW/SPILL CALCS.		
Step 1: Liquid Flow Rate Released		
Calculated Liquid Release Rate, Lcalc (lb/min)	-	-
Time to Deplete System Inventory, (min)	-	-
Liquid Release Rate to Use, L (lb/min)	-	-
Step 2: Total Liquid Released		
Calculated Total Liquid Release, WTcalc (lb)	-	-
System Inventory, WInvt (lb)	-	-
Total Liquid Release, WT (lb)	-	-
Step 3: Fraction Flashed		
Fraction Flashed, Fv	-	-
Calculated Flash Rate, AQfcalc (lb/min)	-	-
Time to Deplete System Inventory, (min)	-	-
Airborne Quantity by Flash to Use, AQf (lb/min)	-	-
Step 4: Liquid Pool Size		
Mass of Liquid Entering Pool, Wp (lb)	-	-
Calculated Liquid Pool Area, Ap calc (ft2)	-	-
Liquid Pool Area, Ap (ft2)	-	-
Step 5: Evaporation from Pool Surface		
Molecular Weight, MW	-	-
Characteristic Pool Temperature, T (°F)	-	-
Vapor Pressure at Ts, Pvp (psia)	-	-
Vapor Pressure at T, Pvp (psia)	-	-
Evaporation from Pool Surface, AQp (lb/min)	-	-
Step 6: Total Airborne Quantity		
Calculated Airborne Rate, AQoscalc (lb/min)	-	-
Time to Deplete System Inventory, (min)	-	-
Airborne Quantity for CEI, AQos (lb/min)	-	-

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12" Feed Line to RD
Chlorine

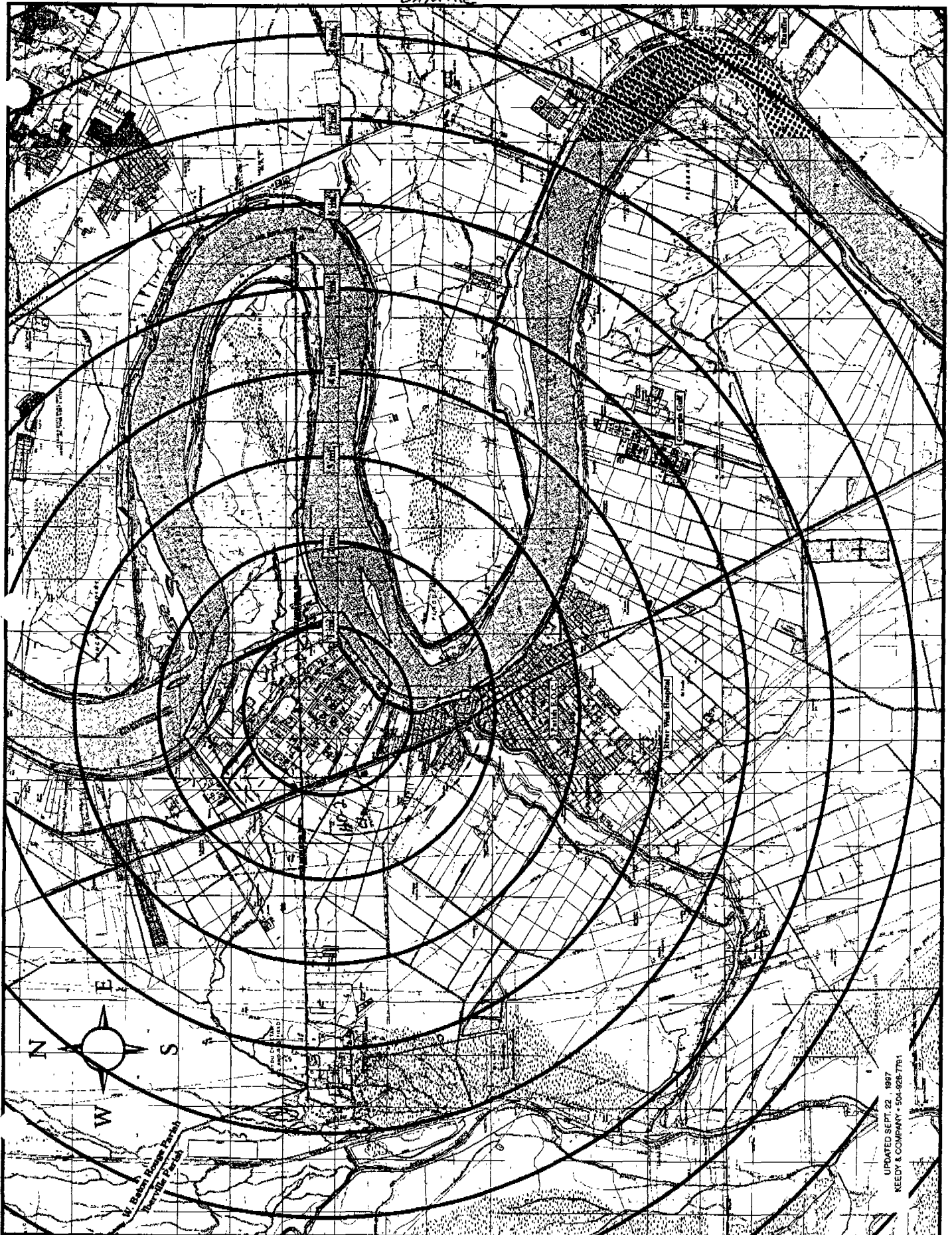
HD-2
-82 miles



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C-510 Bottoms Line Failure
Chlorine

HD-2 1.7 mi.



