

TECHNICAL PROGRESS REPORT

Quarterly

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Reporting Period end date: March 31, 2003

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Submitting Organization:  
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Advanced Gas Turbine Systems Research Program  
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# **Technical Quarterly Progress Report**

Advanced Gas Turbine Systems Research  
Cooperative Agreement DE-FC21-MC29061

January 1, 2003 to March 31, 2003

## **ABSTRACT:**

The quarterly activities of the Advanced Gas Turbine Systems Research (AGTSR) program are described in this quarterly report. As this program administers research, we have included all program activity herein within the past quarter as dated. More specific research progress reports are provided weekly at the request of the AGTSR COR and are being sent to NETL. As for the administration of this program, items worthy of note are presented in extended bullet format following the appropriate heading. No new memberships, workshops, research projects, internships, faculty fellowships or special studies were initiated during this reporting period. Contract completion is set for June 30, 2003. During the report period, nine subcontractor reports were received (5 final reports and 4 semi-annual reports). The report technology distribution is as follows: 3—aero-heat transfer, 2—combustion and 4—materials. AGTSR continues to project that it will under spend DOE obligated funds by approximately \$329K.

## **TABLE OF CONTENTS:**

- Executive Summary:
- Experimental
- Results and Discussion: Research Items
- Conclusion
- References

**Technical Quarterly Progress Report**  
Advanced Gas Turbine Systems Research  
Cooperative Agreement DE-FC21-92MC29061

January 1, 2003 to March 31, 2003

**EXECUTIVE SUMMARY:**

The AGTSR is now functioning under a time extension approved by DOE/NETL. The AGTSR completion date is set for June 30, 2003. During this time extension period, no new activities were added to AGTSR. Research work continued as the university subcontractors continue/complete their work. SCIES continues to provide the necessary oversight to assure progress is made. No new Membership, Workshops, Research Projects, Internships, Faculty Fellows or Special Studies were initiated under AGTSR. AGTSR received 9 Progress Reports during this reporting period.

Five of the reports were final reports; these are as follows:

- Tip Clearance Heat Transfer and Desensitization in High Pressure Turbines, PI-Jay Kapat, University of Central Florida, SR080
- Rotating and Stationary Rectangular Coding Passage Heat Transfer and Friction with Ribs, Pins and Dimples, PI-J. C. Han, Texas A&M University, SR082
- Correlation of Ignition Delay with Fuel Composition and State for Application to Gas Turbine Combustion, PI-Scott Samuelsen, University of California, Irvine, SR084cs
- The Staged Pre vaporizing-Premixer Injector: High Pressure Evaluation, PI-Philip C. Malte, University of Washington, SR087
- Improvements in Thermal Barrier Coatings Durability Via Combustion Chemical Vapor Deposition, PI-W. B. Carter, Georgia Tech, SR066

These five final reports have shown the following (in order of report listing):

- The University of Central Florida project terminated early because the Air Force Research Laboratory, a participating partner, needed to withdraw from the program. However, the program was able to demonstrate the use of temperature sensitive paint (TSP) for measurement of transient surface temperature distribution on exposed blade surfaces. Accuracy to less than 0.7°C was observed.
- The Texas A&M project performed in cooperation with the University of Utah was conducted in three phases—rotating heat transfer, stationary heat transfer and numerical prediction. Much needed data to assist designers in improving cooling performance and thermal efficiency of engines is provided.
- The University of California, Irvine, project expanded available information on ignition delay of single component gases to those of gas mixtures as a function of fuel composition, inlet air temperature, inlet pressure, fuel/air ratio, free stream velocity and inlet turbulence intensity were investigated. The application is to lean burn gas turbine combustion.

- The University of Washington studied staged prevaporized-premixer technology for injecting liquid fuels into lean prevaporized-prevaporized (LPP) gas turbine engine combustors. The primary fuel in these studies is diesel fuel.
- The Georgia Tech program goal was to develop combustion CVD deposited coatings as interlayers test buttons over coated with yttria stabilized zirconia top coat. It was concluded that none of the interlayers investigated improved thermal cycling behavior of the TBC relative to industry provided control samples. Rather, decrease in thermal cycling performance was observed.

The remaining four reports were semi-annual reports generating no final project conclusions.

