General Characteristics		
1	**Abstract of Model Capabilities**	OMEGA is a fully-functional numerical weather prediction model with an embedded Atmospheric Dispersion Model (ADM). ADM has both Eulerian and Langrangian modes of operation and can be used to monitor the dispersion of hazardous aerosols and gases, including chemical, biological, and nuclear hazards. OMEGA/ADM can be used in regions of complex terrain and/or in regions that are data-sparse. It can be used either in a true forecast mode, or in analysis mode to aid in the reconstruction of past events. OMEGA can simulate atmospheric conditions of a scale as small as down to 1 km horizontal resolution and, using the Lagrangian mode, the dispersion at even finer scales. OMEGA/ADM is supported by worldwide databases for evaluation, land/water fraction, vegetation, soil type, land use, soil temperature, sea surface temperature, and soil moisture.
2	**Sponsor and/or Developing Organization**	Dr. David P. Bacon Science Applications International Corporation 1710 Goodridge Dr., McLean, VA 22102 (703) 821-4594 (703) 821-1134 **Fax** bacon@apo.saic.com **developing organization**
3	**Last Custodian/ Point of Contact**	Dr. David P. Bacon Science Applications International Corporation 1710 Goodridge Dr., McLean, VA 22102 (703) 821-4594 (703) 821-1134 **Fax** bacon@apo.saic.com **primary individual** sarma@apo.saic.com **secondary individual**
4	**Life-Cycle**	OMEGA v 3.5 is the latest version of a model originally developed to support the US DOD in a variety of missions Version 1.0 became operational in April 1995. Since then a significant amount of new functionality has been added. This has included improvements in the Graphical User Interface (GUI), the analysis modules, the model physics and the hydrodynamic solver, and the post-processing routines. Currently capable of point-wise four-dimensional data assimilation (FDDA), a full continuous FDDA scheme is currently under development. In addition, additional real-time data ingest routines are being developed to expand the range of data sources that can be assimilated using the Optimal Interpolation-based data assimilations system.
5	**Model Description Summary**	! Governing equations - Fully non-hydrostatic equation set ! Dimensionality - 3D ! Grid structure - Unstructured and adaptive triangular prisms ! Coordinate system - Rotating Cartesian coordinate framework ! Numerics - Finite volume based upon Smolarkiewicz ! Horizontal Resolution - 1-100 km ! Vertical Resolution - 20 - 1000 m ! Surface Roughness - Specified over land, predicted over water ! Soil Surface - Based on the force-restore rate method ! PBL - Planetary boundary layer is treated separately as viscous sublayer, surface layer, and transition layer ! Turbulence closure - 1.5 order closure: Based on turbulent kinetic energy and its dissipation ! Cu parameterization - Modified Kuo scheme ! Microphsyics - Extensive bulk-water microphysics ! Radiation - Shortwave absorption by water vapor and longwave emissivities of water vapor and carbon dioxide and computationally efficient technique of Sasamori ! Initialization - Based on 4D data assimilation ! Transport/diffusion - Embedded Eulerian and Lagrangian aersol transport algorithms ! Operational Status - Real-time Operational Configuration (Research Mode also Supported)
6	**Application Limitation**	The model is very general. Its primary limitation is an inability to consider urban canyons or other microscale features.
7	**Strengths/ Limitations**	**Strengths:** The model is a state-of-the-art weather prediction model, so all scales (both spatial and temporal) are considered. The model is worldwide relocatable; all required global datasets have been created. The model is extremely easy to use. Initial training for simple problems can take less than 1 day. **Limitations:** The model does not include urban canyons or other city-scape features. The model does not include mitigation features. The model does not include casualty or human effects modules.
8	**Model References**	! The Operational Multiscale Environment model with Grid Adaptivity (OMEGA) ! David P. Bacon, et al., DNA-TR-95-30, Defense Special Weapons Agency, 6801 Telegraph Rd., Alexandria, VA 22310-3398.

