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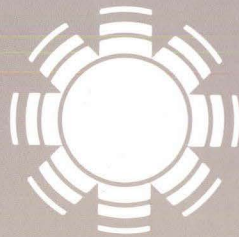
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**Wind Energy Systems
Quarterly Review**

GOLDEN, COLORADO 80401

July 1, 1979 - September 30, 1979

Prepared for the
U.S. Department of Energy
Division of Solar Technology
Under Contract No. EG-77-C-01-4042



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Solar Energy Research Institute

1536 Cole Boulevard
Golden, Colorado 80401

A Division of Midwest Research Institute

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SERI/PR-351-480

WIND ENERGY SYSTEMS
QUARTERLY REVIEW
JULY 1, 1979-SEPTEMBER 30, 1979

NOVEMBER 16, 1979

SOLAR ENERGY RESEARCH INSTITUTE
1536 COLE BOULEVARD
GOLDEN, COLORADO 80401
A DIVISION OF MIDWEST RESEARCH INSTITUTE

PREPARED FOR THE
U.S. DEPARTMENT OF ENERGY
DIVISION OF SOLAR TECHNOLOGY
UNDER CONTRACT No. EG-77-C-01-4042

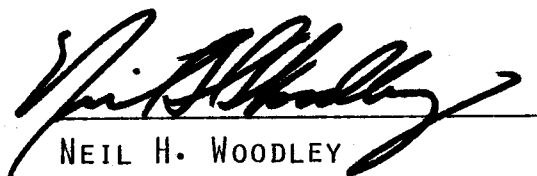
FOREWORD

THE QUARTERLY REVIEW FOR THE WIND ENERGY SYSTEMS (WES) PROGRAM IS A VISUAL PRESENTATION PREPARED BY THE SOLAR ENERGY RESEARCH INSTITUTE (SERI) AS AN OVERVIEW OF THE EFFORTS IN THE PROGRAM. THIS QUARTERLY REVIEW IS DELIVERED TO FULFILL SERI'S ANNUAL OPERATING PLAN (AOP) REPORTING REQUIREMENTS. THE REVIEW PRESENTS THE OBJECTIVES, ACCOMPLISHMENTS, ACTIVITIES, AND OUTPUTS OF EACH OF THE TASKS IN THE WES PROGRAM.

DISTRIBUTION OF THIS REPORT IS LIMITED TO THOSE DIRECTLY INVOLVED IN THIS PROJECT AS DEFINED BY DOE. THE REVIEW IS PREPARED FOR DOE BY THE STAFF OF THE SOLAR ENERGY RESEARCH INSTITUTE, A DIVISION OF THE MIDWEST RESEARCH INSTITUTE (MRI) UNDER CONTRACT No. EG-77-C-01-4042.

REPORT No. SERI/PR-351-480
DATE: NOVEMBER 1979
PROGRAM: WIND ENERGY SYSTEMS
TASK: 3531.10
CONTRACT: EG-77-C-01-4042
START DATE: OCTOBER 1978
COMPLETION DATE: CONTINUOUS
CONTRACTOR: SOLAR ENERGY RESEARCH INSTITUTE
1536 COLE BOULEVARD
GOLDEN, COLORADO 80401

APPROVED FOR:
SOLAR ENERGY RESEARCH INSTITUTE



NEIL H. WOODLEY
BRANCH CHIEF
SYSTEMS ANALYSIS



IRWIN E. VAS
PROGRAM COORDINATOR

AGENDA

PR-480
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PROGRAM OVERVIEW

IRWIN E. VAS

A TOTAL OF ELEVEN TASKS ARE CURRENTLY IDENTIFIED IN THE WIND ENERGY SYSTEM PROGRAM AREA 3.

THREE ADDITIONAL WIND ENERGY RELATED TASKS ARE CARRIED OUT IN OTHER PROGRAM AREAS.

NOVEMBER 16, 1979

WIND ENERGY RELATED TASKS

WIND ENERGY INNOVATIVE SYSTEMS	I. E. VAS
COST ESTIMATING AND ENGINEERING ANALYSIS OF INNOVATIVE WECS	R. McCONNELL
UTILITY ANALYTICAL MODELING	D. PERCIVAL
ECONOMICS OF SWECS TIED TO UTILITIES	M. EDESESS
LIABILITY ASSOCIATED WITH SWECS	R. NOUN
ENVIRONMENTAL IMPACT ASSESSEMENT OF SWECS	K. LAWRENCE
SELECTED UTILITIES VALUE ANALYSIS	G. FEGAN
TELEVISION INTERFERENCE AND WECS	R. McCONNELL
NOISE MEASUREMENTS AT SELECTED WIND SYSTEM SITES	R. McCONNELL

A COMPREHENSIVE GUIDE: WECS CONNECTED
TO ELECTRIC UTILITIES

R. TAYLOR

PLANNING

I. E. VAS

WIND RESOURCE ANALYSIS^A

R. HULSTROM

TECHNICAL INFORMATION DISSEMINATION^B

P. WEIS

SOLAR COST DATA BANK^C

J. LAVENDER

^ABASIC AND APPLIED RESEARCH - PROGRAM AREA 14

^BCOMMERCIALIZATION ACTIVITIES - PROGRAM AREA 18

^CSOLAR COST DATA BANK - PROGRAM AREA 10

WIND ENERGY INNOVATIVE SYSTEMS
IRWIN VAS

OBJECTIVE

DETERMINE TECHNICAL AND ECONOMIC FEASIBILITY OF INNOVATIVE WIND ENERGY SYSTEMS.

ACCOMPLISHMENTS

COMPLETED TECHNICAL REVIEWS OF ONE UNSOLICITED PROPOSAL "NICOLAIDES PARAFOIL" FROM PROFESSOR HAFEMEISTER.

AWARDED A CONTRACT TO MARKS POLARIZED CORPORATION FOR FOLLOW-ON WORK IN "RESEARCH ON ELECTROFLUID DYNAMIC AEROSOL CHARGING DEVICES" FOR \$64K.

SUBMITTED TO TIC FY78 FINAL REPORTS BY

WEST VIRGINIA UNIVERSITY
(SUBCONTRACT CONTINUING)

VERTICAL AXIS WIND TURBINE DEVELOPMENT

SOUTH DAKOTA SCHOOL OF MINES
AND TECHNOLOGY
(SUBCONTRACT CONTINUING)

ENERGY FROM HUMID AIR

UNIVERSITY OF DAYTON RESEARCH
INSTITUTE
(NO FURTHER CONTRACT EFFORT
PLANNED)

AN ANALYSIS OF THE MADARAS ROTOR POWER
PLANT

NOVEMBER 16, 1979

AWARDED THREE CONTRACTS IN RESPONSE TO RFP-9-8085 "ADVANCED AND INNOVATIVE WIND ENERGY CONCEPT DEVELOPMENT"

AEROVIRONMENT, INC.	DYNAMIC INDUCER	\$121.8K
UNITED TECHNOLOGIES RESEARCH CENTER	OSCILLATING VANE	\$119.9K
WASHINGTON UNIVERSITY TECHNOLOGY ASSOCIATES	YAWING WITH BLADE CYCLIC PITCH	\$106.3K

PLANNED ACTIVITIES

COMPLETE SUBTASK DESCRIPTION FOR THE PROGRAM DEVELOPMENT PLAN.
PREPARE WORK STATEMENTS FOR ASSESSMENT STUDIES OF INNOVATIVE CONCEPTS.
CONDUCT DETAILED REVIEW OF THE DAWT AND TORNADO PROJECTS.
PREPARE A PAPER FOR WIND WORKSHOP IV.
REVIEW UNSOLICITED PROPOSALS.
COMPLETE THE PROCEEDINGS FOR THE WEIS CONFERENCE. (COMPLETE DECEMBER 1979)
REVIEW TWO SUBCONTRACTOR DRAFT FINAL REPORTS.

OUTPUT

DEVELOPMENT OF ADVANCED WIND SYSTEMS THAT HAVE THE POTENTIAL OF BEING COST
COMPETITIVE WITH CONVENTIONAL SYSTEMS

TECHNICAL REPORTS ON THE INNOVATIVE R&D STUDIES

TECHNICAL AND PROGRAMMATIC SUPPORT OF THE FEDERAL WIND ENERGY PROGRAM

BUDGET FOR FY79

TRANSFER FROM FY78

EXPENDITURES

\$160K

\$466K

INITIAL \$724K

COMMITMENTS

REPROGRAMMED \$754K

\$465K

NOVEMBER 16, 1979

COST ESTIMATING AND ENGINEERING ANALYSIS OF INNOVATIVE WECS

ROBERT McCONNELL

OBJECTIVE

ESTABLISH COSTING METHODOLOGIES SUITABLE FOR INNOVATIVE WECS (IWECS) IN THEIR CONCEPTUAL, DEVELOPMENTAL, AND PRODUCTION PHASES TO ESTIMATE THEIR COST OF ENERGY.

ACCOMPLISHMENTS

COMPLETED FINAL REPORT ENTITLED "A GENERAL RELIABILITY AND SAFETY METHODOLOGY AND ITS APPLICATION TO WIND ENERGY CONVERSION SYSTEMS," SERI/TR-35-234.

RECEIVED FROM SAI FINAL VERSION OF MANUSCRIPT ENTITLED "SCREENING METHODOLOGY FOR INNOVATIVE WIND SYSTEMS." [NOT FOR PUBLIC DISSEMINATION]

DEVELOPED A REVISED SCREENING METHODOLOGY TO MEET TASK OBJECTIVE UTILIZING SAI STUDY AS A BASIS.

NOVEMBER 16, 1979

PLANNED ACTIVITIES

PREPARE REVISED WORK STATEMENT FOR DEVELOPMENT COSTING METHODOLOGY.

PREPARE PAPER ENTITLED "A SCREENING METHODOLOGY FOR WIND ENERGY CONVERSION SYSTEMS" FOR THE ISES ANNUAL MEETING IN JUNE 1980.

CONTINUE STUDIES ON DEVELOPMENT COSTING METHODOLOGIES.

SUPPORT WEIS TASK ON REVIEW OF THE DAWT AND TORNADO PROJECTS.

OUTPUT

A METHODOLOGY FOR EVALUATING RELIABILITY AND SAFETY OF AN INNOVATIVE WECS AND ITS ASSOCIATED OPERATION AND MAINTENANCE COSTS.

A METHODOLOGY FOR SCREENING INNOVATIVE WECS IN THEIR CONCEPT PHASE.

AN ESTIMATING TECHNIQUE FOR DEVELOPMENT COSTS OF INNOVATIVE WECS.

BUDGET FOR FY79

INITIAL \$124K

REPROGRAMMED \$174K

EXPENDITURES

\$162K

COST PLUS COMMITMENT.

UTILITY ANALYTICAL MODELING
DAVID PERCIVAL

OBJECTIVE

ESTABLISH THE CAPABILITY TO REPRESENT WIND-DERIVED GENERATION IN ELECTRIC UTILITY GENERATION PLANNING MODELS SO THAT THE ECONOMIC VALUE OF THE WECS OPTION MAY BE EXAMINED.

APPROACH

PROCURE ESTABLISHED UTILITY GENERATION PLANNING MODELS.

DEVELOP METHODOLOGY FOR WECS REPRESENTATION AND INTEGRATE IT INTO THE UTILITY MODELS.

NOVEMBER 16, 1979

ACCOMPLISHMENTS

UTILITY MODELS:

SUBMITTED PAPER ENTITLED "INTEGRATION OF INTERMITTENT RESOURCES INTO BALERIAUX-BOOTH PRODUCTION COST MODELS" TO IEEE.

COMPLETED PROCUREMENT OF PROMOD.

WECS REPRESENTATIONS:

SELECTED STONE AND WEBSTER MODELS TO BUILD UPON WEATHER TAPE PREPROCESSOR (WTP) AND RUN OF THE SUN POWER AVAILABILITY MODULE (ROSPAM).

MADE WIND SPEED AND POWER REFINEMENTS AS DEVELOPED BY JUSTUS TO ROSPAM.

COMMENCED IMPLEMENTATION OF A PROGRAM TO DEVELOP WEIBULL PARAMETERS FROM HISTORICAL WEATHER DATA BASED AROUND WTP.

NOVEMBER 16, 1979

PLANNED ACTIVITIES

COMMENCE TRAINING ON PROMOD.

COMPLETE PROGRAM TO CALCULATE WEIBULL PARAMETERS.

REVISE ROSPAM TO ACCEPT WEIBULL PARAMETERS INSTEAD OF RAW WEATHER DATA.

DEVELOP A PROGRAM TO PRODUCE RESIDUAL HOURLY UTILITY LOADS UTILIZING RESULTS OF REVISED ROSPAM.

OUTPUT

REPORT ON UTILITY PRODUCTION COST MODEL EVALUATIONS.

REPORT ON METHODOLOGY AND USERS MANUAL FOR THE WECS REPRESENTATION.

UTILITY PLANNING MODELS INCORPORATING WECS SUCH THAT DOE/SERI STUDIES MAY BE PERFORMED.

PLANNED COMPLETION: APRIL 1980

BUDGET

EXPENDITURE

INITIAL \$145K

\$105K

ECONOMICS OF WECS TIED TO THE UTILITY GRID
MICHAEL EDESESS

PR-480
NOVEMBER 16, 1979

OBJECTIVE

INVESTIGATE THE ECONOMICS OF USER-OWNED, ON-SITE WECS WITH UTILITY BACK-UP.

ACCOMPLISHMENTS

CONSTRUCTED METHOD FOR ASSESSING THE RATE OF RETURN ON INVESTMENT FOR ON-SITE WECS, CONSIDERING UTILITY BACK-UP AND BUY-BACK RATES, WIND REGIME, LOAD PROFILE AND RELATIVE WECS FINANCIAL RISK COMPARED WITH RISK OF TOTAL DEPENDENCE ON UTILITY FOR POWER.

PLANNED ACTIVITIES

COMPLETE DRAFT REPORT DESCRIBING METHOD FOR ASSESSING THE ECONOMICS OF ON-SITE WECS, AND ANALYZING ON-SITE WECS ECONOMIC ATTRACTIVENESS IN NEAR AND INTERMEDIATE TERMS.

OUTPUT

DRAFT REPORT AT END OF NEXT QUARTER.

BUDGET

EXPENDITURE

INITIAL \$195K
REPROGRAMMED \$120K

\$84K

PR-480
NOVEMBER 16, 1979

PRODUCTS LIABILITY ISSUES ASSOCIATED WITH SWECS

ROBERT NOUN

OBJECTIVE

PROVIDE POLICY ALTERNATIVES TO ASSURE THAT PRODUCTS LIABILITY ISSUES ASSOCIATED WITH SWECS DO NOT IMPEDE THE INCREASED USE OF SUCH SYSTEMS.

ACCOMPLISHMENTS

COMPLETED DEVELOPMENT AND ANALYSIS OF POLICY ALTERNATIVES.

CIRCULATED FOR REVIEW FINAL REPORT, NOW IN FINAL PUBLICATION STAGE.

NOVEMBER 16, 1979

PLANNED ACTIVITIES

COMPLETE FINAL REPORT SUMMARIZING LEGAL ISSUES AND PROVIDING A SET OF POLICY ALTERNATIVES.

OUTPUT

REPORT SUMMARIZING LEGAL ISSUES, POSSIBLE ALTERNATIVES FOR ADDRESSING THESE ISSUES, AND AN INTEGRATED SET OF POLICY ALTERNATIVES. THE POLICY ALTERNATIVES WILL BE USEFUL TO DOE, WIND SYSTEMS INDUSTRY, AND OTHERS INVOLVED IN WIND ENERGY.

BUDGET

INITIAL \$67K
REPROGRAMMED \$52K

EXPENDITURE

\$42K

ENVIRONMENTAL IMPACT ASSESSMENT OF SMALL WIND ENERGY CONVERSION SYSTEMS
KATHRYN LAWRENCE

OBJECTIVE

IDENTIFY AND ANALYZE THE LIFE-CYCLE ENVIRONMENTAL IMPACTS ASSOCIATED WITH DEPLOYING SMALL (LESS THAN 100 KW) UTILITY CONNECTED AND NON-UTILITY CONNECTED WECS.

ACCOMPLISHMENTS

QUANTIFIED MATERIALS NECESSARY FOR SWECS MANUFACTURE (THROUGH COORDINATING WITH ROCKY FLATS WIND SYSTEMS GROUP); ENVIRONMENTAL EMISSIONS ASSOCIATED WITH MATERIAL PROCESSING QUANTIFIED AND PRESENTED IN PROGRESS REPORT.

SUMMARIZED AND EVALUATED PREVIOUS WECS ENVIRONMENTAL RESEARCH, AND PRESENTED IN PROGRESS REPORT.

FINALIZED SURVEY ON THE AESTHETICS OF SWECS; SURVEY WAS APPROVED BY SERI'S SURVEY REVIEW COMMITTEE AND ROCKY FLATS WIND SYSTEMS GROUP; DATA COLLECTION WAS INITIATED AUGUST 31, 1979 AND WILL CONTINUE INTO NEXT QUARTER.

PLANNED ACTIVITIES

CONTACT SELECTED SWECS MANUFACTURERS TO DETERMINE IF ENVIRONMENTAL BARRIERS HAVE BEEN ENCOUNTERED.

ASSESS HEALTH AND ECOLOGICAL IMPLICATIONS OF SWECS EMISSIONS; QUANTIFY AND PRESENT IN THE DRAFT FINAL REPORT.

COMPLETE DATA COLLECTION ON THE AESTHETICS OF SWECS; ANALYZE DATA AND PRESENT RESULTS IN THE DRAFT FINAL REPORT.

PREPARE TECHNICAL PAPER ON THE AESTHETICS SURVEY METHODOLOGY AND DATA ANALYSIS.

OUTPUT

A 15 MINUTE COLOR VIDEOCASSETTE PRESENTING POTENTIAL TV INTERFERENCE BY THE BLOCK ISLAND WTG.

PROGRESS REPORT PRESENTING A SYNTHESIS AND EVALUATION OF PREVIOUS WECS ENVIRONMENTAL RESEARCH; SERI'S SURVEY ON THE AESTHETICS OF SWECS; A DESCRIPTION OF GENERIC SWECS DESIGNS FOR WHICH ENVIRONMENTAL ANALYSES WILL BE PERFORMED; AND AN OUTLINE OF PLANNED TASK ACTIVITIES.

FINAL REPORT WHICH PRESENTS AN ANALYSIS OF THE POTENTIAL HEALTH AND ECOLOGICAL EFFECTS OF SWECS FOR EACH LIFE-CYCLE PHASE (SYSTEM FABRICATION THROUGH DECOMMISSION) AND AN EVALUATION OF THE CURRENT STATUS OF ENVIRONMENTAL EFFECTS RESEARCH AND RECOMMENDATION OF ADDITIONAL RESEARCH NEEDS.

TECHNICAL PAPER WHICH PRESENTS THE RESULTS OF THE AESTHETICS SURVEY OF SWECS.

BUDGET

EXPENDITURES

INITIAL \$143K
REPROGRAMMED \$123K

\$85.2K

SELECTED UTILITIES VALUE ANALYSIS
GEORGE FEGAN

OBJECTIVE

DETERMINE THE VALUE OF WECS AT SPECIFIC SITES IN RELATIONSHIP TO SYSTEM MIX OF SELECTED UTILITIES.

ACCOMPLISHMENTS

INITIATED TASK EFFORT 4TH QUARTER FY79.
DEVELOPED WORK STATEMENT AND SUBMITTED RFP TO SELECTED SOURCES. (AEROSPACE CORP., GENERAL ELECTRIC CORP., JBF SCIENTIFIC CORP.)

