TO: Office of Scientific Computing, Office of Energy Research, Department of Energy

FROM: Paul G. Huray, Carolina Distinguished Professor P. G. H.

RE: Final Report on Award for "Partnership in Computational Science" (USC # 22000F300) (DOE Grant #DE-AC05-84OR21400) and covers DE-FG05-93ER25759

DATE: February 24, 1999

This is the final report for the "Partnership in Computational Science" (PICS) award DE-~~AC05-84OR21400~~ FG05-93ER25759 in an amount of $500,000 for the period January 1, 1993 through December 31, 1993. A copy of the proposal with its budget is attached as Appendix A. This report first describes the consequent significance of the DOE award in building infrastructure of high performance computing in the Southeast and then describes the work accomplished under this grant and a list of publications resulting from it.

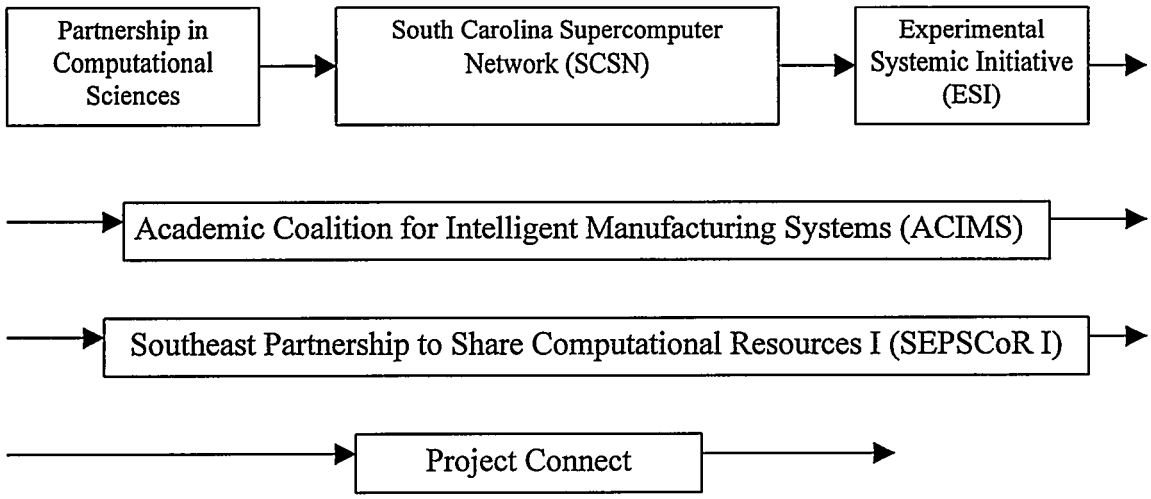
History of Subsequent Awards:

In late 1993, USC used the Intel Paragon Model A4 Parallel Supercomputer as the basis for a statewide supercomputer network. The three South Carolina research universities, Clemson, the Medical University of South Carolina, and the University of South Carolina signed a Memorandum of Understanding to use the parallel computer as the cornerstone facility for the network. The Agreement was also signed by then Governor Carroll Campbell and Fred Sheheen, Executive Director of the state's Commission on Higher Education. A copy of that agreement is attached in Appendix B.

In 1994, South Carolina used the above cooperative agreement to request funding for the Experimental Systemic Initiative award for a South Carolina High Performance Computing Network. NSF invested $450,874 in the program and the state Experimental Program to Stimulate Competitive Research (EPSCoR) matching allocation provided $487,347 for the period Aug. 1, 1994 to July 31, 1996 to bring about systemic change in research computing in the state. The impact was enormous:

- The Paragon supercomputer network was upgraded to provide high-speed, high-resolution access via seven Silicon graphics Indy workstations (at least one on every campus). An additional Indy 2 front end was added to the Paragon to allow high-speed disk transfer and to provide a multi-user interface.
- More than 100 faculty and students received tutorials from Patrick Fay, Beverly Huntsberger, and Abhijit Sengupta. These tutorials included hands-on experience using the Paragon via the state network.
- Thirteen graduate students were selected as South Carolina Supercomputer Network Graduate Fellows and taught other students how to use parallel computers.
- Three junior faculty from the College of Charleston, South Carolina State University and USC-Aiken were supported to become senior users of parallel computing.

The Paragon computer led to a succession of programmatic developments that enhanced the research capability, not only in South Carolina, but also among southeastern universities:



These projects were supported by the state of South Carolina, ARPA, NIST, the Department of Education, and NSF supported four of the awards. The total support for these infrastructure awards totaled more than $6.5 million.

PICS Results:

The Groundwater Component of PICS was a consortium of five universities, Princeton, University of Texas at Austin, State University of New York, Stony Brook, Texas A & M, and the University of South Carolina; and three national laboratories, Oak ridge National Laboratory, Brookhaven National Laboratory, and Savannah River Laboratory.

The Grand Challenge in Groundwater Remediation addressed the computational power issues of modeling efforts by focusing on massively parallel computing. The project sought to develop a new, state-of-the-art, parallelized flow and transport code to model groundwater transport as well as supporting technologies for parameter estimation (see http://www.isc.tamu.edu/PICS/.) These issues are further explained at http://hpccdmz.hpcc.gov/pubs/blue94/section.5.6.html, which cites the need for hierarchical models of groundwater flow and associated chemical transport at the local basin, and regional scales to assess waste transport and remediation schemes. Current models are limited computationally in two ways: first, models can only include a limited number of physical and chemical processes before computing runtimes become prohibitive; second, modules lack adequate field data to characterize geologic and chemical factors that influence contaminant behavior. High performance computing systems were needed both to model complex transport processes and to overcome data limitations by using computationally intensive parameter estimation techniques. The Partnership in Computational Science (PICS) explored new approaches to modeling groundwater flow at waste sites in extremely complex hydrogeologic settings.

USC component activities included (See http://www.math.sc.edu/~sharpley/pics.html)

1. Analysis and Code Development.
    - Numerical solution of degenerate equations.
    - Eulerian-Lagrangian method for convection-diffusion equations.
    - Multiresolution analysis.
    - Postprocessed simulations.
2. Graphical User Interfaces and Enabling Technologies.
    - G3D - time animated 3D postprocessing tools
    - G3D's Grid generation and model preprocessing http://www.math.sc.edu/~sharpley/PICS/USC_PICS_4b.html
    - Interactive tracking and steering for remote simulations http://www.math.sc.edu/~sharpley/Steer.html
    - Compression of 3D (and higher) data
3. Modeling and Field Studies.
4. Computational resources. http://www.math.sc.edu/~sharpley/PICS/USC_PICS_4a.html#movie
5. Multiresolution analysis using biorthogonal wavelets and encoding algorithms were used to investigate data compression and archival of large geophysical data sets that arise in connection with simulations. In collaboration with Ronald DeVore and an ONR project, USC developed wavelet compression techniques for multidimensional data sets which achieve high compression for use in Remote Tracking and Steering of simulations on remote supercomputers. Our initial work involved developing a 3D generalization of Shapiro's EZM encoder using 6-10 biorthogonal hyperbolic wavelets with appropriate extensions to handle logically rectangular data of arbitrary dimensions in the coordinate directions. In order to obtain higher compression rates and to make the transition from image compression to 3D (and higher dimensions) with arbitrary array sizes more transparent and efficient, we have developed new encoders which outperform current compression encoders even when restricted to the case of images.

Other potential uses of these multi-resolution methods are in the direction of 3D-feature extraction for registration in geophysical databases, denoising and assimilation of field data, and scaleup of parameter estimates from laboratory experiments. Wavelets are also being used to study nonlinear conservation laws and parabolic/elliptic Partial Differential Equations.

