General Characteristics		
1	**Abstract of Model Capabilities**	PIKE is an analog model that estimates the release into the atmosphere of large volumes of gaseous and particulate matter from prompt massive ventings following underground nuclear explosions. The release occurs within minutes of the detonation. Considerable pressure and heat are present with the release. The model utilizes buoyancy, wind speed and wind shear to define a fallout pattern along with centerline peak and integrated radiological exposures. These exposures are in roentgens for external gamma values.
2	**Sponsor and/or Developing Organization**	NOAA, ARL/SORD P.O. Box 94227 Las Vegas, NV 89193-4227 (702) 295-1232 (702) 295-3068 **Fax** soule@doe.nv.gov **sponsoring organization** soule@doe.nv.gov **developing organization**
3	**Last Custodian/ Point of Contact**	NOAA, ARL/SORD P.O. Box 94227 Las Vegas, NV 89193-4227 (702) 526-3463 (702) 526-3787 **Fax** soule@doe.nv.gov **primary individual** soule@doe.nv.gov **secondary individual**
4	**Life-Cycle**	The PIKE model was initially developed after the PIKE event in the mid 1960s, which released a large amount of radioactive debris into the atmosphere within minutes after the detonation. Due to the uniqueness of underground nuclear explosions and the unknowns in the release mechanisms, it was deemed necessary to use an analog model for future accidental release following these tests. Refinements in the model have been accomplished with further understanding of the radioactive decay schemes and careful analysis of the ground fallout pattern from the PIKE event.
5	**Model Description Summary**	The model uses the local main meteorological factors, wind speeds through a defined layer above the surface, wind directions shear, and atmospheric stability, to modify the distribution and fallout pattern of radioactive particles from a release similar to the PIKE event release. Within the model, the meteorology is meshed with the known effects from the PIKE event to produce estimates of radiological exposures along the centerline of the ground fallout pattern. A fallout pattern is constructed on a map of the Nevada Test Site area and surrounding locales. This pattern is used for estimating exposures at various locations for safety purposes
6	**Application Limitation**	The PIKE model uses only locally obtained pibal or radiosonde information as its basic input. Additionally the model is based on the release mechanisms being similar to those that occurred during the PIKE event. The local terrain is only used to modify the shear angles - lifting and impaction of particles is not considered. No dynamic effects or scavenging mechanisms, such as precipitation, are included in the model.
7	**Strengths/ Limitations**	**Strengths:** Strengths include readily available meteorology, simple input parameters, portability of code (FORTRAN), quick estimates of exposures, conservative values for safety. **Limitations:** Lack of areal meteorology, terrain effects very crudely accounted for, no dynamic interactions, basic analog may be un realistic (although probably conservative). No modifications are planned at present.
8	**Model References**	• A Radiation Briefer's Guide to The PIKE Model, NOAA, 1990 • Analyses & Evals. Of Radiological and Met. Data For PIKE, NOAA, 1990
9	**Input Data/Parameter Requirements**	Average wind speed through the fallout layer, wind direction shear through the layer (modified by terrain), atmospheric stability estimates for initial cloud rise, amount of potentially released radioactivity in kilotons.
10	**Output Summary**	Tables of radioactive exposures as a function of time and distance along the centerline of the fallout pattern. These tables include exposures for rates (/hour) and integrated (1 year). The tables ar generally for external gamma exposures, but also include potential exposures to the thyroid from ingestion of contaminated milk (I-131).
11	**Applications**	The model has only been used for underground nuclear tests, mainly at the Nevada Test Site. Some off-site tests have been conducted at other locations, but no ventings have occurred at other locations.
12	**User-Friendliness**	The computer programs available interact with the user via a command line prompt. The program asks the user for the meteorological and other input values. The output goes to a local file or to a printer.