PLANNED ACTIVITIES

NEGOTIATE CONTRACTS WITH POTENTIAL SUBCONTRACTORS AND COMMENCE SUBCONTRACTED EFFORT IN NEXT QUARTER.

OUTPUT

16 DRAFT REPORTS SUMMARIZING THE VALUE ANALYSIS RESULTS AND METHODOLOGY FOR EACH SITE.
A FINAL ONE-VOLUME SUMMARY OUTLING METHODOLOGY AND HIGHLIGHTING MAJOR RESULTS.

BUDGET	EXPENDITURES
TOTAL (FY79) \$500K	\$30K

NOVEMBER 16, 1979

TELEVISION INTERFERENCE AND WECS

R. McCONNELL

OBJECTIVES

MEASURE AND DOCUMENT SYSTEMATICALLY THE INTERFERENCE TO TELEVISION AND OTHER ELECTROMAGNETIC SIGNALS IN THE VICINITY OF OPERATIONAL WIND TURBINES.

DEVELOP AND VALIDATE CALCULATIONS OF TV INTERFERENCE FOR BOTH LARGE AND SMALL WIND ENERGY CONVERSION SYSTEMS.

ACCOMPLISHMENTS

INITIATED TASK EFFORT DURING THE 4TH QUARTER OF FY79.

HELD A MEETING IN ANN ARBOR, MICH. TO EXPLAIN THE TRANSFER OF TECHNICAL MANAGEMENT TO SERI FROM THE DOE WIND SYSTEMS BRANCH OF AN EXISTING DOE SUBCONTRACT GRANTED TO THE UNIVERSITY OF MICHIGAN.

PERFORMED PRELIMINARY MEASUREMENTS OF TVI AT THE MOD-1 SITE.

NOVEMBER 16, 1979

PLANNED ACTIVITIES

COMPLETE DETAILED TVI MEASUREMENTS AT THE SITE OF THE CABLE TELEVISION (CATV) ANTENNA TOWER 2 KM WEST OF THE MOD-1.

COMPLETE A DETAILED TVI FIELD SURVEY AT THE MOD-0A SITE IN BLOCK ISLAND, R.I. AND AT THE MOD-1 SITE.

OUTPUT

SYSTEMATIC TVI MEASUREMENTS AT LARGE WIND TURBINE SITES.

AN UPDATED TVI SITING HANDBOOK FOR LARGE WIND SYSTEMS.

A TVI SITING HANDBOOK SUITABLE FOR THE HOMEOWNER CONTEMPLATING THE INSTALLATION OF A SMALL WIND SYSTEM.

BUDGET

EXPENDITURES

FY79 15K (+\$97K WSB SUBCONTRACT)

\$5K

FY80: \$100K

NOVEMBER 16, 1979

NOISE MEASUREMENTS AT SELECTED WIND SYSTEM SITES
R. McCONNELL

OBJECTIVES

MEASURE AND DOCUMENT THE NOISE GENERATED BY WIND TURBINES AT SELECTED WIND SYSTEM SITES.

RELATE THE MEASUREMENTS, THEIR ANALYSIS, AND APPROPRIATE NOISE REGULATIONS IN A HANDBOOK SUITABLE FOR FUTURE SITING OF WIND TURBINES.

ACCOMPLISHMENTS

INITIATED TASK EFFORT DURING THE 4TH QUARTER OF FY79.

COLLECTED AND REVIEWED PREVIOUS DOCUMENTATION OF NOISE MEASUREMENTS AT WIND TURBINE SITES.

PREPARED AND SUBMITTED FOR REVIEW A WORK STATEMENT FOR FIELD MEASUREMENTS OF NOISE GENERATED BY WIND TURBINES.

NOVEMBER 16, 1979

PLANNED ACTIVITIES

ESTABLISH A WORK PLAN FOR PRELIMINARY MEASUREMENTS OF SOUND PRESSURE LEVELS (NOISE) AT THE MOD-1 SITE IN BOONE, N.C.

MAKE PRELIMINARY MEASUREMENTS OF SOUND PRESSURE LEVELS AT THE MOD-1 SITE. THESE MEASUREMENTS ARE TO BE MADE BY SERI'S MEASUREMENT DESIGN AND SUPPORT BRANCH.

COMPLETE A DETAILED NOISE SURVEY AT THE MOD-1 SITE.

OUTPUT

FIELD MEASUREMENTS OF NOISE GENERATED BY LARGE WIND TURBINES AT CLAYTON, N.M.; BOONE, N.C.; BLOCK ISLAND, R.I.; AND OTHER WIND TURBINE SITES TO BE SPECIFIED.

A SITING HANDBOOK TREATING NOISE GENERATED BY LARGE WIND TURBINES.

BUDGET

EXPENDITURES

FY79: \$150K

\$5K

NOVEMBER 16, 1979

A COMPREHENSIVE GUIDE OF WECS CONNECTED TO ELECTRIC UTILITIES
ROGER TAYLOR

OBJECTIVES

PROVIDE A COMPREHENSIVE, CONSOLIDATED, READABLE SOURCE OF INFORMATION OF WECS AS IT RELATES TO ELECTRIC UTILITIES.

PROVIDE A KEY REFERENCE DOCUMENT TO UTILITIES, PUBLIC UTILITY COMMISSIONS, STATE ENERGY OFFICES AND OTHERS ON THE DEVELOPMENTS WHICH HAVE TAKEN PLACE IN THE RECENT PAST AND ARE CURRENTLY TAKING PLACE IN THE FIELD OF WIND ENERGY.

NOVEMBER 16, 1979

ACCOMPLISHMENTS

INITIATED EFFORT DURING THE 4TH QUARTER OF FY79.

ASSEMBLED AND DISTRIBUTED FOR COMMENT PRELIMINARY TABLE OF CONTENTS.

COMMENCED REVIEW OF VALUE ANALYSIS STUDIES.

PLANNED ACTIVITIES

INITIATE SOLE SOURCE SUBCONTRACT FOR MAJOR PORTIONS OF SECTION 1.0.

PREPARE DRAFT OF VALUE ANALYSIS CHAPTER, SECTION 5.1.

INITIATE CONSULTANT EFFORTS AS REQUIRED.

OUTPUT

PREPARE DRAFT REPORT DURING 3RD QUARTER FY80.

PREPARE FINAL REPORT END OF 4TH QUARTER FY80.

BUDGET

EXPENDITURES

TOTAL (FY79) \$240K

\$10K

PLANNING

OBJECTIVES

DEVELOP PLANS AND COORDINATE THE EFFORTS OF SERI WIND ENERGY SYSTEMS PROGRAM.

PROVIDE SERI SUPPORT OF THE FEDERAL WIND ENERGY PROGRAM.

ACCOMPLISHMENTS

COMPLETED AND PRESENTED THE WIND ENERGY SYSTEMS PORTION OF THE SERI RESEARCH QUARTERLY REVIEW.

COMPLETED AND PRESENTED THE SERI WIND ENERGY SYSTEMS QUARTERLY REVIEW.

INITIATED PLANNING ON THE SERI WIND ENERGY SYSTEMS FY80 PROGRAM DEVELOPMENT PLAN.

PLANNED ACTIVITIES

UPDATE TASK PLANS FOR FY80 AND FY81 FOR SERI AND WSB.

COMPLETE DRAFT PROGRAM DEVELOPMENT PLAN FOR WIND ACTIVITIES.

BUDGET

EXPENDITURE

INITIAL \$32K

\$67K

REPROGRAMMED \$62K

NOVEMBER 16, 1979

WIND — MILESTONES

Tasks	Fiscal Year 1979											
	O	N	D	J	F	M	A	M	J	J	A	S
WIND ENERGY INNOVATIVE SYSTEMS					● ¹ ● ²			▲ ³		△ ⁴		▲ ⁵
COST ESTIMATING AND ENGINEERING ANALYSIS OF INNOVATIVE WECS						● ⁶ ▲ ⁷		▲ ⁸			▲ ⁹ ▲ ¹⁰	▲ ¹¹
UTILITY ANALYTICAL MODELING						● ¹²						△ ¹³
ECONOMICS OF SMALL SYSTEMS TIED TO UTILITIES												▲ ¹⁴
LIABILITY ASSOCIATED WITH SMALL SYSTEMS										▲ ¹⁵		▲ ¹⁶
ENVIRONMENTAL ANALYSIS OF SMALL SYSTEMS									▲ ¹⁷			● ¹⁸
PLANNING SYSTEMS STUDIES			● ¹⁹									△ ²⁰
										○ ²¹		

<ol style="list-style-type: none"> 1. Award of generic study contracts 2. RFP released on R&D studies 3. WEIS Conference 4. Completion of generic studies 5. Award of new R&D studies 6. Survey completed of cost studies 7. Draft report of reliability 8. Draft report of screening methodology 9. Final report of reliability and maintenance cost study 10. Final report of screening methodology 11. Draft work statement on cost methodology for development phase of innovative concepts 12. Survey completed 13. Model operational 14. Draft report on the evaluation of on-site wind power 15. Critical issues defined 16. Analysis completed 17. TV interference film completed 18. Draft progress report on environmental effects of the production of WECS 19. Draft program development plan completed 20. Draft program development plan 	<ol style="list-style-type: none"> 21. Approval of 189 to commence a) Selected Value Analysis, b) WECS/Utility Comprehensive Guide, c) Noise Measurements, and d) Television Interference
--	--

<p>Legend:</p> <p>○ Start or Scheduled Intermediate Event</p> <p>● Completed Intermediate Event</p> <p>△ Scheduled Milestone</p> <p>▲ Completed Milestone</p>
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WIND ENERGY SYSTEMS (WES) PROGRAM FUNDING

<u>TASK</u>	<u>LEAD BRANCH</u>	<u>SUBCON- TRACTS</u>	<u>TOTAL</u>	<u>TOTAL EXPENDED</u>	<u>TOTAL COMMITTED</u>	<u>CARRYOVER TO FY80</u>
WIND ENERGY INNOVATIVE SYSTEMS PROGRAM	SPECIAL PROJECTS	631	754 +160*	466	465	447
COST ESTIMATING & ENGINEERING ANALYSIS	SYSTEMS ANALYSIS	10	174	162	0	12
UTILITY ANALYTICAL MODELING	SYSTEMS ANALYSIS	45	145	105	40	40
ECONOMICS OF SMALL SYSTEMS TIED TO UTILI- TIES	SYSTEMS ANALYSIS	0	120	84	0	36
LIABILITY ASSO- CIATED WITH SMALL SYSTEMS	INSTITUTIONAL & ENVIRONMENTAL ASSESS.	0	52	42	0	10
ENVIRONMENTAL ANALYSIS OF SMALL SYSTEMS	INSTITUTIONAL & ENVIRONMENTAL ASSESS.	0	123	85	0	38
SELECTED UTILI- TIES VALUE ANAL- YSIS	SYSTEMS ANALYSIS	420	500	30	0	470
TELEVISION INTER- FERENCE AND WECS	SYSTEMS ANALYSIS	0	15	5	0	10

*CARRYOVER FY78

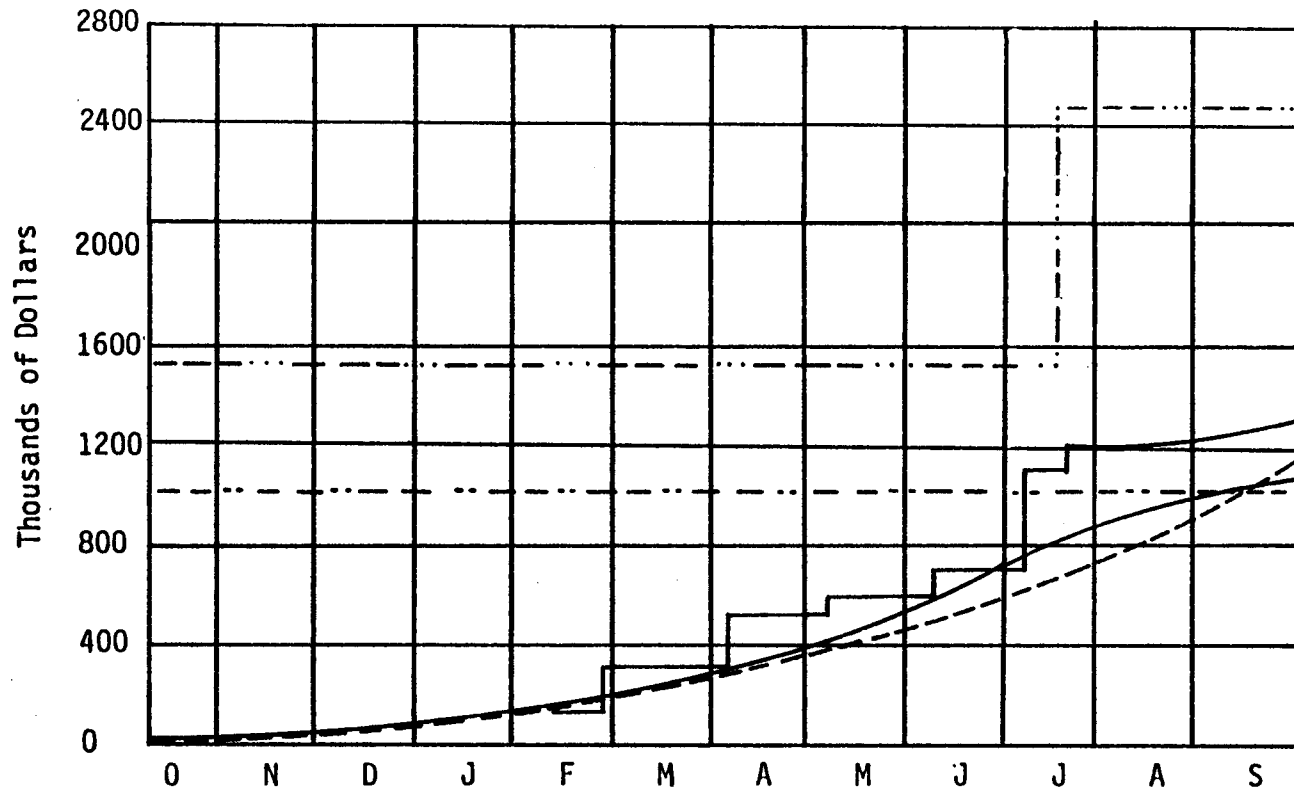
<u>TASK</u>	<u>LEAD BRANCH</u>	<u>SUBCON- TRACTS</u>	<u>TOTAL</u>	<u>TOTAL EXPENDED</u>	<u>TOTAL COMMITTED</u>	<u>CARRYOVER TO FY80</u>
NOISE MEASURE- MENTS AT SELECT- ED WECS SITES	SYSTEMS ANALYSIS	120	150	5	0	145
A COMPREHENSIVE GUIDE: WECS CONNECTED TO ELECTRIC UTILI- TIES	SYSTEMS ANALYSIS	80	240	10	0	230
PLANNING & ADMINISTRATION	SYSTEMS ANALYSIS	0	62	67	0	(5)

WIND RESOURCES ANALYSIS ^A	ENERGY RESOURCE	45	140	--	--	--
TECHNICAL INFORMATION ^B DISSEMINATION	COMMUNI- CATIONS	186	303	--	--	--

A BASIC AND APPLIED RESEARCH (PROGRAM AREA 14)
B COMMERCIALIZATION ACTIVITIES (PROGRAM AREA 18)

WIND ENERGY SYSTEMS

- Planned Obligation rate
- - - - - Planned Expenditure to Date - (Dollars)
- Actual Expenditure to Date - (Dollars)
- · - · - · - Financial Plan
- - - - - Budget Authority



Analysis of Variance as of 9/30/79

PR-480
NOVEMBER 16, 1979

WIND ENERGY INNOVATIVE SYSTEMS

IRWIN E. VAS

NOVEMBER 16, 1979

OBJECTIVE

DETERMINE TECHNICAL AND ECONOMIC FEASIBILITY OF INNOVATIVE WIND ENERGY SYSTEMS.

APPROACH

MONITOR, REVIEW, AND ASSESS ON-GOING R&D PROJECTS.

CONDUCT SITE VISITS AND PROJECT REVIEWS.

SUPPORT GENERIC STUDIES BY SUBCONTRACTS.

CONDUCT A PROGRAMMATIC WORKSHOP.

REVIEW AND ASSESS UNSOLICITED PROPOSALS.

SUPPORT SPECIFIC R&D SOLICITED INNOVATIVE STUDIES.

NOVEMBER 16, 1979

PRINCIPAL SUBCONTRACTORS FOR FY79 R&D PROJECTS

PROJECT TITLE	SUBCONTRACTOR	PROJECT CODE	CONTRACT No.	PRINCIPAL INVESTIGATOR
INNOVATIVE WIND TURBINE	WEST VIRGINIA UNIVERSITY	WVU	EY-76-C-05-5135	RICHARD E. WALTERS
DIFFUSER AUGMENTED WIND TURBINES (DAWT)	GRUMMAN AEROSPACE	G-D	XH-9-8073-1	KEN FOREMAN
TORNADO-TYPE WIND ENERGY SYSTEMS PHASE II (TORNADO)	GRUMMAN AEROSPACE	G-T	EX-76-C-01-2555	JAMES T. YEN
TESTS AND DEVICES FOR WIND/ELECTRIC POWER CHARGED AEROSOL GENERATORS (EFD)	MARKS POLARIZED	MP	XH9-8128-1	ALVIN M. MARKS
ELECTROFLUID DYNAMIC WIND GENERATOR PROGRAM (EFD)	UNIVERSITY OF DAYTON	UDE	XH-9-8074-1	JOHN E. MINARDI
ENERGY FROM HUMID AIR (HUMID AIR)	SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY	SD	DE-AC01-79ET23052	THOMAS K. OLIVER
VORTEX AUGMENTORS FOR WIND ENERGY CONVERSION (VORTEX)	POLYTECHNIC INSTITUTE OF NEW YORK	PINY	E(49-18)2358	PASQUALE M. SFORZA
ADVANCED AND INNOVATIVE WIND ENERGY CONCEPT DEVELOPMENT-DYNAMIC INDUCER (DYNAMIC INDUCER)	AEROVIRONMENT	ADI	XH-9-8085-1	PETER B.S. LISSAMAN
OSCILLATING VANE CONCEPT (OSCILLATING VANE)	UNITED TECHNOLOGIES RESEARCH CENTER	UTRC	XH-9-8085-2	R. L. BIELAWA
THE YAWING OF WIND TURBINES WITH BLADE CYCLIC PITCH (CYCLIC PITCH)	WASHINGTON UNIVERSITY TECHNOLOGY ASSOC.	WUCP	XH-9-8085-3	K. H. HOHENEMSER

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NOVEMBER 16, 1979

INNOVATIVE WIND TURBINES
WEST VIRGINIA UNIVERSITY
EY-76-C-05-5153
(RICHARD E. WALTERS, P.I.)

OBJECTIVE

INVESTIGATE THE TECHNICAL AND ECONOMIC FEASIBILITY OF A VERTICAL AXIS WIND TURBINE HAVING STRAIGHT BLADES CONSTRUCTED WITH CIRCULATION CONTROL AIRFOIL SECTIONS.

APPROACH

DESIGN AND CONSTRUCT A REVISED VAWT TEST MODEL AND ASSOCIATED INSTRUMENTATION.

CONDUCT INDOOR TEST TO ASSESS LIFT, DRAG, AND MOMENT CHARACTERISTICS.

PREDICT PERFORMANCE OF CIRCULATION CONTROLLED VAWT IN A WIND SITUATION.

ESTIMATE ECONOMIC VIABILITY OF SYSTEM AS COMPARED TO CONVENTIONAL SYSTEMS.