The University of South Carolina contributed primarily in five areas to the PICS project: (i) ELLAM algorithm development for advection-diffusion-reaction equations, (ii) development and testing of data compression algorithms to enable interactive simulations over standard bandwidth networks, (iii) development of graphical user interfaces for preprocessing input data, model development, and post-processing simulations for analysis, (iv) development of a general purpose library for remote interactive tracking and steering of simulations on massively parallel machines, and (v) collaboration with the Savannah River Site in providing realistic field site data as test cases for the PICS

simulators. More details on the University of South Carolina's PICS contributions and activities are available at http://www.math.sc.edu/~sharpley/pics.html.

The sensitive numerics of advection-diffusion equations, appearing both in the saturation equation of the flow code and in the transport equations, require careful treatment in order to efficiently achieve the accuracy required for these coupled model equations. South Carolina continued its collaboration with Princeton and Texas A&M on Eulerian-Lagrangian Localized Adjoint Methods (ELLAM) for the numerical solution of advection-dominated partial differential equations. Significant results have been obtained on the convergence analysis of ELLAM schemes (see Wang.H.1, Wang.H.2), development of algorithms for advection-diffusion-reaction equations (see Qin, Wang.H.1, Wang.H.2, Wang.H.3, Wang.H.4), domain decomposition and space-time local refinements (see Wang.H.2, Wang.H.4), and the numerical simulation of compositional models (see Qin).

Many numerical methods for the solution of one- and two-dimensional advection-diffusion-reaction partial differential equations, including ELLAM schemes, Galerkin finite element methods, quadratic Petrov-Galerkin methods, cubic Petrov-Galerkin methods, streamline diffusion methods, Flux Corrected Transport, and Godunov schemes, have been systematically compared under a variety of initial and boundary conditions. The result of these comparisons have demonstrated the strong potential of ELLAM schemes to address the model transport equations.

South Carolina, in collaboration with Princeton, Savannah River, and Texas A&M provided boundary condition specifications. The primary input modules were developed by Mohamed Al-Lawatia and have been delivered to satisfy the corresponding part of the milestones. Complete documentation and examples were included. The modules were merged into the official GCT 1.3 code and conform to the new input standards. This effort was coordinated with Pasciak (BNL), Vassilev (TAMU), Celia (Princeton), and the G3D development team. Thorough testing has been completed for each of the primary WEB modules (grid, initial conditions, boundary conditions, and material properties). Special data structures were designed and implemented for the efficient building, handling and storage of time-dependent boundary condition data sets.

A comprehensive suite of graphical pre- and post-processors has been developed to assist practitioners with model formulation and development. These GUI's allow for easy input of all necessary parameters and system properties, and for meaningful graphical display of output from the numerical simulations. The current version of these interfaces has been developed through funding from DOE with matching funds from the University of South Carolina. G3D currently provides a fully functional pre- and post-processing graphical interface that allows the user to easily generate and modify the numerical grid, to input and modify soil and rock properties, and to impose appropriate initial and boundary conditions. It provides a data synthesis capability, which facilitates detection of user-input errors as well as providing an efficient methodology for refinement of the modeling process. G3D provides animated graphical display of evolving contaminant

plumes in three-dimensions, with options to plot iso-concentration surfaces or color shadings with varying degrees of opacity.

Additional G3D tools include 3-D mouse view control, multiple views, VCR record and playback, overlay and stereo imaging, grid and model editing, including full boundary condition GUI editing for time-dependent boundary conditions of all types. Multiple scalar and vector data are simultaneously processed, as well as the simultaneous rendering of soil and fluid features. Additional images, model animations, and source codes are available from the WEB site printed above, and the URL http://www.math.sc.edu/~sharpley/PICS/USC/PICS_4a_html/movie.

In order to provide for efficient and effective use of both the GUI's and the parallel simulators on remote massively parallel machines, we have also developed a general purpose Controller Library that is described in more detail in the next subsection.

An Interactive Tracking/Steering Library with the parallel machine (e.g., Paragon) as server and UNIX workstations (e.g. Silicon Graphics) as clients has been developed and may be obtained from the ORNL repository or from South Carolina's ftp site.

This is a general-purpose library which was developed for interactive remote tracking and steering of simulations and which conforms to specifications as set by GCT code developer J. Pasciak (BNL). The library has been tested on the satellite PICS Paragons, as well as the main production machines at ORNL, to ensure compatibility of the remote procedure calls with security at each site. Components delivered include: (i) client and server libraries, (ii) Steering/Tracking instrumented versions of GCT1.2 and US3D (\cite Johnson.1) for interactive remote use with the G3D graphical interface, (iii) four additional working example codes in increasing order of complexity, (iv) TeX user documentation, (v) FAQ (Frequently asked questions), 'Man' pages for on-line help. Additional information and a user manual are available online at the URL

The library permits remote tracking and steering of simulations on supercomputers from local workstations with user-determined levels of interruption to maintain load-balance, synchronization, and integrity of data to be transferred. This library has been ported to the MPI message passing language, has been coupled with G3D, specialized data compression modules, and three of the PICS groundwater contaminant codes (cite Johnson.1, Mahinthakumar) to provide interactive groundwater simulations on remote Paragons.

Extensive testing and usage of network connections to PICS machines at ORNL and member institutions, provided convincing evidence that the use of compatible data compression tools will be necessary for hydrologists and field engineers to perform interactive Grand Challenge simulations from their local workstations.

South Carolina has developed algorithms for both client and server compression modules to address this problem and are tuning them for groundwater applications. During this grant period, we have developed and implemented 3D algorithms (both single and

multiple processor versions on the server machine, i.e. Paragon) designed to be coupled with the user interface codes and compress data as it is generated by GCT applications in a non-interruptive manner. The algorithms and research codes use nonlinear approximation and specialized entropy encoders, which have proven to be extremely successful for wavelet compression of 2D images applied to hyperbolic wavelet bases. We have developed 3D variants of Shapiro's method for comparison and have tested these implementations with our Steering library coupling with our G3D graphical user interface.

These compression algorithms applied to the both smooth (e.g., pressures) and to rough fields (transport solutions generated by the highly heterogeneous Old Burial Ground data at SRS) have achieved impressive rates of compression without discernable loss of visual information, and provides up to 1,200 times compression with excellent visual retention of qualitative features. Data was provided in several forms by our collaborators in the Environmental Sciences Division of the Savannah River Technology.

Project personnel James Brannan of Clemson University worked closely with Luther Hamm and Gregory Flach of SRS to assist in developing the theory, algorithms and software tools for processing raw data into input files for both HPC codes. The goal is to create software which incorporates scale-up techniques, data fusion methods, and permits input of soft or subjective geological knowledge. These issues will be critical for providing practicing hydrologists access to HPC simulators developed through the PICS project.

The SRS raw data was assimilated and used for flow and transport simulations on $128 times 128 times 64 model runs, as well as several smaller model versions. Qualitative feedback of the model runs by SRS collaborators has resulted in a detailed flow field of the site.

The model data were also critical in debugging several components of the GCT codes and illustrated the need for distributed I/O for model data in this application field. QuickTime and MPEG animations of the simulations were produced by applying G3D to the output of these models for both flow.

The original flow runs were performed on the XPS150 at ORNL by South Carolina personnel and the results were demonstrated at the ORNL booth during SuperComputing `95.

Bibliography of Publications Resulting from PICS

R.J. Babarsky and R.C. Sharpley, "Expanded Stability through Higher Temporal Accuracy for Time-centered Advection Schemes. " Monthly Weather Review, (June 1997), 1277-1295.