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OPERATING PROCEDURE FOR THE CEI2 SYSTEM - VERSION 2.0

INTRODUCTION

The CEI2 System helps prepare Chemical Exposure Index Calculations based on the New CEI Methodology utilized in the "CHEMICAL EXPOSURE INDEX GUIDE", 2nd Edition, issued in September 1993. The CEI2 System is comprised of EXCEL spreadsheets and macros and features fully automated, menu-driven operation with extensive on-line help. Full cases results as well as the CEI Summary Form are output in the designated format.

VER 2.0 - NOTE

Due to significant changes, Ver-1.0 Work Files CANNOT be processed using the CEI2 Ver-2.0.

REQUIREMENT

The CEI2 System runs on a DOS-based computer running Microsoft Windows and requires at least Microsoft EXCEL Version-4.0.

INSTALLATION

The CEI2 System is located on the Midland USPWS4 Fileserver as:

DOWSLPS

Spredsht

CEI2

CEI2_DEN (DOS English units)

CEI2_DSI (DOS SI units)

Copy the desired folder/directory to your computer hard drive from the Fileserver as well as Operating Procedure and Management of Change documentation.

USING THE SYSTEM

1. Double-click on the file named 'CEI2.XLS' in the downloaded directory/folder. Note the ".xls" extension may not appear depending on the options you have chosen under "View" in the Menu Bar.
2. This opens the required files and starts the CEI2 System.
3. Use the CEI2 Menu to navigate through the CEI2 System and refer to the On-line Help for additional information.
4. The CEI2 System employs the 'Cases Concept'; hence, data in a case column (in blue) may be changed at any time, prior to performing the calculations.
5. Printing of the Cases File and CEI Summary Form for a desired case is through EXCEL's 'Print-Preview' to allow flexibility in page set-up and printer selection.
6. Quit the CEI2 System using the CEI2 Menu upon completion.

WARNINGS

1. The CEI2 Menu MUST BE used for ALL data input and file opening, saving and closing.
2. A Work File MUST BE opened and processed through the CEI2 System to make changes and for proper operation.
3. Double-clicking on a Work File DOES NOT start the CEI2 System.
4. NONE of the CEI2 files EXCEPT the user Work File MUST BE CLOSED BEFORE EXITING the CEI2 System!

CHANGE MANAGEMENT

The management of change form must be used to initiate changes to the CEI2 System and directed to Norm Scheffler, Process Safety Services, 2030 Building.

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Tips for using the CEI Spreadsheet, Version 2.0

- 1) Spreadsheets generated with version 1.0 of the CEI Spreadsheet can not be updated with version 2.0 of the CEI spreadsheet. You must go back to version 1.0 or re-enter the data in the new version 2.0.
- 2) All data entry should occur in the CEI2.XLS file, not the workfile that you create and name. The data entered into the CEI2.XLS file is saved to your workfile as calculations are completed.
- 3) When entering system inventory data, be sure that there is sufficient inventory for at least a 5 minute release, especially for a gas pipeline release. The CEI calculations do not allow credit for block valves to automatically shutoff and terminate a gas release.
- 4) When entering hole diameter for a liquid release scenario, use the PIPE diameter. The spreadsheet automatically calculates the hole size based on PIPE size and CEI guideline rules.
- 5) When entering hole diameter for a gas release scenario, you must determine the HOLE diameter as specified by the CEI guidelines first. The spreadsheet does NOT automatically calculate the hole size.
- 6) Any adjustments to the operating temperature must be made through the CEI menu, NOT as an entry on the spreadsheet. The physical properties will not recalculate if operating temperature is changed via a direct spreadsheet entry.
- 7) For some compounds, the physical properties are NOT temperature compensated. Butadiene is a known example of this. If you specify an operating temperature other than that corresponding to the CEI database, the physical property data should be gathered and manually entered.
- 8) For some compounds, the physical property data prediction algorithms have a limited temperature range. You will get an error message. Again, data should be gathered and manually entered for these situations. An example is anhydrous HCL at low temperature (heat capacities come out negative!).
- 9) The CEI summary form (the sheet which summarizes the CEI and hazard distances and also has space for signatures) that is generated from the workfile after calculations are complete does not print out correctly. Attempts to reformat the document to produce a useable printout were unsuccessful. If you can't get a good printout, make a copy of the file called CEI Form.doc and manually transfer your data into that document.
- 10) If you get a "halt, step, continue" error message when saving the work file, you may lose all your data if you "step or continue" through the process. Select "halt" to stop the process. Hopefully, you have saved your work as you went along so that you won't lose anything or lose very little. You then need to close all files by:
 - a) quitting the CEI System (close, not minimize!) and
 - b) closing EXCEL (hidden files will come up that need to be closed).

Curtis Tong
10/30/96

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