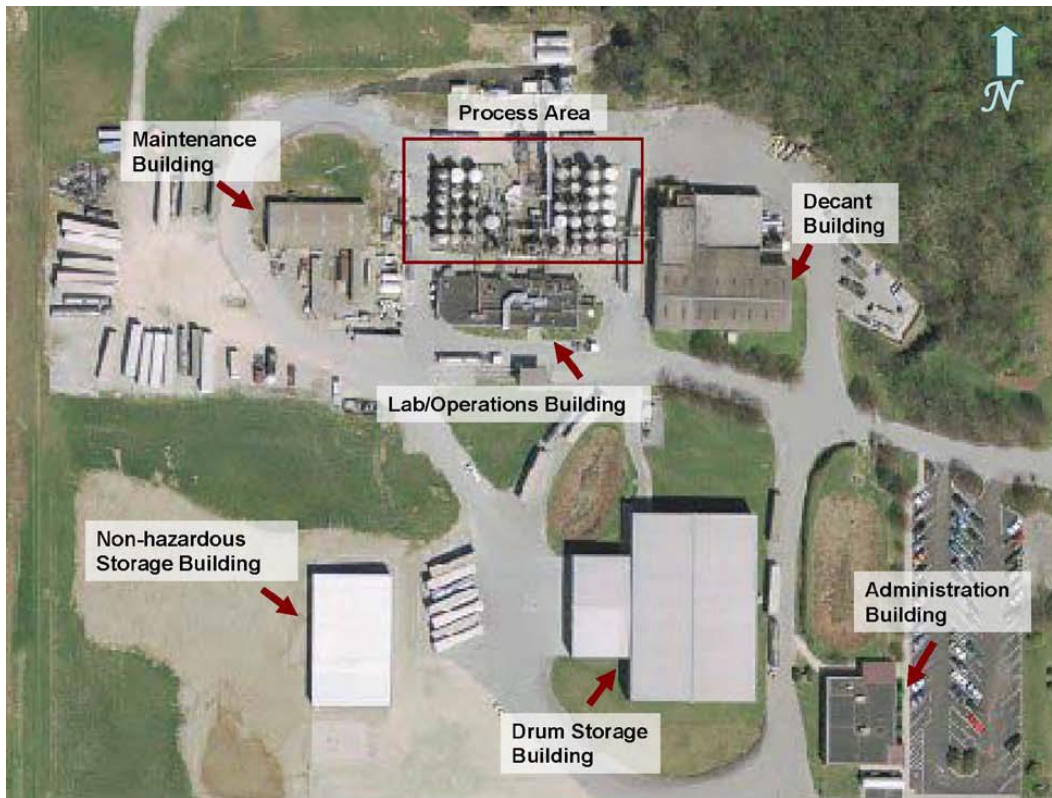


WHAT WOULD YOU DO DIFFERENT IN THE SITE LAYOUT OF THIS PLANT?





**VEOLIA TECHNICAL
SOLUTIONS LLC**

**PLANT AFTER VAPOR
CLOUD EXPLOSION**

(PICTURES FROM CSB)