K. J. Bene, E. K. Paleologos, M. M. Meadows, "Geostatistical Analyses of Laboratory and In-situ Measurements of Saturated Hydraulic Conductivity", Abstracts of the 46th Annual Southeastern Section of the Geological Society of America, (March 1997), p. 4.

K. J. Bene, R. P. Ray, M.M. Meadows, E. K. Paleologos, "Application of Geostatistics to Site Characterization", Annales Geophysicae, European Geophysical Society (1997), p. C266.

Z. Gao, A. Andreev and R.C. Sharpley, "Elementary Encoding of Wavelet Coefficients", IMI Report 97:02, Department of Mathematics, University of South Carolina, Columbia, SC (Jan. 97).

L.S. Johnson, A. Kaulgud, R.C. Sharpley, R.E. Ewing, Z. Leyk, J. Pasciak, M. Celia, and J.R. Brannan, "Integration of Contaminant Transport Simulators on Parallel Machines with a Graphical User Interface for Remote Interactive Modeling", in Proceedings of the 1997 Simulation Multiconference, Atlanta, April 1997, Soc. for Computer Simulation International, San Diego.

L.S. Johnson, A. Kaulgud and R.C. Sharpley, G3D: "A 3D User Environment for Partial Differential Equations", IMI Report 97:01, Department of Mathematics, University of South Carolina, Columbia, SC (Jan. 97).

A. Kaulgud and R.C. Sharpley. "An Interactive Tracking/Steering Library", IMI Report 95:10, Department of Mathematics, University of South Carolina, Columbia, SC (Aug. 1995, rev. July 1997).

G. Mahinthakumar, R.C. Sharpley, A. Kaulgud, and L.S. Johnson, "Groundwater Remediation Experiments Using Interactive Computational Steering on the Intel Paragon", Intel Supercomputer Users Group Annual Conference (ISUG97), Albuquerque, NM, June 11-13, 1997.

G. Qin, H. Wang, M.S. Espedal, R.E. Ewing, and R.C. Sharpley, "Development of an ELLAM Simulator for Compositional Fluid Flows", submitted.

H. Wang, M. Al-Lawatia, and S.A. Telyakovskiy, "A Runge-Kutta Characteristic Method for First-order Linear Hyperbolic Equations", Numerical Methods for PDEs, (1997), 617--661.

H. Wang, M. Al-Lawatia, and R.C.Sharpley, "A Characteristic Domain Decomposition and Space-time Local Refinement Method for First-order Linear Hyperbolic Equations with Interfaces", submitted.

H. Wang, H.K. Dahle, R.E. Ewing, M.S. Espedal, R.C. Sharpley, and S. Man, "An Eulerian-Lagrangian Localized Adjoint Method for Advection-dispersion Equations in Two Dimensions and its Comparison to other Schemes", accepted for publication in SIAM J. Scientific Computing.

H. Wang and B-G Ersland, A characteristic domain decomposition technique for two-phase flows with interfaces, accepted for publication in Proceedings of the Ninth International Conference on Domain Decomposition Methods, Ullensvang, Norway, June 1996.

Sample model runs of the spread of a contaminant which were generated by PICS codes on USC's Paragon: http://www.math.sc.edu/~sharpley/PICS/USC_PICS_4a.html.

Attachment A ATTACHMENT A ATTACHMENT A ATTACHMENT A

PICS

THE UNIVERSITY OF SOUTH CAROLINA

COLUMBIA CAMPUS

Paul G. Huray, Vice Provost
Professor of Physics
Office of Research

106 Osborne Building
Columbia, SC 29208
803-777-9520
FAX 803-777-3557

December 15, 1992

Dr. Gary Johnson, Program Manager
U.S. Department of Energy
Scientific Computing Staff, MS G-236/GTN
Washington, DC 20585

Dear Dr. Johnson:

On behalf of the University of South Carolina (USC), I am hereby requesting a grant in the amount of $500,000, which will be matched by USC ($300,000) and by an Intel Infrastructure Grant ($739,000) and discount from the Intel Corporation ($171,000). These funds will be used for the purchase of an Intel Paragon XP/S Model A4 parallel computer, including maintenance and operating software, with a total retail value of $1,710,000.

The proposed DOE grant will additionally be matched as follows:

1) USC will provide facilities for the computer and for offices and support within an specially designated research center;

2) The Intel Corporation will provide one-half FTE for an operating technician, to be matched with funds from an EPSCoR grant so as to provide a full-time technician;

3) Leading faculty from both the USC Colleges of Engineering and Science and Mathematics, as well as junior faculty, post-doctoral fellows, and graduate students will commit time and resources from various grants to the operation; and

4. The State of South Carolina is expected to waive approximately $30,000 in sales tax.

In return for this proposed grant, nominally one-half of the cycles on this machine will be dedicated entirely to the DOE funded Partnership in Computational Sciences (PICS) for the life of the program. These cycles will be utilized by USC researchers in collaboration with researchers at other PICS universities and Federal Labs for developing code to be run on the larger 512-node Intel Paragon to be installed at Oak Ridge National Laboratory. The remainder of the cycles will be dedicated to other research programs including site-specific Hazardous Waste and Environmental Restoration programs at the Savannah River Site.

Sincerely,

Paul G. Huray

INTERNET: pghuray@univscvm.csd.scarolina.edu

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91)
Other Editions Are Obsolete)

Department of Energy
Office of Energy Research (OER)

Face Page

19* 1400
(OMB Burden Disclosure
Statement on Back)

TITLE OF PROPOSED RESEARCH: Partnership in Computational Science

PLEASE TYPE THE FOLLOWING INFORMATION:

1. CATALOG OF FEDERAL DOMESTIC ASSISTANCE NUMBER: 81.049

2. CONGRESSIONAL DISTRICT:
Applicant Organ's Dist.: 2nd Cong. Dist.
Project Site's Dist.: same

3. I.R.S. ENTITY IDENTIFICATION OR SOCIAL SECURITY NUMBER:
57-6001153

4. AREA OF RESEARCH OR ANNOUNCEMENT TITLE/NUMBER
SK966-19

5. HAS THIS RESEARCH PROPOSAL BEEN SUBMITTED TO ANY OTHER FEDERAL AGENCY? ☐ yes ☐ no
PLEASE LIST

6. DOE/OER PROGRAM STAFF CONTACT (if known)
Gary Johnson

7. TYPE OF APPLICATION: ☒ New ☐ Continuation
☐ Supplement ☐ Renewal ☐ Revision

8. ORGANIZATION TYPE: Local Government ☐
State Government ☐ Non-Profit ☒ Hospital ☐
Indian Tribal Government ☐ Individual ☐ Other ☐
Institution of Higher Education ☐ For-Profit ☐
(Small Business ☐ Disadvantaged Business ☐ 8(a) ☐
Women-owned ☐)

9. CURRENT DOE AWARD NUMBER (IF APPLICABLE)

10. WILL THIS RESEARCH INVOLVE:
10A. Human Subjects no ☒ If yes, ☐
Exemption No. (or)
IRB Approval Date
Assurance of Compliance No.
10B. Vertebrate Animals no ☒ If yes, ☐
IACUC Approval Date
Animal Welfare Assurance No.