## **EXPERIMENTAL:**

No experimental data to include from the administration of this program. At the request of the AGTSR COR, weekly research progress reports are being sent to NETL

## **RESULTS AND DISCUSSION:**

### **Program Administration:**

- The AGTSR/ATS Quarterly Technical Report for the reporting period of October to December 2002 was submitted to NETL on February 10, 2003. This report was submitted via hard copy and disk.
- Normal administrative functions required to monitor existing AGTSR contracts continued through the reporting period.

### **Research:**

- Attachment I contains a listing of the AGTSR technical progress reports released during this reporting period.
- Attachment II shows that 8 AGTSR research contracts are still being completed. Of these 8, only 3 research projects are continuing “research” and expected to close by May, two projects (SR074 and SR076) are closed but delinquent in reporting. The PI and contracting office at the respective universities have been contacted numerous times. The remaining projects are closed and we expect final reports.

### **AGTSR Financial Status:**

- Attachment III is the SF269A form submitted to NETL. AGTSR has combined these financial figures with the needs of the continuing research programs and summarized this information on Attachment IV. As of the end of this report quarter, AGTSR now projects that approximately 329K\$ of DOE obligations to AGTSR will be unspent.

SCIES will continue to monitor AGTSR expenditures closely and continue exploring with the AGTSR potential mechanisms to use the unspent AGTSR \$’s for advanced power systems purposes.

Ideas that have surfaced for use of these funds (if available include):

1. provide funding for SCIES proposal addressing research needs for turbine flow path protection for use of syngas and other alternate fuels
2. provide funding for the Louisiana Department of Natural Resources proposal "Improving Energy Efficiency and Emissions for Gas/Oil Refinery, and Petrochemical Industries Utilizing High Efficiency Engines and Turbines"
3. provide funding to support the increase in number of student Fellowships beyond the 15 planned for the UTSR budget.

### **CONCLUSIONS:**

The AGTSR program is now scheduled for completion on June 30, 2003. It is anticipated that all subcontracts with ongoing research will complete their work on time. AGTSR will continue to contact the two delinquent PI's and their contracts office. Urgency will be stressed. Otherwise, this quarter ended with continued success in the administration of the Advanced Gas Turbine Systems Research Program. At the request of the AGTSR COR, weekly research progress reports are being sent to NETL. Individual conclusions on those projects are included at that time.

### **REFERENCES:**

All references to specific projects are included at the end of each project's specific progress report. At the request of the AGTSR COR, weekly research progress reports are being sent to NETL. Individual reference listings on those projects are included at that time.

ATTACHMENT I

## Progress Reports Received

January 1 — March 31, 2003

<b>Aero-Heat Transfer</b>	University of Central Florida <b>FINAL REPORT</b> Subcontract #99-01-SR080 <b>PAPER COPY ONLY</b>	Tip Clearance Heat Transfer and Desensitization in High Pressure Turbines  <i>PI – Jay Kapat</i>
<b>Aero-Heat Transfer</b>	Texas A&M University <b>FINAL REPORT</b> Subcontract #00-01-SR082 <b>LINK TO REPORT</b>	Rotating and Stationary Rectangular Cooling Passage Heat Transfer and Friction with Ribs, Pins and Dimples <i>PI – J. C. Han</i>
<b>Aero-Heat Transfer</b>	University of North Dakota <b>Semi-Annual Report</b> 6/02—12/02 Subcontract #00-01-SR086 <b>LINK TO REPORT</b>	Characterization of Catalytic Combustor Turbulence and its Influence on Vane and Endwall Heat Transfer and Endwall Film Cooling <i>PI – Forrest Ames</i>
<b>Combustion</b>	University of California, Irvine <b>FINAL REPORT</b> Subcontract #00-01-SR084cs <b>LINK TO REPORT</b>	Correlation of Ignition Delay With Fuel Composition and State for Application to Gas Turbine Combustion <i>PI – Scott Samuelson</i>
<b>Combustion</b>	University of Washington <b>FINAL REPORT</b> Subcontract #00-01-SR087 <b>LINK TO REPORT</b>	The Staged Prevaporizing-Premixing Injector: High Pressure Evaluation  <i>PI – Philip Malte</i>
<b>Materials</b>	Georgia Tech <b>FINAL REPORT</b> Subcontract #98-01-SR066 <b>PAPER COPY ONLY</b>	Improvements in Thermal Barrier Coatings Durability Via Combustion Chemical Vapor Deposition <i>PI – W. B. Carter</i>
<b>Materials</b>	UCONN <b>Semi-Annual Report</b> 2/1/02—7/31/02 Subcontract #00-01-SR081 <b>LINK TO REPORT</b>	Advanced Thermal Barrier Coatings for Industrial Gas Turbine Engines  <i>PI – Nitin Padture, Maurice Gell</i>
<b>Materials</b>	UCONN <b>Semi-Annual Report</b> 7/1/02—2/28/03 Subcontract #01-01-SR091 <b>LINK TO REPORT</b>	Thermal Barrier Coatings and Metallic Coatings with Improved Durability  <i>PI – Maurice Gell, Eric Jordan</i>
<b>Materials</b>	University of California, Santa Barbara <b>Semi-Annual Report</b> 2/1/02—9/31/02 Subcontract #01-01-SR093 <b>LINK TO REPORT</b>	A Science Based Approach to Enhanced Zirconia-Based Thermal Barrier Coatings for Advanced Gas Turbine Applications <i>PI – D. Clarke, C. Levi, A. Evans</i>