Occupied Buildings Safety

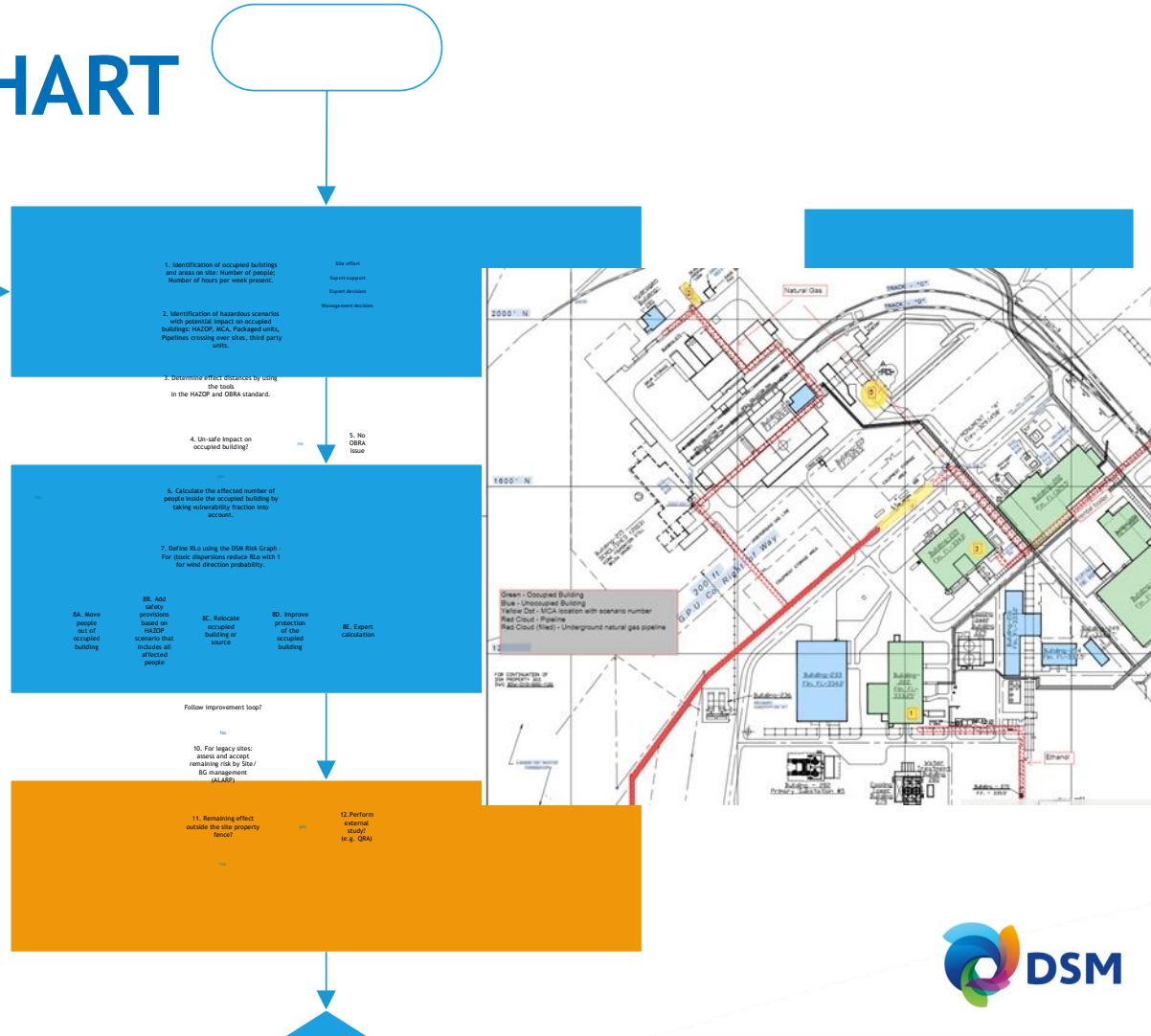
Protect people in buildings
against potential
consequences of major
process-related incidents



“Wrong dosing, runaway”