11. AMOUNT REQUESTED FROM DOE FOR ENTIRE PROJECT PERIOD $ 500,000

12. DURATION OF ENTIRE PROJECT PERIOD
1/1/93 (Mo/day/yr.) to 12/31/93 (Mo/day/yr.)

13. REQUESTED AWARD START DATE
1/1/93 (Mo/day/yr.)

14. IS APPLICANT DELINQUENT ON ANY FEDERAL DEBT?
☐ Yes (If "Yes," attach an explanation) ☐ No

15. PRINCIPAL INVESTIGATOR/PROGRAM DIRECTOR NAME, TITLE, ADDRESS AND PHONE NUMBER

Paul G. Huray
Senior V.P. for Research
University of South Carolina
Columbia, S.C. 29208
Phone (803) 777-9520
Fax (803) 777-9557
Internet: pghuray@univscvm.csd.scarolina.edu

SIGNATURE OF PRINCIPAL INVESTIGATOR/ PROGRAM DIRECTOR _____ Date

PI PD ASSURANCE: I agree to accept responsibility for the scientific conduct of the project and to provide the required progress reports if an award is made as a result of this submission. Willful provision of false information is a criminal offense. (U.S. Code, Title 18, Section 1001).

16. ORGANIZATION'S NAME, ADDRESS AND CERTIFYING REPRESENTATIVE'S NAME, TITLE AND PHONE NUMBER

Sponsored Programs and Research
University of South Carolina
Columbia, SC 29208
Ardis Savory, Associate Vice Provost

SIGNATURE OF ORGANIZATION'S CERTIFYING REPRESENTATIVE _____ Date

CERTIFICATION & ACCEPTANCE: I certify that the statements herein are true and complete to the best of my knowledge, and accept the obligation to comply with DOE terms and conditions if an award is made as the result of this submission. A willfully false certification is a criminal offense. (U.S Code, Title 18, Section 1001).

NOTICE FOR HANDLING PROPOSALS

This submission is to be used only for DOE evaluation purposes and this notice shall be affixed to any reproduction or abstract thereof. All Government and non-Government personnel handling this submission shall exercise extreme care to ensure that the information contained herein is not duplicated, used, or disclosed in whole or in part for any purpose other than evaluation without written permission except that if an award is made based on this submission, the terms of the award shall control disclosure and use. This notice does not limit the Government's right to use information contained in the submission if it is obtainable from another source without restriction. This is a Government notice, and shall not itself be construed to impose any liability upon the Government or Government personnel for any disclosure or use of data contained in this submission.

PRIVACY ACT STATEMENT

If applicable, you are requested, in accordance with 5 U.S.C., Sec. 552A, to voluntarily provide your Social Security Number (SSN). However, you will not be denied any right, benefit, or privilege provided by law because of a refusal to disclose your SSN. We request your SSN to aid in accurate identification, referral and review of applications for research/training support and for efficient management of Office of Energy Research grant/contract programs.

DOE F 1430.22
(04-91)
All other editions
are obsolete
(Replaces DOE F 538)

OMB Control No.
1910-1400
Burden Disclosure
Statement on Back

U.S. DEPARTMENT OF ENERGY

NOTICE OF ENERGY RD&D PROJECT

1. DOE CONTRACT OR GRANT NUMBER DE-AC05-840R21400

☐ New contract ☐ Continuation/Revision

2. A. NAME OF PERFORMING ORGANIZATION University of South Carolina

B. Department or Division Office of Research

C. Street Address 106 Osborne Administration Building

City Columbia State SC Zip 29208

D. Type of Performing Organization (circle only one two-letter code)

CU–College, university, or trade school
EG–Electric or gas utility
FF–Federally funded RD&D centers or laboratory operated for agency of US government
IN–Private industry
NP–Foundation or laboratory not operated for profit
ST–Regional, state, or local government facility
TA–Trade or professional organization
US–Federal Agency
XX–Other

3. PRINCIPAL OR SENIOR INVESTIGATOR

A. Last Huray First Paul MI G

B. Phone: Commercial (803) 777-9520 FTS

4. DOE SPONSORING OFFICE OR DIVISION Scientific Computing Staff

5. TITLE OF PROJECT

Partnership in Computational Science

6. DESCRIPTIVE SUMMARY (limit to 200 words)

See attached

---

7. RESPONDENT INFORMATION. List name and address of person filling out this form. Give telephone number and extension where person can be reached. Record the date this form was completed or updated. This information will not be published.

Last Huray First Paul MI G

Address University of South Carolina, Office of Research, 106 Osborne

City Columbia State SC Zip 29208

Phone (803) 777-9520 Date 12/15/92

ER F 4620 1 (11-90)

U.S. Department of Energy
Grant Application Budget Period Summary

(See Reverse for Definitions and Instructions)

Please Print or Type

OMB Approval No. 1910-1400

Organization:	Period Covering:	FOR DOE USE ONLY
University of South Carolina	From: 1/1/93	PROPOSAL NO:
Principal Investigator (P.I.)/Project director (P.D.): Paul G. Huray	To: 12/31/93	AWARD NO.:

A. SENIOR PERSONNEL PI/PD Co. PIs, Faculty and Other Senior Associates (List each separately with title, A.6 show number in brackets. Attach separate sheet, if required.)	DOE Funded Person-Mos. Cal.	Acad.	Sumr.	Funds Requested By Applicant $
1. Ralph E. White, Prof. & Chrm. Dept. of Chem Engr				
2. Colin Bennett, Prof. of Mathematics				
3. Robert Sharpley, Prof. of Mathematics				
4. Howard Reeves, Asst. Prof. of Geological Scien.				
5.				
6. ( ) TOTAL SENIOR PERSONNEL				
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)				
1. ( ) POST DOCTORAL ASSOCIATES				
2. ( ) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)				
3. ( ) GRADUATE STUDENTS				
4. ( ) UNDERGRADUATE STUDENTS				
5. ( ) SECRETARIAL-CLERICAL				
6. ( ) OTHER				
TOTAL SALARIES AND WAGES (A + B)				
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM) Intel Paragon Model A-4 Parallel Supercomputer				
TOTAL EQUIPMENT				1,710,000.00
E. TRAVEL				
1. DOMESTIC (INCL. CANADA AND U.S. POSSESSIONS)				
2. FOREIGN				
F. OTHER DIRECT COSTS				
1. MATERIALS AND SUPPLIES				
2. PUBLICATION COSTS/PAGE CHARGES				
3. CONSULTANT SERVICES				
4. COMPUTER (ADPE) SERVICES				
5. CONTRACTS AND SUBGRANTS				
6. OTHER				
TOTAL OTHER DIRECT COSTS				
G. TOTAL DIRECT COSTS (A THROUGH F)				1,710,000.00
H. INDIRECT COSTS (SPECIFY RATE AND BASE)				
TOTAL INDIRECT COSTS				-0-
I. TOTAL DIRECT AND INDIRECT COSTS (G & H)				1,710,000.00
J. APPLICANT'S COST SHARING (IF ANY)				1,210,000.00
K. TOTAL AMOUNT OF THIS REQUEST (ITEM I LESS ITEM J)				500,000.00

PI/PD TYPED NAME & SIGNATURE Paul G. Huray	DATE 12/15/92
INST. REP. TYPED NAME & SIGNATURE Ardis Savory	DATE 12,15,92

BUDGET

Purchase of the following equipment is proposed:

Configuration: Intel Paragon Parallel Supercomputer
- 4.2 G-flop peak performance
- 56 each i860-XP 16 m-byte processing nodes
- 3 mass storage RAID arrays
- 1 multiuser service node
- 1 VME interface
- 1 Ethernet controller
- 1 backup tape drive

Purchase Price:

Retail Price (see attached quote):	$1,710,000.00

Funding Request:

Retail Price	$1,710,000.00
Less: USC Match:	(300,000.00)
Less: Intel University Discount:	(171,000.00)
Intel Infrastructure Grant:	(739,000.00)
Total Requested:	$500,000.00

Included in the purchase price is three years of maintenance at an approximate value of $63,000 per year, for a total of $189,000. USC will continue to provide maintenance on the Intel machine after the end of this three-year period. USC will provide additional matching to this grant request in the form of facilities to house the computer and provide space for researchers and support activities, operational support from other grants, and anticipated waiver of sales tax from the State of South Carolina. One-half of the cycles (nominally) will be devoted to use by USC researchers under the DOE sponsored PICS program.