**1-Apr-03**  
**Financial Status of AGTSR Subcontracts**  
**RFP93, RFP94, RFP95, RFP6, 97 Interns,**  
**RFP97, RFP98, RFP99, RFP00**

**ATTACHMENT II**

				a	b		c	d	e	
	Institution	Term in years	End Date	Requested AGTSR Funding	Obligated to Date	Expenditures to:		a-c Balance	b-c Balance	
<b>RFP93</b>										
c	SR007	Cal-Berkeley	3	3/31/97	\$518.20	\$518.20	3/97f	\$518.20	\$0.00	\$0.00
c	SR008	Vanderbilt	3	12/31/96	\$862.60	\$862.60	12/96f	\$862.60	\$0.00	\$0.00
c	SR009	Purdue	3	2/27/97	\$801.69	\$801.69	2/97f	\$801.69	\$0.00	\$0.00
c	SR010	Lehigh	3	12/31/96	\$748.39	\$748.39	12/96f	\$748.39	\$0.00	\$0.00
c	SR011	Texas A&M	3	2/28/97	\$585.88	\$585.88	2/97f	\$585.88	\$0.00	\$0.00
c	SR012	Penn State	3	12/31/96	\$628.81	\$628.81	12/97f	\$628.81	\$0.00	\$0.00
c	SR013	Virginia Tech*	3	3/31/97	\$462.01	\$462.01	3/97f	\$462.01	\$0.00	\$0.00
c	SR014	Brigham Young	4	12/31/97	\$1,040.99	\$1,040.99	12/97f	\$1,040.99	\$0.00	\$0.00
c	SR015	LSU	3	2/28/97	\$478.18	\$478.18	2/97f	\$478.18	\$0.00	\$0.00
c	SR016	Clarkson	2	3/31/96	\$522.80	\$522.80	3/96f	\$522.80	\$0.00	\$0.00
		<b>Subtotal</b>			<b>\$6,649.55</b>	<b>\$6,649.55</b>		<b>\$6,649.55</b>	<b>\$0.00</b>	<b>\$0.00</b>
<b>RFP94</b>										
c	SR017	MIT	1	8/31/95	\$156.46	\$156.46	7/95f	\$156.46	\$0.00	\$0.00
c	SR018	Cornell	2	8/31/96	\$165.70	\$165.70	8/96f	\$165.70	\$0.00	\$0.00
c	SR019	Purdue	3	2/28/98	\$675.69	\$675.69	4/98f	\$675.69	\$0.00	\$0.00
c	SR020	Cal-Irvine	3	03/31/98	\$529.47	\$529.47	3/98f	\$529.47	\$0.00	\$0.00
c	SR021	Minnesota	3	12/31/97	\$670.27	\$670.27	12/97f	\$670.27	\$0.00	\$0.00
c	SR022	Central Fla	1	8/18/95	\$73.84	\$73.84	8/95f	\$73.84	\$0.00	\$0.00
c	SR023	Carnegie Mellon	3	8/31/97	\$537.37	\$537.37	7/97f	\$537.37	\$0.00	\$0.00
c	SR024	Clemson	3	8/31/97	\$601.19	\$601.19	8/97f	\$601.19	\$0.00	\$0.00
c	SR025	Wyoming	1	7/15/95	\$69.26	\$69.26	7/95f	\$69.26	\$0.00	\$0.00
c	SR026	Michigan State	1	8/31/95	\$178.42	\$178.42	7/95f	\$178.42	\$0.00	\$0.00
c	SR027	Georgia Tech	3	4/15/98	\$432.48	\$432.48	4/98f	\$432.48	\$0.00	\$0.00
c	SR028	Maryland	3	4/16/98	\$573.14	\$573.14	4/98f	\$573.14	\$0.00	\$0.00
c	SR029	Oklahoma	2	6/30/97	\$297.71	\$297.71	6/97f	\$297.71	\$0.00	\$0.00
		<b>Subtotal</b>			<b>\$4,961.00</b>	<b>\$4,961.00</b>		<b>\$4,961.00</b>	<b>\$0.00</b>	<b>\$0.00</b>
<b>RFP95</b>										
c	SR030	Conn	3.5	2/28/99	\$500.00	\$500.00	2/99f	\$500.00	\$0.00	\$0.00
