General Characteristics		
1	**Abstract of Model Capabilities**	GASFLOW addresses geometrically complex containments, buildings, and ventilation systems with multiple compartments and internal structures. It calculates gas and aerosol behavior of low-speed buoyancy-driven flows, diffusion-dominated flows, and turbulent flows during deflagrations, and can model condensation in the bulk fluid regions; heat transfer to wall and internal structures by convection, radiation, and condensation; chemical kinetics of combustion of hydrogen or hydrocarbons; fluid turbulence; and the transport, deposition, and entrainment of discrete particles.
2	**Sponsor and/or Developing Organization**	Los Alamos National Laboratory (LANL) Department of Energy (DOE) DP and EM Nuclear Regulatory Commission (NRC)
3	**Last Custodian/ Point of Contact**	Dr. Kim Lam MS-575 Los Alamos National Laboratory Los Alamos, NM 87545 PHN: 505/665-3362 FAX: 505/665-0879 E-mail: klam@lanl.gov
4	**Life-Cycle**	GASFLOW 2.0 is the same as the GASFLOW 1.1 code version, except one-dimensional ventilation system models and multi-block capability have been added to the GASFLOW 2.0 code version. GASFLOW 1.1 was based on the HMS series of codes originally developed by the NRC for the investigation of hydrogen in containments. The GASFLOW series of codes has been funded by DOE-DP, DOE-EM, and NRC, GASFLOW is currently at the end of its development stage and will soon be released.
5	**Model Description Summary**	GASFLOW 2.0 can model geometrically complex containments, buildings, and ventilation systems with multiple compartments and internal structures. It can calculate gas and aerosol behavior of low-speed buoyancy-driven flows, diffusion-dominated flows, and turbulent flows during deflagrations. The code can model condensation in the bulk fluid regions; heat transfer to wall and internal structures by convection, radiation, and condensation; chemical kinetics of combustion of hydrogen or hydrocarbons; fluid turbulence; and the transport, deposition, and entrainment of discrete particles. Heat conduction within walls and structure is one-dimensional. The geometry, gas components species, boundary conditions, and other relevant factors are input parameters.
6	**Application Limitation**	! For ventilation system modeling, only six connections are allowed per cell; and, ! No solids or liquids combustion models are available. Energy and mass source for solids and/or liquids burning must be provided as input.
7	**Strengths/ Limitations**	**Strengths**: Full governing equations are utilized, without assumptions for incompressible flow; Multi-dimensional flow, multi-species diffusion, and chemistry models are available; Several turbulence models are available; Multi-block can be interconnected by one-dimensional ductwork models; A Lagrangian aerosol model is available; and, A complete ventilation system modeling capability. **Limitations:** There is no agglomeration model. However, this should yield conservative results since agglomeration would in general increase particle sizes and would tend to reduce the respirable interaction; and, No internal code model for user-friendly representation of log-normal particle distribution.
8	**Model References**	J.R. Travis, K.L. Lam, T.L. Wilson, “GASFLOW: A Three-Dimensional Finite-Volume Fluid-Dynamics Code for Calculating the Transport, Mixing, and Combustion of Flammable Gases in Geometrically Complex Domains, Volume 3, Assessment Manual”, Los Alamos National Laboratory Report LA-UR-94-2270, July 11, 1994.

9	**Input Data/Parameter Requirements**	**Data and input parameter and boundary condition requirements:** **Gas properties are available as fits for the following gas species:** Carbon, Carbon Monoxide, Carbon Dioxide, Hydrogen, Water Vapor, Nitrogen, Nitrous Oxide, Oxygen, Air, Argon, Helium, Ammonia, Methane, Hydroxyl, Hydrogen, Hydroperoxyl, Nitric Oxide, Oxygen, Imidogen, Nitroxyl Hydride, Amidogen, Light Gas, and Benzene. **Depending on the models selected, additional model inputs are required. For example:** Algebraic turbulence models need mixing length input; Kappa-epsilon turbulence model needs κ–ε turbulence parameters; and, Blower model needs vendor information on performance characteristics.
10	**Output Summary**	Output is a form of printed output as well as graphical output. The graphical output can be displayed with the graphics package included with GF2. In addition, selected information is written to the terminal and message files. Input is echoed to the TAPE16 file.
11	**Applications**	! Hanford waste tank ventilation studies; ! Burp and burn calculations for Hanford Waste Tanks; ! Replacement Tritium Facility tritium mixing and combustion; ! TA-55 Fire Bounding Fire; ! Bureau of Mines combustion data for hydrogen-nitrous oxide-air mixtures; ! Savannah River Site K-Reactor; and, NRC Containment Loads Working Group standard problems.
12	**User-Friendliness**	GASFLOW is user friendly due to input error checks, the availability of cylindrical and rectangular geometries, and that three-dimensional blocks can be built with only a few inputs.
13	**Hardware-Software Interface Constraints/ Requirements**	CRAY/UNICOS SGI/UNIX SUN/UNIX A FORTRAN 77 compiler is required.
14	**Operational Parameters**	Memory requirements depend on the problem size.
15	**Surety Considerations**	**Quality Assurance:** J.R. Travis, K.L. Lam, T.L. Wilson, "GASFLOW: A Three-Dimensional Finite-Volume Fluid-Dynamics Code for Calculating the Transport, Mixing, and Combustion of Flammable Gases in Geometrically Complex Domains, Volume 3, Assessment Manual", Los Alamos National Laboratory Report LA-UR- 94-2270, July 11, 1994. **Error Handling and Reporting:** Yes. **Benchmarking and V & V:** J.R. Travis, K.L. Lam, T.L. Wilson, "GASFLOW: A Three-Dimensional Finite-Volume Fluid-Dynamics Code for Calculating the Transport, Mixing, and Combustion of Flammable Gases in Geometrically Complex Domains, Volume 3, Assessment Manual", Los Alamos National Laboratory Report LA-UR-94-2270, July 11, 1994.
16	**Runtime Characteristics**	Execution time depends on the machine, detail of the model, and the length of the transient. Runtimes on the CRAY vary from a few seconds to a few hours. Typical runtimes for Hanford waste tank burps and burns are several hours on an SGI workstation. Typical runtimes for long multi-day transients for a large passively ventilated tank farm are several days on a SUN SPARC 10 workstation.

Specific Characteristics		
Part A: Source Term Submodel Type		
A1	**Source Term Algorithm?**	_✔_YES __NO
Part B: Dispersion Submodel Type (Not Applicable)		
Part C: Transport Submodel Type (Not Applicable)		
Part D: Fire Submodel Type		
D1	**Radiant Energy**	Yes
D2	**Fireballs**	Yes
Part E: Energetic Events Submodel Type		
E3	**Deflagrations**	Yes
E4	**Detonations**	Yes
Part F: Health Consequence Submodel Type (No Information Provided.)		
Part G: Effects and Countermeasures Submodel Type (No Information Provided.)		
Part H: Physical Features of Model (No Information Provided.)		
Part I: Model Input Requirements (See Item 9.)		
Part J: Model Output Capabilities		
J2	**Graphic Contours and Resolution**	Yes
J4	**Tabular at Fixed Downwind Locations**	Yes
Part K: Model Usage Considerations (See Items 5 - 7.)		