General Characteristics		
1	**Abstract of Model Capabilities**	RTVSM Version 3.02 is designed to calculate dosage, intravenous dosage, concentration, concentration versus time profiles, fumigation concentration, time-average concentration, vertical deposition, precipitation deposition, and gravitational deposition. The aforementioned calculations can be performed using elevated buoyant and/or non-buoyant point, volume, area, stack, and/or line sources. The source emissions can be instantaneous, quasi-continuous square wave (constant), quasi-continuous exponential wave (exponential decay), and/or continuous. Source emissions that can be addressed by RTVSM are gaseous, particulate, evaporation from surface liquid spills, evaporation from falling drop liquid, and/or evaporation from material that has impacted the terrain surface. RTVSM implements the generalized Gaussian dispersion model, and accordingly inherits all of the weaknesses associated with this Eulerian reference frame type model. RTVSM is an interactive, menu-driven program which can also be executed in a batch environment. RTVSM produces both tabular and graphic output products.
2	**Sponsor and/or Developing Organization**	Meteorology Division West Desert Test Center U.S. Army Dugway Proving Ground Dugway, UT 84022-5000
3	**Last Custodian/ Point of Contact**	Jim Rafferty or James Bowers (801) 831-5101
4	**Life-Cycle**	RTVSM was developed in the late-1980's and early 1990's as a replacement for the Dugway Proving Grounds Volume Source Diffusion Model (VSDM). It has undergone various improvements to its present Version 3.02 level. It is expected to continue to expand in scope.
5	**Model Description Summary**	RTVSM is used to assist in the design and analysis of chemical and biological agent stimulant and military smoke/obscurant dissemination tests. The source and receptor locations can be entered in either Cartesian or polar coordinates. Both regular and discrete receptor arrays can be specified. Emission rates are user-specified for instanteous, quasi-continuous, exponentially decaying, and continuous sources. RTVSM can consider the evaporation of both falling and deposited drops. However, the User must provide the latent heat of vaporization, liquid surface tension, and vapor pressure or Antoine constants as input to the model. The plume behavior is either steady state (Gaussian puff or plume) or non-steady state (Gaussian segmented plume), depending on the source, with consideration for buoyant cloud or plume rise in either mode. RTVSM uses a power law wind profile, and in the non-steady state mode, it can interpolate winds from an array of meteorological stations. RTVSM utilizes site-specific dispersion algorithms (i.e., Cramer) developed from tracer studies at Dugway. It treats removal processes by exponential decay, wet deposition, or dry deposition; the latter parameterized by a surface reflection coefficient, which is related to a terminal fall velocity.
6	**Application Limitation**	RTVSM inherits the typical limitations associated with Gaussian-type models. In addition, it does not consider dry deposition for particles with aerodynamic equivalent diameters less than 10 microns. In its real-time mode, it is designed to access the real-time data file from Dugway Proving Ground's network of remote automated weather stations and would have to be modified for real-time applications at other locations.
7	**Strengths/ Limitations**	**Strengths:** Site-specific dispersion parameterization based on tracer studies. Ability to address a wide spectrum of source terms. **Limitations:** Gaussian model. Inability to address submicron particulate sources.
8	**Model References**	**!** Bjorklund, J.R., 1990, User Instructions for the Real Time Volume Source Dispersion Model (RTVSM), Version 3.00, Report No. TR-90-374-02, H.E. Cramer Company, Inc., prepared for Army Dugway Proving Ground, Dugway, UT, 84022.
9	**Input Data/Parameter Requirements**	Minimum inputs consist of wind speed and direction, mixing depth, and net radiation index. Designed to use onsite measurements where available, including multi-level wind profiles and turbulence intensities or standard deviations of wind azimuth and elevation angles.
10	**Output Summary**	Source inputs, meteorological inputs, program control parameters, and tabular listings and/or isopleth maps of concentration, dosage, or deposition for regular and discrete receptors.
11	**Applications**	RTVSM is exclusively used at the Dugway Proving Grounds since it was developed for assessment of chemical and biological weaponry that is part of the Dugway mission. Accordingly, RTVSM would require modification for use at other locations due to real-time data array and site-specific dispersion parameterization. Since there are somewhat unique algoritha in RTVSM, use of selected modules in other models deficient in these algoritha, has merit.