13	**Hardware-Software Interface Constraints/ Requirements**	**Computer operating system:** MS DOS, DG AOS/VS **Computer platform:** PC or Minicomputer (DG) **Disk space requirements:**.200K **Run execution time** (for a typical problem)**:**1 minute **Programming language:** FORTRAN **Other computer peripheral information:** Local printer
14	**Operational Parameters**	**Identify whether the code has any error diagnostic messages to assist the user in troubleshooting operational problems:** None **Set up time for: Typical times are:** ***first-time user:*** 10 min ***experienced user:*** 2 min
15	**Surety Considerations**	**All quality assurance documentation:** Published reports **Benchmark runs:** Done on PIKE, other events **Validation calculations:**.Verified against PIKE Analyses **Verification with field experiments that has been performed with respect to this code:** Verfied against several tests that had ventings.
16	**Runtime Characteristics**	About 1 minute

Specific Characteristics

Part A: Source Term Submodel Type (Not Applicable)		
Part B: Dispersion Submodel Type (No Information Provided.)		
Part C: Transport Submodel Type		
C2	**Deterministic**	The model uses locally determined meteorological conditions, along with general large scale flow considerations from NCEP operational models, to define the constraints. These values include mean layer winds, frontal boundaries, and diurnal effects.
C4	**Frame of Reference**	**_✔_ Eulerian __ Lagrangian __ Hybrid __ Eulerian-Lagrangian**
Part D: Fire Submodel Type (Not Applicable)		
Part E: Energetic Events Submodel Type		
E9	**Nuclear Detonations**	Model based on defined characteristics fro Prompt Massive Venting from underground nuclear explosions. These charteristics include heat and pressure producing high velocity jets or plumes form the ground. Model based on analog to the PIKE event.
Part F: Health Consequence Submodel Type		
F2	**For Radiological Consequence Assessment Models**	**Cloudshine: _✔_ finite cloud __ semi-finite 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**
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		
G3	**For Weapons Consequence Assessment Models**	**Land contamination:** Possible removel of surface layer, if needed, otherwise use evacuation **Economic costs:** Costs to be paid by DOE,includes possible replacement of contaminated food. **Evacuation:** Used for small controlled populations, if time permits. **Sheltering:** Used for large populations for short time constraints. **Interdiction:**
Part H: Physical Features of Model		
H2	**Release Elevation**	**_✔_ ground __ roof**

H5	**Horizontal/Vertical Wind Shear:**	Vertical wind shear through a layer of about 1000 to 1500 meters at zero-time. Some horizontal shear downwind due to terrain.
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**
H12	**Radionuclide Ingrowth and Decay**	Gross fission products decay scheme devised by LLNL.
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:** Diurnal effects - up-vally and down-vally (day/night) **High velocity wind phenomena: __ tornado __ hurricane __ supercane __ microburst**
Part I: Model Input Requirements (See Item5.)		
Part J: Model Output Capabilities		
J1	**Hazard Zone**	Model output utilized to construct areal fillout with hazard limits indicted on plot (5r, 500mR, 170mR)
J2	**Graphic Contours and Resolution**	No contours, only centerline values at distances downwind
J3	**Concentration Versus Time Plots**	Cloud passage and integrated exposures at time/distance
J4	**Tabular at Fixed Downwind Locations**	Local population centers, facilties near NTS
J5	**Health Effects**	**__ toxicity indices [e.g., ERPG's, PAG's] _✔_ potential fatalities** **_✔_ cancers _✔_ other adverse effects**
J6	**Number of People Affected, Calculated at What Resolution?**	**__ block __ block group _✔_ country**
J7	**Graphic Contours of Probability of Exceeding Concentration**	Centerline exposure values at time/distance
J10	**Other**	Use AutoCad for graphical output
J11	**Accuracy of Output, Calculated in Terms of Percentages of Population Impacted More Than Predicted at one, two, and three Standard Deviations in Urban and Rural Areas**	Predictions are for unsheltered individuals

Part K: Model Usage Considerations		
K1	**Ease of Model Use**	**Training required to run the model:** _2_ **background (years of education)** _1-2 weeks_ **training time needed on the model to be able to exercise all model capabilities** **Training required to continue development of the model:** _2-5 years specialized_ **background (years of education)** **__ training time needed on the model to be able to exercise all model capabilities**
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**	1-2 hours
K3	**Ease of Use of Output, Evaluated as the Time Needed to Train a College Graduate in the Use of the Output**	One week due to specialized nature of subject.