| | | General Characteristics |
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| 1 | **Abstract of Model Capabilities** | Hazard Prediction & Assessment Capability (HPAC) is a Gaussian puff model which uses a second order closure model for the treatment of the turbulence component. HPAC predicts hazards from nuclear, biological, chemical, and radiological (NBCR) weapons and facilities. It is a forward-deployable (i.e., counterproliferation), counter force disaster preparedness capability. HPAC provides collateral effects of counterproliferation strikes and exposure information for military and/or civilian populations attacked with NBCR weapons. HPAC also provides exposure information for populations in the vicinity of accidents involving nuclear power plants, chemical and biological production facilities, and NBCR storage facilities/transportation containers. HPAC models atmospheric dispersion of vapors, particles, or liquid droplets from multiple sources, using arbitrary meteorological input ranging from a single surface wind speed and direction up to 4-dimensional gridded wind and temperature field input. The model accounts for dynamic plume rise and dense gas effects, time- and space-dependent boundary layers, and flow over complex terrain. The model predicts the 3-dimensional concentration field as a function of time (e.g., 4-dimensionality), with integrated inhalation dosage and surface deposition fields. Primary and secondary droplet evaporation algorithms are included. |
| 2 | **Sponsor and/or Developing Organization** | Defense Special Weapons Agency (DSWA)<br>6801 Telegraph Road<br>Alexandria, VA 22310<br>(703) 325-6106<br>(703)325-0398 Fax<br>hpac@hq.dswa.mil<br>for HPAC integration and coordination with the many other developers: tmazzola@logicon.com |
| 3 | **Current Custodians** | David B. Myers<br>DSWA/WEL<br>6801 Telegraph Road<br>Alexandria, VA 22310<br>(703)325-6883 (703)325-0398 **Fax**<br>myersd@hq.dswa.mil<br>tmazzola@logicon.com |
| 4 | **Life-Cycle** | SCIPUFF, the transport and dispersion module, was initially developed under Electric Power Research Institute (EPRI) sponsorship in the mid-1980's. The Defense Nuclear Agency (DNA) adopted the model and applied it to nuclear dust cloud transport problems in the late-1980's and early-1990's. SCIPUFF was ported to Windows for DNA starting in 1993.<br>Later, it was joined with elements of the Nuclear Regulatory Commission (NRC) RASCAL model and a climatology database, to provide an end-to-end capability to analyze potential radiological releases from nuclear reactor facilities. Under Department of Defense (DoD) counterproliferation sponsorship, this combined end-to-end capability was integrated with the ability to analyze chemical and biological hazards to form HPAC. HPAC version 1.0 was released in early 1994. The current version, HPAC 3.1, was released in June 1998.<br>HPAC 3.1 readily treats hazard scenarios involving nuclear, chemical and biological hazards from facilities, weapons, accidents, etc. Planned upgrades include incorporation of land cover and population data bases, use of vegetative canopy information to modify transport calculations, and development of an urban modeling capability. Other potential upgrades include chemical reactions between radionuclides and modeling of land water interfaces. |
| 5 | **Model Description Summary** | HPAC consists of several components:<br>SCIPUFF is the atmospheric transport model. SCIPUFF utilizes a second order closure model for turbulence. The details of SCIPUFF are covered in more detail in later parts of this survey.<br>There are six user-friendly incident and source term description modules, Nuclear Facility, Biological Facility, Chemical Facility, Nuclear Weapon, Chemical/Biological Weapon, and Radiological Weapon.<br>HPAC uses the SWIFT mass-consistent wind field model for flow over terrain. SWIFT was derived from Electricite de France models. The user interface, the Graphical User Interface (GUI), provides flexible input for all types of particle, liquid and gas hazard sources through SCIPUFF advanced editor.<br>The world-wide climatology database on the HPAC CD allows assessment of typical and climatological bounds on hazards transport. The worldwide terrain elevation database at 1 km horizontal resolution is used with the SWIFT mass-consistent wind model. HPAC utilizes flexible access to weather data. Readers translate standard weather reports available over the Internet into HPAC readable formats. DSWA maintains Meteorological Data Servers which give timely and efficient access to recent observations and wind field forecasts worldwide. |