12	**User-Friendliness**	The Tier 2 evaluation did not involve running RTVSM with the seven scenarios. There is a User Manual available which gives detailed instructions to the User, as well as various examples.
13	**Hardware-Software Interface Constraints/ Requirements**	**Computer operating system:** Unknown **Computer platform:** No Information Provided. **Disk space requirements:** Source code is 1.5 megabytes in length, and executable binary code is 2.3 megabytes in length. RTVSM requires one temporary direct access data file of up to 0.65 megabyte, depending on the problem being run, and optionally up to 12 additional data files of varying length, depending on the options selected by the user. **Run execution time** (for a typical problem)**:** Unknown **Programming language:** Unknown **Other computer peripheral information:** Portability is likely to poor, due to site-specific dispersion coefficients and alignment with Dugway meteorological tower array.
14	**Operational Parameters**	**Identify whether the code has any error diagnostic messages to assist the user in troubleshooting operational problems:** Approximately a third of the RSAC-5 program is devoted to error diagnostics. RSAC+ checks all fields to assure that data is in range for the given variable and that consistency in an input series is maintained. **Set up time for:** Setup up times are dependent on the complexity of the run being made. **Typical times are:** ***first-time user:*** .5-1 h ***experienced user:*** 5-10 min
15	**Surety Considerations**	**All quality assurance documentation:** The transport and diffusion components have been validated using data from Dugway Proving Ground chemical/biological agent and stimulant and smoke/obscurant field tests. **Benchmark runs:** No Information Provided. **Validation calculations:** No Information Provided. **Verification with field experiments that has been performed with respect to this code:** No Information Provided.

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** **Pressurized releases: __ two-phase jets __ flashing __ entrainment __ aerosol formation** **Solid spills: __ resuspension __ sublimation**
A4	**For Weapons Consequence Assessment Models**	**Chemical weapon and biological weapon release characteristics:** The user needs to input discrete values for various parameters (e.g., molecular weight of evaporating vapor from drop, droplet diameter spectrum, density of liquid drop, etc.) to facilitate source term calculation.

Part B: Dispersion Submodel Type

B1	**Gaussian**	**✔ Straight-line plume ✔ Segmented plume __ Statistical plume ✔ Statistical puff**
B9	**Multiple Capabilities**	If a time step is 2.5 sec or less, RTVSM considers it an instantaneous release. If it is between 2.5 and 15 sec, it is treated as a quasi-continuous release. Otherwise it is considered a continuous release. RTVSM also addresses continuous square wave time scales/sources.

Part C: Transport Submodel Type

C1	**Prognostic**	RTVSM is a deterministic model without any prognostic capability.
C4	**Frame of Reference**	**✔ Eulerian __ Lagrangian __ Hybrid __ Eulerian-Lagrangian**

Part D: Fire Submodel Type (Not Applicable)

Part E: Energetic Events Submodel Type (Not Applicable)

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-Gilfford-Turner:** Stability class is generally not used to type turbulence. **STAR:** Used in the absence of sigma-azimuth and sigma-elevation data. **Irwin:** **Sigma theta:** Turbulence is calculated from measured values of sigma-azimuth and sigma-elevation. **Richardson number:** **Monin-Obukhov length:** **TKE-driven:** **Split sigma:**
H2	**Release Elevation**	**✔ ground ✔ roof**
H5	**Horizontal/Vertical Wind Shear:**	Yes
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:** **Canopies:** **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:** **Temporally variant winds:** **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**
I2	**Meteorological Parameters**	**Wind speed and wind direction: ✔ single point ✔ single tower/multiple point** **✔ multiple towers** **Temperature: ✔ single point __ single tower/multiple point __ multiple towers** **Dew point temperature: ✔ single point __ single tower/multiple point** **__ multiple towers** **Precipitation: ✔ single point __ single tower/multiple point __ multiple towers** **Turbulence typing parameters: __ temperature difference ✔ sigma theta** **✔ sigma phi __ Monin-Obukhov length __ roughness length** **✔ cloud cover ✔ incoming solar radiation ✔ user-specified** **Four dimensional meteorological fields from prognostic model:**
Part J: Model Output Capabilities		
J1	**Hazard Zone**	Yes
J2	**Graphic Contours and Resolution**	Yes
J3	**Concentration Versus Time Plots**	Yes
J4	**Tabular at Fixed Downwind Locations**	Yes
J5	**Health Effects**	**__ toxicity indices [e.g., ERPG's, PAG's] __ potential fatalities** **__ cancers ✔ other adverse effects**
Part K: Model Usage Considerations (See Items 5 - 7.)		