SERI/PR-35-291

Wind Energy Systems Quarterly Review January 1, 1979-March 30, 1979

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

SERI

Solar Energy Research Institute

1536 Cole Boulevard
Golden, Colorado 80401

A Division of Midwest Research Institute

NOTICE

SERI/PR-35-291

WIND ENERGY SYSTEMS
QUARTERLY REVIEW
JANUARY 1, 1979-MARCH 30, 1979

JUNE 4, 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-35-291
DATE: JUNE 1979
PROGRAM: WIND ENERGY SYSTEMS
TASK: 3520
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

MELVIN K. SIMMONS
ASSISTANT DIRECTOR
ANALYSIS DIVISION

NEIL H. WOODLEY
BRANCH CHIEF
SYSTEMS ANALYSIS

IRWIN E. VAS
PROGRAM COORDINATOR

AGENDA

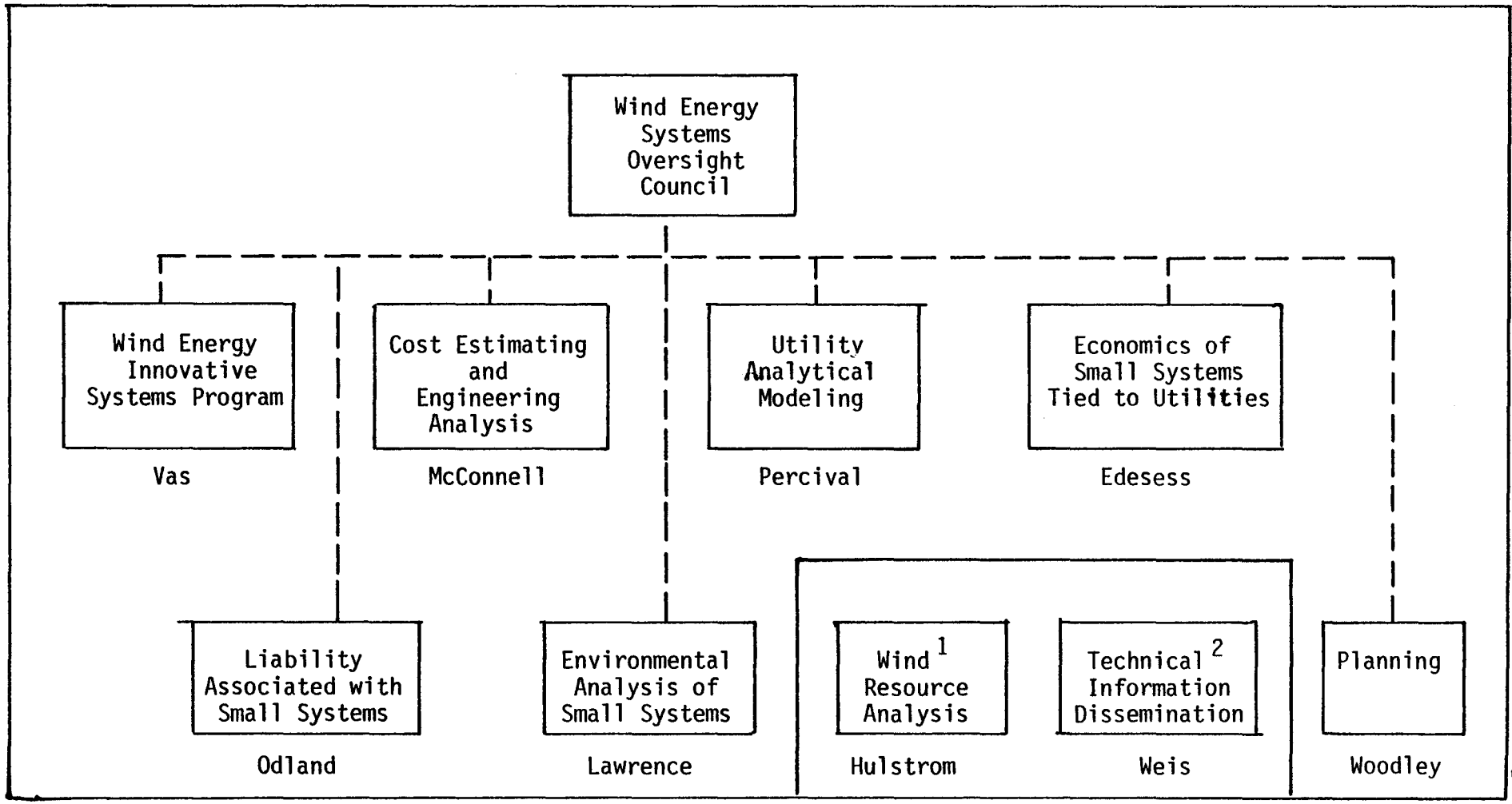
PROGRAM OVERVIEW

IRWIN E. VAS

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

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

WIND ENERGY RELATED TASKS



[1] Basic and Applied Research - (Program Area 14)

[2] Commercialization Activities - (Program Area 18)

THE OVERSIGHT COUNCIL IS COMPRISED OF:

NEIL WOODLEY	CHAIRMAN
IRWIN VAS	PROGRAM COODINATOR
IRWIN VAS	PROGRAM MANAGER
ROBERT LORMAND	
KATHERYN LAWRENCE	
ROBERT MCCONNELL	
BOB ODLAND	
JON VEIGEL	
PAT WEIS	

WIND ENERGY INNOVATIVE SYSTEMS

Objective

Determine technical and economic feasibility of Innovative Wind Energy systems

Accomplishments

Released RFP RH-9-8005 entitled "Advanced and Innovative Wind Energy Concept Development" and received 37 responses

Awarded six contracts in response to RFP RH-9-8003 entitled "Generic Studies of Wind Energy Systems"

