General Characteristics		
1	**Abstract of Model Capabilities**	This is a recently-developed code modification of the Terrain Responsive Atmospheric Code (TRAC) code at the Rocky Flats Environmental Technology Site (RFETS). This code was specially developed to address risk assessments and hazard assessments in complex terrain. TRAC is a deterministic methodology that treats plume transport and diffusion in complex air flow fields. It develops three-dimensional time-and-space-varying meteorological fields, including winds, then releases simulated puffs of material into the flow. Customized versions of this code have been developed for various applications, inclusive of TRAC RA/HA which focuses on risk assessment and hazard assessment applications.
2	**Sponsor and/or Developing Organization**	Alpha-TRAC, Inc. is the current sponsor and developer of this code. They are maintaining and constantly improving TRAC through a cooperative agreement with DOE/RFETS.
3	**Last Custodian/ Point of Contact**	C. Reed Hodgin, President Alpha-TRAC, Incorporated Sheridan Park 8, Suite 120 8670 Wolff Court Westminster, Colorado, 80030-3692 Phone: 303/428-5670 Fax: 303/428-5930 e-mail: Alphatrac@eazy.net
4	**Life-Cycle**	The TRAC code was developed in 1985 to address the complex atmospheric flow phenomena associated with the Rocky Flats Environmental Technology Site, which is situated at the front range of the Rocky Mountains. Prior to the code development, a series of field studies under the Atmospheric Studies Over Complex Terrain (ASCOT) program identified the complexityof the flow patterns in this region. Straight-line Gaussian models, which were commonly used at this location at that time, no longer could be depended upon to effectively characterize atmospheric airflow trajectory reversals and non-linear atmospheric flows. TRAC continued to develop in complexity through 1991 when RFETS abandoned model development in favor of privatizing it through a cooperative agreement with Alpha-TRAC, Inc. Alpha-TRAC, Inc. has been improving the TRAC model and its applications since it assumed custodial responsibilities of the code.
5	**Model Description Summary**	TRAC RA/HA is a Langrangian mass-consistent three-dimensional complex terrain atmospheric dispersion model developed to address the complex terrain atmospheric flow phenomena of the front range. It was expanded from its earlier emergency management application to address risk assessment and hazard assessment problems. TRAC RA/HA is written in FORTRAN 77 and runs on a DEC VAX family of computers with a VMX operating system. TRAC RA/HA has been formally reviewed by the State of Colorado, and this approval has been listed in the Colorado State Register. TRAC RA/HA can model releases of plutonium, enriched uranium, depleted uranium, criticality fission products, and non-reactive radiological particulates and gases. It considers radioactive ingrowth and decay, wet and dry deposition effects, and gravitational settling. TRAC RA/HA operates in a Lagrangian frame of reference, emitting an ellipsoidal puff for each 5 minutes of release. Although it embodies some Particle-In-Cell (PIC) principles, it is not a true PIC model. Time-varying emission rates can also be considered by the user. TRAC RA/HA outputs dose and deposition data and maps for each model scenario, maps showing the probability of dose and deposition exceeding the user-specified threshold, and statistical summaries of doses and deposition.
6	**Application Limitation**	Although the present version does not yet address detonations, deflagrations, fires, two-phase flows, or isotopic exchange, future upgrades are intended to allow the model the capabiltiy to address these types of energetic release problems.
7	**Strengths/ Limitations**	TRAC RA/HA is a state-of-the-art model that addresses the three-dimensional complex flows commonly occurring at the front range of the Rocky Mountains, and at other mountain-valley locations, and calculates offsite and onsite doses out to 100 km. Enhancements identified in Section 4.1.13 will extend its scope to solve wider problem sets and applications. It does not address health effects and countermeasures, and only briefly applies to environmental and economic effects analyses.
8	**Model References**	! "TRAC Transport and Dispersion: Features and Software Overview", RFP_4516, October 28, 1991. ! "TRAC Risk Assessment/Hazard Assessment Project Software Design Document", Alpha TRAC Incorporated, December 8, 1996.
9	**Input Data/Parameter Requirements**	15-minute average surface and upper air wind and temperature measurements at multiple locations.