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| 6 | **Application Limitation** | **Strengths:** HPAC does not currently address:<br>! Aerodynamic flow around buildings<br>! Very high altitude dispersion (>30km)<br>! Flow within a forest/vegetation canopy.<br>**Limitations:** overcome the model weaknesses):<br>Current HPAC weaknesses include:<br>! Lack of integral land cover and population data bases<br>! Lack of vegetative canopy profiles, and inability to model flow around buildings in an urban area.<br>Integral worldwide population and land cover data bases will be provided in the March 1999 HPAC release. DSWA plans to add vegetative canopy profiles as an initial step to handling vegetative canopies and flow around urban areas. DSWA will pursue more detailed urban modeling capabilities after incorporation of the vegetative canopy profiles. |
| 7 | **Strengths/ Limitations** | HPAC has the following strengths:<br>! Dispersion methodology is based on second order turbulence closure scheme.<br>! The probabilistic prediction is based on fluctuation variance.<br>! Accurately incorporates wind shear.<br>! SCIPUFF includes a rational description of time-averaging effects.<br>! Utilizes an integrated description of dynamic effects. |
| 8 | **Model References** | ! Sykes, R. I., S. F. Parker, D. S. Henn and R. S. Gabruk (1996), "PC-SCIPUFF Version 0.2 Technical Documentation", Defense Nuclear Agency, DNA-TR-96-27. [Version 1.0 report (Draft)]<br>! Sykes, R. I. and R. S. Gabruk (1997), "A second-order closure model for the effect of averaging time on turbulent plume dispersion", J. Appl. Met, 36, 165-184.<br>! Sykes, R. I. and D. S. Henn (1995), "Representation of velocity gradient effects in a Gaussian puff model", J. Appl. Met., 34, 2715-2723.<br>! Sykes, R. I., S. F. Parker, D. S. Henn and W. S. Lewellen (1993), "Numerical simulation of ANATEX tracer data using a turbulence closure model for long-range dispersion", J. Appl. Met., 32, 929-947.<br>! Sykes, R. I., W. S. Lewellen and S. F. Parker (1986), "A Gaussian plume model of atmospheric dispersion based on second-order closure", J. Clim. & Appl. Met., 25, 322-331. |
| 9 | **Input Data/Parameter Requirements** | HPAC contains two editors to receive input data. The Operational Editor is designed for the user who needs a fast answer based on limited data. The Operational Editor uses simple, descriptive inputs for operators which invoke "smart" defaults. Inputs to an Incident description include where, when and what happened. The Weather description can include historical, forecast or current weather.<br>The Advanced Editor allows more detailed input. Material files can be tailored to specific particle/droplet size groups, liquid vapor pressures, and other parameters. New material files can be developed. The Source description includes instantaneous, continuous, and moving releases, source size, release quantity, moving velocity, and source buoyancy. Input for the Domain description includes space and time. |
| 10 | **Output Summary** | HPAC provides multiple output options. These include horizontal and vertical slices through the instantaneous concentration field, integrated dosage and deposition, and point sampler time history.<br>Both mean values and probability fields are available. Probability fields are the key to assessing hazard uncertainty. HPAC currently includes a beta capability for hazard areas. These hazard areas show where the hazardous material might go given weather and turbulence uncertainty. Field plots are overlaid on Digital Chart of the World maps. Vector Maps will be integrated into future HPAC releases. Standard contours show common military and civilian toxicity or regulatory levels. |
| 11 | **Applications** | Military Commander In Chiefs use HPAC for offensive and defensive planning. European Command, Pacific Command, Strategic Command and Central Command currently have HPAC. HPAC has also been used to support the Bosnia deployment and Desert Thunder planning. Defense Intelligence Agency, Joint Chiefs of Staff and National Command Authority for assessment of potential WMD hazards also use HPAC. The Chemical and Biological Incident Response Force, the Directorate of Operations for Military Support for Domestic Preparedness, the Federal Bureau of Investigation, and the Center for Disease Control use HPAC for domestic support. The Gulf War Office, has used HPAC to evaluate the impact on soldiers of destruction of chemical weapons after the Gulf War. Numerous military and civilian government agencies are using HPAC to determine hazards of potential weapons of mass destruction. |