TASKS

	<u>TASK NUMBER</u>
CIRCULATION CONTROL BLADE THEORY WITH VISCOUS EFFECTS	1.1
TARE AIRFOIL COMPUTER CODES	1.2
CIRCULATION CONTROL BLADE AND FLIP TESTS	1.3
DESIGN STUDY, SENSOR LOCATION STUDY, AND HARDWARE PREPARATION	1.4
LARGE BLADE TESTS	1.5
SYSTEM/COST STUDY (ALLEGHANY BALLISTICS LAB)	1.6
BLADE AND INSTRUMENT DESIGN	1.7
BLADE AND INSTRUMENTATION PROCUREMENT AND FABRICATION	1.8
INDOOR TESTS	1.9

NOVEMBER 16, 1979

ACCOMPLISHMENTS

INDOOR TESTING CONTINUED ON THE CONVENTIONAL BLADE MEASURING BLADE LIFT, DRAG, AND PITCHING MOMENT.

ANALYSIS WAS INITIATED FOR DATA COLLECTED ON THE CONVENTIONAL BLADE LIFT, DRAG, AND PITCHING MOMENT.

SUBMITTED THE FINAL REPORT FOR FY78 FUNDED EFFORT.

NOVEMBER 16, 1979

PLANNED ACTIVITIES

COMPLETE INDOOR TESTS AND ANALYZE DATA.

COMPLETE THE FINAL REPORT VOL. III FOR TASKS 1.1 THRU 1.6 (SERI).

SUBMIT THE DRAFT FINAL REPORT FOR THE FY79 FUNDED EFFORT ON TASKS 1.7 THRU 1.9.

ASSESSMENT

NO PROBLEMS ON CURRENT WORK ARE FORESEEN AT THIS TIME.

PROJECT WILL PROBABLY BE COMPLETED BY DECEMBER 30, 1979.

NOVEMBER 16, 1979

DIFFUSER AUGMENTED WIND TURBINE

GRUMMAN AEROSPACE CORPORATION
XH-9-8073-1
(KEN FOREMAN, P.I.)

OBJECTIVE

DEVELOP AND REFINE THE ENGINEERING DESIGN OF DIFFUSER AUGMENTED WIND TURBINES (DAWT) FOR SMALL AND INTERMEDIATE SIZED MACHINES.

APPROACH

DETERMINE COST AND POWER ESTIMATES FOR CANDIDATE DAWT SYSTEMS WHEN CONSTRUCTED OF THREE SEPARATE MATERIALS.

DETERMINE SIZE, COST, MANUFACTURING, AND INSTALLATION APPROACHES FOR EACH CANDIDATE DAWT SYSTEM.

TASKS

TASK NUMBERS

WIND TUNNEL AND SMALL SCALE TESTS	2.1
FIELD TEST PLAN	2.2
WINDSTREAM 18 DIFFUSER, TURNTABLE, INSTRUMENT DESIGN	2.3
PERFORMANCE CALCULATION	2.4
ECONOMIC ANALYSIS	2.5
SIZE AND POWER RATING	2.6
DESIGN STUDIES FOR THREE MATERIALS OF CONSTRUCTION	2.7
MANUFACTURING AND INSTALLATION APPROACHES	2.8
COST AND POWER ESTIMATE	2.9
PROTOTYPE SIZING AND COSTING	2.10

NOVEMBER 16, 1979

ACCOMPLISHMENTS

COMPLETED AND SUBMITTED THE FINAL REPORT FOR THE FY78 FUNDED EFFORT.

SIZE AND POWER RATING STUDIES HAVE BEEN COMPLETED FOR THREE DAWT SYSTEMS (7.5, 47, AND 120 KW AT 20 MPH.)

COMPLETED GENERAL COST TREND STUDIES OF DAWT SYSTEMS CONSTRUCTED OF FERROCEMENT.

INITIATED THE DESIGN STUDY OF THE REINFORCED FIBERGLASS DAWT.

COMPLETED THE DETAILED DESIGN LAYOUT FOR THE ALUMINUM DAWT.

PLANNED ACTIVITIES

COMPLETE THE DESIGN STUDIES AND THE EVALUATION OF MANUFACTURING AND INSTALLATION APPROACHES.

COMPLETE ESTIMATES OF COST AND POWER OUTPUT.

INITIATE THE DETERMINATION OF THE PROTOTYPE SIZE AND COST.

ASSESSMENT

THE FINAL REPORT FOR THE FY78 FUNDED EFFORT HAS BEEN SUBMITTED TO TIC.

THE FY79 FUNDED EFFORT IS ON SCHEDULE.

TORNADO TYPE WIND ENERGY SYSTEMS

GRUMMAN AEROSPACE CORPORATION
EX-76-CO-01-2555
(JAMES T. YEN, P.I.)

OBJECTIVE

DETERMINE TECHNICAL AND ECONOMIC FEASIBILITY OF THE TORNADO TYPE MACHINE.

APPROACH

COMPLETE THEORETICAL ANALYSES UTILIZING MODELS TO PREDICT OPTIMUM CONFIGURATIONS AND PERFORMANCE OF FULL-SCALE SYSTEMS.

CONDUCT WIND TUNNEL TESTS OF SMALL MODELS AND COMPARE THE PERFORMANCE CHARACTERISTICS WITH PREDICTED VALUES.

ESTIMATE THE AUGMENTATION FACTOR FOR THE SYSTEM USING MEASURED RESULTS.

DESIGN, CONSTRUCT, AND TEST MID-SCALE SPIRAL AND VANED TYPE MODELS.

NOVEMBER 16, 1979

TASKSTASK NUMBERS

FLOW FIELD ANALYSIS OF VORTEX SYSTEMS	3.1
THREE-FOOT MODEL TESTS	3.2
SIX-FOOT SPIRAL MODEL DESIGN AND FABRICATION	3.3
TWO AND A HALF-FOOT TURBINE DESIGN AND FABRICATION	3.4
VANED MODEL, DESIGN, AND FABRICATION	3.5
TESTS OF VANED MODEL	3.6
STRUCTURAL AND COST ANALYSIS	3.7

ACCOMPLISHMENTS

COMPLETED THE CONSTRUCTION OF ADDITIONAL 4 IN. DIAMETER TURBINES WHICH HAVE ROTORS ONLY AND NO STATORS.

CONDUCTED TESTS WITH HIGH SPEED WIND TUNNEL MODELS IN THE NASA LANGLEY V/STOL TUNNEL UTILIZING TURBINES WITH STATORS AND ROTORS.

INITIATED ANALYSIS OF DATA COLLECTED FROM HIGH SPEED TESTS WHICH INDICATES THE BEST PRELIMINARY C_p OBTAINED IS 0.10 BASED ON TOWER FRONTAL AREA.

INITIATED A MORE EFFICIENT STRUCTURAL DESIGN AND ANALYSIS FOR THE TOWER.

CONDUCTED ADDITIONAL TESTS OF THE 30 IN. TURBINE IN THE TURBINE TEST RIG WITH VARIED STATOR AND ROTOR ANGLES.

NOVEMBER 16, 1979

PLANNED ACTIVITIES

COMPLETE TESTS OF THE NEW 4 IN. DIAMETER TURBINES AT THE NASA LANGLEY V/STOL WIND TUNNEL. (TESTS WITH TURBINE ALONE, NO STATORS)

COMPLETE THE ANALYSIS OF COLLECTED DATA.

COMPLETE THE MORE EFFICIENT STRUCTURAL DESIGN AND ANALYSIS FOR THE TOWER.

COMPLETE FINAL REPORT OF THE FY77 FUNDED EFFORT.

COMPLETE THE DRAFT FINAL REPORT FOR THE FY78 FUNDED EFFORT.

ASSESSMENT

THE CURRENT EFFORT IS BEHIND SCHEDULE DUE TO THE LACK OF AN AVAILABLE WIND TUNNEL TESTING FACILITY.

A NO COST EXTENSION HAS BEEN REQUESTED TO MODIFY THE CONTRACT COMPLETION DATE FROM AUGUST 30, 1979 TO DECEMBER 30, 1979.

PR-480
NOVEMBER 16, 1979

TEST AND DEVICES FOR WIND/ELECTRIC POWER
CHARGED AEROSOL GENERATOR

MARKS POLARIZED CORPORATION
XH9-8128-1
(ALVIN M. MARKS, P.I.)

OBJECTIVE

EXPERIMENTALLY EVALUATE THE INDUCTION CHARGING/WATERJET
TECHNIQUE OF PRODUCING CHARGED AEROSOLS FOR A VARIETY OF
GEOMETRIES AND TEST CONDITIONS.

APPROACH

MINIMIZE PRESSURE DROP BY VARYING ORIFICE GEOMETRY.

EVALUATE PERFORMANCE USING WIND TUNNEL TESTS FOR A RANGE OF
ATMOSPHERIC CONDITIONS OF VELOCITY, RELATIVE HUMIDITY, AND
TEMPERATURE.

EVALUATE THE CHARGING METHOD AND COMPARE THE EXPERIMENTAL
RESULTS WITH THE ANALYTICAL PREDICTIONS.

TASKS

	<u>TASK NUMBERS</u>
TEST OF ARRAY 1	4.1
TEST OF WATER JET/METAL CHARGING METHOD	4.2
TEST OF ELECTROJET CHARGING METHOD	4.3
TEST OF STEAM/METAL CHARGING METHOD	4.4
TEST OF STEAM MICROJET CONDENSATION METHOD	4.5
ESTABLISH MINIMUM PRESSURE DROPS AS A FUNCTION OF GEOMETRIC VARIATIONS OF ORIFICE	4.6
WIND TUNNEL PERFORMANCE EVALUATION FOR A RANGE OF ATMOSPHERIC CONDITIONS	4.7

NOVEMBER 16, 1979

ACCOMPLISHMENTS

THE DRAFT FINAL REPORT HAS BEEN REVIEWED AND COMMENTS RETURNED TO THE PRINCIPAL INVESTIGATOR.

COMPLETED THE DESIGN AND CONSTRUCTION OF ORIFICE DIAMETERS FROM 2μ TO 70μ .

INITIATED TESTS OF THICKNESS--LENGTHS OF 12-4000 μ .

COMPLETED TESTS VARYING THE EXCITER DIAMETER AND THE EXCITER TO ORIFICE DISTANCE.

PLANNED ACTIVITIES

COMPLETE AND SUBMIT THE FINAL REPORT ON TASKS 4.1 TO 4.5.

COMPLETE ALL TESTING TO MINIMIZE PRESSURE DROP.

CONTINUE TESTING PERFORMANCE FOR VARYING ATMOSPHERIC CONDITIONS.

ASSESSMENT

THE FOLLOW-ON CONTRACT WAS AWARDED TO MARKS POLARIZED CORPORATION AT A FUNDING LEVEL OF \$64K. THE CONTRACT IS TO EXPIRE APRIL 1980.

NOVEMBER 16, 1979

ELECTROFLUID DYNAMIC WIND DRIVEN GENERATOR

UNIVERSITY OF DAYTON RESEARCH INSTITUTE
XH-9-8074-1
(JOHN E. MINARDI, P.I.)

OBJECTIVE

PROVIDE A SUFFICIENT DENSITY OF CHARGED WATER DROPLETS OF LOW-MOBILITY TO EXPERIMENTALLY EVALUATE EFD GENERATOR GEOMETRIES.

DEVELOP TECHNIQUES FOR PROVIDING LOW-MOBILITY CHARGED WATER DROPLETS FOR WIND ENERGY APPLICATIONS IN A COST EFFECTIVE MANNER.

APPROACH

DEVELOP THEORETICAL MODELS TO PROVIDE LIMITING CONDITIONS FOR DROPLET AND GENERATOR PERFORMANCE.

CONDUCT WIND TUNNEL STUDIES, DEVELOP CHARGE DROPLET PRODUCTION METHODS, AND COMPARE RESULTS WITH ANALYSES.

NOVEMBER 16, 1979

TASKS

	<u>TASK NUMBERS</u>
LABORATORY COLLOID GENERATING EXPERIMENT	5.1
EXPERIMENTAL CONFIGURATION	5.2
COLLOID GENERATION EXPERIMENTS	5.3
EFD GENERATOR PERFORMANCE	5.4
CRITICAL PROBLEM AREAS PHASE I	5.5
THEORETICAL STUDIES OF ECONOMIC CURRENT PRODUCTION AND GENERATOR GEOMETRY	5.6
ENERGY ECONOMIC CHARGE PRODUCTION EXPERIMENTS	5.7
GENERATOR PERFORMANCE EXPERIMENTS	5.8
CRITICAL PROBLEM AREAS PHASE II	5.9

NOVEMBER 16, 1979

ACCOMPLISHMENTS

ADVANCED THEORY OF THE PRODUCTION OF CHARGED DROPLETS USING
PRE-FORMED BUBBLES.

CONDUCTED EXPERIMENT TO STUDY MOVEMENT AND CONTROL OF WATER
DROPLETS WHICH IMPACT AN ELECTRODE.

CONTINUED FABRICATION OF A SINGLE LARGE ELECTRODE GEOMETRY
AND SMALL BUBBLE GENERATOR.

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NOVEMBER 16, 1979

PLANNED ACTIVITIES

CONTINUE THEORETICAL STUDIES OF CURRENT PRODUCTION AND GENERATOR GEOMETRY.

CONDUCT TESTS OF ECONOMIC CHARGE PRODUCTION AND GENERATOR GEOMETRIES.

ASSESSMENT

THE CURRENT EFFORTS ARE ON SCHEDULE.

NOVEMBER 16, 1979

ENERGY FROM HUMID AIR

SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY
DE-AC01-79ET23052
(THOMAS K. OLIVER)

OBJECTIVE

DETERMINE A COST EFFECTIVE METHOD OF CONVERTING THE LATENT
HEAT OF WATER VAPOR IN HUMID AIR INTO MECHANICAL WORK.

APPROACH

DETERMINE THE POTENTIAL OF THE EXPANSION-COMPRESSION
TECHNIQUE FOR REMOVING ENERGY FROM HUMID AIR.

NOVEMBER 16, 1979

TASKSTASK NUMBERS

DEVELOP METHODS TO EVALUATE TOWER FLOW, LOSSES, CONDENSATION, AND COMPRESSION	6.1
INVESTIGATE COOLING METHODS BASED ON AVAILABLE METEOROLOGICAL DATA	6.2
PERFORM PARAMETRIC STUDIES FOR TASK 6.1	6.3
DEVELOP ECONOMIC ANALYSIS	6.4
COMPUTER MODELING OF THE FLOW	6.5
STUDY OF LOSSES	6.6
CONDENSATION & COOLING DYNAMICS	6.7
SYSTEM PERFORMANCE	6.8
STRUCTURAL DESIGN	6.9
ECONOMIC ESTIMATES	6.10

NOVEMBER 16, 1979

ACCOMPLISHMENTS

THE FINAL REPORT FOR THE FY78 FUNDED EFFORT HAS BEEN COMPLETED AND SUBMITTED TO TIC.

COMPLETED THE SEARCH OF CURRENT LITERATURE AND PUBLISHED DATA IN THE AREAS OF ROTATING VORTEX AND SWIRLING FLOWS.

INITIATED WORK ON CONDENSATION DYNAMICS.

CONTINUED WORK ON COMPUTER MODEL TO MATCH CONDITIONS FOR THE INNER AND OUTER FLOW BOUNDRIES IN ORDER TO OBTAIN A CONTINUOUS SOLUTION.

PLANNED ACTIVITIES

CONTINUE WORK ON CONDENSATION DYNAMICS.

CONTINUE WORK ON COMPUTER MODEL REVISIONS.

ASSESSMENT

THE CURRENT EFFORTS ARE BEHIND SCHEDULE DUE TO A LATE START AT THE BEGINNING OF THE CONTRACT AND A THREE MONTH NO-COST EXTENSION HAS BEEN REQUESTED.

VORTEX AUGMENTORS FOR WIND ENERGY CONVERSION

POLYTECHNIC INSTITUTE OF NEW YORK
ET-77-C-01-2358
(PASQUALE M. SFORZA)

OBJECTIVE

DETERMINE THE TECHNICAL FEASIBILITY, PERFORMANCE, AND ECONOMIC POTENTIAL OF THE DELTA WING TYPE VORTEX AUGMENTOR CONCEPT.

APPROACH

ADEQUATELY INSTRUMENT THE PROTOTYPE DELTA WING VORTEX AUGMENTOR.

DETERMINE STABILITY AND CONTROL SAFETY ASPECTS OF THE SYSTEM UNDER OPERATING CONDITIONS.

DEVELOP PERFORMANCE CHARACTERISTICS OF THE PROTOTYPE SYSTEM.

TASKS

	<u>TASK NUMBERS</u>
FIELD TEST PROGRAM	8.1
TEST AND ANALYSIS	8.2
WIND TUNNEL TESTS	8.3
ECONOMIC STUDIES	8.4

NOVEMBER 16, 1979

ACCOMPLISHMENTS

COMPLETED FIELD TESTING

PLANNED ACTIVITIES

DEVELOP THE ECONOMIC MODEL FOR THE VAC.

COMPLETE AND SUBMIT THE DRAFT FINAL REPORT FOR REVIEW.

ASSESSMENT

THE PROJECT IS BEHIND SCHEDULE DUE TO PREVIOUS WEATHER DELAYS AND A NO COST EXTENSION WAS APPROVED TO AUGUST 31, 1979.

NOVEMBER 16, 1979

DYNAMIC INDUCER
AEROVIRONMENT, INC.
XH-9-8085-1
PETER B. S. LISSAMAN

OBJECTIVE

DETERMINE THE PERFORMANCE AND COST EFFECTIVENESS OF TIP VANE POWER AUGMENTATION ON AN ACTUAL 4M DIAMETER WIND TURBINE OPERATING IN THE FIELD.

APPROACH

DETERMINE THE OPTIMAL TIP VANE GEOMETRY WITH WIND TUNNEL TESTING WITHOUT BLADES.

ESTABLISH THE POWER OUTPUT AND TORQUE FOR DYNAMIC INDUCER WITH BLADES IN THE WIND TUNNEL.

CONDUCT FIELD TESTS OF THE DYNAMIC INDUCER.

COMPLETE ANALYSIS OF THE PERFORMANCE AND COST EFFECTIVENESS OF THE DYNAMIC INDUCER.

ASSESSMENT

THE SUBCONTRACT WAS AWARDED OCTOBER 1, 1979.

PR-480
NOVEMBER 16, 1979

OSCILLATING VANE CONCEPT
UNITED TECHNOLOGIES RESEARCH CENTER
XH-9-8085-2
R. L. BIELAWA

OBJECTIVE

EVALUATE THE FEASIBILITY OF THE OSCILLATING VANE CONCEPT AS APPLIED TO WIND ENERGY CONVERSION.

APPROACH

DESIGN, CONSTRUCT, AND TEST A 4 FT WIND TUNNEL MODEL TO ESTABLISH PERFORMANCE.

VALIDATE AND UPGRADE AEROELASTIC/PERFORMANCE ANALYSIS.

COMPLETE DESIGN OF A FULL SCALE OSCILLATING VANE WECS.

ASSESSMENT

THE SUBCONTRACT WAS AWARDED SEPTEMBER 15, 1979.

NOVEMBER 16, 1979

THE YAWING OF WIND TURBINES
WITH BLADE CYCLIC PITCH
WASHINGTON UNIVERSITY TECHNOLOGY ASSOC., INC.
XH-9-8085-3
DR. K. H. HOHENEMSER

OBJECTIVE

DETERMINE THE POTENTIAL FOR WIND ENERGY CONVERSION USING A HORIZONTAL AXIS ROTOR WITH BLADE CYCLIC PITCH VARIATION.