9	**Input Data/Parameter Requirements**	Meteorological data: Upper Air Soundings, Surface Observations, Gridded Analyses and/or Forecast information. Release data: Location/Elevation (x,y,z coordinates) of Release. Release quantity as a function of time.
10	**Output Summary**	Three-dimensional snapshots of concentration at regular intervals of times. Two dimensional snapshots of dosage at regular intervals of time.
11	**Applications**	Southeastern US (1996 Olympic Games) Southwestern US (AF Dispersion tests) Europe (ETEX) Asia (continental scale atmospheric radioactivity monitoring) Kuwait (regional scale atmospheric radioactivity monitoring) Southeast Asia (Fires in Borneo and Sumatra)
12	**User-Friendliness**	Graphical User Interface (GUI) Command Line Interface for Daily Operations
13	**Hardware-Software Interface Constraints/ Requirements**	**Computer operating system:** X-windows/Motif **Computer platform:** CRAY (J-90/Y-MP/C-90/T3E) **Disk space requirements:** 1 GB for Installation/0.5 GB per run archived. **Run execution time** (for a typical problem)**:** 0.1 - 0.2 times the simulated time. **Programming language:** FORTRAN (model) & C (GUI) **Other computer peripheral information:**
14	**Operational Parameters**	**Identify whether the code has any error diagnostic messages to assist the user in troubleshooting operational problems:** **Set up time for: Typical times are: *first-time user:*** 3 hours ***experienced user:*** <1hour
15	**Surety Considerations**	**All quality assurance documentation:** **Benchmark runs:** Yes. Installed as part of the system. **Validation calculations:** Yes **Verification with field experiments that has been performed with respect to this code:** Yes
16	**Runtime Characteristics**	Single Processor performance for a 24 hour simulation: CRAY Y-MP: 3:26:33 CPU hours:minutes:seconds CRAY J-90: 3:42:57 IBM R/S 6000 (580) 13:37:31 SGI (Origen 2000) 3:24:00 SUN SPARC-20 24:59:00

Specific Characteristics

Part A: Source Term Submodel Type

A1	**Source Term Algorithm?**	_✔_YES __NO
A2	**For Chemical Consequence Assessment Models**	**Liquid spill: _✔_ pool evaporation __ particulate resuspension** Specified mass flux rate vs. time. **Pressurized releases:__ two-phase jets__ flashing__ entrainment__ aerosol formation** **Solid spills: __ resuspension _✔_ sublimation** Specified mass flux rate vs. time.
A3	**For Radiological Consequence Assessment Models**	**Gaseous releases: _✔_ noble gases _✔_ iodines _✔_ other non-reactive gases** **Aerosol releases:** Specified mass flux rate and particle size vs. time. **_✔_ Chemistry __ Isotopic exchange _✔_ Physical properties capability**
A4	**For Weapons Consequence Assessment Models**	**Chemical weapon release characteristics:** Specified mass flux rate and particle size vs. time. Submodels also exist for specifying the mass flux and particle size depending on the weapon type and chemical agent used. **Biological weapon release characteristics:** Specified mass flux rate and particle size vs. time. Submodels also exist for specifying the mass flux and particle size depending on the weapon type and biological agent used.

Part B: Dispersion Submodel Type

B1	**Gaussian**	**__Straight-line plume __Segmented plume _✔_ Statistical plume _✔_ Statistical puff** OMEGA has a Gaussian puff model with uncertainty capabilities.
B2	**Similarity**	**__ Plume __ Puff**