Awarded a contract to University of Dayton Research Institute on "Electrofluid Dynamic Wind Generator Study" for $117K

Received management responsibilities for the renewal contract with South Dakota School of Mines and Technology entitled "Energy from Humid Air" for $69K

PLANNED ACTIVITIES

COMPLETE CONTRACT NEGOTIATIONS FOR THE "DAWT", AND "AEROSOL GENERATOR"

COMPLETE EVALUATION FOR THE RFP ON "ADVANCED AND INNOVATIVE WIND ENERGY CONCEPT DEVELOPMENT"

CONDUCT WEIS CONFERENCE

REVIEW 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

COST ESTIMATING AND ENGINEERING ANALYSIS OF INNOVATIVE WECS

OBJECTIVE

ESTIMATE THE COST OF ENERGY PRODUCED BY INNOVATIVE WECS

ACCOMPLISHMENTS

REQUESTED PROPOSALS FOR A LOW BUDGET ($10K) SHORT TERM (6 WEEKS) DEVELOPMENT OF A METHODOLOGY FOR ESTIMATING COST OF ENERGY FOR INNOVATIVE SYSTEMS IN THEIR CONCEPT STAGE

CONTRACT GIVEN TO SCIENCE APPLICATIONS, INC. FOR DEVELOPMENT OF A SCREENING METHODOLOGY FOR INNOVATIVE WECS AND APPLICATION OF THE METHODOLOGY TO THE GRUMMAN DAWT

COMPLETED DRAFT REPORT ENTITLED "A GENERAL RELIABILITY AND SAFETY METHODOLOGY AND ITS APPLICATION TO WIND ENERGY CONVERSION SYSTEMS"

PLANNED ACTIVITIES

REVIEW AND REQUEST REVIEWS OF SCREENING METHODOLOGY FOR INNOVATIVE WECS

REQUEST REVIEWS OF RELIABILITY AND SAFETY METHODOLOGY REPORT

BEGIN EXPLORATORY SUBCONTRACT ON DETAILS OF COSTS OF DEVELOPMENT PHASE IN WEIS LIFE CYCLE

OUTPUT

TECHNICAL REPORT DESCRIBING A METHODOLOGY FOR EVALUATING AN INNOVATIVE WEC's RELIABILITY AND SAFETY AND ITS ASSOCIATED OPERATION AND MAINTENANCE COSTS