APPROACH

DETERMINE BY TESTS AND ANALYSES THE YAW CONTROL SYSTEM CHARACTERISTICS OF A SMALL SCALE WIND ROTOR USING BLADE CYCLIC PITCH.

DETERMINE BY ANALYSIS THE YAW CHARACTERISTICS, POWER OUTPUT, AND LOADS OF A SPECIFIC HAWT AND A MOD-OA SIZED MACHINE.

VERIFY THE ANALYTICAL RESULTS WITH FREE ATMOSPHERIC TESTING.

ASSESSMENT

THE SUBCONTRACT WAS AWARDED SEPTEMBER 15, 1979

PRINCIPAL SUBCONTRACTS FOR FY79 GENERIC STUDIES

A DEFINITIVE GENERIC STUDY OF AUGMENTED HORIZONTAL AXIS WES (HAWT)	AEROVIRONMENT, INC.	AH	AH-9-8003-1	PETER LISSAMAN
A DEFINITIVE GENERIC STUDY OF HIGH LIFT DEVICE WES (HIGH LIFT)	AEROVIRONMENT, INC.	AHL	AH-9-8003-2	PETER LISSAMAN
A DEFINITIVE GENERIC STUDY OF AUGMENTED HORIZONTAL AXIS WES (HAWT)	TETRA-TECH, INC.	TT	AH-9-8003-3	MARK HARPER
A DEFINITIVE GENERIC STUDY OF AUGMENTED VERTICAL AXIS WES (VAWT)	NEW YORK UNIVERSITY	NYU	AH-9-8003-4	MARTIN HOFFERT
A DEFINITIVE GENERIC STUDY OF SAIL WING WES (SAIL WING)	WASHINGTON UNIVERSITY TECHNICAL ASSOCIATES	WU	AH-9-8003-5	K. H. HOHENEMSER
A DEFINITIVE GENERIC STUDY OF VORTEX EXTRACTION WES (VORTEX)	JBF SCIENTIFIC CORP.	JBF	AH-9-8004-6	THEODORE R. KORNREICH

NOVEMBER 16, 1979

"A DEFINITIVE GENERIC STUDY OF AUGMENTED
HORIZONTAL-AXIS WIND ENERGY SYSTEMS"

AEROVIRONMENT, INC.
(AH-9-8003-1)

PETER LISSAMAN

OBJECTIVE

PROVIDE A CRITICAL EVALUATION OF THE POTENTIAL COST-EFFECTIVENESS OF AUGMENTED HORIZONTAL-AXIS WIND ENERGY SYSTEMS.

APPROACH

THE STUDY WILL ADDRESS THE FOLLOWING TOPICS FOR EACH WIND ENERGY SYSTEM:

COST-EFFECTIVENESS (\$/kWh)
ADVANTAGES AND DISADVANTAGES OF CONCEPT
CAPACITY FACTORS
POTENTIAL AREAS FOR IMPROVEMENT
DIRECTION FOR FUTURE EFFORTS, IF ANY
BIBLIOGRAPHY--THE LISTING PROVIDED ABOVE IS TO BE USED AS A GUIDE. DOCUMENTATION OF ADDITIONAL CRITICAL FACETS FOR THE STUDY MAY BE INCLUDED.

TASKS

TASK NUMBERS

PERFORM A CRITICAL TECHNICAL REVIEW
OF THE GENERIC GROUP AUGMENTED
HORIZONTAL AXIS WIND ENERGY SYSTEMS

9.1

COMPARE THE VARIOUS TYPES OF AUGMENTED
HORIZONTAL-AXIS WIND ENERGY SYSTEMS
WITH UNAUGMENTED CONVENTIONAL WIND
ENERGY SYSTEMS

9.2

ACCOMPLISHMENTS

COMPLETED ALL TECHNICAL TASKS.

THE DRAFT FINAL REPORT HAS BEEN REVIEWED.

NOVEMBER 16, 1979

PLANNED ACTIVITIES

THE FINAL REPORT IS TO BE SUBMITTED DURING THE FIRST QUARTER OF FY80.

ASSESSMENT

A NO COST EXTENSION HAS BEEN REQUESTED TO ALLOW FOR INCORPORATION OF THE COMMENTS INTO THE FINAL REPORT.

"A DEFINITIVE GENERIC STUDY OF HIGH LIFT DEVICE
WIND ENERGY SYSTEMS"

AEROVIRONMENT
(AH-9-8003-2)

PETER LISSAMAN

OBJECTIVE

PROVIDE A CRITICAL EVALUATION OF THE POTENTIAL COST-
EFFECTIVENESS OF HIGH LIFT DEVICE WIND ENERGY SYSTEMS.

APPROACH

THE STUDY WILL ADDRESS THE FOLLOWING TOPICS FOR EACH WIND
ENERGY SYSTEM:

COST-EFFECTIVENESS (\$/KWH)
ADVANTAGES AND DISADVANTAGES OF CONCEPT
CAPACITY FACTORS
POTENTIAL AREAS FOR IMPROVEMENT
DIRECTION FOR FUTURE EFFORTS, IF ANY
BIBLIOGRAPHY--THE LISTING PROVIDED ABOVE IS TO BE USED
AS A GUIDE. DOCUMENTATION OF ADDITIONAL CRITICAL
FACETS FOR THE STUDY MAY BE INCLUDED.

NOVEMBER 16, 1979

TASKS

	<u>TASK NUMBERS</u>
PERFORM A CRITICAL TECHNICAL REVIEW OF THE GENERIC GROUP HIGH LIFT WIND ENERGY SYSTEMS	10.1
COMPARE THE VARIOUS TYPES OF HIGH LIFT WIND ENERGY SYSTEMS WITH UNAUGMENTED CONVENTIONAL WIND ENERGY SYSTEMS	10.2

ACCOMPLISHMENTS

ALL TECHNICAL TASKS HAVE BEEN COMPLETED.

THE DRAFT FINAL REPORT HAS BEEN REVIEWED.

PR-480
NOVEMBER 16, 1979

PLANNED ACTIVITIES

THE FINAL REPORT IS TO BE SUBMITTED DURING THE FIRST QUARTER OF FY80.

ASSESSMENT

A NO COST EXTENSION HAS BEEN REQUESTED TO ALLOW FOR COMMENTS TO BE INCORPORATED INTO THE FINAL REPORT.

"A DEFINITIVE GENERIC STUDY OF AUGMENTED
HORIZONTAL-AXIS WIND ENERGY SYSTEMS"

TETRA-TECH, INC.
(AH-9-8003-3)

MARK HARPER

OBJECTIVES

PROVIDE A CRITICAL EVALUATION OF THE POTENTIAL COST-EFFECTIVENESS OF AUGMENTED HORIZONTAL-AXIS WIND ENERGY SYSTEMS.

APPROACH

THE STUDY WILL ADDRESS THE FOLLOWING TOPICS FOR EACH WIND ENERGY SYSTEM:

COST-EFFECTIVENESS (\$/kWh)
ADVANTAGES AND DISADVANTAGES OF CONCEPT
CAPACITY FACTORS
POTENTIAL AREAS FOR IMPROVEMENT
DIRECTION FOR FUTURE EFFORTS, IF ANY
BIBLIOGRAPHY--THE LISTING PROVIDED ABOVE IS TO BE USED AS A GUIDE. DOCUMENTATION OF ADDITIONAL CRITICAL FACETS FOR THE STUDY MAY BE INCLUDED.

NOVEMBER 16, 1979

TASKS

	<u>TASK NUMBERS</u>
PERFORM A CRITICAL TECHNICAL REVIEW OF THE GENERIC GROUP AUGMENTED HORIZON- TAL-AXIS WIND ENERGY SYSTEMS	11.1
COMPARE THE VARIOUS TYPES OF AUGMENTED HORIZONTAL-AXIS WIND ENERGY SYSTEMS WITH UNAUGMENTED CONVENTIONAL WIND ENERGY SYSTEMS	11.2

ACCOMPLISHMENTS

ALL TECHNICAL TASKS HAVE BEEN COMPLETED.

THE DRAFT FINAL REPORT HAS BEEN REVIEWED.

NOVEMBER 16, 1979

PLANNED ACTIVITIES

THE FINAL REPORT IS TO BE SUBMITTED DURING THE FIRST QUARTER OF FY80.

ASSESSMENT

A NO COST EXTENSION HAS BEEN REQUESTED TO ALLOW FOR THE INCORPORATION OF COMMENTS INTO THE FINAL REPORT.

NOVEMBER 16, 1979

"A DEFINITIVE GENERIC STUDY OF AUGMENTED
VERTICAL-AXIS WIND ENERGY SYSTEMS"

NEW YORK UNIVERSITY
(AH-9-8003-4)

MARTIN I. HOFFERT

OBJECTIVE

PROVIDE A CRITICAL EVALUATION OF THE POTENTIAL COST-EFFECTIVENESS OF AUGMENTED VERTICAL-AXIS WIND ENERGY SYSTEMS.

APPROACH

THE STUDY WILL ADDRESS THE FOLLOWING TOPICS FOR EACH WIND ENERGY SYSTEM:

COST-EFFECTIVENESS (\$/KWH)
ADVANTAGES AND DISADVANTAGES OF CONCEPT
CAPACITY FACTORS
POTENTIAL AREAS FOR IMPROVEMENT
DIRECTION FOR FUTURE EFFORTS, IF ANY
BIBLIOGRAPHY--THE LISTING PROVIDED ABOVE IS TO BE USED AS A GUIDE. DOCUMENTATION OF ADDITIONAL CRITICAL FACETS FOR THE STUDY MAY BE INCLUDED.

NOVEMBER 16, 1979

TASKS

	<u>TASK NUMBERS</u>
PERFORM A CRITICAL TECHNICAL REVIEW OF THE GENERIC GROUP AUGMENTED VERTICAL-AXIS WIND ENERGY SYSTEMS	12.1
COMPARE THE VARIOUS TYPES OF AUGMENTED VERTICAL-AXIS WIND ENERGY SYSTEMS WITH UNAUGMENTED CONVENTIONAL WIND ENERGY SYSTEMS	12.2

ACCOMPLISHMENTS

ALL TECHNICAL TASKS HAVE BEEN COMPLETED.

THE DRAFT FINAL REPORT HAS BEEN REVIEWED.

PLANNED ACTIVITIES

THE FINAL REPORT IS TO BE SUBMITTED DURING THE FIRST QUARTER OF FY80.

ASSESSMENT

A NO COST EXTENSION HAS BEEN REQUESTED TO ALLOW COMMENTS TO BE INCORPORATED INTO THE FINAL REPORT.

PR-480
NOVEMBER 16, 1979

"A DEFINITIVE GENERIC STUDY OF SAIL WING
WIND ENERGY SYSTEMS"

WASHINGTON UNIVERSITY TECHNOLOGY ASSOC., INC.
(AH-9-8003-5)

DR. K. H. HOHENEMSER

OBJECTIVE

PROVIDE A CRITICAL EVALUATION OF THE POTENTIAL COST-EFFECTIVENESS OF SAIL WING WIND ENERGY SYSTEMS.

APPROACH

THE STUDY WILL ADDRESS THE FOLLOWING TOPICS FOR EACH WIND ENERGY SYSTEM:

COST-EFFECTIVENESS (\$/KWH)
ADVANTAGES AND DISADVANTAGES OF CONCEPT
CAPACITY FACTORS
POTENTIAL AREAS FOR IMPROVEMENT
DIRECTION FOR FUTURE EFFORTS, IF ANY
BIBLIOGRAPHY--THE LISTING PROVIDED ABOVE IS TO BE USED AS A GUIDE. DOCUMENTATION OF ADDITIONAL CRITICAL FACETS FOR THE STUDY MAY BE INCLUDED.

TASKS

TASK NUMBERS

PERFORM A CRITICAL TECHNICAL REVIEW
OF THE GENERIC GROUP SAIL WING
WIND ENERGY SYSTEMS

13.1

COMPARE THE VARIOUS TYPES OF SAIL
WING WIND ENERGY SYSTEMS WITH
UNAugMENTED CONVENTIONAL WIND
ENERGY SYSTEMS

13.2

ACCOMPLISHMENTS

ALL TECHNICAL TASKS HAVE BEEN COMPLETED.

THE DRAFT FINAL REPORT HAS BEEN REVIEWED.

NOVEMBER 16, 1979

PLANNED ACTIVITIES

THE FINAL REPORT IS TO BE SUBMITTED DURING THE FIRST QUARTER
OF FY80.

"A DEFINITIVE GENERIC STUDY OF VORTEX
EXTRACTION WIND ENERGY SYSTEMS"

JBF SCIENTIFIC, INC.
(AH-9-8003-6)

THEODORE R. KORNREICH

OBJECTIVE

PROVIDE A CRITICAL EVALUATION OF THE POTENTIAL COST-
EFFECTIVENESS OF VORTEX EXTRACTION WIND ENERGY SYSTEMS.

APPROACH

THE STUDY WILL ADDRESS THE FOLLOWING TOPICS FOR EACH WIND
ENERGY SYSTEM:

COST-EFFECTIVENESS (\$/KWH)
ADVANTAGES AND DISADVANTAGES OF CONCEPT
CAPACITY FACTORS
POTENTIAL AREAS FOR IMPROVEMENT
DIRECTION FOR FUTURE EFFORTS, IF ANY
BIBLIOGRAPHY--THE LISTING PROVIDED ABOVE IS TO BE USED
AS A GUIDE. DOCUMENTATION OF ADDITIONAL CRITICAL
FACETS FOR THE STUDY MAY BE INCLUDED.

TASKS

	<u>TASK NUMBERS</u>
PERFORM A CRITICAL TECHNICAL REVIEW OF THE GENERIC GROUP VORTEX EXTRACT- TION WIND ENERGY SYSTEMS	14.1
COMPARE THE VARIOUS TYPES OF VORTEX EXTRACTION WIND ENERGY SYSTEMS WITH UNAugMENTED CONVENTIONAL WIND ENERGY SYSTEMS	14.2

ACCOMPLISHMENTS

ALL TECHNICAL TASKS HAVE BEEN COMPLETED.
THE DRAFT FINAL REPORT HAS BEEN REVIEWED.

PLANNED ACTIVITIES

THE FINAL REPORT IS TO BE SUBMITTED DURING THE FIRST QUARTER OF FY80.

ASSESSMENT

A NO COST EXTENSION HAS BEEN REQUESTED TO ALLOW FOR COMMENTS TO BE INCORPORATED INTO THE FINAL REPORT.

NOVEMBER 16, 1979

PROJECT MANAGEMENT

ACCOMPLISHMENTS

REVIEWED CURRENT R&D PROJECTS ON A CONTINUING BASIS--DETAILS PROVIDED PREVIOUSLY.

COMPLETED THE TECHNICAL REVIEW OF ONE UNSOLICITED PROPOSAL.

COMPLETED TECHNICAL REVIEWS OF SEVEN SUBCONTRACTOR DRAFT FINAL REPORTS.

AWARDED THREE R&D SUBCONTRACTS IN RESPONSE TO PROPOSALS FOR RFP-9-8085 -- DETAILS PROVIDED EARLIER.

AWARDED A FOLLOW-ON CONTRACT TO MARK'S POLARIZED CORP. -- DETAILS PROVIDED EARLIER.

PLANNED ACTIVITIES

INITIATE ACTIVITIES RELATING TO A FUTURE WEIS ASSESSMENT STUDIES RFP.

INITIATE REVIEWS OF THE ELEVEN FY80 R&D SUBCONTRACTS.

REVIEW UNSOLICITED PROPOSALS.

COMPLETE THE PROCEEDINGS OF THE WEIS CONFERENCE.

SUPPORT THE PLANNING OF THE SERI WIND ENERGY SYSTEMS PROGRAM.

OUTPUT

DEVELOP AND CONFIRM BY ADEQUATE TESTS SPECIFIC INNOVATIVE CONCEPTS THAT HAVE THE POTENTIAL OF BEING COST EFFECTIVE AS COMPARED TO CONVENTIONAL SYSTEMS.

CONTINUE TO DEVELOP A PROGRAM PLAN FOR FY80 INCORPORATING INPUT PROVIDED AT THE WEIS CONFERENCE AND SUPPLEMENTED BY RECOMMENDATIONS OF THE ADVISORY COMMITTEE.

PROVIDE SUPPORT TO WSB IN THE PROGRAMMATIC ACTIVITIES.

R&D SUBCONTRACTED PROJECTS, FY78 AND 79

TITLE/SUBCONTRACTOR	TERMINATION DATE	FUNDING STATUS		PROJECTED FUNDING FY80
		FUNDING FY78	FUNDING FY79	
INN. - W. VA. UNIV.	AUGUST 15, 1979	99,888	0	120,000
DAWT - GRUMMAN	DECEMBER 15, 1979	201,964	89,293	120,000
TORNADO - GRUMMAN	AUGUST 30, 1979	236,115	N/A	200,000
EFD - MARKS	APRIL 30, 1980	99,448	64,007	N/A
EFD - U. DAYTON	MARCH 31, 1980	102,264	117,523	120,000
HUM. AIR - S. DAKOTA	MARCH 12, 1980	99,547	68,975	N/A
MADARAS - U. DAYTON	MAY 31, 1979	143,171	0	0
VORTEX - PINY	AUGUST 31, 1979	43,924	N/A	N/A
DYN. IND. - AEROV.	OCTOBER 1, 1980	N/A	121,835	N/A
OSCILL. VANE - UTRC	SEPTEMBER 15, 1980	N/A	119,900	
CYCLIC PITCH - WUTA	SEPTEMBER 15, 1980	N/A	106,318	N/A

NOVEMBER 16, 1979

GENERIC SUBCONTRACTED PROJECTS FY79

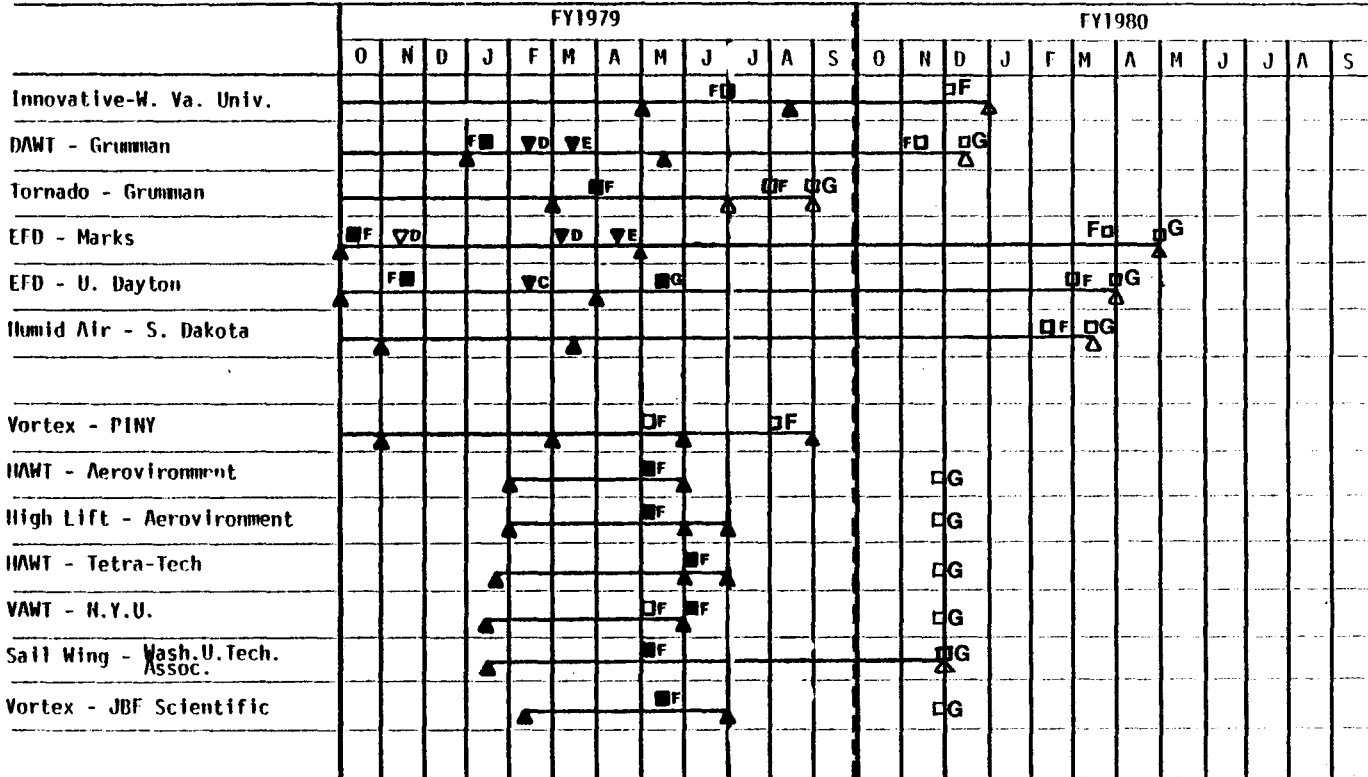
TITLE/SUBCONTRACTOR	PROPOSED COMPLETION DATE	<u>FUNDING STATUS</u>
		FUNDING FY79
HAWT - AEROVIRONMENT	MAY 31, 1979	21,827
HIGH LIFT - AEROVIRONMENT	JUNE 30, 1979	22,772
HAWT - TETRA-TECH	JUNE 30, 1979	24,677
VAWT - N.Y.U.	MAY 31, 1979	24,951
SAIL WING - W.U.T.A.	SEPTEMBER 30, 1979	22,500
VORTEX - JBF SCIENTIFIC	JUNE 30, 1979	24,950

