a two-phase, multi-compound mixture of non-reactive compounds or hydrogen fluoride (HF) with chemical reactions. The individual models are:

Database program:

- DATAPROP generates physical properties used in other HGSYSTEM models
- Source term models:
- SPILL transient liquid release from a pressurized vessel
- HFSPILL SPILL version specifically for HF
- LPOOL evaporating multicompound liquid pool model
- Near-field dispersion models: AEROPLUME high-momentum jet
- dispersion model HFPLUME AEROPLUME version
- specifically for HF
- HEGABOX dispersion of instantaneous heavy gas releases
- Far-field dispersion models:
 - HEGADAŚ(S,T) heavy gas dispersion (steady-state and transient version)
 - PGPLUME passive Gaussian dispersion

Utility programs:

- HFFLASH flashing of HF from pressurized vessel
- POSTHS/POSTHT post-processing of HEGADAS(S,T) results
- PROFILE post-processor for concentration contours of airborne plumes
- GÉT2COL utility for data retrieval

The models assume flat, unobstructed terrain. HGSYSTEM can be used to model steady-state, finite-duration, instantaneous and time dependent releases, depending on the individual model used. The models can be run consecutively, with relevant data being passed on from one model to the next using link files. The models can be run in batch mode or using an iterative utility program.

a. Recommendations for Regulatory Use

HGSYSTEM can be used as a refined model to estimate short-term ambient concentrations. For toxic chemical releases (non-reactive chemicals or hydrogen fluoride; 1-hour or less averaging times) the expected area of exposure to concentrations above specified threshold values can be determined. For flammable non-reactive gases it can be used to determine the area in which the cloud may ignite.

b. Input Requirements

1. HFSPILL input data: reservoir data (temperature, pressure, volume, HF mass, mass-fraction water), pipe-exit diameter and ambient pressure.

2. EVAP input data: spill rate, liquid properties, and evaporation rate (boiling

pool) or ambient data (non-boiling pool).

3. HFPLUME and PLUME input data: reservoir characteristics, pollutant parameters, pipe/release data, ambient conditions, surface roughness and stability class.

4. HEGADAS input data: ambient conditions, pollutant parameters, pool data or data at transition point, surface roughness, stability class and averaging time.

5. PGPLUME input data: link data provided by HFPLUME and the averaging time.

c. Output

1. The HGSYSTEM models contain three post-processor programs which can be used to extract modeling results for graphical display by external software packages. GET2COL can be used to extract data from the model output files. HSPOST can be used to develop isopleths, extract any 2 parameters for plotting and correct for finite release duration. HTPOST can be used to produce time history plots.

2. HFSPILL output data: reservoir mass, spill rate, and other reservoir variables as a function of time. For HF liquid, HFSPILL generates link data to HFPLUME for the initial phase of choked liquid flow (flashing jet), and link data to EVAP for the subsequent phase of unchoked liquid flow (evaporating liquid pool).

3. EVAP output data: pool dimensions, pool evaporation rate, pool mass and other pool variables for steady state conditions or as a function of time. EVAP generates link data to the dispersion model HEGADAS (pool dimensions and pool evaporation rate).

4. HFPLUME and PLUME output data: plume variables (concentration, width, centroid height, temperature, velocity, etc.) as a function of downwind distance.

5. HEGADAS output data: concentration variables and temperature as a function of downwind distance and (for transient case) time.

6. PGPLUME output data: concentration as a function of downwind distance, cross-wind distance and height.

d. Type of Model

HGSYSTEM is made up of four types of dispersion models. HFPLUME and PLUME simulate the near-field dispersion and PGPLUME simulates the passive-gas dispersion downwind of a transition point. HEGADAS simulates the ground-level heavy-gas dispersion.

e. Pollutant Types

HGSYSTEM may be used to model non-reactive chemicals or hydrogen fluoride.

f. Source-Receptor Relationships

HGSYSTEM estimates the expected area of exposure to concentrations above user-specified threshold values. By imposing conservation of mass, momentum and energy the concentration, density, speed and temperature are evaluated as a function of downwind distance.

g. Plume Behavior

1. HFPLUME and PLUME: (1) are steady-state models assuming a top-hat profile with cross-section averaged plume variables; and (2) the momentum equation is taken into account for horizontal ambient shear, gravity, ground collision, gravity-slumping pressure forces and ground-surface drag.

2. HEGADAS: assumes the heavy cloud to move with the ambient wind speed, and adopts a power-law fit of the ambient wind speed for the velocity profile.

3. PGPLUME: simulates the passivegas dispersion downwind of a transition point from HFPLUME or PLUME for steady-state and finite duration releases.

h. Horizontal Winds

A power law fit of the ambient wind speed is used.

i. Vertical Wind Speed

Not treated.

j. Horizontal Dispersion

1. HFPLUME and PLUME: Plume dilution is caused by air entrainment resulting from high plume speeds, trailing vortices in wake of falling plume (before touchdown), ambient turbulence and density stratification. Plume dispersion is assumed to be steady and momentum-dominated, and effects of downwind diffusion and wind meander (averaging time) are not taken into account.

2. HEGADAS: This model adopts a concentration similarity profile expressed in terms of an unknown center-line ground-level concentration and unknown vertical/cross-wind dispersion parameters. These quantities are determined from a number of basic equations describing gas-mass conservation, air entrainment (empirical law describing vertical top-entrainment in terms of global Richardson number), cross-wind gravity spreading (initial gravity spreading followed by gravitycurrent collapse) and cross-wind diffusion (Briggs formula).