OBRA FLOWCHART

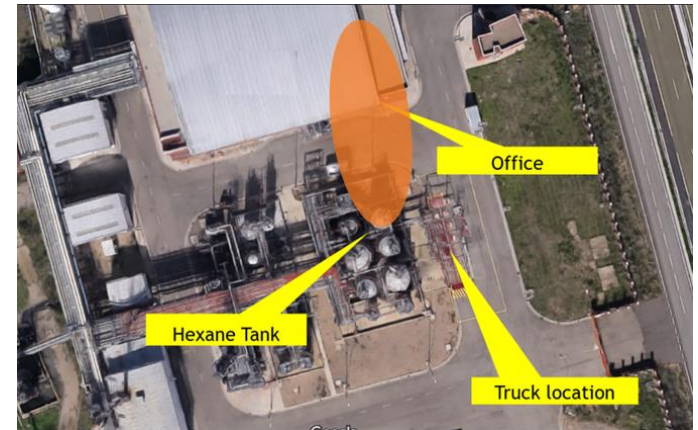
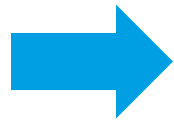
- Occupied buildings
- Hazards
- Effect calculations
- People affected
- Risk determination
- Measures
- Risk reduction



DETERMINE THE EFFECT DISTANCES BY USING TOOLS

- Expert software (e.g. PHAST, SafeSite, Effects)
- CHEF (or RAST) Excel tool - Available via CCPS and EPSC

VAPOR DISPERSION INPUT INFORMATION		JET MIXING		SMALL VAPOR DISPERSION	
STEP 1 - Select Location, Type of Release, Concentration and Distance of Interest Release Location: <input type="text"/> (Horizontal Distance) Type of Release: <input type="text"/> (Vertical Distance) Use Averaging Time Correction for Flammable Releases: <input type="checkbox"/>		Vapor Density: $\rho = \text{atmospheric pressure} \times \text{Equation 2-30} / \rho_a = 0.075(31.05/101.325) \times 2.82 \text{ kg/m}^3$ Discharge Velocity Equation 2-5: $V = 1.17(20) \times 0.7 = 1.67 \text{ m/sec}$		For 3 meters Wind Speed, Class D Atmospheric Stability, and Neutral Horizontal Distance: <input type="text"/> m Vertical Distance: <input type="text"/> m	
Concentration of Interest: <input type="text"/> ppm Distance of Interest: <input type="text"/> m		Concentration at X, Equation 2-2: $C_x = 1.85 C_0 (L / (L + X))^{1.19}$ Jet Mixing Transition Distance Equation 2-31: $X_{JM} = 1.05(4) / (1.67) = 2.5 \text{ m}$		Plume Concentration: 0.00001 kg/m^3 Plume Concentration at 100m: $1.0 \times 10^{-5} \text{ kg/m}^3$	
STEP 2 - Enter Chemical Properties (or Select Chemical Name from the List) Chemical Name: <input type="text"/> (CAS No.) Lower Flammable Limit (LFL): <input type="text"/> % Vapor Molecular Weight, M_v : <input type="text"/> g/mol Normal Boiling Point, T_b : <input type="text"/> °C		DISTANCE CORRECTION FOR INITIAL CONCENTRATION Vapor from Liquid Evaporation, Equipment Repair, or Low Vapor Vapors: <input type="checkbox"/>		Test for Plume versus Puff Model at Dispersion Conditions for Estimated Exposure Duration - Continuous Dispersion (Equation 2-32): $T = 10 \text{ min}$	
STEP 3 - Enter Process Information Release Rate, Q : <input type="text"/> kg/sec Release Temperature, T : <input type="text"/> °C Total Release Quantity, Q_T : <input type="text"/> kg Liquid or Two-Phase Release Velocity, V_{LP} : <input type="text"/> m/sec Vapor Pressure at Release, P_{VP} : <input type="text"/> kPa		CORRECTION FOR RELEASE ELEVATION Effective Release Elevation Equation 2-24: $H_{eff} = 1.18(1) \times 1.18 = 1.39 \text{ m}$		Maximum Observed Distance to Concentration of Interest Continuous Dispersion (Equation 2-25): $X_{max} = 100 \text{ m}$	
STEP 4 - Enter Enclosure and Plant Layout Information Enclosure Type: <input type="text"/> Enclosure Area, A_{enc} : <input type="text"/> m ² Enclosure Process Area Volume, V_{enc} : <input type="text"/> m ³ Enclosure Process Area Ventilation Rate, R_{enc} : <input type="text"/> 1/hr		CORRECTION FOR RELEASE WITHIN ENCLOSED SPACE Steady State Concentration within Enclosed Process Area (Equation 2-26): $C_{enc} = 1.85 C_0 (L / (L + X))^{1.19} = 1.85 \times 10^{-5} \text{ kg/m}^3$		Minimum Ground Level Concentration from Elevated Contin...	