CONTRACT NO. EG-77-C-01-4042 PRINCIPAL INVESTIGATOR Irwin E. Vas

CONTRACTOR SPO/SERI

TITLE Wind Energy Innovative Systems

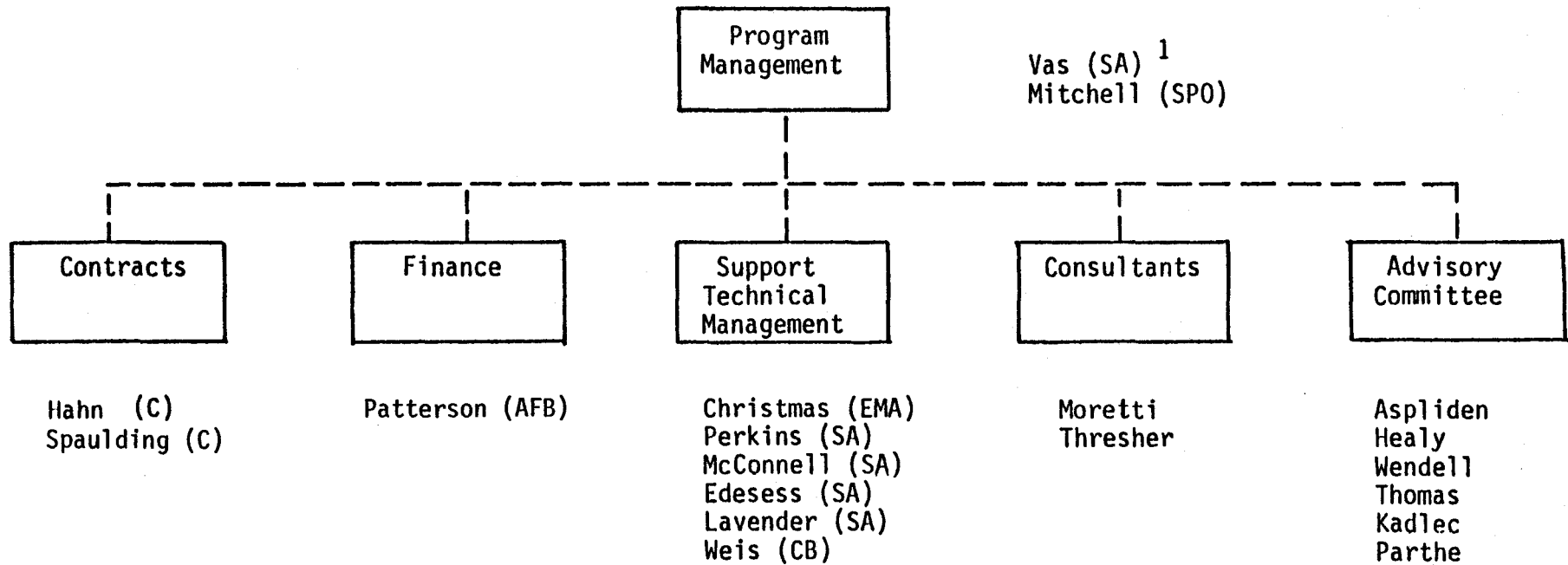
PHONE NO. (303) 231-1935



A Contract Review, Site Visit	E Procurement Initiation	▽ Intermediate Event	EXPLANATION
B Semi-Annual Report	F Draft Final Report	△ Milestone	Delivered - Filled Symbol
C Proposal Submission	G Final Report	□ Report	Planned - Open Symbol
D Proposal Resubmission			

MAJOR MILESTONE CHART FOR WEIS PROJECTS IN FY79 AND FY80.

WEIS PROGRAM MANAGEMENT CHART



¹ Office/Branch abbreviations are defined below:

- SPO Special Projects Office
- C Contracts
- AFB Accounting, Finance, and Budget
- EMA Economics and Market Analysis
- ERA Energy Resource Assessment
- SA Systems Analysis
- CB Communications Branch

PR-480
NOVEMBER 16, 1979

COST ESTIMATING AND ENGINEERING ANALYSIS
OF INNOVATIVE WECS

ROBERT McCONNELL

OBJECTIVE

ESTIMATE COSTING METHODOLOGIES SUITABLE FOR INNOVATIVE WECS (IWECS) IN THEIR CONCEPTUAL, DEVELOPMENTAL, AND PRODUCTION PHASES TO ESTIMATE THEIR COST OF ENERGY.

ACCOMPLISHMENTS

COMPLETED FINAL REPORT ENTITLED "A GENERAL RELIABILITY AND SAFETY METHODOLOGY AND ITS APPLICATION TO WIND ENERGY CONVERSION SYSTEMS", SERI TR-35-234.

RECEIVED FROM SAI FINAL VERSION OF MANUSCRIPT ENTITLED "SCREENING METHODOLOGY FOR INNOVATIVE WIND SYSTEMS".

DEVELOPED A REVISED SCREENING METHODOLOGY TO MEET TASK OBJECTIVE UTILIZING SAI STUDY AS A BASIS.

NOVEMBER 16, 1979

PLANNED ACTIVITIES

PREPARE REVISED WORK STATEMENT FOR DEVELOPMENT COSTING METHODOLOGY.

PREPARE PAPER ENTITLED "A SCREENING METHODOLOGY FOR WIND ENERGY CONVERSION SYSTEMS" FOR THE ISES ANNUAL MEETING IN JUNE 1980.

SUPPORT WEIS TASK ON REVIEW OF THE DAWT AND TORNADO PROJECTS.

OUTPUT

A METHODOLOGY FOR EVALUATING AN INNOVATIVE WECS RELIABILITY AND SAFETY AND ITS ASSOCIATED OPERATION AND MAINTENANCE COSTS.

A METHODOLOGY FOR SCREENING INNOVATIVE WECS IN THEIR CONCEPT PHASE.

AN ESTIMATING TECHNIQUE FOR DEVELOPMENT COSTS OF INNOVATIVE WECS.

Major Milestones	FY-79												FY-80					
	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
1. Assess Previous Studies				▼														
2. Quarterly Review - WSB				◆				◆		◆								
3. Reliability - O&M Costs						□					■							
4. Giromill Overview								■										
5. Screening Methodology (revised)								□		■					□			■
6. Development Costing Work Statement										△					▽			
7. Cost Definitions Workshop (cancelled)										△				◆				
8. Production Costs Methodology																△		
9. Engineering Analysis of Innovative WECS.																△		

△ Begin Milestone

□ Draft Final Report

▼ Milestone Complete

■ Final Report

◆ Workshop or Special Meeting

SCREENING METHODOLOGY FOR INNOVATIVE WIND SYSTEMS

THE FINAL VERSION OF THIS WORK WAS SUBMITTED TO SERI BY SCIENCE APPLICATIONS INC. THE FINAL VERSION DID NOT ADEQUATELY RESPOND TO THE REVIEWER COMMENTS AND THEREFORE WILL REMAIN AS AN INTERNAL SERI WORKING DOCUMENT FOR THE TASK.

THE SIGNIFICANT REVIEWER COMMENTS (PRESENTED IN DETAIL IN THE LAST QUARTERLY REVIEW, SERI/PR-35-356) ARE THE FOLLOWING:

THE METHODOLOGY SHOULD PROVIDE GUIDELINES RATHER THAN SIMPLY AN ACCEPTANCE OR REJECTION OUTPUT.

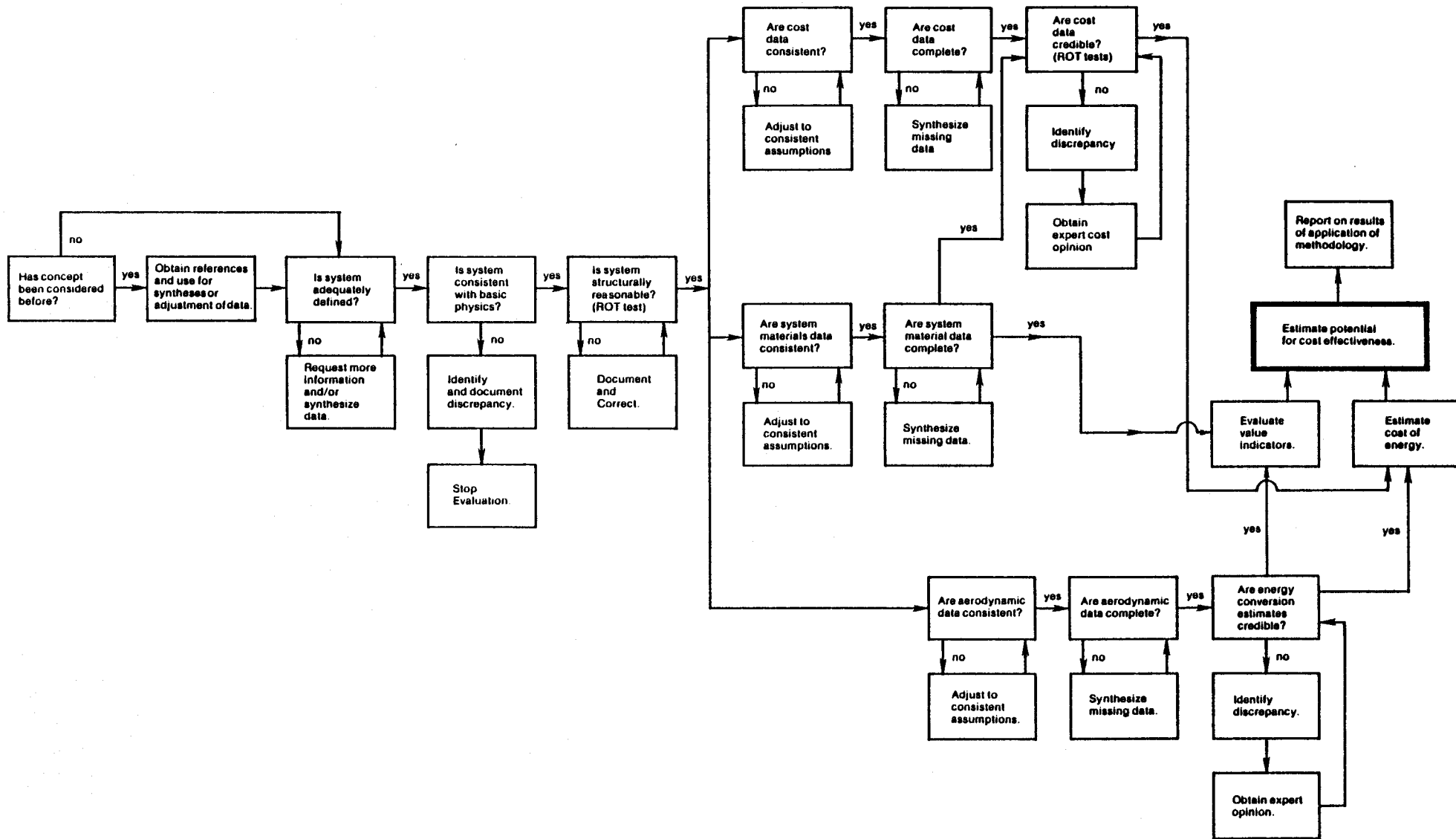
THE DAWT DATA USED FOR THE EXAMPLE APPLICATION WAS OUT-OF-DATE.

THE IDEA AND GENERAL APPROACH OF THE METHODOLOGY ITSELF IS GOOD.

REVIEWERS OF THE DRAFT REPORT WERE KADLEC (SANDIA); THRESHER, MORETTI, FOREMAN (GRUMMAN).

BECAUSE OF THE SMALL BUDGET REMAINING FOR THE WORK (\$11K TOTAL BUDGET) UP-TO-DATE DAWT DATA COULD NOT BE GATHERED FOR A SECOND EXAMPLE APPLICATION. HOWEVER, A REVISED SCREENING METHODOLOGY, SIMILAR IN MANY WAYS TO SAI'S METHODOLOGY, HAS BEEN SUBMITTED FOR PRESENTATION AT THE ANNUAL MEETING OF THE AMERICAN SECTION OF THE INTERNATIONAL SOLAR ENERGY SOCIETY (PHOENIX, ARIZ., JUNE 1980). A DIFFERENT EXAMPLE APPLICATION, THAT OF THE TRACKED-VEHICLE AIRFOIL CONCEPT ONCE STUDIED BY MONTANA STATE UNIVERSITY, HAS BEEN CHOSEN FOR THE PRESENTATION. THE FLOW CHART FOR THE METHODOLOGY IS SHOWN IN THE FIGURE. R. McCONNELL (SERI) AND E. MOORE (SAI) ARE THE PROPOSED CO-AUTHORS. THE INITIAL SAI WORK, ITS SUBSEQUENT REVIEW BY CONVENTIONAL AND INNOVATIVE WIND ENERGY RESEARCHERS, AND THE APPLICATION OF THE METHODOLOGY TO MANY DIFFERENT TYPES OF WECS DURING FY79 (E.G., GIROMILL OVERVIEW) HAS PROVIDED VALUABLE INPUT FOR THE REVISED SCREENING METHODOLOGY.

A Screening Methodology for Wind Energy Conversion Systems



A GENERAL RELIABILITY AND SAFETY METHODOLOGY AND ITS APPLICATION
TO WIND ENERGY CONVERSION SYSTEMS

ESSENTIALLY NO CHANGE WAS REQUIRED FOR THIS REPORT AS A RESULT OF THE REVIEW PROCESS. IN GENERAL, THE REVIEWERS CONSIDERED THIS METHODOLOGY TO BE BOTH USEFUL AND IMPORTANT (DETAILED COMMENTS ARE PRESENTED IN THE PREVIOUS QUARTERLY REVIEW, SERI/PR-35-356). REVIEWERS OF THE DRAFT REPORT WERE MORETTI, REILLY (NASA LEWIS), BRAASCH (SANDIA), HEALY (ROCKY FLATS). A SLIGHTLY ABBREVIATED VERSION OF THE FINAL REPORT (SERI/TR-35-234) WILL BE SUBMITTED FOR EXTERNAL PUBLICATION. NO FURTHER WORK IS PLANNED TO USE THE METHODOLOGY FOR MORE DETAILED ESTIMATES OF OPERATIONS AND MAINTENANCE COSTS UNTIL THE PRODUCTION COSTING METHODOLOGY WORK HAS BEGUN.

PR-480
NOVEMBER 16, 1979

ASSESSMENT

THE TASK WORK HAS SLIPPED DUE TO THE LACK OF IN-HOUSE SUPPORT PERSONNEL DURING THE LAST QUARTER OF FY79. STEPS HAVE ALREADY BEEN TAKEN TO ACQUIRE NECESSARY SUPPORT PERSONNEL.

PR-480
NOVEMBER 16, 1979

UTILITY ANALYTICAL MODELING

DAVID PERCIVAL

OBJECTIVE

ESTABLISH THE CAPABILITY TO REPRESENT WIND-DERIVED GENERATION IN ELECTRIC UTILITY GENERATION PLANNING MODELS SO THAT THE ECONOMIC VALUE OF THE WECS OPTION MAY BE EXAMINED.

APPROACH

PROCURE ESTABLISHED UTILITY GENERATION PLANNING MODELS.

DEVELOP METHODOLOGY FOR WECS REPRESENTATION AND INTEGRATE IT INTO THE UTILITY MODELS.

PR-480
NOVEMBER 16, 1979

OUTPUT

REPORT ON UTILITY PRODUCTION COST MODEL EVALUATIONS

REPORT ON METHODOLOGY AND USERS MANUAL FOR THE WECS REPRESENTATION

UTILITY PLANNING MODEL INCORPORATING WECS SUCH THAT DOE/SERI STUDIES MAY BE PERFORMED

PLANNED COMPLETION - - APRIL 1980

ACCOMPLISHMENTS

UTILITY MODELS:

SUBMITTED PAPER ENTITLED "INTEGRATION OF INTERMITTENT RESOURCES INTO BALERIAUX-BOOTH PRODUCTION COST MODELS" TO IEEE.

DRAFT VERSION SUBMITTED TO TOM REDDOCH, PETER MORETTI, GERRY PARK, ROBERT SULLIVAN AND JEFF RUMBAUGH FOR REVIEW AND COMMENT.

COMPLETED PROCUREMENT OF PROMOD.

WECS REPRESENTATIONS:

SELECTED STONE AND WEBSTER MODELS TO BUILD UPON WEATHER TAPE PRE-PROCESSOR (WTP) AND RUN OF THE SUN POWER AVAILABILITY MODULE (ROSPAM).

MADE WIND SPEED AND POWER REFINEMENTS AS DEVELOPED BY JUSTUS ON ROSPAM.

COMMENCED IMPLEMENTATION OF A PROGRAM TO DEVELOP WEIBULL PARAMETERS FROM HISTORICAL WEATHER DATA BASED AROUND WTP.

STONE AND WEBSTER INITIAL PROGRAMS

WTP - - WEATHER TAPE PREPROCESSOR:

READS SOLMET, TMY, TDF AND AEROSPACE WEATHER TAPES.

CONVERTS DATA TO CONSISTENT UNITS AND FILLS IN MISSING DATA.

ROSPAM - - RUN OF THE SUN POWER AVAILABILITY MODULE:

CALCULATES ELECTRICAL OUTPUT FROM ONE OR MORE SOLAR DEVICES UTILIZING THE
RESULT OF WTP EXECUTION AT A SITE.

PRODUCES UP TO THREE TYPICAL CURVES OF HOURLY ELECTRICAL OUTPUT FOR EACH
MONTH.

CAN STUDY WECS, PV, AND SOLAR THERMAL DEVICES.

WIND MODEL MODIFICATIONS

WTP:

BEGAN REVISIONS TO CALCULATE WEIBULL PARAMETERS - = 24 SETS FOR EACH MONTH.

ROSPAM:

REVISED TO ALLOW OUTPUT OF ALL HOURLY VALUES INSTEAD OF PRODUCING TYPICAL DAILY PROFILES.