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| 12 | **User-Friendliness** | The Operational Editor allows the user to provide descriptive, limited input of generic incidents. It is designed for quick response when little detail is known. The Advanced Editor allows the user to provide detailed, numeric input of specific incidents. It is suitable for detailed analysis and unusual incidents. The plot GUI allows flexible depiction of results in a DCW map context. It also supports detailed export of results to other display environments (i.e., EIS, ArcView, etc) An on-line, context sensitive HELP system is available to guide the user as needed. |
| 13 | **Hardware-Software Interface Constraints/ Requirements** | **Computer operating system:** Minimum system requirements are a 80486 90 MHZ class system, 16 MB of RAM (although 32 MB are recommended), a CD ROM Drive, 20 Megabytes of hard disk space for minimum installation, at least 10 MB for project files, and Windows 3.1, Windows 3.11, Windows 95, or Windows NT. Windows 3.1 and 3.11 users must also have a permanent swap file. RAM plus the swap file must be a minimum of 60 MB. Future versions of HPAC will require Windows 95 or Windows NT. HPAC supports UNIX systems (SGI and SUN OS).<br>**Computer platform:** 486, 90MHz PC and up<br>**Disk space requirements:** Minimum 20 MB for code plus approximately 50MB virtual memory on Windows 3.1; hundred's of MB for data if loaded from CD to hard disk (i.e.,available at run time from CD)<br>**Run execution time** (for a typical problem)**:** a few to tens of minutes depending on complexity<br>**Programming language:** FORTRAN / C++<br>**Other computer peripheral information:** No information provided. |
| 14 | **Operational Parameters** | **Identify whether the code has any error diagnostic messages to assist the user in troubleshooting operational problems:** This code has numerous diagnostic messages. If the user fails to enter the minimum data required to assess a hazard, an error message will appear specifying what additional data is needed. Examples of this type message include messages prompting the user to include where the release occurred or when the release occurred. If the user enters contradictory data, an error message which identifies the contradiction will occur. An example of this type message would be a continuous release where the user specified the end of the release occurring at an earlier time than the start of the release. If the user does not select certain options with certain hazardous materials, an error message will appear. The error message will ask the user if they want to use a specific option. An example of this type of error message will appear if the user enters chlorine gas as the hazardous material and does not select the dense gas option. The error message will ask the user if the dense gas option is desired.<br>**Set up time for:** 10 minutes **Typical times are:** ***first-time user:*** 1 minute ***experienced user:*** 5-10 min |
| 15 | **Surety Considerations** | **All quality assurance documentation:** Bradley, S., et al., "Initial Verification and Validation of HPAC 1.3", Defense Nuclear Agency, DNA-TR-96-8.<br>Bradley, S., et al., "Verification and Validation of HPAC 3.0", Logicon Corporation, LRDA-TR-211-8261-3103-001, June 1998. (To be published as DSWA Technical Report (TR))<br>**Benchmark runs:** 17 Test Cases are used with various options turned on and off to ensure verification standards between versions. These cases are documented in Table 4-1 of Bradley, S., et al., "Verification and Validation of HPAC 3.0", Logicon Corporation, LRDA-TR-211-8261-3103-001, June 1998. (To be published as DSWA TR). Many of these benchmark tests are run against data referenced in Attachments A and B.<br>**Validation calculations:** DSWA has an active and extensive HPAC Verification and Validation Program. This program is reflected in Attachments A and B.<br>**Verification with field experiments that has been performed with respect to this code:** 770+ events with thousands of data points have been compared to HPAC predictions. These are documented in the V&V documents by Bradley et al. Data points are listed in Attachments A and B. |
| 16 | **Runtime Characteristics** | The runtimes vary depending on specifics of the source material, the terrain, and the weather inputs.<br>A typical instantaneous chemical release with 4 hour transport will often run in a minute or less. Continuous releases will run longer, on the order of 10 minutes. These longer runs occur with secondary vapor formation from chemical deposition. With familiarity the user can usually obtain useful answers in 5 or 10 minutes for quick response using best immediately available weather. Follow up with detailed analyses (e.g., solution of mass-consistent winds over terrain with downloaded forecast weather) can be accomplished within the next hour or less. |

**Specific Characteristics**

**Part A: Source Term Submodel Type**

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| A1 | **Source Term Algorithm?** | _✔_YES __NO |

