General Characteristics		
1	**Abstract of Model Capabilities**	The SUDU computer program was developed specifically to provide rapid initial assessment of radiological emergency situations at the Siemens Power Corporation, Richland, WA site. It is designed to estimate the downwind doses that would result from an unintentional release of radioactive material. A straight-line Gaussian atmospheric dispersion model is used, and the program accesses a library of source terms derived from the Siemens Emergency Assessment Resource Manual (EARM). The program uses ICRP 26/30 dose factors to calculate inhalation and semi-infinite cloud air submersion doses consistent with emergency response criteria. This code is based on HUDU, the Hanford Unified Dose Utility, which was developed for the Hanford Site.
2	**Sponsor and/or Developing Organization**	Robert Scherpelz and Kathy Probasco Pacific Northwest National Laboratory/Siemens Power Corporation P.O. Box 999 Richland, WA 99352 (509) 375-4338 (509) 375-3886 **Fax** km.probasco@pnl.gov **sponsoring organization** scherpelz@pnl.gov **developing organization**
3	**Last Custodian/ Point of Contact**	Robert Scherpelz Pacific Northwest National Laboratory P.O. Box 999 Richland, WA 99352 (509) 375-6492 (509) 375-6936 **Fax**
4	**Life-Cycle**	The code was developed in 1992, based on the HUDU code that had been in use for several years at Hanford. The development effort involved very little change in the modification of models or algorithms used to estimate atmospheric transport and dose assessment. Modification were aimed at making SUDU site-specific for use at the Siemens Fuel Cycle Facility, Richland, WA.

5	**Model Description Summary**	User input: Upon invocation of the code, the user enters all data needed to perform the calculations. These values include current atmospheric conditions and data describing the release, including conditions affecting plume rise or building wake effect, and abundances of radionuclides in the release. Selection of preselected scenarios: Several accident scenarios that were identified for the site are available for selection by the user. This choice will provide a radionuclide release list and release condition. Selection of previous runs: The results of previous SUDU runs are stored on computer, and the input screen for any stored run can be called up and rerun, or modified, if needed. Modification of input: Any data on the input screen can be changed by the user before the calculations begin. "GO" button: When the user is satisfied that the input data is complete and correct, GO is selected to begin calculations. No user interaction is possible until the calculations are complete and the results are displayed. Calculation of atmospheric transport: Atmospheric transport of released radionuclides is performed using a straight-line Gaussian model. Calculations are performed at the downwind dose receptor locations selected by the user. Plume rise due to buoyancy or momentum effects may be calculated if the user chooses (e.g., default is no plume rise), and aerodynamic building wake effects may be calculated if the user chooses (e.g., default is no wake effect). The transport calculations produce relative air concentrations on the plume centerline for all downwind dose locations. Calculation of doses: Radionuclide decay and ingrowth during plume transport are caculated based on a transit time found using the wind speed and transport distance. At each dose point, the decayed radionuclide inventory is multiplied by relative air concentrations and dose factors to obtain the following doses: ! External due to air submersion (assuming a semi-infinite cloud of radionuclides) ! Inhalation of radionuclides in the plume for dose equivalent to: Lung, Red Bone Marrow, Thyroid, Effective Dose Equivalent (EDE) Dose factors were derived from ICRP-26 and ICRP-30. Output: After calculation, the output is displayed (see #10, below). The user is provided a choice to print out the data at the system printer, to terminate the SUDU run, or to rerun the current or previous scenario.
6	**Application Limitation**	Models and algorithms were selected for ease of use in an emergency situation, requiring minimal user selection of data and judgment on selection of model options. Thus the atmospheric transport and dispersion is a simple straight-line Gaussian model. Real-time data and two-, or three-dimensional windfields can not be used.
7	**Strengths/ Limitations**	**Strengths:** Downwind dose estimates are obtained quickly; Minimal user training is required; users who run the code only rarely can produce reasonable results; Minimal computer hardware requirements; and, large base of user experience which was determined to be mostly bug-free. **Limitations:** Pre-windows technology; old dose factors; and, simple straight-line model.
8	**Model References**	! Scherpelz, R. I. 1991. HUDU - The Hanford Unified Dose Utility Computer Code, PNL-7636, Pacific Northwest Laboratory, Richland, Washington. ! Scherpelz, R. I. And K. M.Probasco. 1994. SUDU - Siemens Dose Assessment Code - Version 1.1 User's Guide. Pacific Northwest Laboratory, Richland, Washington ! Napier. B.A., D.L. Strenge, R. A. Peloquin, and J.V. Ramsdell. 1988 GENII - The Hanford Environmental Radiation Dosimetry Software System. Volume 1 and 2. PNL-6584. Pacific Northwest Laboratory, Richland, WA.

9	**Input Data/Parameter Requirements**	Meteorological Data: Stability Class Wind speed Mixing layer depth Air Temperature Release Conditions: Release Elevation Conditions for plume rise calculation Conditions for building wake effect calculation Downwind receptor locations Selection of preselected accident scenarios Selection of released radionuclides
10	**Output Summary**	On-screen: a display of downwind distances vs plume-centerline doses. Doses are categorized by affected organ. Printable file: includes the downwind dose table plus a summary of all input data.
11	**Applications**	Estimate of downwind doses (plume centerline) resulting from an atmospheric release (i.e., short-term) of radionuclides.
12	**User-Friendliness**	SUDU is considered to be user-friendly for a DOS-based code; At the time of development it was a considerable improvement over most character-based applications. Windows users would not rate it very user-friendly. Efforts were made to simplify user input by means of screen color, cursor movement by arrow keys, single keystrokes.
13	**Hardware-Software Interface Constraints/ Requirements**	**Computer operating system:** MS DOS **Computer platform:** 80X86 **Disk space requirements:** 1MB **Run execution time** (for a typical problem)**:** User setup time: 1-5 minutes, CPU time: <1 minute **Programming language:** Fortran 1C **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:** Minimal error messages, but user experiences indicate a low error rate. **Set up time for: Typical times are: *first-time user:*** 15 minutes ***experienced user:*** 5 minutes
15	**Surety Considerations**	**All quality assurance documentation:** Derived from HUDU Code **Benchmark runs:** Comparison to HUDU and GENII **Validation calculations:** Comparison to HUDU and GENII **Verification with field experiments that has been performed with respect to this code:** None
16	**Runtime Characteristics**	User interaction: Typically 1-5 minutes Model calculations: 80286: <1 minute Faster on other 80 X86 CPUs

Specific Characteristics

Part A: Source Term Submodel Type

A1	**Source Term Algorithm?**	_✔_YES __NO Previously defined accident scenarios.
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**

Part C: Transport Submodel Type

C2	**Deterministic**	Gaussian Plume
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:** _✔ semi-infinite cloud __ semi-finite cloud __ other **Groundshine:** __ short-term __ long-term-0700. **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		
H1	**Stability Classification Turbulence Typing**	**Pasquill-Gilfford-Turner:** Yes **STAR:** **Irwin:** **Sigma theta:** **Richardson number:** **Monin-Obukhov length:** **TKE-driven:** **Split sigma:**
H2	**Release Elevation**	_✔_ ground _✔_ roof
H3	**Aerodynamic Effects from Buildings and Obstacles**	_✔_ building wake _✔_ cavity __ K-factors __ flow separation
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**	Yes
Part I: Model Input Requirements (See Item 9.)		
Part J: Model Output Capabilities (See Item 10.)		
Part K: Model Usage Considerations (See Items 5 - 7.)		