ER F 4620 1A
(7-85)

U.S. Department of Energy

GRANT APPLICATION
PROJECT PERIOD SUMMARY

(Must be completed for all new and renewal applications.)

Please Print or Type

OMB Approval
No. 1910-1400

Categories	01 Budget Period	02 Budget Period	03 Budget Period	04 Budget Period	05 Budget Period
A. Senior Personnel Totals					
B. Other Personnel Totals					
C. Fringe Benefit Totals					
Total of A, B & C					
D. Equipment	1,710,000.00				
E. Travel 1. Domestic					
2. Foreign					
F. Other Direct Costs					
G. Total Direct Costs	1,710,000.00				
H. Total Indirect Costs					
I. Total Direct & Indirect Costs	1,710,000.00				
J. Applicant's Cost-Sharing (If any)	1,210,000.00				
K. Total Amount of Request (Item I. Less Item J.)	(1)* 500,000.00	(2)	(3)	(4)	(5)

*This should equal Item K on Budget Period Summary (ER/F/4620.1)

ESTIMATE

TOTAL COST OF PROJECT

$ 500,000.00

(add K(1) thru (5))

Memorandum of Understanding

to establish a

South Carolina University High Performance Computing System

South Carolina University Research Computing Background:

In November of 1991, Governor Carrol Campbell called for South Carolina institutions of Higher Education to study the needs and opportunities for a shared state High Performance Computing System. In response, an ad hoc panel consisting of representatives of the research universities and state computational offices was assembled under the auspices of the Commission on Higher Education. The committee adopted working principles and conducted a survey of existing equipment and needs for the faculty of the three research universities. The committee merged the university reports and produced a long list of joint research needs which were unmet by existing computer resources. The survey revealed that individual South Carolina researchers had procured a number of high performance workstations to accomplish research projects funded by external sources (mostly by agencies of the Federal Government) but that those computers were not generally available to all users. The committee concluded that some of the state research needs could be met through a pooling of computer resources among the three research universities.

In parallel, the committee addressed the potential source of funds to support the procurement of an additional computer system to be shared amont the state's researchers. A variety of options were considered, but because of limitations of the state budget, a direct request for state funding was not pursued.

The University Agreement:

In order to begin a process, whereby the state's researchers share their computer resources, Clemson, USC and MUSC hereby agree to initiate a shared, networked computer system. The system will be designed to allow evolution to the most desirable configuration which satisfies the most research needs at optimum cost. Although the evolution may require the procurement of larger computers in future years, the universities agree to begin the system within their available resources, and by utilizing statewide links to one another provided by the Internet.

The universities agree, where practicable, to procure hardware and system software which will allow and encourage compatible growth and will utilize their individual computers on a more continuous basis. The existing computer operations staff at each of the institutions will maintain their respective portion of the system but will work in concert with one another via a joint

advisory committee to formulate strategy and build a computing infrastructure which supports the maximum number of researchers.

Initiating a Joint Research Computing System:

To produce a tangible product for researchers of the State of South Carolina in a timely fashion, the research universities have established a set of tasks which will allow the State to accomplish its overall research objectives:

1. **Establish a Joint Computational Advisory Committee:** The three South Carolina research institutions will establish a joint computational advisory committee with the objective of developing a common market for research computing through shared resources.

2. **Establish Common Operating Systems for Workstations:** USC, Clemson and MUSC will endeavor to establish clusters of workstations which serve the needs of their research faculty via compatible campus wide networks. The Joint Computational Advisory Committee will assist the institutions in defining and implementing a common operating system.

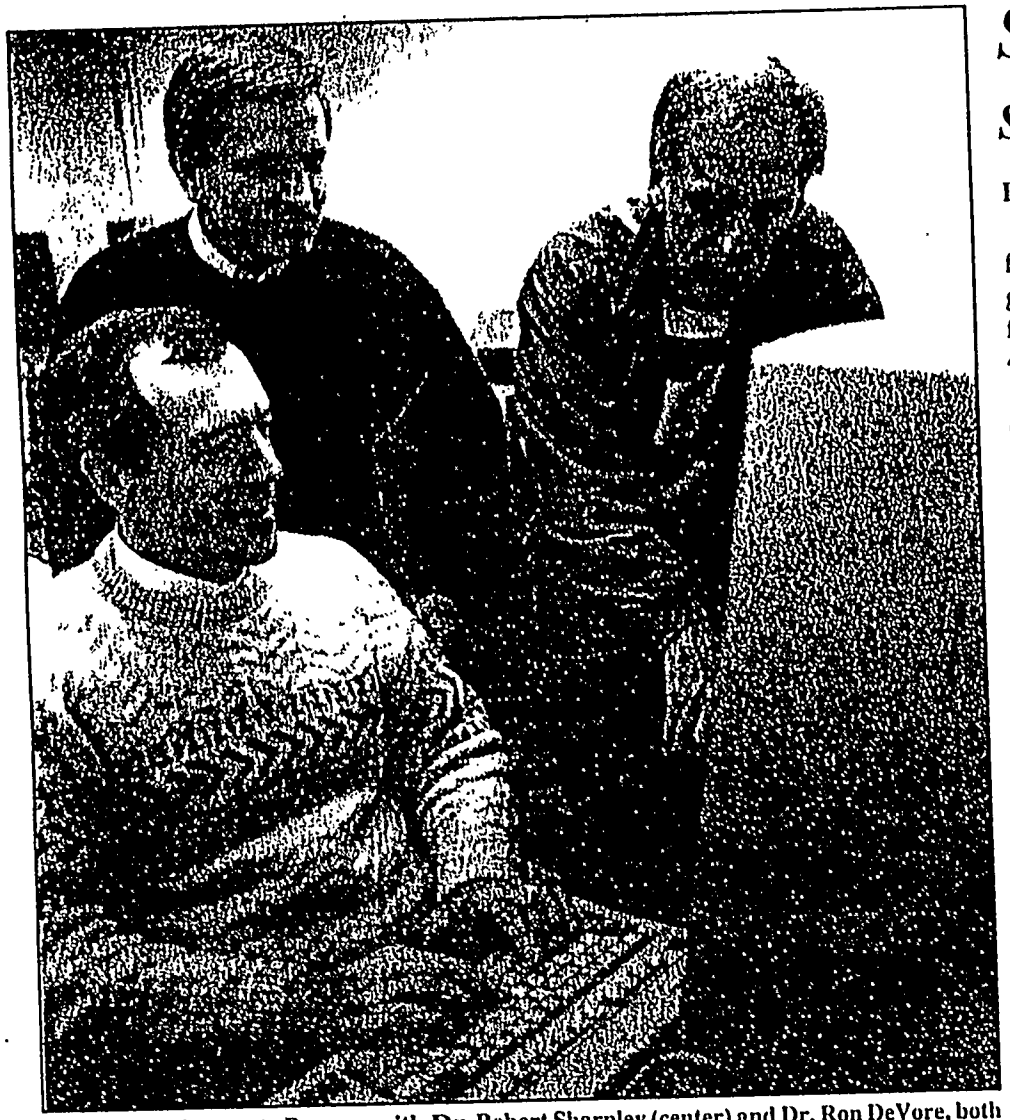
3. **Jointly Provide High Performance Computer Access to Researchers:** A statewide High Performance Computing System will be initiated through common access to an Intel Paragon Computer. The Joint Computational Advisory Committee will assist the institutions by assuring that the High Performance Computing System is available from workstations on the system which adopt the common operating system.