MADE WIND SPEED AND POWER REFINEMENTS AS DEVELOPED BY C. G. JUSTUS:

CALCULATION OF POWER LAW EXPONENT FOR HEIGHT PROJECTION BASED ON ANEMOMETER HEIGHT AND READ WIND SPEED.

WIND SHEAR POWER OVER ENTIRE ROTOR AREA.

ANEMOMETER ERRORS OF OVERSPEED, INCLINATION, AND DATA PROCESSING.

WIND GUSTING.

FUTURE PLANS

COMMENCE PROMOD TRAINING.

COMPLETE PROGRAM TO CALCULATE WEIBULL PARAMETERS.

REVISE ROSPAM TO ACCEPT WEIBULL PARAMETERS INSTEAD OF RAW WEATHER DATA.

DEVELOP A PROGRAM TO PRODUCE RESIDUAL HOURLY UTILITY LOADS UTILIZING RESULTS OF REVISED ROSPAM.

	FY79												FY80					
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
1. Workable probabilistic WECS value model	△			▽														
2. Documentation			△			□		■										
3. Innovative WECS inclusion						△						▽						

- △ Begin Milestone
- ▽ Milestone Complete
- ◆ Workshop or Special Meeting

- Draft Final Report
- Final Report

PR-480
NOVEMBER 16, 1979

ECONOMICS OF SWECS TIED TO THE UTILITY GRID

MICHAEL EDESESS

ECONOMICS OF SWECS OWNERSHIP BY END-USER,
FROM POINT OF VIEW OF END-USER

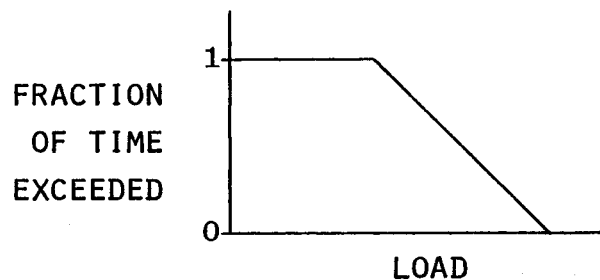
(IMPACT ON UTILITY ECONOMICS IN INTERCONNECTED APPLICATIONS NOT CONSIDERED.)

FOR COMPARISON WITH CONVENTIONAL ELECTRIC COSTS, SWECS COSTS MUST INCLUDE
BACKUP AND SELL-BACK.

UNCERTAINTY MUST BE TAKEN INTO ACCOUNT IN PROJECTIONS; INTERVAL ESTIMATES
ARE BETTER THAN POINT ESTIMATES.

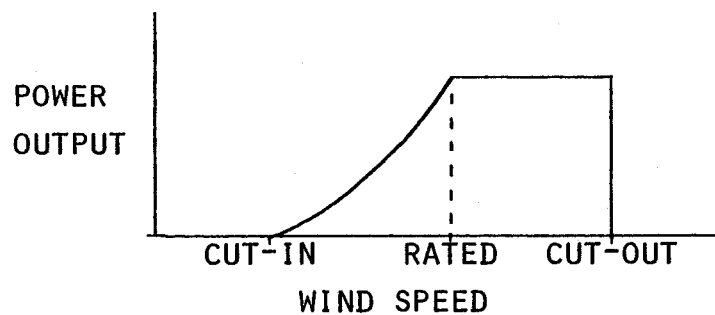
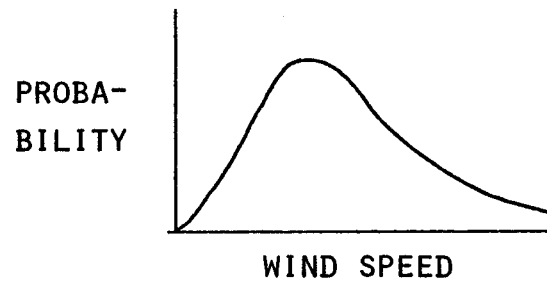
POINT ESTIMATES SHOULD BE DERIVED FROM INTERVAL ESTIMATES, BY CONSIDERING
USER'S DISUTILITY FOR UNCERTAINTY.

INCORPORATING BACKUP AND BUY-BACK IN COST OF SWECS



ASSUME SIMPLE TWO PARAMETER LOAD DURATION CURVE
(DETERMINED BY PEAK DEMAND AND LOAD FACTOR)

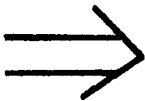
ASSUME WEIBULL DISTRIBUTION FOR WIND SPEED



ASSUME QUADRATIC SWECS PERFORMANCE CURVE
(SEE JUSTUS)

INCORPORATING BACKUP AND BUY-BACK IN COST OF SWECS

LOAD DURATION CURVE & WIND SPEED DISTRIBUTION & SWECS PERFORMANCE CURVE


(ANALYTICALLY)

PROBABILITY DISTRIBUTION OF
DEMAND MINUS SWECS OUTPUT
(I.E. DEMAND UNSERVED--POSSIBLY NEGATIVE)

FROM PROBABILITY DISTRIBUTION OF DEMAND UNSERVED, AND FROM BACKUP AND BUY-BACK RATE STRUCTURES, ANNUAL COST OF BACKUP LESS BUY-BACK MAY BE EASILY DERIVED (EXCEPT IF RATE STRUCTURES STIPULATE TIME DEPENDENCY--E.G., TIME-OF-DAY RATES).

ANALYSIS EASIEST IF ZERO WIND-LOAD CORRELATION ASSUMED.

NON-ZERO CORRELATION COEFFICIENT BETWEEN LOAD AND WIND SPEED DISTRIBUTIONS CAN PROBABLY BE INCORPORATED IN ANALYSIS.

IF LEVELIZED COST OR PRESENT WORTH OF COSTS IS USED
TO COMPARE SWECS OWNERSHIP WITH ALL-CONVENTIONAL ELECTRICITY

SWECS ESTIMATED COST = FUNCTION OF (INITIAL CAPITAL COST,
ESTIMATED WIND SPEED DISTRIBUTION,
ESTIMATED SWECS PERFORMANCE FUNCTION,
ESTIMATED USEFUL LIFETIME OF SWECS,
ESTIMATED O&M COSTS,
ESTIMATED FUTURE BACKUP AND BUY-BACK
RATES)

CONVENTIONAL ELECTRICITY
ESTIMATED COST = FUNCTION OF (ESTIMATED FUTURE ELECTRICITY RATES;
WHICH ARE IN TURN A FUNCTION OF
ESTIMATED FUTURE FUEL, CAPACITY
AND O&M COSTS)

IF LEVELIZED COST OR PRESENT WORTH OF COSTS IS USED
 TO COMPARE SWECS OWNERSHIP WITH ALL-CONVENTIONAL ELECTRICITY

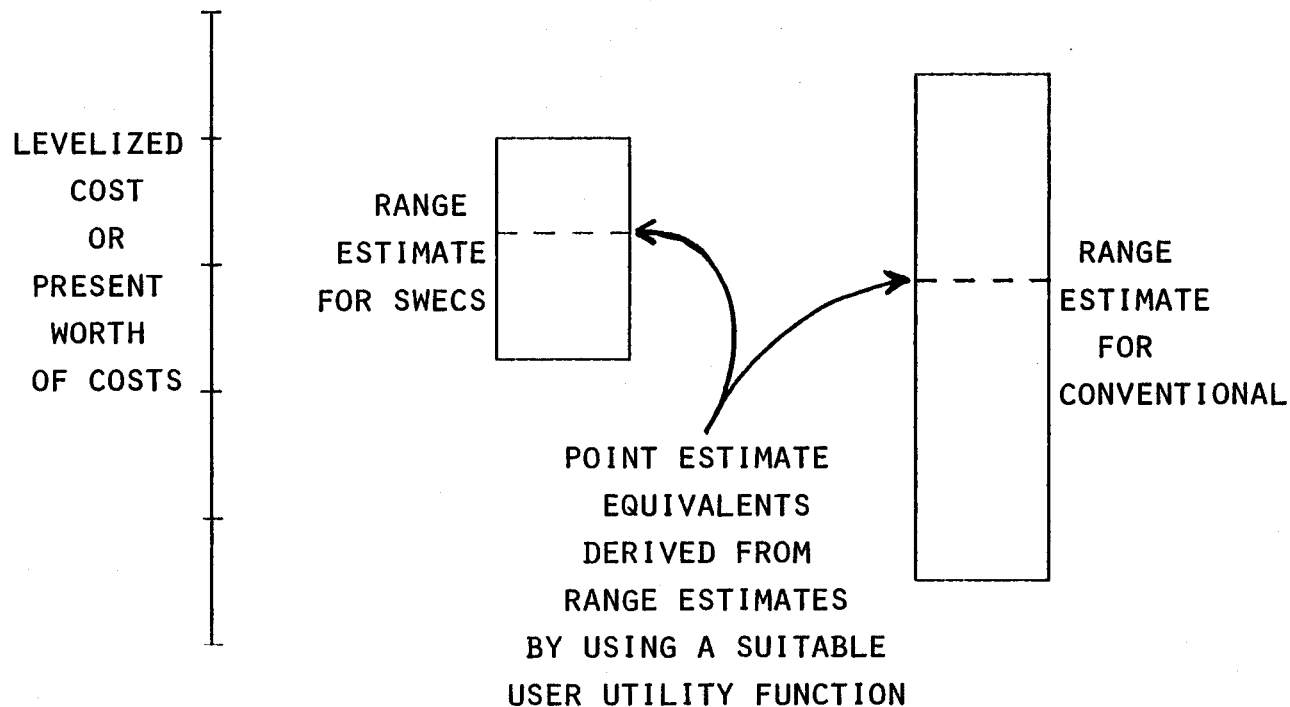
UNCERTAINTY IN
 SWECS ESTIMATED COST = FUNCTION OF (UNCERTAINTY IN ESTIMATED WIND SPEEDS;
 " " " PERFORMANCE
 FUNCTION;
 " " " USEFUL LIFETIME;
 " " " O&M COSTS;
 " " " BACKUP AND BUY-
 BACK RATES)

UNCERTAINTY IN
 CONVENTIONAL ELECTRICITY
 ESTIMATED COST = FUNCTION OF (UNCERTAINTY IN FUTURE FUEL COSTS;
 " " " CAPACITY COSTS;
 " " " O&M COSTS;
 " " " COST OF SERVICE
 ALLOCATIONS)

IF LEVELIZED COST OR PRESENT WORTH OF COSTS IS USED
TO COMPARE SWECS OWNERSHIP WITH ALL-CONVENTIONAL ELECTRICITY

RANGE ESTIMATE OF COST OF EITHER SWECS OR CONVENTIONAL

= FUNCTION OF (ESTIMATED COST; UNCERTAINTY OF ESTIMATED COST)



PR-480
NOVEMBER 16, 1979

PROBLEM: HOW TO CHOOSE A DISCOUNT RATE FOR EITHER PRESENT WORTH OR LEVELIZING?

SOLUTION: EXPRESS COMPARISON AS RATE OF RETURN ON INVESTMENT IN SWECS RATHER THAN AS COMPARISON OF LEVELIZED COSTS OR PRESENT WORTH OF COSTS.

NOVEMBER 16, 1979

HOW IS UNCERTAINTY OF PROJECTIONS INCORPORATED
WHEN COMPARISON IS STATED AS A RATE OF RETURN ON INVESTMENT IN SWECS?

BOTH AN EXPECTATION \hat{R} AND STANDARD DEVIATION σ_R MAY BE DERIVED FOR THE RATE OF RETURN (ROR) ON INVESTMENT IN SWECS, GIVEN THE EXPECTATIONS AND STANDARD DEVIATIONS OF THE VARIABLES UPON WHICH SWECS ROR IS DEPENDENT.

THEN THE RATE OF RETURN \hat{R} ADJUSTED BY THE RISK σ_R MAY BE COMPARED WITH ALTERNATIVE INVESTMENTS. THIS APPROACH AGREES WITH CONTEMPORARY INVESTMENT DECISION-MAKING PROCEDURES.

	FY79												FY80						
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	
Draft Report																			



1.. Complete draft report

RECOMMENDATIONS:

INCORPORATE BACKUP AND BUY-BACK COSTS (IF ANY) IN COST OF SWECS.

CONSIDER UNCERTAINTY EXPLICITLY IN QUANTITATIVE ASSESSMENTS OF ECONOMICS OF SWECS VS. CONVENTIONAL ELECTRICITY.

EXPRESS ECONOMICS OF SWECS AS AN EXPECTED ROR ON THE SWECS INVESTMENT, TOGETHER WITH THE UNCERTAINTY (E.G, STANDARD DEVIATION) OF THAT ROR.

COMPARE SWECS INVESTMENT WITH ALTERNATIVE INVESTMENTS ON RISK-ADJUSTED BASIS.

PR-480
NOVEMBER 16, 1979

PRODUCTS LIABILITY ISSUES ASSOCIATED WITH SWECS

ROBERT NOUN

PR-480
NOVEMBER 16, 1979

OBJECTIVE

PROVIDE POLICY ALTERNATIVES FOR

DEPARTMENT OF ENERGY

WIND ENERGY INDUSTRY

OTHERS

TO ASSURE THAT PRODUCTS LIABILITY ISSUES
ASSOCIATED WITH SWECS DO NOT IMPEDE THEIR
INCREASED USE.

SUBTASK 1 - FORMULATE CRITICAL ISSUES

COMPLETED - - SEE 3RD QUARTER REPORT

SUBTASK 2 - DEVELOPMENT & ANALYSIS OF POLICY ALTERNATIVES

ANALYZE

LEGAL PROBLEMS
ECONOMIC IMPACTS
PROTECTION OF PUBLIC
PROTECTION OF PEOPLE WHO MAY BE LIABLE
EASE OF IMPLEMENTATION AND OTHER
ADVANTAGES/DISADVANTAGES OF EACH ALTERNATIVE

STATUS

COMPLETED

NOVEMBER 16, 1979

PRODUCT

DRAFT FINAL REPORT COMPLETED, REVIEWED, AND NOW IN FINAL PUBLICATION

PURPOSE

PROVIDE ALTERNATIVES FOR DISCUSSION.

CONSIDER PROS AND CONS OF EACH ALTERNATIVE WITHOUT PROVIDING RECOMMENDATIONS.

QUALITY CONTROL

INTERNAL SERI REVIEW

EXTERNAL REVIEW REQUESTED OF TENNYSON (WSB), MAYO (GEORGE WASHINGTON UNIVERSITY), TAUBENFELD (SOUTHERN METHODIST UNIVERSITY), THOMAS (AMERICAN BAR FOUNDATION), HOSENBALL (NASA GENERAL COUNSEL), STRAUSS (DOE OFFICE OF GENERAL COUNSEL), RUBIN (COUNSEL, AWEA), WEINSTEIN (CARNEGIE MELLON UNIV., CONSULTANT)

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SUBTASK 3 - REFINEMENT OF POLICIES

ACTIVITIES

CONSIDER COMMENTS

FURTHER ANALYSIS

RELATIONSHIP AMONG POLICIES

STATUS

IN FINAL PUBLICATION

PRODUCT

INTEGRATED SET OF ISSUES AND POLICY ALTERNATIVES TO BE
COMPLETED DURING NEXT QUARTER.

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PURPOSE

PROVIDE BASIS FOR FURTHER ACTION

QUALITY CONTROL

INTERNAL SERI REVIEW

EXTERNAL REVIEW GROUP

COMPARISON OF TWO STUDIES

SERI

ROCKY FLATS

PRODUCTS LIABILITY ISSUES ASSOCIATED
WITH SWECS

SWECS PRODUCT LIABILITY
INSURANCE ASSESSMENT

PRODUCT LIABILITY LEGAL ISSUES ONLY

PRODUCT LIABILITY INSURANCE
ONLY

PROVIDE POLICY ALTERNATIVES

IDENTIFY DATA REQUIREMENTS

PROVIDE BASIC LEGAL AND POLICY
BACKGROUND

BUILD UPON SERI TASK

	FY 79												FY 80				
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
1. Formulate critical issues									△	▼							
2. Development and analysis of policy alternatives										△	▼						
3. Refinement of policies																	
4. Reports										△		□					

Nov. 00
FY81

△ Begin Milestone

□ Draft Final Report

▼ Milestone Complete

■ Final Report

◆ Workshop or Special Meeting

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ENVIRONMENTAL IMPACT ASSESSMENT OF SMALL WIND ENERGY CONVERSION SYSTEMS

KATHRYN LAWRENCE
AND
CARL STROJAN

OBJECTIVES

IDENTIFY POTENTIAL LIFE-CYCLE ECOLOGICAL AND HEALTH IMPACTS OF SMALL WECS (LESS THAN 100 kW) INTERCONNECTED TO UTILITY GRIDS.

DETERMINE THE ENVIRONMENTAL IMPLICATIONS OF ECOLOGICAL AND HEALTH IMPACTS.

DEFINE POTENTIAL ENVIRONMENTAL BARRIERS TO SMALL WECS DEPLOYMENT.

SUBTASK 1: HUMAN-ENVIRONMENTAL ASSESSMENT

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STEPS

QUANTIFY MATERIALS REQUIRED FOR SYSTEM MANUFACTURE AND OPERATION.

CALCULATE EMISSIONS FROM MATERIALS ACQUISITION AND PROCESSING.

EVALUATE HEALTH RISK FROM EMISSIONS.

DETERMINE INJURY AND ACCIDENT INCIDENCE FROM MANUFACTURE, INSTALLATION, AND OPERATION BY APPLYING APPROPRIATE INDUSTRIAL STATISTICS.

ASSESS RISK OF SMALL WECS OPERATION TO HUMAN POPULATIONS (E.G., POTENTIAL INJURIES FROM BLADE FAILURE).

DETERMINE AESTHETIC IMPACT OF SWECS BY CONDUCTING A NONRANDOM SURVEY OF VISITORS TO THE ROCKY FLATS WIND TEST SITE.

DEVELOP A PILOT SURVEY TO EXAMINE THE VISUAL IMPACTS (AND VISUAL AESTHETICS) OF SWECS.

STATUS

WORK IS SCHEDULED FOR COMPLETION DURING NEXT QUARTER; THE CONSULTANT (JEROME WEINGART OF LBL) HAS BEEN OBTAINED TO INDEPENDENTLY VERIFY SERI RISK ASSESSMENTS.

VISUAL AESTHETICS SURVEY COMPLETED AND APPROVED BY THE SERI SURVEY REVIEW COMMITTEE AND ROCKY FLATS WIND SYSTEMS GROUP FOR DISTRIBUTION AT THE ROCKY FLATS TEST SITE; DATA COLLECTION INITIATED AUGUST 31, 1979 AND WILL CONTINUE THROUGH NOVEMBER OR UNTIL APPROXIMATELY 250 SURVEY RESPONSES ARE OBTAINED.

MATERIALS NECESSARY FOR MANUFACTURE OF 2, 8, AND 40 KW MACHINES HAVE BEEN QUANTIFIED; INITIAL CALCULATIONS OF PRODUCTION EMISSIONS WERE DEVELOPED AND PRESENTED IN THE PROGRESS REPORT.

PRODUCT

TABULATIONS OF MATERIALS NECESSARY FOR SWECS MANUFACTURE AND EMISSIONS ASSOCIATED WITH THEIR PROCESSING WERE PRESENTED IN THE PROGRESS REPORT.

SUMMARY OF LIFE-CYCLE ENVIRONMENTAL HEALTH EFFECTS AND RESULTS OF THE AESTHETICS SURVEY WILL BE PRESENTED IN THE DRAFT FINAL REPORT, BY END OF NEXT QUARTER.