c	SR031	Georgia Tech	3	8/31/98	\$571.52	\$571.52	8/98f	\$571.52	\$0.00	\$0.00
c	SR032	Penn State	3	2/28/99	\$600.63	\$600.63	1/99f	\$600.63	\$0.00	\$0.00
c	SR033	Arizona State	4	1/31/00	\$327.70	\$327.70	1/00f	\$327.70	\$0.00	\$0.00
c	SR034	Clemson	4	2/29/00	\$538.04	\$538.04	2/00f	\$538.04	\$0.00	\$0.00
c	SR035	Conn	1	5/22/97	\$88.48	\$88.48	5/97f	\$88.48	\$0.00	\$0.00
c	SR036	Penn State	3	09/30/00	\$450.00	\$450.00	9/00f	\$450.00	\$0.00	\$0.00
c	SR037	Syracuse	2	2/28/98	\$170.97	\$170.97	2/98f	\$170.97	\$0.00	\$0.00
c	SR038	MIT	1	8/31/96	\$151.79	\$151.79	8/96f	\$151.79	\$0.00	\$0.00
c	SR039	Central Fla	2	3/31/98	\$178.21	\$178.21	3/98f	\$178.21	\$0.00	\$0.00
c	SR040	Michigan State	1	12/31/96	\$140.00	\$140.00	12/96f	\$140.00	\$0.00	\$0.00
c	SR041	Wyoming	0.25	8/31/96	\$5.50	\$5.50	10/96f	\$5.50	\$0.00	\$0.00
		<b>Subtotal</b>			<b>\$3,722.84</b>	<b>\$3,722.84</b>		<b>\$3,722.84</b>	<b>\$0.00</b>	<b>\$0.00</b>
<b>RFP96</b>										
c	SR042	Cleveland State	3	12/12/00	\$313.68	\$313.68	12/00f	\$311.23	\$2.45	\$2.45
c	SR043	Wisconsin	3	6/12/00	\$370.56	\$370.56	6/00f	\$370.56	\$0.00	\$0.00
c	SR044	Purdue	2	5/12/00	\$204.07	\$204.07	5/00f	\$204.07	\$0.00	\$0.00
c	SR045	MIT	3	12/15/00	\$276.98	\$276.98	12/00f	\$276.11	\$0.87	\$0.87
c	SR046	Pittsburgh	3	6/12/00	\$500.10	\$500.10	6/00f	\$500.10	\$0.00	\$0.00
c	SR047	Northwestern	4	6/12/01	\$545.01	\$545.01	03/01f	\$545.01	\$0.00	\$0.00
T	SR048	California/Davis	3	06/12/98	\$17.98	\$17.98	1/98f	\$17.98	\$0.00	\$0.00
c	SR049	Cornell	3	06/12/00	\$594.22	\$594.22	6/00f	\$594.22	\$0.00	\$0.00
c	SR050	Penn State	3	6/12/00	\$317.81	\$317.81	8/99f	\$317.81	\$0.00	\$0.00
		<b>Subtotal</b>			<b>\$3,140.41</b>	<b>\$3,140.41</b>		<b>\$3,137.09</b>	<b>\$3.32</b>	<b>\$3.32</b>
<b>1997 issued(interns &amp; add-on)</b>										
c	SR051	Univ of Buffalo		8/31/97	\$5.50	\$5.50	8/97f	\$5.50	\$0.00	\$0.00
c	SR052	USC		8/31/97	\$5.53	\$5.53	7/97f	\$5.52	\$0.01	\$0.01
c	SR053	Univ of Washing		9/15/97	\$6.65	\$6.65	9/97f	\$6.65	\$0.00	\$0.00
c	SR054	Purdue		8/31/97	\$5.50	\$5.50	8/97f	\$5.50	\$0.00	\$0.00
c	SR055	Univ of Arkansas		8/15/97	\$6.91	\$6.91	8/97f	\$6.91	\$0.00	\$0.00
c	SR056	Clarkson		12/31/98	\$10.46	\$10.46	11/98f	\$10.46	\$0.00	\$0.00
c	SR057	Univ of Cen Flor		8/31/97	\$5.50	\$5.50	8/97f	\$5.50	\$0.00	\$0.00
c	SR058	Michigan State		8/31/97	\$6.44	\$6.44	8/97f	\$6.44	\$0.00	\$0.00