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| A2 | **For Chemical Consequence Assessment Models** | **Liquid spill: _✔_ pool evaporation __ particulate resuspension**<br>SCIPUFF, the transport module of HPAC, models evaporation from a liquid pool by analogy with the different modes of heat transfer. The droplet saturation concentration is a function of the pool temperature. The pool temperature is obtained from an energy balance method. Vapor puffs form at the surface as the liquid pool evaporates.<br>**Pressurized releases:__ two-phase jets_✔_ flashing__ entrainment_✔_ aerosol formation**<br>**Solid spills: _ resuspension _ sublimation** |
| A3 | **For Radiological Consequence Assessment Models** | **Gaseous releases: _✔_ noble gases _✔_ iodines _✔_ other non-reactive gases**<br>The model treats up to 1100 radioisotopes individually, or in groupings, depending upon the release treatment. The decay chains for all isotopes are used to determine decay during transport a priori as a function of release scenario. All releases are then grouped into two categories: a depositing and non-depositing gas with a specified deposition velocity.<br>**Aerosol releases:** Aerosol releases are treated as depositing gases.<br>**Particulate releases:**<br>**_ Chemistry __ Isotopic exchange _ Physical properties capability** |
| A4 | **For Weapons Consequence Assessment Models** | **Chemical weapon release characteristics:** HPAC uses physical and empirical algorithms for agents released from explosive dissemination, sprayers, bombs, artillery shells, etc. The source terms are developed from an ensemble of puffs representing point, volume, and line geometries for continuous and instantaneous releases.<br>**Biological weapon release characteristics:** HPAC uses physical and empirical algorithms for agents released from explosive dissemination, sprayers, submunitions, etc. Source terms are developed from an ensemble of puffs representing point, volume, and line geometries for continuous and instantaneous releases. |
| **Part B: Dispersion Submodel Type** | | |
| B1 | **Gaussian** | **__Straight-line plume __Segmented plume __ Statistical plume _✔_ Statistical puff** |
| B7 | **Turbulent Kinetic Energy (TKE)-Driven** | The dispersion algorithm is based on a second-order closure scheme using turbulent velocity variances. |
| **Part C: Transport Submodel Type** | | |
| C1 | **Prognostic** | HPAC provides a prognostic predictive capability when run with forecast weather tools such as OMEGA or RAMS. |
| C2 | **Deterministic** | HPAC can mimic a near-deterministic result, with the concentration variance limited to cloud- or plume-scale turbulence and smaller. This provides a reasonable mean plume mass distribution similar in kind to many other turbulent diffusion transport models which solve only for the mean result. |
| C3 | **Stochastic** | The meteorological turbulence introduces a stochastic element into the dispersion of the hazard concentration field. Through second order closure, HPAC provides both an ensemble mean and variance solution for transport of the hazardous material. This allows HPAC to display the mean concentrations and/or doses and the probability of exceeding selected concentrations and /or doses. |
| C4 | **Frame of Reference** | **__ Eulerian _✔_ Lagrangian __ Hybrid __ Eulerian-Lagrangian** |
| **Part D: Fire Submodel Type** | | |
| D2 | **Fireballs** | Calculates the dynamic rise of a fireball based on the initial buoyancy and momentum. |
| D3 | **Jet Fires** | Calculates the lofting of material from jet fires in a similar manner to fireballs. Material rise is based on continuous buoyancy and momentum fluxes. |
| **Part E: Energetic Events Submodel Type** | | |
| E1 | **Blast Overpressures** | HPAC provides a collateral effects overpressure circle for nuclear weapon incidents. The circle radius is for 1 psi overpressure at the surface for the yield at height of burst specified. The circle radius is based on the Brode ideal airblast curve fit. |
| E8 | **High Explosives** | If the buoyancy of the explosive gases is known, the cloud rise can be simulated. Cloud rise will be calculated based on the initial buoyancy derived from initial cloud volume and over temperature. |
| E9 | **Nuclear Detonations** | Nuclear Weapon (NWPN), the nuclear weapons source module, emphasizes the radiological fallout. However, it also provides sure-safe level circles for prompt radiation (i.e., 50 rads), thermal radiation (i.e., 2 calories per square centimeter), and blast (i.e., 1 psi peak overpressure). |

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| **Part F: Health Consequence Submodel Type** | | |
