

**PACKAGE ID** - 000198CY00100 FEM3

**KWIC TITLE** - Heavy Gas Dispersion Incompressible Flow

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**LIMITATION CODE** -UNL                   **AUDIENCE CODE** - UNL

**COMPLETION DATE** - 08/01/1983   **PUBLICATION DATE** - 12/01/1983

**DESCRIPTION** - FEM3 is a numerical model developed primarily to simulate heavy gas dispersion in the atmosphere, such as the gravitational spread and vapor dispersion that result from an accidental spill of liquefied natural gas (LNG). FEM3 solves both two and three-dimensional problems and, in addition to the generalized anelastic formulation, includes options to use either the Boussinesq approximation or an isothermal assumption, when appropriate. The FEM3 model is composed of three parts: a preprocessor PREFEM3, the main code FEM3, and two postprocessors TESSERA and THPLOTX.

**PACKAGE CONTENTS** - Media Directory; Software Abstract; UCRL-53397;  
Media Includes Source Code, Sample Problems Input and Output,  
Auxiliary Programs;

**SOURCE CODE INCLUDED?** - Yes

**MEDIA QUANTITY** - 1 CD Rom

**METHOD OF SOLUTION** - The model is based on solving the time-dependent, multidimensional conservation equations of mass, momentum, energy, and species. A generalized anelastic approximation is employed to accommodate large density changes and yet preclude sound waves (i.e., the fluid is considered to be basically incompressible but to have variable density). A modified Galerkin finite element method with eight-node isoparametric hexahedron elements (four-node quadrilaterals in two dimensions) is used for spatial discretization, and an improved forward Euler method is employed for time integration. The discretized Poisson equation for pressure is solved by a skyline solver.

**COMPUTER** - CRAY1

**OPERATING SYSTEMS** - CTSS

**PROGRAMMING LANGUAGES** - FORTRAN IV (CFT)

**SOURCE CODE AVAILABLE (Y/N)** - Y

**OTHER PROG/OPER SYS INFO** - PACKAGE SHOULD ONLY BE CONSIDERED FOR CRAY1,  
WITH CTSS OPERATING SYSTEM. CHANGING TO OTHER MODELS OF CRAY WITH  
OTHER OPERATING SYSTEMS MAY REQUIRE SIGNIFICANT WORK. The

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**OTHER PROG/OPER SYS INFO - (CONT)** postprocessors, used for plotting velocity vectors, contours, time histories, etc., depend heavily on LLNL computing environment graphics software which is not included. The Cray1 versions of PREFEM3 and FEM3 use a limited number of LLNL computing environment system subroutines, which are not included. These are identified in the program and should be easily replaceable with equivalent subroutines suited to the local computing environment. Descriptions of the missing subroutines are included in the reference report.

**REFERENCES** - Stevens T. Chan, FEM3 - A Finite Element Model for the Simulation of Heavy Gas Dispersion and Incompressible Flow: User's Manual, UCRL-53397, February 1983 with errata December 1983.

**ABSTRACT STATUS** - Abstract first distributed October 1983. Cray1 version submitted August 1983.

**SUBJECT CLASS CODE** - RH

**KEYWORDS** -

COMPUTER PROGRAM DOCUMENTATION  
EARTH ATMOSPHERE  
FUEL GAS  
INCOMPRESSIBLE FLOW  
FINITE ELEMENT METHOD  
FLUIDS  
HYDRODYNAMICS  
LIQUEFIED NATURAL GAS  
GAS SPILLS  
GASEOUS DIFFUSION  
F CODES

**EDB SUBJECT CATEGORIES** -

990200 030800 540120 420400

**SPONSOR** - DOE/EH

**PACKAGE TYPE** - AS - IS