DEFINE AFFECTED NUMBER OF PEOPLE

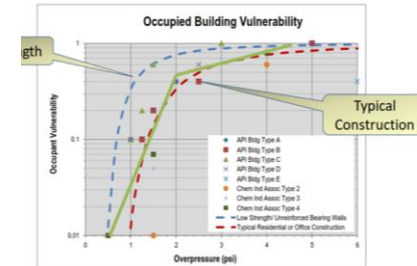
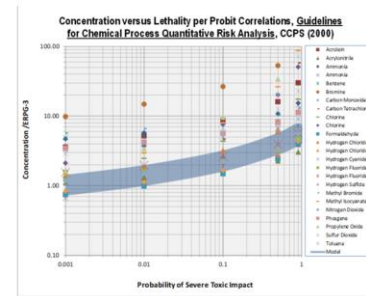
People affected = Occupancy x vulnerability factor

Define vulnerability factor for toxic concentration in a building

- ERPG-3 = 0%
- 5 times ERPG-3 = 100%

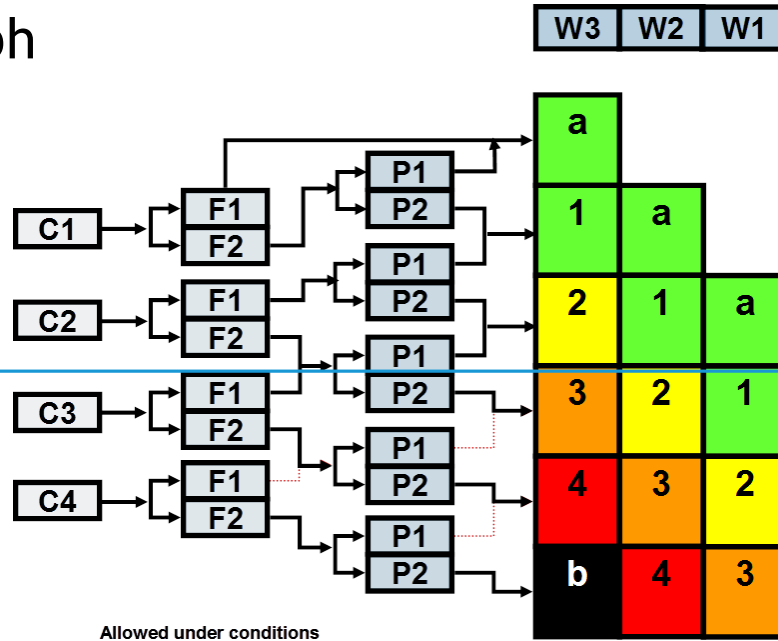
Define vulnerability factor for explosion pressure @ building

- 30 mbar = 0 %
- 300 mbar = 100%



DEFINE THE RISK

DSM RiskGraph



1. Identification
and areas on site
Number of hours

2. Identification of
with potential

OBRA MEASURES FOR RISK GAP CLOSING

- A. Move people out of occupied buildings
- B. Improve/increase the safeguarding to mitigate the risk
- C. Relocate the occupied building or source of the hazard
- D. Modify occupied buildings



1. Identification
and areas on site
Number of hours

2. Identification of
with potential

FLIXBOROUGH, UK - 1974

OBRA RELATED INCIDENT

- Explosion equivalent to 15 Tonnes TNT
- 1,800 buildings within 1 mile radius damaged
- All 18 people in control room killed
- 500+ would have been killed during a weekday



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