4. **Evolve the Joint HPC System:** The Joint Computational Advisory Committee will assist the research institutions in procuring future hardware and software which is compatible. The objective will be to encourage the evolution of individual campus computers which are not duplicitous but which provide greater system-wide strength.

James B. Edwards
President, MUSC

Max Lennon
President, Clemson Univ.

John M. Palms
President, USC



Fay (seated), logs on to Paragon with Dr. Robert Sharpley (center) and Dr. Ron DeVore, both of the Department of Mathematics.

Scientist hired to teach faculty, students use of Paragon computer

By Chris Horn

With its flashing lights and sleek, black front panel, the University's new Intel Paragon A-4 parallel computer looks as powerful as it's billed to be, and that's powerful — 4 billion computations per second.

Unfortunately, speed and power do not equate with ease of use. When it comes to computers, the phrase "user friendly" is a relative term. "It's a Unix-based system, which is familiar to users of scientific work stations," said Dr. Patrick Fay, a new computational scientist in the Office of Research. "It's meant for people with large-scale computing problems and large capacity memory needs."

Fay plans to make the experience of using the Paragon computer a positive one. In fact, that's just what he was hired to do: work with faculty and graduate student researchers who want to use the Paragon.

"The computer is not that difficult in itself to use. The hardest part is to adapt one's research codes to run in parallel form," Fay said. "That's not a trivial thing to do, but there is really no other choice [than parallel processing] for some large-scale research problems."

Fay is no stranger to computers, having worked with many different systems during the past 14 years. And he's no stranger to USC Columbia, either, having received a bachelor's degree in physics in 1980, and a MIBS degree (Spanish track) in 1987. Fay recently earned his Ph.D. in physics from Clemson University.

"At Clemson, we were using a very fast workstation to carry out simulations with 5,000 atoms. It would take the machine several weeks to complete the computations," Fay said. "This Paragon machine could do the same calculations overnight."

A bright note for researchers: USC has a site license for Parasoft Express, an integrated software package that allows parallel programs to be developed in almost any type of workstation. Programs using Express can be developed, tested and run on workstations, then moved to the Paragon without changes when supercomputer performance is needed. "It's best if researchers start using the software early on in a research project," Fay said.

He hopes to offer seminars soon on use of the Paragon computer, and he encourages interested faculty members and graduate students to call him at 7-4804 or send a message to his E-mail address: pfay@kermit.csd.scarolina.edu to arrange introductory and tutorial sessions on the Paragon.

Major gifts from

USC will spotlight Russian connections

Poet Yevgeny Yevtushenko to visit University

South Carolina Supercomputer Network
News Conference
Agenda

10 a.m. -- Computer Services building/second floor
Demonstration: Paul Huray will be present to welcome and explain the demonstration (Governor and the press will be key people present)

10:15 a.m. -- third floor auditorium (Governor, press, Dr. Palms, Tim Walgren, representatives from Clemson, MUSC and USC, as well as EPSCOR representatives)

Formal Announcement:

Dr. Palms: Welcome
Announce acquisition and agreement
Introduce speakers:
Gov. Carroll Campbell
Tim Walgren, vice president of Alumax in Charleston and chairman of the Governor's Science and Math Advisory Committee

Gov. Carroll Campbell: Importance of the supercomputer and agreement to South Carolina

Tim Walgren: Benefits to higher education and industry of having this high tech tool available in state

Dr. Palms: Concluding remarks

10:35 a.m.

10:35-11 a.m. Additional demonstrations on second floor

intel · Supercomputer Systems Division:

15201 N.W. Greenbrier Parkway,
Beaverton, OR 97006-5771
503-629-7600

QUOTATION

To: Dr. Paul G. Huray (803-777-9520)

From: Andre Turenne (503-629-7608)
FAX: (503-629-9147)

Address: University of South Carolina
Senior Vice President
Office of Research
Columbia, SC 29208

Quote #: 9205016

Quote Date: 5/15/92

INTEL IS PLEASED TO QUOTE AS FOLLOWS:

Product	Description	QTY	List Price	Annual Univ. Partne Maintenanc
University Paragon XP/S Model A4	Paragon parallel supercomputer with fifty-six 16 MByte i860-XP processing nodes, three mass storage RAID arrays, one multiuser service node, one VME interface, one Ethernet controller, and one backup tape drive. System performance: Peak performance: 4.2 GFlops. System main memory: .9 GBytes. System disk storage: 14.4 GBytes. Operating System software includes: OSF/1 operating system, TCP/IP support, Network File System (NFS), MACS resource control system and Network Queing System (NQS). Development software includes: Optimized C or Fortran compilers, Interactive Parallel Debugger, Performance Analysis Tool, Basic Math Library (BLAS1, 2, 3, and FFT's), Assembler, Linker, Loader and Object Code management tools. Warranty: 36 months of Paragon University Partners maintenance is included with system purchase price.	1	$1,710,000	$63,000
	System Price		$1,710,000	$63,00
	Standard University Discount (10%)		(171,000)	
	Intel Infrastructure Grant		(739,000)	
	Total University Infrastructure Price * Maintenance charges begin year 4		$800,000	$63,00

Quote effective until 1st ten A4 orders have been placed.	All items FOB Beaverton, OR, USA. 3 month warranty is included with system.

This quotation is not an offer. It is a solicitation for an offer and is made only on the terms and conditions contained her: Buyer's offer to purchase products must be on these terms and conditions. Intel hereby specifically rejects any terms a conditions on Buyer's offer in conflict with or in addition to these terms and conditions. Buyer's offer will not be deem acceptable until Intel has issued a written acknowledgement.

Intel SSD

By: [signature]

THE UNIVERSITY OF SOUTH CAROLINA

MEDIA ADVISORY

Office of Public Affairs
Columbia, SC 29208
Telephone (803) 777-1234

FOR MORE INFORMATION, CONTACT:
Debra Allen or Jo Fleischer

For Immediate Release
November 18, 1993
Admn069

South Carolina universities linked by Intel supercomputer

The most powerful computer in the history of South Carolina, which will be shared by the state's research universities, was unveiled by Gov. Carroll Campbell today (Nov. 18).

The $1.75 million Intel supercomputer, capable of 5 billion calculations per second, was demonstrated for Campbell and higher education officials in the University of South Carolina's Computer Services building.

The machine was acquired through a research association with the U.S. Department of Energy, but an agreement will make at least half of the machine's computing capacity available to researchers in all disciplines at Clemson University, the Medical University of South Carolina and USC.

"This is the most powerful computer that has ever been used for any purpose in South Carolina, and it is very gratifying to see it used in a collaborative effort involving the state's research universities and the Department of Energy," Campbell said. "This cooperation will produce important benefits for students and researchers in South Carolina, and provide important research for business and industrial growth."

Using various computer networks, professors at the state's research universities will be able to gain access to the computer from their own offices. Researchers say its enormous capacity will be valuable in probing complex problems such as global warming and drug interactions.

"Joining in this computer network has brought South Carolina research universities a learning tool that is available in just a handful of other states. And it was done at a cost of less than $300,000 to the taxpayers," Campbell said.

--more--

The supercomputer's principal use will be as part of the DOE's Partnership in Computational Science (PICS) program, which provided a $500,000 grant toward its purchase. USC provided approximately $300,000, while the Intel Supercomputer Division provided a grant of $739,000 plus software and a three-year maintenace contract to aid in the purchase of the Intel Paragon A-4 supercomputer.

