		General Characteristics
1	**Abstract of Model Capabilities**	Environmental Tritium Model (ETMOD) simulates: the transport of release of elemental tritium (designated HT) and/or tritiated water vapor (designated HTO) in the atmosphere; deposition of HT from the plume to the ground; in-ground conversion of HT to HTO by microbial action; uptake of HTO by plants; re-emission of HTO from plants and/or soil; atmospheric dispersion of this re-emitted material; the radiation dose to an in-plume resident. Plume depletion by deposition, and direct in-plume oxidation of HT to HTO are accounted for.
2	**Sponsor and/or Developing Organization**	S.B. Russel and G.L. Ogram Ontario Hydro Research Division Ontario Hydro Toronto, M5G 1X6
3	**Last Custodian/ Point of Contact**	S.B. Russel, Nuclear Safety Department Design and Development Division Ontario Hydro Toronto, M5G 1X6, Canada L. Ogram Ontario Hydro Research Division Ontario Hydro Toronto, M5G 1X6, Canada
4	**Life-Cycle**	ETMOD originated as TRITMOD which was developed at Savannah River Laboratory by C.E. Murphy and M.M. Pendargast in the early 80's. The code was adopted by Ontario Hydro in 1985 and renamed OHTDC (Ontario Hydro Tritium Dispersion Code). OHTDC was transferred to the Canadian Fusion Fuels Technology Project (CFFTP) and improved and renamed ETMOD. ETMOD Version 0.0 was released October 1991. Associated Quality Assurance Documentation was released August 1992.
5	**Model Description Summary**	ETMOD simulates the transport of a release of elemental tritium (designaed HT) and/ot tritiated water (designated HTO) in the atmosphere. It also addresses deposition of HT from the plume to the ground, in-ground conversion of HT to HTO by microbial action, uptake of HTO by plants, re-emission of HTO from plants and/or soil, atmospheric dispersion of this re-emitted material, and the radiation dose to an in-plume resident. In addition, plume depletion by deposition and direct in-plume oxidation of HT to HTO are accounted for.
6	**Application Limitation**	ETMOD has been designed for tritium releases only.
7	**Strengths/ Limitations**	**Strengths:** The code is fairly easy to run and provides a lot of output information. **Limitations:** The documentation provided with ETMOD is very limited, and does not contain any information on default values or valid ranges. Tritium is the only radionuclide that is available. The verification model does not verify models but simply describes some of them. While the code may be technically valid, the documentation does not convey this. The user's manual does not show any sample output files.
8	**Model References**	! J.W. Thompson, J.A. Kennedy, J-M. Lina, *ETMOD Software Quality Assurance Documentation Volume 3*, Atlantic Nuclear Services Ltd., CFFTP P-9205, August 1992.
9	**Input Data/Parameter Requirements**	Five different input files must be prepared for each run. This files are: 1) TERRAIN.DAT, 2) SOIL.DAT, 3) METEOR.DAT, 4) DOSIM.DAT, 5) SCENE.DAT. In TERRAIN.DAT the user enters terrain for a user-defined rectangular grid. In SOIL.DAT the user enters various soil parameters and specifies the number of soil layers. In METEOR.DAT various constants are entered as well as information (wind speed, temperature, rainfall, etc.) for different time steps as specified by the user. DOSIM.DAT input includes: dose conversion factors, breathing rate, skin absorption factor, and occupancy factor. SCENE.DAT contains scenario specific data related to the release and its location.
10	**Output Summary**	The five different output files and a brief description of each follows: 1) ETSOIL.OUT - Soil concentration output data file 2) ETGRAPH.OUT - Graphical output data file 3) ETINFO.OUT - Dispersion and depletion output data file 4) ETINTENS.OUT - Air concentration output data file 5) ETMOD.OUT - Total concentrations and dose output data file
11	**Applications**	Biological life cycleand doses for HT and HTO releases.
12	**User-Friendliness**	ETMOD is fairly easy to use.

13	**Hardware-Software Interface Constraints/ Requirements**	FORTRAN 77 – Any PC with MS-DOS
14	**Operational Parameters**	Can run on any MS-DOS PC (45 min on 486) however can take a long time on laptop (13 hr).
15	**Surety Considerations**	Although a QA package exists it is very limited and does not contain much detail in the user's manual or verification manual. The validation document mostly compares the effect of using different input parameters and shows one case with comparison to measured data which differs greatly from the code predictions. The conclusion of the validation report even states, "A number of deficiencies have been identified in the ETMOD code."

Specific Characteristics

Part A: Source Term Submodel Type		
A3	**For Radiological Consequence Assessment Models**	HT and HTO only.
Part B: Dispersion Submodel Type		
B1	**Gaussian**	**_✔_ Straight-line plume __ Segmented plume __ Statistical plume __ Statistical puff**
Part C: Transport Submodel Type		
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** **Food/Water Ingestion: __ dynamic __ static** **Skin dose: __ absorption __ other** **Dose assessment: _✔_ ICRP-60 criteria __ organs __ 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**
H3	**Aerodynamic Effects from Buildings and Obstacles**	**_✔_ building wake __ cavity __ K-factors __ flow separation** **Increase initial diffusion coefficients accordingly.**
H4	**Horizontal Plume Meander**	All stability classes; if activated.

H9	**(Radio)chemical Transformation and In-Cloud Conversion Processes**	Oxidation of HT
H10	**Depositon**	**___ gravitational setting _✔_ dry deposition __ precipitation scavenging** **__ resistance theory deposition __ simple deposition velocity __ liquid deposition** **__ plateout and re-evaporation**
H11	**Resuspension**	Re-emission of HTO via vegetative expiration
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		
J4	**Tabular at Fixed Downwind Locations**	Data files.
Part K: Model Usage Considerations (See Items 5 - 7)		