| F1 | **For Chemical Consequence Assessment Models** | **Health effects:** ✔ **fatalities** ✔ **cancers** ✔ **latent cancers** ✔ **symptom onset**<br>HPAC can look at any health effects for which toxicity levels are available.<br>**Health criteria**<br>✔ IDLH ✔ STEL ✔ TLV ✔ TWA<br>✔ **ERPG** ✔ **TEEL** ✔ **AEGL** ✔ **WHO**<br>**Zones with flammable limits:** __ **UFL** __ **LFL**<br>**Blast overpressure regions:**<br>**Fire radiant energy zones:**<br>**Risk qualification:**<br>**Concentration:** ✔ **single value** ✔ **time-history** ✔ **integrated dose**<br>**Probits:** |
| F2 | **For Radiological Consequence Assessment Models** | **Cloudshine:** ✔ **finite cloud** ✔ **semi-finite cloud** __ **other**<br>**Groundshine:** ✔ **short-term** ✔ **long-term**<br>**Inhalation:** __ **short-term** ✔ **long-term**<br>✔ **Total effective dose equivalent**<br>✔ **Uptake of respirable fraction of particle spectra**<br>**Resuspension:** __ **short-term** __ **long-term** __ **Anspaugh**<br>**Food/Water Ingestion:** __ **dynamic** ✔ **static**<br>**Skin dose:** ✔ **absorption** ✔ **other**<br>**Dose assessment:** __ **ICRP-60 criteria** __ **organs** __ **pathways**<br>**Health effects:** __ **early** __ **latent** |
| F3 | **For Weapons Consequence Assessment Models** | **Health effects:** ✔ **fatalities** ✔ **cancers** ✔ **latent cancers** ✔ **symptom onset**<br>**Health criteria**<br>✔ **IDLH** ✔ **STEL** ✔ **TLV** ✔ **TWA**<br>✔ **ERPG** ✔ **TEEL** ✔ **AEGL**<br>**Concentration:** ✔ **single value** ✔ **time-history** ✔ **integrated dose**<br>**Probits:** Probits are used for developing some chemical and biological lethality levels. |
| **Part G: Effects and Countermeasures Submodel Type** | | |
| G1 | **For Chemical Consequence Assessment Models** | **Evacuation:** Does not directly assess countermeasure options but has been used to define civilian hazard areas (community exposure). Output can be imported into tools which support emergency response command and control (C2) applications or other C2 decision algorithms (e.g., DSWA's CATS tool). Many of the default contour levels are based on intervention/regulatory levels. For example, levels may be derived from the Environmental Protection Agency (EPA) guidance. Plot contours can be defined by the user.<br>**Sheltering:**<br>**Interdiction:**<br>**Spray/Foam:**<br>**Victim Treatment/Treatment Measures:** |
| G2 | **For Radiological Consequence Assessment Models** | **Land contamination: Does not directly assess countermeasure options but has been used to** define civilian hazard areas (community exposure). Output can be imported into tools which support emergency response command and control (C2) applications or other C2 decision algorithms (e.g., DSWA's CATS tool). Many of the default contour levels are based on intervention/regulatory levels. For example, levels may be derived from the Environmental Protection Agency (EPA) guidance. Plot contours can be defined by the user.<br>**Economic Costs:**<br>__ **decontamination** __ **interdiction**<br>__ **foodstuff losses** __ **denial of facility access**<br>__ **victim treatment**<br>**Evacuation:** hazard areas (community exposure). Output can be imported into tools which support emergency response command and control (C2) applications or other C2 decision algorithms (e.g., DSWA's CATS tool). Many of the default contour levels are based on intervention/regulatory levels. For example, levels may be derived from the Environmental Protection Agency (EPA) guidance. Plot contours can be defined by the user.<br>Sheltering:<br>Interdicition: |
| **Part H: Physical Features of Model** (No information provided) | | |
| H1 | **Stability Classification Turbulence Typing** | SCIPUFF has a "calculated boundary layer" option which uses bowen ratio, albedo and solar intensity to calculate a complete boundary layer. This is the most often used mode, however, Pasquill-Gilfford-Turner stability categories can be used if desired. |

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| H2 | **Release Elevation** | **_x _ground _x_roof**<br>Any altitude or elevation from sea level up to 30 kilometers can be used with HPAC 3.1. The HPAC March 1999 release will handle releases from sea level up to approximately 100 km. |
| H4 | **Horizontal Plume** | HPAC includes turbulent meander in its transport algorithm. |
| H5 | **Horizontal/Vertical Wind Shear** | High resolution spatial and temporal wind fields and puff splitting and merging algorithms are used to accurately account for horizontal and vertical wind shear. |
| H6 | **Mixing Layer** | _x_trapping _x_lofting _x_reflection<br>_x_penetration _x_inversion breakup fumigation<br>_x_temporal variability |
| H7 | **Cloud Buoyancy** | _x_neutral [passive]<br>_x_dense [negative]<br>_x_plume rise [positive] |
| H8 | **Cloud Liquid Droplet Formation/ Aerosolization** | HPAC assumes instantaneous equilibrium between the droplets and the vapor. See Part A of this survey for more details. |