c	SR059	Univ of Cal-Berk		8/31/97	\$8.25	\$8.25	8/97f	\$8.25	\$0.00	\$0.00
c	SR060	Virginia Polytech		8/31/97	\$11.00	\$11.00	8/97f	\$10.10	\$0.90	\$0.90
c	SR061	Cal-Berkeley		12/31/97	\$30.04	\$30.04	12/97f	\$30.04	\$0.00	\$0.00
		<b>Subtotal</b>			<b>\$101.78</b>	<b>\$101.78</b>		<b>\$100.87</b>	<b>\$0.91</b>	<b>\$0.91</b>
		<b>1998(RFP97)</b>								
c	SR062	Cal-Irvine	3	12/31/01	\$449.94	\$449.94	9/00f	\$449.94	\$0.00	\$0.00
c	SR063	CIT	3	06/30/01	\$390.20	\$390.20	06/01f	\$390.20	\$0.00	\$0.00
c	SR064	Purdue	2	07/31/00	\$159.81	\$159.81	7/00f	\$158.23	\$1.58	\$1.58
c	SR065	VPI	3	08/30/01	\$603.39	\$603.39	08/02f	\$603.09	\$0.30	\$0.30
c	SR066	Ga Tech	3	07/31/02	\$441.00	\$441.00	07/02f	\$433.99	\$7.01	\$7.01
c	SR067	U Central FL	2	06/30/00	\$198.62	\$198.62	6/00f	\$198.62	\$0.00	\$0.00
c	SR068	Cal-Santa Barba	3	01/31/01	\$599.94	\$599.94	12/00f	\$599.12	\$0.82	\$0.82
c	SR069	Purdue	3	07/31/01	\$427.94	\$427.94	07/01f	\$408.35	\$19.59	\$19.59
t	SR070	Car Mellon	3	01/31/00	\$374.44	\$374.44	1/00f	\$359.11	\$15.33	\$15.33
c	SR071	Minn	3	07/31/01	\$600.00	\$600.00	07/01f	\$600.00	\$0.00	\$0.00
c	SR072	CIT(faculty spec)	1	08/31/99	\$25.00	\$25.00	8/99f	\$25.00	\$0.00	\$0.00
c	SR088	U Pittsburgh	1	07/31/01	\$185.53	\$185.53	07/01f	\$185.53	\$0.00	\$0.00
	see SR070	<b>Subtotal</b>			<b>\$4,455.81</b>	<b>\$4,455.81</b>		<b>\$4,411.18</b>	<b>\$44.63</b>	<b>\$44.63</b>
		<b>1999(RFP98)</b>								
c	SR073	Univ of Conn	3	01/31/02	\$448.66	\$448.66	01/02f	\$432.16	\$16.50	\$16.50
	SR074	UCBerkeley	3	11/30/02	\$195.00	\$195.00	May-02	\$175.54	\$19.46	\$19.46
c	SR075	GaTech	3	07/31/02	\$449.98	\$449.98	01/02f	\$449.98	\$0.00	\$0.00
	SR076	Miss State Univ	3	02/28/02	\$321.37	\$321.37	Jan-02	\$319.92	\$1.45	\$1.45
c	SR077	Univ Pittsburgh	3	07/31/02	\$430.64	\$430.64	07/02f	\$430.64	\$0.00	\$0.00