COMPLETE AESTHETICS SURVEY METHODOLOGY AND DEVELOPMENT. RESULTS WILL BE ISSUED AS A TECHNICAL PAPER BY END OF NEXT QUARTER.

PURPOSE

PROVIDE ESTIMATES OF THE EFFECTS OF SWECS ON HUMAN ENVIRONMENTS TO BE INTEGRATED WITH ECOLOGICAL EFFECTS ESTIMATES.

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QUALITY CONTROL

INTERNAL SERI REVIEW

REVIEW BY SELECTED, EXTERNAL PROFESSIONALS (AESTHETICS SURVEY REVIEW CONDUCTED BY ROCKY FLATS WIND SYSTEMS GROUP AND ROBERT FERBER, SURVEY RESEARCH LABORATORY, UNIVERSITY OF ILLINOIS)

DOE REVIEW OF DRAFT FINAL REPORT

STEPS

REVIEW EXISTING SWECS ECOLOGICAL EFFECTS AND TECHNOLOGICAL DATA.

CONTACT SELECTED SWECS MANUFACTURERS TO DETERMINE IF ENVIRONMENTAL PROBLEMS HAVE BEEN ENCOUNTERED AND COLLECT APPROPRIATE DATA.

EXAMINE AND QUANTIFY WHERE POSSIBLE POTENTIAL ECOLOGICAL EFFECTS ON:

LAND USE: REQUIREMENTS OF TOWERS; SAFETY ZONES, MULTIPLE SWECS DEPLOYMENT; SOIL EROSION; RECLAMATION FOLLOWING SWECS DECOMMISSION

AIR QUALITY: INDIRECT EFFECTS FROM USE OF EXOTIC MATERIALS DURING SWECS MANUFACTURE; NOISE; EM INTERFERENCE

WATER QUALITY: SOIL EROSION AND RUNOFF DURING CONSTRUCTION AND OPERATION; RELEASE OF TOXIC FLUIDS (E.G., STORAGE MEDIA IF USED)

BIOTA: DISPLACEMENT OR DESTRUCTION OF PLANT AND ANIMAL COMMUNITIES AND HABITATS; RELEASE OF TOXIC SUBSTANCES THROUGHOUT LIFE-CYCLE; EFFECTS OF ROTOR BLADES.

STATUS

LITERATURE ON PAST WIND-ENVIRONMENTAL RESEARCH WAS SYNTHESIZED AND PRESENTED IN THE PROGRESS REPORT.

GRADUATE SUMMER INTERN JOINED SUBTASK TEAM JUNE THROUGH AUGUST 1979.

PRODUCT

QUALITATIVE AND QUANTITATIVE ANALYSIS OF THE LIFE-CYCLE ECOLOGICAL EFFECTS OF SWECS; EFFECTS WILL BE INTEGRATED WITH HEALTH RISK ESTIMATES AND PRESENTED IN THE DRAFT FINAL REPORT, END NEXT QUARTER.

PURPOSE

PROVIDE ECOLOGICAL EFFECTS ESTIMATES TO BE INTEGRATED WITH HEALTH RISK ESTIMATES.

QUALITY CONTROL

INTERNAL SERI REVIEW

REVIEW BY SELECTED, EXTERNAL PROFESSIONALS

SUBTASK 3: LIFE-CYCLE ENVIRONMENTAL ASSESSMENT

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ACTIVITIES

ANALYZE ENVIRONMENTAL IMPLICATIONS OF HEALTH AND ECOLOGICAL EFFECTS ESTIMATES FOR EACH LIFE-CYCLE PHASE, SWECS DESIGN OPTION, AND DEPLOYMENT OPTION.

DEVELOP A RANKING SYSTEM FOR EACH LIFE-CYCLE PHASE WHICH INCORPORATES THE QUANTITATIVE ESTIMATES OF EFFECTS AND EMISSION WITH THE DURATION OF EACH PHASE.

STATUS

SUBTASK IS BEHIND SCHEDULE; WORK WILL BE CONDUCTED DURING THE NEXT QUARTER.

PRODUCT

INTEGRATED SWECS LIFE-CYCLE ENVIRONMENTAL EFFECTS ESTIMATES TO BE PRESENTED IN THE DRAFT FINAL REPORT, END NEXT QUARTER.

PURPOSE

PROVIDE DETAILED INFORMATION ON POTENTIAL ENVIRONMENTAL BARRIERS AND BENEFITS OF SWECS DEPLOYMENT.

QUALITY CONTROL

INTERNAL SERI REVIEW OF DRAFT FINAL REPORT

PEER REVIEW OF DRAFT FINAL REPORT

DOE REVIEW OF DRAFT FINAL REPORT

SUBTASK 4: VIDEO FILM OF WECS TV INTERFERENCE

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ACTIVITIES

PROVIDE A 15-MINUTE COLOR VIDEO FILM TO SERI AND DOE WHICH PRESENTS THE POTENTIAL ORIGIN AND TV INTERFERENCE OF THE BLOCK ISLAND WIND TURBINE GENERATOR (WTG).

FILM WILL IDENTIFY WHAT ARE AND ARE NOT PROBABLE EFFECTS.

AUDIENCE WILL BE BLOCK ISLAND RESIDENTS AND OTHER INTERESTED LAYMEN.

STATUS

UNIVERSITY OF MICHIGAN RADIATION LABORATORY (THOMAS SENIOR) WAS SELECTED FOR PREPARATION OF THE FILM; SUBTASK EFFORT WAS COMPLETED (SEE 3RD QUARTER REPORT).

ENVIRONMENTAL IMPACT ASSESSMENT FOR SMALL SYSTEMS*

	FY79												FY80					
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Assessment of effects on humans					1						2	3	4	4				
Assessment of ecological effects					1							4	4	4	5			
Video film TV interference					6			7		8								
Life cycle environmental assessment															5			

*Task redefined March/April '79 to incorporate WSB/DOE comments.

1. Collect data
2. Final selection of SWECS designs and deployment options for study
3. Complete SWECS visual aesthetics survey.
4. Progress Report
5. Draft final report
6. Initiate preparation of TV interference film
7. Issue subcontract
8. Complete TV interference film

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SELECTED UTILITIES VALUE ANALYSIS

GEORGE FEGAN

NOVEMBER 16, 1979

OBJECTIVE

DETERMINE THE VALUE OF WECS AT SPECIFIC SITES IN RELATIONSHIP TO SYSTEM MIX OF SELECTED UTILITIES.

ACCOMPLISHMENTS

INITIATED TASK EFFORT DURING THE 4TH QUARTER OF FY79.

DEVELOPED WORK STATEMENT AND SUBMITTED RFP TO SELECTED SOURCES.

PLANNED ACTIVITIES

NEGOTIATE CONTRACTS WITH POTENTIAL SUBCONTRACTORS AND COMMENCE SUBCONTRACTED EFFORT IN NEXT QUARTER.

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WORK STATEMENT FOR SUBCONTRACTED STUDY REVIEWED BY SERI STAFF, TOM REDDOCH, GERRY PARK, AND PETER MORETTI.

REQUEST FOR PROPOSALS SENT TO JBF SCIENTIFIC CORPORATION, AEROSPACE CORPORATION, AND GENERAL ELECTRIC COMPANY.

RESPONSES TO RFPs HAVE BEEN RECEIVED AND EVALUATED. REQUEST FOR INFORMATION ON SPECIFIC REQUIREMENTS HAVE BEEN ANSWERED. CONTRACTS HAVE BEEN NEGOTIATED AND COST ESTIMATES HAVE BEEN NEGOTIATED WITH JBF AND AEROSPACE CORP.

GENERAL ELECTRIC DID NOT RESPOND TO THE RFP.

PROJECT SCHEDULE: COMMENCE STUDY OF SAN GORGONIO 1ST QUARTER FY80 (NOVEMBER 15, 1979) BY BOTH COMPANIES. COMPLETION 3RD QUARTER FY80 (APRIL 15, 1980). COMPLETION OF 11 STUDIES BY END FY80. COMPLETION OF 5 STUDIES ORIGINALLY PLANNED FOR GE BY 2ND QUARTER FY81 (JANUARY 1981).

	FY80												FY81					
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Phase I San Gorgonio Analysis		▽ ¹		▽ ²			▽ ³											
(Phase II) Site 2						▽ ¹		▽ ²		▽ ³								
Site 3									▽ ¹	▽ ²	▽ ³							
Site 4										▽ ¹	▽ ²		▽ ³					
Site 5											▽ ¹	▽ ²		▽ ³				
Site 6																		▽ ⁴

1. Collect data
2. Review of data and preliminary results
3. Delivery of rough draft report
4. Start of Phase III: Analysis of last 6 sites.

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TELEVISION INTERFERENCE AND WECS

R. McCONNELL

NOVEMBER 16, 1979

OBJECTIVES

MEASURE AND DOCUMENT SYSTEMATICALLY THE INTERFERENCE TO TELEVISION AND OTHER ELECTROMAGNETIC SIGNALS IN THE VICINITY OF OPERATIONAL WIND TURBINES.

DEVELOP AND VALIDATE CALCULATIONS OF TV INTERFERENCE FOR BOTH LARGE AND SMALL WIND ENERGY CONVERSION SYSTEMS.

ACCOMPLISHMENTS

INITIATED TASK EFFORT DURING THE 4TH QUARTER OF FY79.

HELD A MEETING IN ANN ARBOR, MICH TO EXPLAIN THE TRANSFER OF TECHNICAL MANAGEMENT TO SERI FROM THE DOE WIND SYSTEM BRANCH OF AN EXISTING DOE SUBCONTRACT GRANTED TO THE UNIVERSITY OF MICHIGAN.

PERFORMED PRELIMINARY MEASUREMENTS OF TVI AT THE MOD-1 SITE.

PLANNED ACTIVITIES

COMPLETE DETAILED TVI MEASUREMENTS AT THE SITE OF THE CABLE TELEVISION (CATV) ANTENNA TOWER 2 KM WEST OF THE MOD-1.

COMPLETE A DETAILED TVI FIELD SURVEY AT THE MOD-0A SITE IN BLOCK ISLAND, R. I. AND AT THE MOD-1 SITE.

OUTPUT

SYSTEMATIC TVI MEASUREMENTS AT LARGE WIND TURBINE SITES.

AN UPDATED TVI SITING HANDBOOK FOR LARGE WIND SYSTEMS.

A TVI SITING HANDBOOK SUITABLE FOR THE HOMEOWNER CONTEMPLATING THE INSTALLATION OF A SMALL WIND SYSTEM.

RESULTS OF THE SEPT. 14 MEETING IN ANN ARBOR, MICHIGAN

THE UNDERSTANDING RESULTING FROM THE MEETING WAS THAT THE BLOCK ISLAND SYSTEMATIC TVI SURVEY IS TO BE DONE BEFORE THE SYSTEMATIC SURVEY OF BOONE. A PRELIMINARY SURVEY IS TO BE CARRIED OUT AT BOONE TO RESPOND TO THE TVI COMPLAINT SITUATION. R. McCONNELL AND JOE FERRIS WENT THERE ON SEPTEMBER 19 FOR THAT PURPOSE. THE SCHEDULE FOR THE TVI SMALL SYSTEMS STUDIES IS ALLOWED TO SLIP UNTIL NEXT YEAR. THE MOD-1 AND MOD-OA WORK WILL HAVE FIRST PRIORITY. THE UNIVERSITY OF MICHIGAN CONTRACT, THEREFORE, IS TO BE REWRITTEN SO AS TO ADD NEW DELIVERABLES. R. McCONNELL IS TO PROVIDE A REWRITTEN WORK STATEMENT. IN APPROXIMATE ORDER OF PRIORITY, THE FOLLOWING WORK IS TO BE DONE:

UNIVERSITY OF MICHIGAN IS TO HAVE REPRESENTATIVES ON BLOCK ISLAND FOR THE TOWN MEETING ON SEPTEMBER 26;

THE COMPLAINT QUESTIONNAIRE IS TO BE PREPARED;

THE DETAILED TEST PLAN IS TO BE WRITTEN;

THE CONTRACT DELIVERABLES NEED TO BE RESPECIFIED; AND

A NEW CONTRACT (EFFECTIVELY AN EXTENSION) IS TO BE PREPARED.

PARTICIPANTS SEPT. 14, 1979 ANN ARBOR, MI.

TOM SENIOR	THE RADIATION LABORATORY OF THE UNIVERSITY OF MICHIGAN
DIPAK SENGUPTA	"
JOE FERRIS	"
IVAN LAHAIE	"
PAUL JEDRZEJEWSKI	"
DAN ANCONA	DOE WIND SYSTEMS BRANCH
DARREL BALDWIN	NASA-LEWIS WIND ENERGY PROJECT OFFICE
ART BIRCHENOUGH	"
ALAN SAUNDERS	"
IRWIN VAS	SERI
ROBERT MCCONNELL	"

ON-SITE TV INTERFERENCE PLAN FOR WTG - BLOCK ISLAND

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IDENTIFY SEVERAL TEST SITES WITHIN 0.25 - 0.5 MILES OF THE WTG.

SET UP THE TEST EQUIPMENT AT ONE OF THE SELECTED SITES, AND POSITION THE TV ANTENNA TO RECEIVE AN AVAILABLE UHF TV CHANNEL SIGNAL.

LOCK THE WTG BLADES HORIZONTAL WITH THEIR PITCH SET FOR MAXIMUM POWER, AND ROTATE THE TURBINE NACELLE IN AZIMUTH.

RECORD THE RECEIVED TV SIGNAL AT THE TEST SITE WITH ANTENNA AS IN THE PRECEDING STEP. REPOSITION THE ANTENNA TO RECEIVE MAXIMUM SIGNAL SCATTERED OFF THE WTG BLADES. LOCK THE NACELLE AT THE AZIMUTH OF MAXIMUM RECEIVED SIGNAL.

ROTATE WTG BLADES IN THE VERTICAL PLANE. OBSERVE AND RECORD INTERFERENCE EFFECTS.

REPEAT ABOVE FOR TWO OR THREE TV CHANNELS.

REPEAT ABOVE AT THREE OR FOUR SELECTED TEST SITES.

SELECT THREE OR FOUR AVAILABLE HOMES, AND USE THEIR TV ANTENNAS TO OBSERVE AND RECORD INTERFERENCE EFFECTS.

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TIME PERIOD

PREPARATION	1 WEEK
TRAVEL	1 WEEK
TEST 1 - 7	1 WEEK
TEST 8	<u>1 WEEK</u>
TOTAL	4 WEEKS

TRAVEL

MAKE ONE OVERNIGHT 2-MAN TRIP FOR INITIAL EXAMINATION OF THE SITE.

PERSONNEL

J. E. FERRIS (IN CHARGE OF TESTS)

I. LAHAIE

D. L. SENGUPTA

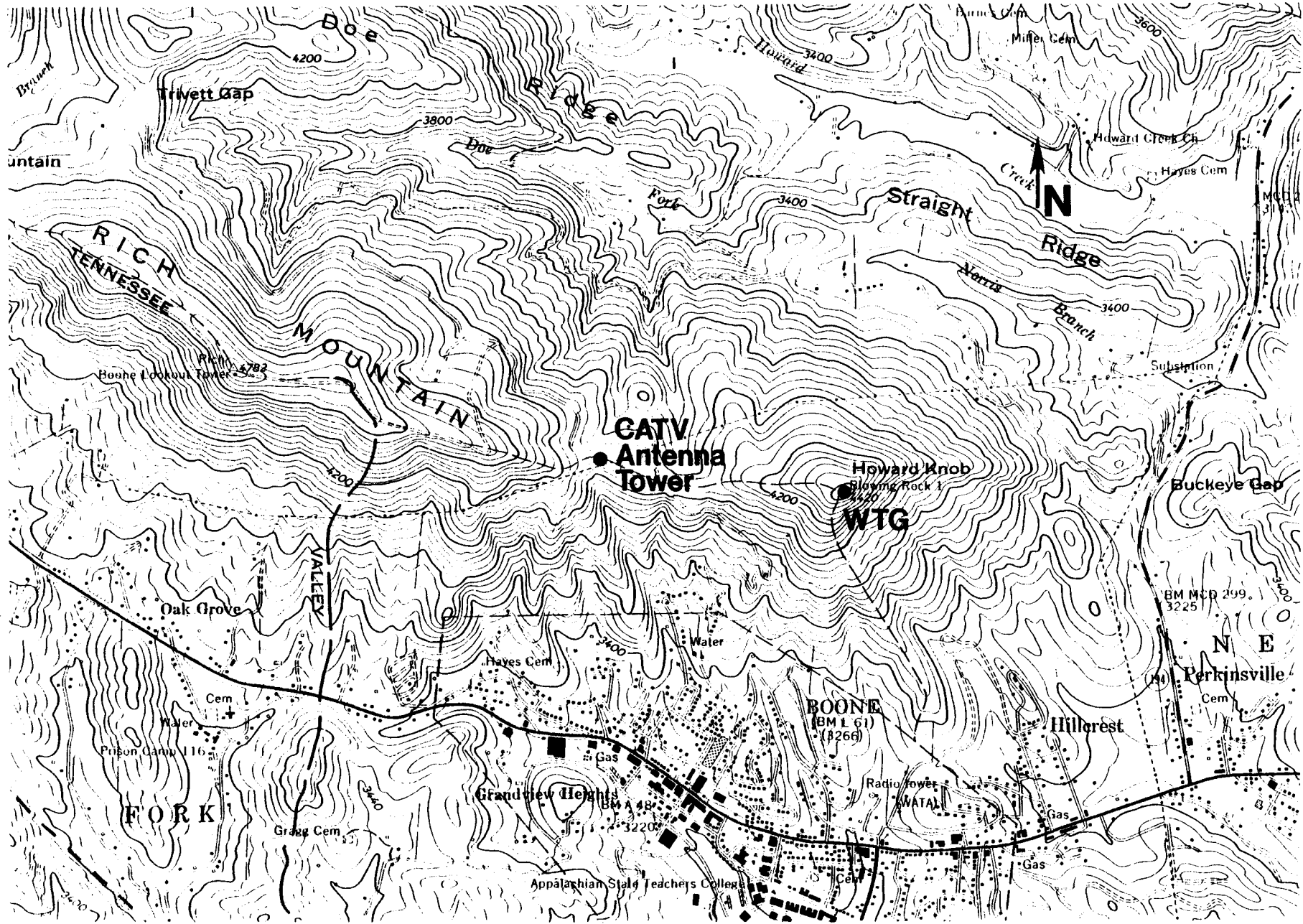


Fig. 1 Map Showing the Topographical Characteristics of the WTG Site and the Surrounding Area at Boone, N.C.

EXCERPTS FROM TRIP REPORT TO BOONE, N. C., SEPT. 20, 1979

AT THE A. T. VANDUREN'S WHICH IS 1 KM WEST OF THE MOD-1, JOE FERRIS CONNECTED THE SPECTRUM ANALYZER TO THE VANDUREN'S ANTENNA AND MEASURED THE SIGNAL STRENGTH ON ALL OF THE TV CHANNELS. THE BLADES OF THE MOD-1 WERE FIXED IN THE 3-9 POSITION (HORIZONTAL) WITH THE PITCH SET FOR MAXIMUM POWER. THE TURBINE WAS THEN YAWED THROUGH 360°. A REFLECTED SIGNAL (CHANNEL 5) WAS SEEN ON THE SPECTRUM ANALYZER WHICH HAD ALL OF THE CHARACTERISTICS OF HAVING COME FROM THE MOD-1 BLADES. THERE WERE TWO SIGNAL FLUCTUATIONS COMING CLOSE UPON ONE ANOTHER WHICH CORRESPOND TO REFLECTIONS FROM EACH OF THE TWO BLADES. ANOTHER SET APPEARED ABOUT 180° LATER WHICH CORRESPONDS TO REFLECTIONS OFF OF THE OPPOSITE BLADE SURFACES. ONLY AN APPROXIMATE CORRELATION WAS FOUND FOR THE DIRECTION OF CHANNEL 5'S SIGNAL, THE REFLECTED SIGNAL FROM THE MOD-1 BLADES AND THE LOCATION OF THE VANDUREN HOUSE WITH RESPECT TO THE MOD-1. WE DETERMINED THAT WE WOULD HAVE TO HAVE AN AZIMUTH READING FROM THE MOD-1 DURING THE TEST RATHER THAN GETTING CARDINAL DIRECTIONS OVER THE TELEPHONE (N, S, E, W). THE MOD-1 WAS THEN YAWED AGAIN THROUGH 360° WITH THE BLADES IN THE 6-12 POSITION (VERTICAL), AGAIN WITH MAXIMUM BLADE PITCH. NO REFLECTED SIGNALS WERE SEEN WHICH IS TO BE EXPECTED DUE TO TV'S HORIZONTALLY POLARIZED SIGNAL.