B3	**Stochastic**	**✔ Monte Carlo __ Random walk** OMEGA has a Lagrangian Monte Carlo particle dispersion model.
B4	**Gradient Transport or K-Theory**	OMEGA has an Eulerian dispersion model based on K-theory.
B7	**Turbulent Kinetic Energy (TKE)-Driven**	The variances and covariances of wind vellocity components and some non-dimensional parameters used in the Monte Carlo Lagrangian particle dispersion model are driven by Turbulent Kinetic Energy (TKE).
B9	**Multiple Capabilities**	The OMEGA Gaussian puff model has the following capabilities: -horizontal and vertical puff splitting -puff merging -puff purging -mean and variance computation The OMEGA Lagrangian particle model has the following capabilities: -Monte Carlo Dispersion based on TKE
Part C: Transport Submodel Type		
C4	**Frame of Reference**	**✔ Eulerian __ Lagrangian __ Hybrid __ Eulerian-Lagrangian**
Part D: Fire Submodel Type		
D1	**Radiant Energy**	The current version of RSAC does not have a direct model for fires. Fires can be modeled to some extent by using an artificially short stack with a buoyant plume rise model. The downwind dispersion can then be modeled as either a lofted plume or as a well mixed plume between the ground level and the maximum plume rise height.
Part E: Energetic Events Submodel Type		
E8	**High Explosives**	Can be initialized from detonation model output once shock wave has been reduced to near-sonic.
E9	**Nuclear Detonations**	Can be intialized from detonation model output once shock wave has been reduced to near-sonic.
Part F: Health Consequence Submodel Type		
F1	**For Chemical Consequence Assessment Models**	**Health effects: __ fatalities __ cancers __ latent cancers __ symptom onset** **Health criteria** **__ IDLH __ STEL __ TLV __ TWA** **__ ERPG __ TEEL __ AEGL __ WHO** **Zones with flammable limits: __ UFL __ LFL** **Blast overpressure regions:** **Fire radiant energy zones:** **Risk qualification:** **Concentration: __ single value ✔ time-history ✔ integrated dose** **Probits:**
F3	**For Weapons Consequence Assessment Models**	**Health effects: __ fatalities __ cancers __ latent cancers __ symptom onset** **Health criteria** **__ IDLH __ STEL __ TLV __ TWA** **__ ERPG __ TEEL __ AEGL** **Risk quantification:** **Concentration: __ single value ✔ time-history ✔ integrated dose** **Probits:**
Part G: Effects and Countermeasures Submodel Type (No Information Provided.)		
Part H: Physical Features of Model		
H1	**Stability Classification Turbulence Typing**	**Pasquill-Gifford-Turner:** **STAR:** **Irwin:** **Sigma theta:** **Richardson number:** **Monin-Obukhov length:** Monin-Obukhov length is used in the Planetary Boundary Layer model. **TKE-driven:** The Langrangian Monte Carlo model dispersion is driven by TKE. **Split sigma:**
H2	**Release Elevation**	**✔ ground ✔ roof**

H5	**Horizontal/Vertical Wind Shear:**	The influence of directional and speed shear is considered in all dispersion algorithms.
H6	**Mixing Layer**	**__ trapping __ lofting __ reflection __ penetration** **_✔_ inversion breakup fumigation __ temporal variability**
H7	**Cloud Buoyancy**	**_✔_ neutral [passive] __ dense [negative] _✔_ plume rise [positive]**
H10	**Deposition**	**_✔_ gravitational setting _✔_ dry deposition __ precipitation scavenging** **__ resistance theory deposition __ simple deposition velocity __ liquid deposition** **__ plateout and re-evaporation**
H13	**Temporally and Spatially Variant Mesoscale Processes**	**Urban heat island:** Yes **Canopies:** Yes **Complex terrain (land) effects: _✔_ mountain-valley wind reversals** **_✔_ anabatic winds _✔_ katabaic winds** **Complex terrain (land-water) effects: _✔_ seabreeze airflow trajectory reversals** **_✔_ Thermally Induced Boundary Layer definition _✔_ seabreeze fumigation** **_✔_ landbreeze fumigation** **Thunderstorm outflow:** Yes **Temporally variant winds:** Yes **High velocity wind phenomena: _✔_ tornado _✔_ hurricane _✔_ supercane _✔_ microburst**
Part I: Model Input Requirements		
I1	**Radio(chemical) and Weapon Release Parameters**	**Release rate: _✔_ Continuous _✔_ Time dependent _✔_ Instantaneous** **Release container characteristics: __ vapor temperature __ tank diameter** **__ tank height __ tank temperature __ tank pressure __ nozzle diameter** **__ pipe length** **Jet release: __ initial size __ shape** **__ concentration profile at end of jet affected zone** **Release dimensions: _✔_ point __ line __ area** **Release elevation: __ ground __ roof __ stack**
Part J: Model Output Capabilities		
J10	**Other**	Internally developed GIS (Geographic Data Analysis and Query System - GDAQS).
Part K: Model Usage Considerations		
K2	**Time to Process From Notification of Release (including data acquisition) to Production of Product Listed in #K1, Listed for Platforms for Which the Program is Already Compiled**	A few hours. Depends very much on the complexity of the problem.
K3	**Ease of Use of Output, Evaluated as the Time Needed to Train a College Graduate in the Use of the Output**	One week.