General Characteristics		
1	**Abstract of Model Capabilities**	The Explosive Release Atmospheric Dispersion (ERAD) model is a three-dimensional numerical simulation of particle dispersion in the atmosphere. The model was developed to provide real-time predictions of the near-filed radiological hazards which would result from an explosive release of hazardous material. ERAD allows a user to compute and graphically display on a computer screen the predictions of its physical models. These graphical displays can be printed to a postscript printer, or plotted on an HP 7475A plotter.
2	**Sponsor and/or Developing Organization**	Bruce Boughton Sandia National Laboratory Albuquerque, New Mexico 87185 babough@sandia.gov
3	**Last Custodian/ Point of Contact**	Bruce Boughton Sandia National Laboratory Albuquerque, New Mexico 87185 (505)844-8545 Kerry Alt (505)646-3645 ERAD_support@cs.nmsu.edu
4	**Life-Cycle**	ERAD was originally developed to provide real-time estimates of the near-field consequences which result from an explosive release of hazardous material. The model has been extended to treat fire and non-buoyant release mechanisms. Both gaseous monodisperse and polydisperse particle sources can now be simulated.
5	**Model Description Summary**	ERAD is a three-dimensional numerical simulation of turbulent atmospheric transport and diffusion. For buoyant releases, an integral plume rise technique is used to provide a description of physical and thermodynamic properties of the cloud of warm gases. Particle dispersion is treated as a stochastic process which is simulated using a discrete time Lagrangian Monte Carlo method. The stichastic process approach permits a more fundamental treatment of buoyancy effects, calm winds, and spatial variations in meteorological conditions. Computational requirements of the three-dimensional simulation are substantially reduced by using a conceptualization in which each Monte Carlo particle represents a small puff that spreads according to the Gaussian law in the horizontal direction.
6	**Application Limitation**	The available outputs are very limited since the current version of ERAD was sdeveloped for a client who intends to use it for emergency response applications. The handling of one single isotope at a time makes it cumbersome to use for cases involving multiple isotope releases.
7	**Strengths/ Limitations**	**Strengths:** The treatment of vertical dispersion includes current relationships for scaling turbulence within the boundary layer. Friendly, easy to use GUI. The explosive plume rise model is much more complete treatment of the physics than other models and appears to give good results. The treatment of vertical dispersion includes current relationships for scaling turbulence within the boundary layer. **Limitations:** The available outputs are very limited do to the fact that the current version of ERAD was developed for a client who intends to use it for emergency response use. The code would be useful for many more applications if additional output were available. Only a small programming effort would be required to make these changes. The fact that the code handles only one isotope at a time makes it cumbersome to use for cases involving multiple isotopic release.
8	**Model References**	! Boughton, B. a., and DeLaurentis, J.M., 1987, "Am Integral Method of Plume Rise from High Explosive Detonations", 1987 ASME/AIChE National Heat Transfer Conference.
9	**Input Data/Parameter Requirements**	Single site/time vertical profile of wind speed, direction, and temperature. Single value of precipitation, relative humidity, and pressure. Stability is code-calculated.
10	**Output Summary**	Contour plots and tables of dose and deposition.
11	**Applications**	Real-time estimates of the near-field consequences which result from an explosive release of hazardous material. ERAD has been extended to treat fire and non-buoyant release mechanisms.

12	**User-Friendliness**	The interface is a very friendly set of windows. Allowable ranges for all variables are shown. Attempts to user out-of-range values produce error messages and out-of-range values are flagged (with small red bombs!). The program will not allow the user to make computations or to save cases which are incomplete or have values out of range. There is no protection against heights out of order in the meteorological profiles The user has the choice of several different units for most parameters. Values are automatically converted, when the user changes units. A rotating slash and a percent finished label allow the user to see the progress of computations.
13	**Hardware-Software Interface Constraints/ Requirements**	The available outputs are very limited do to the fact that the current version of ERAD was developed for a client who intends to use it for emergency response use. The code would be useful for many more applications if additional output were available. Only a small programming effort would be required to make these changes.
14	**Operational Parameters**	The fact that the code handles only one isotope at a time makes it cumbersome to use for cases involving multiple isotopic release.
15	**Surety Considerations**	ERAD has been evaluated against measurements obtained during Operation Roller Coaster. With few exceptions, cloud top height predictions of the integral plume rise model were within 25% of field observations. The complete model was validated against dose and deposition measurements. Predicted contour areas average within about 50% of the observations. The validation results confirm the model's representation of the physical processes.
16	**Runtime Characteristics**	Overall, the physical models used by ERAD are excellent, but the limited output available in version 2.0 makes it cumbersome for some applications.

Specific Characteristics

Part A: Source Term Submodel Type		
A1	**Source Term Algorithm?**	___YES ✔ NO
Part B: Dispersion Submodel Type		
B1	**Gaussian**	**✔ Straight-line plume __Segmented plume __ Statistical plume __ Statistical puff**
B3	**Stochastic**	**✔ Monte Carlo __ Random walk**
Part C: Transport Submodel Type		
C2	**Deterministic**	Yes
Part D: Fire Submodel Type (Not Applicable)		
Part E: Energetic Events Submodel Type		
E4	**Detonations**	Yes
Part F: Health Consequence Submodel Type		
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		
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**

Part I: Model Input Requirements		
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		
J2	**Graphic Contours and Resolution**	Dose and deposition.
J4	**Tabular at Fixed Downwind Locations**	Dose and deposition.
Part K: Model Usage Considerations (See Items 5 - 7)		