| H9 | **Radio(chemical) Transformation and In-Cloud Conversion Processes** | HPAC can treat multi-component conversions with multiple binary reactions in advanced editor. |
| H10 | **Deposition** | _x_gravitational setting<br>_x_dry deposition<br>_x_precipitation scavenging<br>___resistance theory deposition<br>_x_simple deposition velocity<br>_x_liquid deposition<br>___plateout and re-evaporation |
| **Part I: Model Input Requirements** | | |
| I1 | **Radio(chemical) and Weapon Release Parameters** | **Release rate: ✔ Continuous ✔ Time dependent ✔ Instantaneous**<br>**Release container characteristics: __ vapor temperature __ tank diameter**<br>**__ tank height __ tank temperature __ tank pressure __ nozzle diameter**<br>__ pipe length<br>**Jet release: ✔ initial size __ shape**<br>**__ concentration profile at end of jet affected zone**<br>**Release dimensions: ✔ point ✔ line ___ area**<br>**Release elevation: ✔ ground ✔ roof ✔ stack**<br>HPAC can currently handle release elevations from sea level up to 30 kilometers. The March 1999 version of HPAC will handle releases up to approximately 100 kilometers. |
| I2 | **Meteorological Parameters** | Wind speed and wind direction: ✔single point ✔ single tower/multiple point<br>✔ multiple towers<br>Temperature: ✔ single point ✔ single tower/multiple point ✔ multiple towers<br>Dew point temperature: ✔ single point __ single tower/multiple point<br>✔ multiple towers<br>Precipitation: ✔ single point ✔ single tower/multiple point ✔ multiple towers<br>Turbulence typing parameters: __ temperature difference ___ sigma theta<br>__ sigma phi ✔ Monin-Obukhov length ✔ roughness length<br>✔ cloud cover ✔ incoming solar radiation ✔ user-specified<br>HPAC uses four dimensional fields from a variety of prognostic model, such as OMEGA, RAMS, MM5, COAMPS, NOGAPS, and NORAPS. |
| **Part J: Model Output Capabilities** | | |
| J1 | **Hazard Zone** | Hazard areas can be plotted based on exceeding specific user- defined levels or using the HPAC default levels. The user may specify and plot specific hazard zones of interest |
| J2 | **Graphic Contours and Resolution** | HPAC plots hazard contours as either numerical dosage or concentration values or as text labels indicating the regulatory or "effects" meaning - such as an LD50 contour means 50% fatality level. |
| J3 | **Concentration Versus Time Plots** | Concentration versus time is a post-processed capability using a spread sheet or other similar tool. |

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| J4 | **Tabular at Fixed Downwind Locations** | Tabulated dosage/concentration values may be output as text files for manipulation in a spreadsheet tool. |
| J5 | **Health Effects** | _x __toxicity indices [e.g., ERPG's, PAG's]<br>_x_potential fatalities<br>___cancers<br>_x_other adverse effects…<br>Radiological doses per EPA and NATO standards can be plotted by the user. |
| J6 | **Number of People Affected, Calculated at What Resolution?** | ___block<br>___block group<br>___county<br>HPAC 3.1 provides 2 options:<br>The user can input population density. HPAC will then provide the number of people inside each contour. The user can export HPAC contour files. The user then runs the contour files through their own population post processor. The march 1999 HPAC release will calculate populations within HPAC contours as an integral part of HPAC. |
| J7 | **Graphic Contours of Probability of Exceeding Concentration** | The probability contours for exceeding a HPAC default or user-defined concentration/dosage level can be plotted. |
| J9 | **Commerical Off-the-Shelf (COTS) Geographic Informaiton System (GIS) Used** | HPAC files can be exported to Arc View formats. |
| 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** | HPAC provides the probability of hazardous materials being transported outside specified concentration contours. The user chooses the confidence level desired. The hazard areas are a beta capability in HPAC 3.1. |
| **Part K: Model Usage Considerations** | | |
| K1 | **Ease of Model Use** | Training required to run the model: _MS_ background (years of education)<br>_2+_ training time needed on the model to be able to exercise all model capabilities<br>Training required to continue development of the model:<br>_MS_ background (years of education)<br>_2+_ 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** | 5-10 minutes for “quick cases”<br>ten minutes for “slow cases” or detailed analysis |

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| K3 | **Ease of Use of Output, Evaluated as the Time Needed to Train a College Graduate in the Use of the Output** | For specific applications, a few hours. For all applications, one day. |