EXCERPTS FROM TRIP REPORT TO BOONE, N. C., SEPT. 20, 1979
(CONT.)

BOB BUMGARNER OF BLUE RIDGE ELECTRIC MEMBERSHIP CORPORATION (BREMCO) MADE ARRANGEMENTS FOR US TO MAKE TESTS AT THE T. B. COVELL'S HOUSE AT ABOUT NOON. THEIR HOUSE IS ABOUT 1 KM EAST OF THE TURBINE. THEY PRIMARILY WATCH CHANNELS 3 AND 8 ALTHOUGH CHANNEL 8 IS PERHAPS WATCHED THE MORE FREQUENTLY OF THE TWO. THEIR ANNTENNA, WHICH LOOKED EXPENSIVE, HAD A ROTOR AND WAS POINTED EAST, I.E., 180° AWAY FROM THE TURBINE! THEY ALSO HAD A SMALL SIGNAL BOOSTER CONNECTED BETWEEN THE ANTENNA AND THE TV'S ANTENNA TERMINALS. TESTS WERE MADE ONLY WITH THE MOD-1 BLADES IN A HORIZONTAL POSITION AND WITH MAXIMUM PITCH. FOR THIS TEST AZIMUTH READINGS WERE PROVIDED BY THE NASA MOBILE DATA CENTER AT THE MOD-1 SITE (TELEPHONE NUMBER TO THE DATA CENTER IS 264-5773). THE AZIMUTH READINGS, RECEIVED BY TELEPHONE AT THE HOME, CONSIDERABLY SIMPLIFIED THE CORRELATION OF THE REFLECTED SIGNALS WITH THE HOME'S LOCATION. THE REFLECTED SIGNALS WERE UNUSUALLY STRONG (± 4 DB) CONSIDERING THE SUPPOSED DIRECTIONALITY OF THE COVELL'S ANTENNA.

IN CONCLUSION, STATIC TVI TESTS WERE CARRIED OUT AND CONFIRMED THE EXISTENCE OF TVI AS CAUSED BY THE MOD-1. CONSIDERING THE FACT THAT THE TURBINE HAS OPERATED ONLY ABOUT 20 TO 30 HOURS SINCE ITS DEDICATION ON JULY 11, 1979 AND THAT SEVEN WIND TURBINE TVI COMPLAINTS HAVE BEEN COLLECTED BY THE BREMCO, THE PROBLEM IS SERIOUS.

	FY79												FY80						
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	
TVI site survey											△			▽ ¹		▽ ²			
Small Wind Systems											△								▽ ³

1. Complete systematic TVI site survey at Block Island, Rhode Island.
2. Complete systematic TVI site survey at Boone, North Carolina.
3. Award subcontract extension to University of Michigan for small wind system work and handbook update.

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NOISE MEASUREMENTS AT SELECTED WIND SYSTEM SITES

R. McCONNELL

NOVEMBER 16, 1979

OBJECTIVE

MEASURE AND DOCUMENT THE NOISE GENERATED BY WIND TURBINES AT SELECTED WIND SYSTEM SITES.

RELATE THE MEASUREMENTS, THEIR ANALYSIS, AND APPROPRIATE NOISE REGULATIONS IN A HANDBOOK SUITABLE FOR FUTURE SITING OF WIND TURBINES.

ACCOMPLISHMENTS

INITIATED TASK EFFORT DURING THE 4TH QUARTER OF FY79.

COLLECTED AND REVIEWED PREVIOUS DOCUMENTATION OF NOISE MEASUREMENTS AT WIND TURBINE SITES.

PREPARED AND SUBMITTED FOR REVIEW A WORK STATEMENT FOR FIELD MEASUREMENTS OF NOISE GENERATED BY WIND TURBINES.

PLANNED ACTIVITIES

ESTABLISH A WORK PLAN FOR PRELIMINARY MEASUREMENTS OF SOUND PRESSURE LEVELS (NOISE) AT THE MOD-1 SITE IN BOONE, N. C.

MAKE PRELIMINARY MEASUREMENTS OF SOUND PRESSURE LEVELS AT THE MOD-1 SITE. THESE MEASUREMENTS ARE TO BE MADE BY SERI'S MEASUREMENT DESIGN AND SUPPORT BRANCH.

COMPLETE A DETAILED NOISE SURVEY AT THE MOD-1 SITE.

OUTPUT

FIELD MEASUREMENTS OF NOISE GENERATED BY LARGE WIND TURBINES AT CLAYTON, N. M.; BOONE, N. C.; BLOCK ISLAND, R. I.; AND OTHER WIND TURBINE SITES TO BE SPECIFIED.

A SITING HANDBOOK TREATING NOISE GENERATED BY LARGE WIND TURBINES.

TEST PLAN

PRELIMINARY ACOUSTIC MEASUREMENTS, MOD-1 WIND MACHINE AT BOONE, N. C.
OCTOBER 25-27

PREPARED BY: N. D. KELLEY AND H. E. MCKENNA, MEASUREMENT DESIGN & SUPPORT
BRANCH (SERI)

REVIEWED BY A. BIRCHENOUGH, J. BALOMBIN (NASA LEWIS)

OBJECTIVE: TO PERFORM A SERIES OF PRELIMINARY SOUND LEVEL MEASUREMENTS AT AND
IN THE VICINITY OF THE NASA/DOE MOD-1 WIND TURBINE INSTALLED NEAR BOONE, N. C.
FOR USE AS A BASIS FOR THE DESIGN OF A MORE DEFINITIVE ACOUSTIC MONITORING
PROGRAM AT VARIOUS WIND TURBINE SITES.

METHOD: WIND, WEATHER, AND MACHINE CONDITIONS PERMITTING, THE SOURCE STRENGTH OF THE MACHINE OPERATING NOISE WILL BE MEASURED BY INCIDENT SOUND LEVEL MEASUREMENTS TAKEN WITHIN 50M OF THE MOD-1 ALONG THE PREVAILING WIND AND CROSSWIND AXES. THESE MEASUREMENTS, HOPEFULLY TAKEN DURING PERIODS OF SUSTAINED LOAD CONDITIONS, WILL BE COMPARED WITH SIMILAR READINGS TAKEN DURING MACHINE SHUTDOWN IN ORDER TO ESTIMATE THE EXCESS OF MACHINE NOISE OVER NORMAL BACKGROUND LEVELS. IT IS PLANNED TO REPEAT THE MEASUREMENT SERIES OVER A RANGE OF LOAD CONDITIONS SO THAT THE MACHINE/BACKGROUND NOISE FIGURES CAN BE COMPARED WITH LOCAL WIND VELOCITY REGIMES.

CONCURRENTLY WITH THE MEASUREMENTS TAKEN AT THE MOD-1 INSTALLATION, SIMILAR DATA WILL BE COLLECTED AT VARIOUS HOMESITES WITHIN A 1.6 KM RADIUS OF THE WIND TURBINE. THE HOMES CHOSEN WILL INCLUDE THOSE WHO HAVE MADE COMPLAINTS IN THE PAST, SITES WHICH HAVE DIRECT LINE-OF-SITE EXPOSURES, AND OTHERS, WHICH ARE WITHIN THE CIRCLE OF INTEREST, BUT ARE IN SOME WAY SHIELDED FROM A DIRECT EXPOSURE.

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THE HOMES AT WHICH MEASUREMENTS WILL BE TAKEN WILL BE DETERMINED BY THE AVERAGE WIND DIRECTION AS MEASURED AT THE HUB HEIGHT (45M). BOTH UPWIND AND DOWNWIND READINGS WILL BE TAKEN WITH A PREFERENCE FOR THE DOWNWIND LOCATIONS IN THE EVENT MARGINAL OPERATING CONDITIONS EXIST. REMOTE READINGS MAY ALSO BE TAKEN ALONG THE CROSSWIND AXIS IF TIME AND THE CONDITIONS PERMIT. BACKGROUND LEVELS WILL BE DETERMINED FOR EACH REMOTE SITE DURING MACHINE SHUTDOWN PERIODS SO AS TO INSURE A SIMILAR WIND VELOCITY PATTERN.

MEASUREMENTS: THE ACOUSTIC MEASUREMENTS WILL COVER A RANGE OF 2.6 HZ TO 20 KHZ. STANDARD "A" WEIGHTED SOUND PRESSURE (DBA) READINGS WILL BE TAKEN MANUALLY AT BOTH THE MOD-1 AND REMOTE SITES UTILIZING A BRUEL & KJAER (B&K) TYPE 2203 OR 2215 SOUND LEVEL METER (SLM) (ANSI S1.4-1971, TYPE 1 METER). BOTH THE TYPE 1 SLM'S WILL BE EQUIPPED WITH A B&K TYPE 4165 MICROPHONE WHICH IS SENSITIVE OVER THE RANGE STATED ABOVE. DEPENDING ON THE OPERATING MODE IN USE, A GENRAD TYPE 1565-B (ANSI S1.4-1971, TYPE 2) SLM WILL BE USED TO SUPPLEMENT AND BACKUP THE READINGS AT EITHER THE SOURCE OR REMOTE LOCATIONS.

IN ADDITION TO THE MANUALLY RECORDED DBA READINGS, THE INCIDENT SOUND LEVEL SPECTRUM WILL BE RECORDED ON MAGNETIC TAPE USING A B&K TYPE 7003 INSTRUMENTATION TAPE RECORDER. THIS SIGNAL WILL BE RECORDED UN-WEIGHTED (FLAT) AND WILL COVER A FREQUENCY RANGE OF 2.6 HZ TO 10 KHZ $\pm 0.5\%$. THE "A" WEIGHTED TIME SERIES MAY ALSO BE RECORDED ON ANOTHER CHANNEL FOR COMPARISON. THE RECORDING WILL BE MADE OF THE SOURCE AND, IF TIME AND CONDITIONS PERMIT, AT ONE OR TWO REMOTES. THE RECORDINGS WILL BE USED FOR POST-ANALYSIS AT SERI. AS A BACKUP FOR THE TAPE RECORDING, THE B&K SLM'S ARE EQUIPPED FOR OCTAVE BAND OUTPUTS AND MANUAL READINGS OF EACH BAND WILL BE RECORDED.

THE SLM'S WILL BE CALIBRATED ON SITE WITH A B&K TYPE 4220 OR GENRAD TYPE 1567 SOUND LEVEL CALIBRATORS (SLC'S). ONE CALIBRATOR WILL BE ASSIGNED TO EACH DATA-TAKING LOCATION FOR MAXIMUM FLEXIBILITY.

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WITHIN THE DESIGN LIMITATIONS OF THE SLM MICROPHONES, THE INCIDENT ANGLES OF THE PROPAGATED TURBINE SOUNDS WILL BE ATTEMPTED TO BE ASSESSED, PARTICULARLY AT THE REMOTE (RECEIVER) LOCATIONS. A SEARCH WILL BE MADE FOR THE INCIDENCE ANGLE AT WHICH THE "A"-WEIGHTED, FLAT SPECTRUM, OR OCTAVE BAND LEVELS ARE MAXIMIZED THROUGH THE USE OF AN INCLINOMETER ATTACHED TO THE SLM OR SUPPORTING TRIPOD.

REQUIRED ANCILLARY DATA:

MOD-1 WIND TURBINE. FREQUENT READINGS OF THE TURBINE OPERATING PARAMETERS (PERCENT LOAD, BLADE PITCH ANGLE, AND AZIMUTHAL ORIENTATION) WILL BE NECESSARY FOR LATER INTERPRETATION AND ANALYSIS. IT WOULD BE HIGHLY DESIRABLE IF THIS DATA COULD BE FURNISHED IN A TABULATED, TIME-SERIES FORMAT FROM THE MACHINE'S CONTROL SYSTEM COMPUTERS.

SITE METEOROLOGICAL DATA. TABULATED, TIME-SERIES READINGS OF THE THREE LEVELS OF WIND SPEED AND DIRECTION (18.2, 45.7, AND 76.2 M) FOR THE PERIODS OF SOUND LEVEL MEASUREMENTS. SURFACE DATA INCLUDING BAROMETRIC PRESSURE, TEMPERATURE, RELATIVE HUMIDITY (OR DEW POINT TEMPERATURE), AND THE SURFACE WIND VECTOR ARE ALSO NECESSARY. SERI WILL FURNISH A PORTABLE BAROMETER FOR STATION PRESSURE MEASUREMENTS IF REQUIRED.

UPPER AIR DATA. ARRANGEMENTS HAVE BEEN MADE BY SERI TO OBTAIN ALL UPPER AIR DATA TAKEN AT THE NATIONAL WEATHER SERVICE RADIOSONDE FACILITY AT GREENSBORO, N. C. FROM THE SURFACE TO 10,000 FT (700 MB) FOR OCTOBER 24-28. THIS DATA WILL CONTAIN THE TEMPERATURE, HUMIDITY, AND WIND VECTOR FOR EACH PRESSURE CONTACT POINT IN THE RADIOSONDE ASCENT UP TO 700 MB. THE ALTITUDE OF THE GREENSBORO NWS STATION IS ABOUT 900 FT MSL.

OPERATIONS: SERI PERSONNEL WILL EXPECT TO MONITOR THE INCIDENT SOUND LEVELS AT THE MOD-1 AND REMOTE SITES AS MUCH AS POSSIBLE DURING THE AVAILABLE OPERATING PERIODS FROM OCTOBER 25-27. IT WILL BE NECESSARY TO ASK FOR A COMPLETE SHUTDOWN OF THE MACHINE OCCASIONALLY (AS DETERMINED BY VARIATIONS IN THE CURRENT METEOROLOGICAL REGIME) IN ORDER TO ESTABLISH ACOUSTIC BACKGROUND NOISE UNDER THE PRESENT METEOROLOGICAL SITUATION.

COMMUNICATIONS BETWEEN THE OBSERVER AT THE MOD-1, THE REMOTE OBSERVER, AND THE MOD-1 CONTROL ROOM WILL BE VIA SERI-FURNISHED, HAND-HELD FM RADIOS OPERATING ON A DOE-ASSIGNED FREQUENCY OF 164.750 MHZ.

OPTIONAL OPERATING MODES: IF POSSIBLE, IT WOULD BE HIGHLY DESIRABLE TO HAVE THE MOD-1 OPERATED (WITHIN SAFE LIMITS) IN THE FOLLOWING MANUAL MODES:

1. AN AZIMUTHAL SLEWING OF $\pm 30^\circ$ EITHER SIDE OF THE PREVAILING WIND VECTOR USED FOR MACHINE ORIENTATION; AND
2. TO VARY THE MACHINE LOADING BELOW THE CURRENT AVAILABLE MAXIMUM THROUGH MANUALLY VARYING THE BLADE PITCH ANGLE IN ORDER TO DETERMINISTICALLY MODULATE THE RADIATED MACHINE NOISE.

	FY79									FY80									
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	
Noise Measurements										△								▽ ¹	
First site systematic noise survey (Mod-1)										△									▽ ²

1. Preliminary noise measurements at Mod-1 site.
2. Work Statement for first site systematic noise survey (Mod-1).

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A COMPREHENSIVE GUIDE OF WECS CONNECTED TO ELECTRIC UTILITIES

ROGER TAYLOR

NOVEMBER 16, 1979

OBJECTIVES

PROVIDE A COMPREHENSIVE, CONSOLIDATED, READABLE SOURCE OF INFORMATION ON WECS AS IT RELATES TO ELECTRIC UTILITIES.

PROVIDE A KEY REFERENCE DOCUMENT TO UTILITIES, PUBLIC UTILITY COMMISSIONS, STATE ENERGY OFFICES AND OTHERS ON THE DEVELOPMENTS WHICH HAVE TAKEN PLACE IN THE RECENT PAST AND ARE CURRENTLY TAKING PLACE IN THE FIELD OF WIND ENERGY.

ACCOMPLISHMENTS

INITIATED EFFORT DURING THE 4TH QUARTER OF FY79.

ASSEMBLED AND DISTRIBUTED FOR COMMENT PRELIMINARY TABLE OF CONTENTS.

COMMENCED REVIEW OF VALUE ANALYSIS STUDIES.

PLANNED ACTIVITIES

PREPARE DRAFT OF VALUE ANALYSIS CHAPTER, SECTION 5.1.

INITIATE CONSULTANT EFFORTS AS REQUIRED.

OUTPUT

PREPARE DRAFT REPORT DURING THE 3RD QUARTER OF FY80.

PREPARE FINAL REPORT END OF THE 4TH QUARTER OF FY80.

METHODOLOGY

REVIEW ONGOING LITERATURE AND UPDATE FOR EACH SECTION OF GUIDE.

OBTAIN AS MUCH INFORMATION FROM ONGOING RESEARCH AS POSSIBLE.

CONSOLIDATE INFORMATION INTO DRAFT VERSIONS OF EACH SECTION.

ITERATE WITH INTERNAL AND EXTERNAL REVIEW TO INSURE COMPREHENSIVENESS AND READABILITY.

UTILITY GUIDE DESCRIPTION

- 1.0 INTERESTING RECENT DEVELOPMENTS
 - FEDERAL WIND PROGRAM
 - PRIVATE INDUSTRY DEVELOPMENTS
 - PROJECTIONS OF POTENTIAL WIND ENERGY CONTRIBUTIONS

- 2.0 THE WIND AS AN ENERGY SOURCE
 - RESOURCE AVAILABILITY
 - SITING
 - SENSORS & TECHNIQUES

- 3.0 TECHNICAL CHARACTERISTICS
 - EQUIPMENT
 - PERFORMANCE
 - SYSTEM OPERATION
 - ENVIRONMENTAL
 - RELIABILITY
 - CODES & STANDARDS

4.0 INSTITUTIONAL ISSUES
-LEGAL ISSUES
-SOCIAL ISSUES
-ENVIRONMENTAL ISSUES

5.0 ECONOMIC ASSESSMENT
-THE VALUE OF WECS
-THE COST OF WECS
-THE TRADEOFF

6.0 AVAILABLE TOOLS

APPENDIX A - WECS COMPUTER CODE

APPENDIX B - BIBLIOGRAPHY

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STATUS

PRELIMINARY TABLE OF CONTENTS ASSEMBLED & DISTRIBUTED FOR COMMENT TO TENNYSON (WSB), DIVONE (WSB), RUMBAUGH (EES), HEALY (ROCKY FLATS), REDDOCH.

REVIEW OF VALUE ANALYSIS STUDIES BEGUN.

	FY79												FY80					
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Value Analysis - Section 5.1														△		▽ ¹		
Recent Developments - Section 1.0																△		
Energy Source - Section 2.0																		△
Technical Characteristics - Section 3.0																		△
Institutional Issues - Section 4.0																		△
Costs - Section 5.2																		

1. First Draft



National Renewable
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