c	SR078	PennStateUniv	3	03/31/02	\$452.82	\$452.82	03/02f	\$452.09	\$0.73	\$0.73
c	SR079	PennStateUniv	2	12/30/01	\$427.25	\$427.25	10/01f	\$427.14	\$0.11	\$0.11
c	SR080	Univ Central Fl	3	01/31/01	\$240.00	\$79.90	01/01f	\$75.11	\$164.89	\$4.79
		<b>subtotal</b>			<b>\$2,965.72</b>	<b>\$2,805.62</b>		<b>\$2,762.58</b>	<b>\$203.14</b>	<b>\$43.04</b>
		<b>2000(RFP99)</b>								
c	SR081	U Conn	3	01/31/03	\$335.09	\$335.09	09/02f	\$252.72	\$82.37	\$82.37
c	SR082CS	TEES	2	08/31/02	\$238.63	\$238.63	08/02f	\$238.42	\$0.21	\$0.21
c	SR083	Virginia	2	07/31/02	\$189.64	\$189.64	07/02f	\$189.64	\$0.00	\$0.00
c	SR084CS	UCI	2	09/30/02	\$135.94	\$135.94	07/02f	\$135.94	\$0.00	\$0.00
	SR085CS	Purdue	2	02/28/03	\$167.39	\$167.39	Nov-02	\$154.63	\$12.76	\$12.76
	SR086	N. Dakota	3	05/31/03	\$193.16	\$193.16	Jan-03	\$190.40	\$2.76	\$2.76
c	SR087	Washington	2	05/31/02	\$104.31	\$104.31	04/02f	\$102.86	\$1.45	\$1.45
		<b>subtotal</b>			<b>\$1,364.16</b>	<b>\$1,364.16</b>		<b>\$1,264.61</b>	<b>\$99.55</b>	<b>\$99.55</b>
		<b>2001 (RFP00)</b>								
	SR089	LSU	2	02/28/03	\$171.74	\$171.74	Jan-03	\$168.33	\$3.41	\$3.41
c	SR090	Penn State	2	07/31/02	\$192.87	\$192.87	Jul-02	\$172.47	\$20.40	\$20.40
	SR091	U Conn	2	05/01/03	\$263.76	\$263.76	Dec-02	\$152.63	\$111.13	\$111.13
	SR092	U Texas at Austi	2	05/31/03	\$242.70	\$242.70	Dec-02	\$238.27	\$4.43	\$4.43
c	SR093	UCSB	2	01/31/03	\$299.68	\$299.68	07/02f	\$299.68	\$0.00	\$0.00
c	SR094	TEES	2.5	02/28/03	\$141.40	\$141.40	Dec-02	\$141.36	\$0.04	\$0.04
		<b>subtotal</b>			<b>\$1,312.15</b>	<b>\$1,312.15</b>		<b>\$1,172.74</b>	<b>\$139.41</b>	<b>\$139.41</b>
		<b>GRAND TOTAL ALL</b>			<b>\$28,673.42</b>	<b>\$28,513.32</b>		<b>\$28,182.46</b>	<b>\$490.96</b>	<b>\$330.86</b>
		<b>DOE pay</b>			\$28,131.46	\$27,971.36		\$27,653.47	\$477.99	\$317.89
		<b>IRB pay</b>			\$541.96	\$541.96		\$528.99	\$12.97	\$12.97