10	**Output Summary**	Map with contours representing frequency with which a selected dose threshold would be exceeded within each contour (e.g., a 95% chance of exceeding the threshold within the 1% contour).
11	**Applications**	Authorization basis documentation for facilities located in complex terrain.
12	**User-Friendliness**	For a comprehensive complex terrain model, TRAC RA/HA is relatively user-friendly since it is design to automatically produce plume footprints every 15 minutes.
13	**Hardware-Software Interface Constraints/ Requirements**	Code presently resides in the offices of Alpha TRAC. Internet access to code and its output is password protected.
14	**Operational Parameters**	FORTRAN 77 language on DEC VAX family of computers with VMS operating system.
15	**Surety Considerations**	The code has been accepted by the State of Colorado and has undergone verification and validation per the following 2 documents. “TRAC Transport and Dispersion: Features and Software Overview”, RFP_4516, October 28, 1991. “TRAC Risk Assessment/Hazard Assessment Project Software Design Document”, Alpha TRAC Incorporated, December 8, 1996. Software Quality Assurance documentation has been recently developed.
16	**Runtime Characteristics**	TRAC RA/HA has been designed to automatically produce 15-minute outputs or can produce other information by user intervention. Depending on the complexity of the problem, runs can be made in the 1-3 minute timeframe.

Specific Characteristics

Part A: Source Term Submodel Type		
A1	**Source Term Algorithm?**	_✔_YES __NO
A3	**For Radiological Consequence Assessment Models**	**Gaseous releases:** _✔_ **noble gases** _✔_ **iodines** __ **other non-reactive gases** **Aerosol releases:** **Particulate releases:** _✔_ **Chemistry** __ **Isotopic exchange** _✔_ **Physical properties capability**
Part B: Dispersion Submodel Type		
B1	**Gaussian**	**__Straight-line plume __Segmented plume __ Statistical plume _✔_ Statistical puff**
B5	**Particle-In-Cell**	Some PIC concepts are embodied in the code.
Part C: Transport Submodel Type		
C1	**Prognostic**	Yes
C2	**Deterministic**	Yes
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		
F2	**For Radiological Consequence Assessment Models**	**Cloudshine:** __ **finite cloud** _✔_ **semi-infinite cloud** __ **other** **Groundshine:** _✔_ **short-term** _✔_ **long-term** **Inhalation:** __ **short-term** _✔_ **long-term** _✔_ **Total effective dose equivalent** __ **Uptake of respirable fraction of particle spectra** **Resuspension:** __ **short-term** __ **long-term** _✔_ **Anspaugh (modified)**

F2	**For Radiological Consequence Assessment Models (Cont.)**	**Food/Water Ingestion:** _✔_ **dynamic** _✔_ **static** **Skin dose:** __ **absorption** __ **other** **Dose assessment:** __ **ICRP-60 criteria** _11_ **organs** _6_ **pathways** **Health effects:** __ **early** __ **latent**
Part G: Effects and Countermeasures Submodel Type (No Information Provided.)		
Part H: Physical Features of Model		
H2	**Release Elevation**	_✔_ **ground** _✔_ **roof**
H5	**Horizontal Plume Meander**	**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**
H11	**Resuspension**	Modified Anspaugh approach.
H13	**Temporally and Spatially Variant Mesoscale Processes**	**Urban heat island:** **Canopies:** **Complex terrain (land) effects:** _✔_ **mountain-valley wind reversals** _✔_ **anabatic winds** _✔_ **katabatic winds** **Complex terrain (land-water) effects:** __ **seabreeze airflow trajectory reversals** __ **Thermally Induced Boundary Layer definition** __ **seabreeze fumigation** __ **landbreeze fumigation** **Thunderstorm outflow:** **Temporally variant winds: Yes**
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		
J2	**Graphic Contours and Resolution**	26,000 equally-spaced gridded receptors over a 160 km by 160 km grid. Over 50,000 receptors. Includes dose and deposition data and maps.
J7	**Graphic Contours of Probability of Exceeding Concentration**	Maps showing probability of deposition exceeding user-specified threshold.
Part K: Model Usage Considerations (See items 5 - 7.)		