The PICS effort seeks to bring governmental, industrial and academic researchers together to develop faster and faster computers and the software to operate them as a means to solving major problems such as groundwater contamination. The consortium includes the Oak Ridge National Laboratory in Tennessee, Ames Laboratory in Iowa and Brookhaven National Laboratory in New York, plus Rice University, the University of Tennessee, State University of New York at Stony Brook, Texas A&M University and Vanderbilt University.

"This research has important implications for a number of industries, many of which are grappling with the challenge of monitoring and protecting the environment," said Tim Walgren, chairman of the Governor's Science and Math Advisory Committee. "It shows how science research and industry needs are often closely linked and how universities and business can both find benefits in research collaborations."

USC researchers are now involved in fundamental science research probing the spread of contaminants in groundwater at the DOE's Savannah River and Oak Ridge sites. "This computer will be involved in predicting exactly what is happening with the flow or diffusion of various contaminants under the ground," said Dr. Paul Huray of USC, the principal research investigator for the Energy Department grant that helped fund the supercomputer acquisition.

The development of mathematical models that can exploit new computer technology would save millions of dollars over current methods of determining the presence of pollutants, Huray said.

The Intel machine maximizes its capacity with parallel processing, meaning that it divides a particular problem into pieces that are calculated simultaneously, then the components are compiled into an overall solution.

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USA TODAY 11/19/93

M EVERY STATE

Nancy Keenan said. Lawmakers meet in special session Nov. 29.

NEBRASKA

LINCOLN — The Dept. of Social Services is studying a plan to let it seize tax refunds and lottery winnings (worth over $500) of people behind in child support.

NEVADA

SPARKS — Washoe County School Board Chairman Michael Wright's residency status won't be challenged because he maintains enough residency in his district, the district attorney's office says. A citizen had complained.

NEW HAMPSHIRE

KEENE — A panel on sexually transmitted diseases has voted against recommending condom distribution in Keene Middle School. It will, however, forward that proposal and about 70 others to the school board for discussion.

NEW JERSEY

HOBOKEN — Mayor Anthony Russo said he's optimistic Frank Sinatra's hometown will be the site of a library and museum in the crooner's honor. Other contenders: New York and Washington, D.C.

NEW MEXICO

SANTA FE — The state Environment Dept. plans to install up to 10 test wells to try to find the source of pollution in a water well. High levels of ethylene dibromide led to the closing of the Sangre de Cristo Water Co. well last month.

NEW YORK

BUFFALO — University of Buffalo Law School shouldn't let Pentagon recruiters on campus, a state Supreme Court justice ruled. The court backed up a lesbian student, who said military recruiters wouldn't interview her due to her sexual orientation. ... NEW YORK — Classes resumed in the last New York City school closed since September because of asbestos, linked to cancer. The substance still must be removed from areas in 300 school buildings.

NORTH CAROLINA

CHAPEL HILL — The University of North Carolina-Chapel Hill won a $250,000 grant from the Centers for Disease Control and Prevention to develop a national training center for public health officials. Mission: help smokers quit; keep people from starting.

about government reform, United We Stand America officials said. Venue: the Civic Auditorium.

OHIO

COLUMBUS — A government board blocked the display of a Christmas tree or menorah at the Statehouse, but OK'd a permit for the KKK to rally there on Dr. Martin Luther King Jr.'s birthday.

OKLAHOMA

GUTHRIE — State medical examiners worked to identify the burned bodies of two people killed when a small airplane clipped a power line, crashed into a barn and then caught fire Wednesday.

OREGON

PORTLAND — The state Supreme Court has denied white supremacist Tom Metzger a review of the $12.5 million verdict against him for encouraging skinheads to kill an Ethiopian in '88. The denial clears the way to seize Metzger's assets for restitution.

PENNSYLVANIA

HARRISBURG — Elections officials certified William Stinson's 463-vote Senate victory and Democrats immediately swore him in before the GOP could seek an appeal. Rival Bruce Marks is challenging 550 absentee ballots.

RHODE ISLAND

SMITHFIELD — Members of Phi Kappa Sigma fraternity at Bryant College will spend the night in cardboard shanties to draw attention to homelessness and raise about $2,000 for McAuley House, a Providence shelter.

SOUTH CAROLINA

COLUMBIA — A $1.75 million supercomputer — capable of 5 billion calculations per second — was unveiled at the University of South Carolina. It'll be shared by researchers at USC, Clemson University and the Medical University of South Carolina.

SOUTH DAKOTA

RAPID CITY — Northwest will be the only major airline in town after United Airlines — citing lack of profitability — drops its flights [illegible] Airlines, operating as United Express, plans to beef up its service.

TENNESSEE

MEMPHIS — A report is due next month on whether the city

TEXAS

HOUSTON — Officials warned people not to eat fish or crabs from Clear Creek, which borders Harris, Brazoria and Galveston counties. Tests show the presence of two suspected cancer-causing chemicals. ... SAN MARCOS — The Alpha Kappa Alpha sorority at Southwest Texas State University has been suspended until '97 due to hazing violations, officials say.

UTAH

SALT LAKE CITY — A five-day wait for the purchase of any gun drew the support of majority Salt Lake County commissioners Jim Bradley and Randy Horiuchi.

VERMONT

DUXBURY — Harwood Union School Board OK'd letting some teachers and the school nurse dispense condoms to high school students. It's part of a program of discussing venereal diseases, stressing abstinence. Parents may exclude their own children.

VIRGINIA

VIRGINIA BEACH — A Navy F-14 Tomcat jet based here crashed in Currituck Sound, N.C., while on a routine training mission. Its two crewmen ejected safely. A probe is under way.

WASHINGTON

RICHLAND — The NRC proposes to fine the Washington Public Power Supply System $75,000 over the way it runs a reactor safety system. The NRC found three instances in '91 and '92 in which redundant heating systems were run in violation of its rules.

WEST VIRGINIA

CHARLESTON — Eight UMW workers charged in the strike-related July 22 slaying of non-union worker Eddie York, 39, pleaded innocent. The trial begins Jan. 24.the fatal shot.

WISCONSIN

NEILLSVILLE — A Clark County judge refused to dismiss traffic tickets given to eight Amish men for driving horse-drawn buggies without displaying bright orange "slow-moving vehicle" signs. The men said forcing the signs on them violated their religion.

WYOMING

JACKSON — Another wolf sighting has been reported in the Hayden Valley of Yellowstone Na-

Joining forces

THE STATE 11/19/93

State universities create 'supercomputer network'

By BILL ROBINSON
Staff Writer

For years, South Carolina's research universities have longed to join the high-tech world of supercomputers.

But state government's financial woes and parochial bickering over where the equipment should be placed made acquisition a political hot potato.

Until now.

On Thursday, the University of South Carolina, Clemson University and the Medical University of South Carolina in Charleston formally joined forces to create a "supercomputer network" that should put the state in fast company when it comes to computer-assisted research.

Gov. Carroll Campbell saw a demonstration of the $1.75 million supercomputer at USC's computer services building.

At a higher education conference in November 1991, Campbell said obtaining a supercomputer should be a priority. His interest is credited by some as being a catalyst for getting the universities to put aside their differences about ownership and control.

Bobby Bowers, director of the state research and statistical services division, said, "I applaud the institutions for taking the initiative in pulling this together. I think we're all going to be winners as a result."

In 1989, USC and Clemson battled it out in the Legislature with competing requests for funding so each could buy a supercomputer. The price tag for one machine topped $10 million.

Lawmakers struggling to balance the budget decided the state couldn't afford two computers and named a task force to find a solution.