\* refund rec'd 12/9/99

Notes: These were not research awards: SR041, SR051-SR060, SR072

Total portion of these funds that was for interns: \$91.74

Total portion of these funds that was for faculty fellows: \$25k

# ATTACHMENT III--FINANCIAL STATUS REPORT

(Short Form)

(Follow Instructions on the back)

1. Federal Agency and Organizational Element to Which Report is Submitted U.S. DEPT. OF ENERGY MORGANTOWN, WV 26507-0880		2. Federal Grant or Other Identifying Number Assigned By Federal Agency DE-FC21-92MC29061		OMB Approval No 0348-0039	Page 	of   pages
3. Recipient Organization (Name and complete address, including ZIP Code)  Clemson University Research Foundation PO Box 946 Clemson, S.C. 29633-0946						
4. Employer Identification Number  57-0750000		5. Recipient Account Number or Identifying Number  3-34-7237    219-2000258		6. Final Report <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		7. Basis <input type="checkbox"/> Cash <input checked="" type="checkbox"/> Accrual
8. Funding/Grant Period (See Instructions) From: (Month, Day, Year)  10/15/92		To: (Month, Day, Year)  06/30/03	9. Period Covered by this Report From: (Month, Day, Year)  01/01/03		To: (Month, Day, Year)  03/31/03	
10. Transactions:			I Previously Reported	II This Period	III Cumulative	
a. Total outlays			33,550,374.21	425,157.56	33,975,531.77	
b. Recipient share of outlays			365,465.28	1,847.35	367,312.63	
c. Federal share of outlays			33,184,908.93	423,310.21	33,608,219.14	
d. Total unliquidated obligations					562,579.86	
a. Recipient share of unliquidated obligations					0.00	
f. Federal share of unliquidated obligations					562,579.86	
g. Total Federal share (Sum of lines c and f)					34,170,799.00	
In. Total Federal funds authorized for this funding period					34,170,799.00	
i. Unobligated balance of Federal funds (Line h minus line g)					0.00	
11. Indirect Expense	a. Type of Rate (Place "X" in appropriate box) <input type="checkbox"/> Provisional <input checked="" type="checkbox"/> Predetermined <input type="checkbox"/> Final <input type="checkbox"/> Fixed					
	b. Rate DHHS 44%/46%		c. Base 31,203,624.86		d. Total 2,404,594.28	a. Federal 2,404,594.28
12. Remarks: Attach any explanations deemed necessary or information required by Federal sponsoring agency in compliance with governing legislation.						
13. Certification: I certify to the best of my knowledge and belief that this report is correct and complete and that all outlays and unliquidated obligations are for the purposes set forth in the award documents.						
Typed or Printed Name and Title Roberta H. Elrod, Grants & Contracts Manager Sponsored Programs Accounting & Administration				Telephone (Area code, number and extension)  (864) 656-6151		
Signature of Authorized Certifying Official 				Date Report Submitted  May 06, 2003		

ATTACHMENT IV

**ATS2003 Closeout  
DOE Cooperative Agreement  
DE-FC21-92MC29061**

As of 3/31/03				final due - invoices held			
ATS has				final invoice not yet rec'd			
562,579.86							
	now on hold	now processing	remnng obligtd \$'s	April	May	June	
2000258				10,000.00	10,000.00	10,000.00	
(Adm indirect .204)				2,040.00	2,040.00	2,040.00	
CUTotal				12,040.00	12,040.00	12,040.00	
All remaining subcontracts							
SR066closed	0.00	0	0.00				
SR074ended	19,456.57	0.00	0.00				
SR075closed	0.00	0.00	0.00				
SR076ended	1,442.64	0.00	9.02				
SR077closed	0.00	0.00	0.00				
SR080 closed	0.00	0.00	0.00				
SR081ended	0.00	0.00	51,048.97				
SR082closed	0.00	327.45	0.00				
SR083closed	0.00	0.00	0.00				
SR085ended	16,806.42	0.00	254.14				
SR086	0.00	0.00	1,470.79	1,289.17			
SR087closed	0.00	0.00	0.00	1,450.99			
SR089ended	0.00	0.00	3,406.09				
SR090closed	0.00	0.00	0.00				
SR091	0.00	0.00	86,134.44				
SR092	0.00	0.00	3,222.60	827.20	376.76		
SR093closed	0.00	0.00	0.00				
SR094closed	0.00	0.00	34.86				
Other				316.59	65.00	65.00	
Total CURF Directs	37,705.63	327.45	145,580.91	3,883.95	441.76	65.00	
CURF INDIRECT (.256 CU & .46 CURF)	0.00	0.00	0.00	3,082.24	3,082.24	3,082.24	
<b>Total from DOE</b>	<b>37,705.63</b>	<b>327.45</b>	<b>145,580.91</b>	<b>19,006.19</b>	<b>15,564.00</b>	<b>15,187.24</b>	
On hold awaiting technical reports due			<b>183,613.99</b>			<b>49,757.43</b>	
Will process in 1st Quarter, but has not shown up in system as of yet				Total of all possible spending through 06/03		<b>233,371.42</b>	
Funds which are obligated and could still be claimed for reimbursement				Remaining unspent DOE obligation		329,208.44	