That panel decided South Carolina could use a supercomputer but was unable to resolve where it should be located, or who would be responsible for its operation and maintenance.

Bowers said the governor's decision to appoint a second task force nudged the universities into working together.

By delaying the purchase, USC struck a deal with Intel Corp. to acquire its newest supercomputer more than a year ago for less than $2 million. USC also agreed to accept grants from the company and federal government, a move that cut the university's cost to about $300,000.

The machine was acquired through a research association with the U.S. Department of Energy, but an agreement will make at least half of the machine's computing capacity available to researchers at USC, Clemson and MUSC.

Those who will be using the equipment are excited about what it means to South Carolina.

Jay Gogue, Clemson's top research official, said the supercomputer will help universities recruit top professors.

David Hoel, chairman of the biometry and epidemiology department at MUSC, called it "an important tool that can be useful for a lot research."

A supercomputer, for example, can help medical researchers create models of molecules they believe will enable them to identify new kinds of medications to cure diseases.

Fred Carter, the State Budget and Control Board director, said "having South Carolina as a technology hub identifies us an extra-progressive state. It certainly makes us a more inviting place to locate."

The Charlotte Observer 11-19-93

S.C. universities unveil computer they'll share

By BRENT UNGER
Columbia Bureau

COLUMBIA — S.C. officials unveiled the most powerful computer in state history on Thursday, treating Gov. Carroll Campbell, a Republican, to a graphic display of the letters "GOP" in a modest demonstration of the computer's touted capabilities.

Housed at the University of South Carolina and linked to Clemson and the Medical University of South Carolina in Charleston, the $1.75 million supercomputer will be part of the world's largest supercomputer network, which includes the Department of Energy's supercomputer — what a USC spokesperson called "the mother ship" — in Oak Ridge, Tenn.

While not on the same network, North Carolina universities have shared a supercomputer for about 10 years.

"My mind can't comprehend" the power of these machines, Campbell said.

South Carolina's supercomputer is capable of 5 billion calculations per second, compared to the DOE's 75 billion.

USC President John Palms said simply, "I wish I had that kind of power on the football team."

Today's supercomputers, Campbell said, are 10 times faster and 10 times smaller than those of only five years ago. They're also less expensive.

The Department of Energy and Intel, the supercomputer manufacturer, provided combined grants and discounts of about $1.45 million for the S.C. supercomputer. So S.C. taxpayers will end up paying only about $300,000.

"(In 1989 and 1990), we were talking about tens of millions of dollars per computer," said Marvin Jones, a member of the now-defunct nine-man supercomputing task force created by the General Assembly.

During that time, the task force recommended the state purchase a supercomputer.

But inter-university feuds for possession of the supercomputer, Hurricane Hugo and tight state budgets stalled the purchase until now.

Not everyone, however, is ecstatic. "I would hope that there's some cost savings along the way as a result of having this computer," said Sen. Glenn McConnell, R-Charleston, who led the fight against the supercomputer in 1989.

About half the supercomputer's time will be spent studying groundwater contamination at the Department of Energy's Savannah River and Oak Ridge nuclear weapons complexes. The other half will be made available to researchers at the three universities.

Any leftover time might be leased to private researchers throughout the South.

Although Campbell hailed the interschool cooperation, he suggested USC might want to monopolize the supercomputer on Saturday, the day of the ballyhooed Clemson-USC football game.

"If Clemson has access to the same information, ... I don't believe it will benefit (USC)," Campbell said. "But on Monday, we will come back together to solve the problems for South Carolina and indeed, maybe for the country."

Post 11/19

Computer links schools across state

By BILL STEIGER
Of The Post and Courier staff

COLUMBIA — While Vice President Al Gore dreams of an information super highway spanning the nation, Gov. Carroll A. Campbell Jr. already has one, of sorts.

Actually, the South Carolina Supercomputer Network unveiled Thursday is more like Interstate 26, running from the Lowcountry to the Upstate linking the Medical University of South Carolina, the University of South Carolina and Clemson University

The $1.75 million supercomputer is the most powerful computer ever installed in the state. It will enable the three schools to share research and information at an unprecedented level.

"It just boggles my mind," Campbell said Thursday as USC professors demonstrated the remarkable machine. About the size of half a refrigerator, the supercomputer can make more than 4 billion calculations per second.

"Gee, I wish I had a football team that worked like that," USC President John Palms joked as he watched the supercomputer run through a few equations.

Red and yellow lights on the supercomputer's front panel flickered at a frenzied pace as the calculations continued. At one point, the lights spelled out "GO!" — much to the delight of the Republican governor.

The supercomputer is not a toy, however, and will be used for highly complex studies such as tracking hazardous waste contamination at the Savannah River Site nuclear weapons plant.

"It really opens a new frontier for us," Campbell said, pointing out that the supercomputer also will provide access to a wealth of information at research facilities across the country.

The supercomputer was acquired through the U.S. Department of Energy, which is interested in tracking contamination at SRS. The agency provided a $500,000 grant for the supercomputer and Intel Supercomputer Division, a private firm, kicked in $739,000, leaving the state to come up with about $300,000.

USC professor Paul Huray said joint research into the problems at SRS already is under way with USC studying geological data, Clemson testing soil and MUSC taking a look at potential health hazards.

Creating a model of ground water flow at SRS used to take about nine months with USC's old computer, but the supercomputer can do it in three or four days.

The supercomputer has many other uses, too. It can forecast weather, simulate auto crashes, estimate wind shear for airplanes and assist with advanced medical research and the development of new drugs.

It also should help secure the universities' position in the highly competitive world of scientific research, said Tim Walgren, chairman of the Governor's Science and Math Advisory Committee.

Walgren, who works for Alumax in Berkeley County, said the arrival of the supercomputer should convince gifted math and science students to stay in South Carolina for their college educations rather than going to out-of-state schools with big computer systems.

Other colleges and universities across the state eventually will be able to tap into the supercomputer.

Supercomputer unveiled at USC

The S News 11/19

By James T. Hammond
News Capital Bureau

COLUMBIA — Imagine balancing one million personal checking accounts in less than a second.

That's the speed at which a new $1.75 million Intel supercomputer at the University of South Carolina will function, at five billion calculations per second.

"I wish I had that kind of power on the football team," USC President John Palms said Thursday, noting that USC faces Clemson on the gridiron Saturday.

While the two state universities may be football rivals, their research labs will share with each other and with the Medical University of South Carolina the resources of the supercomputer.

Linked by state-of-the-art fiber optic cables, the three research institutions can gain equal access to the computer.

If they need more computing muscle they can use the machine at USC to tap into a much larger Intel supercomputer at the Department of Energy laboratory, Oak Ridge, Tenn. and take advantage of its 75 billion calculations per second, officials said.

Despite the $1.75 million price tag, South Carolina got a good deal on the Intel machine, which is one-tenth the size of the university's old supercomputer, but is 10 times as fast and has 10 times the memory.

South Carolina will spend less than $300,000 on the system, Gov. Carroll Campbell said in unveiling the machine.

The U.S. Department of Energy provided $500,000 toward the computer's purchase. Intel Supercomputer Division provided a grant of $739,000, software and a three-year maintenance contract. USC provided the remaining $300,000.

Paul Huray, the principal research investigator for the Energy Department grant, said half of the computer's time will be devoted to research on ground water contamination and other environmental problems.

Huray said that by next year, South Carolina research labs will have access to "the mother of all supercomputers" at Oak Ridge, capable of 150 billion calculations per second.

The Energy Department is funding the project as part of its overall environmental clean-up efforts at the Savannah River Site, officials said.