TECHNICAL REPORT DESCRIBING A METHODOLOGY FOR ESTIMATING THE COST OF ENERGY OF INNOVATIVE WECS IN THEIR CONCEPT PHASE

TECHNICAL REPORT ESTIMATING THE IMPACT OF DEVELOPMENT COSTS ON THE LIFE CYCLE COSTS OF INNOVATIVE WECS

UTILITY ANALYTICAL MODELING

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

ACCOMPLISHMENTS

UTILITY MODELS:

VERIFIED THAT SELECTED PROGRAM PROMOD MAY BE USED IN WECS VALUE DETERMINATION

PURCHASE REQUEST FOR PROMOD ISSUED FOR USE ON TYMSHARE

DRAFT REPORT "PRODUCTION COST MODEL EVALUATION" COMPLETED

REVIEWED INFORMATION ON UTILITY EXPANSION PLANNING MODELS

WECS REPRESENTATIONS:

AVAILABLE WRITTEN DOCUMENTATION REVIEWED

COMPUTER TAPES WITH JBF MODELS RECEIVED AND VERIFICATION OF INCLUDED CASES BEGUN

TAPES OF STONE & WEBSTER AND G.E./EPRI PROGRAMS REQUESTED

PLANNED ACTIVITIES

FINALIZE REPORT ON UTILITY PRODUCTION COST MODEL EVALUATIONS

BEGIN TRAINING ON PROMOD

COMPLETE INSTALLATION AND BEGIN TESTING OF JBF, STONE & WEBSTER AND GENERAL ELECTRIC WIND MODELS. ALSO BEGIN TESTING OF BOEING'S SIMWEST

REQUEST A UTILITY EXPANSION PLANNING TOOL

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

ECONOMICS OF SWECS TIED TO THE UTILITY GRID

OBJECTIVE

PERFORM ANALYSES IN CERTAIN UNRESOLVED PROBLEM AREAS PERTAINING TO THE INTERCONNECTION OF SWECS WITH THE UTILITY GRID

INVESTIGATIONS ARE TO COMPLEMENT AND BE CO-ORDINATED WITH "WECS FOR RECS" TASK BEING PERFORMED BY RSSG, INC.

THIS REPRESENTS A CHANGE IN DIRECTION FOR THIS TASK AS COMPARED WITH STATUS AT LAST QUARTERLY REPORT.

ACCOMPLISHMENTS

DISCUSSIONS, RESEARCH OF PRIOR STUDIES, AND REVIEW OF WECS FOR RECS PROPOSAL PROMPTED REDIRECTION OF TASK EFFORT INTO THE FOLLOWING AREAS:

ASSESSMENT OF VALUE OF ELECTRICITY SUPPLIED FROM GRID TO SWECS USER AS BACK-UP, VERSUS VALUE OF ELECTRICITY SUPPLIED FROM SWECS TO GRID AS OVERFLOW

STUDY OF SENSITIVITY OF DEMAND AND ENERGY COSTS TO WIND-LOAD CORRELATION

PLANNED ACTIVITIES

RESEARCH AND IF NECESSARY DERIVE NEW METHODS FOR ASSESSING THE VALUE OF "BUY-BACK" VS. "BACK-UP" ELECTRICITY

TEST ANALYTICALLY AND, TO THE EXTENT POSSIBLE, EMPIRICALLY, THE SENSITIVITY OF DEMAND AND ENERGY COSTS TO DEGREES OF CORRELATION BETWEEN WIND AND LOAD

OUTPUT

REPORT OR REPORTS DESCRIBING METHODS USED AND SAMPLE RESULTS

LIABILITY ISSUES ASSOCIATED WITH SMALL SYSTEMS

OBJECTIVE

PROVIDE POLICY OPTIONS TO ASSURE THAT LIABILITY ISSUES ASSOCIATED WITH SMALL WIND SYSTEMS DO NOT IMPEDE THE INCREASED USE OF SUCH SYSTEMS

ACCOMPLISHMENTS

INITIATED LITERATURE SEARCH OF MATERIAL RELATING TO LEGAL AND SAFETY ISSUES AND LEGAL RESEARCH ON LIABILITY ISSUES

COMPLETED INITIAL RESEARCH ON LEGAL ISSUES OF SMALL WIND SYSTEMS

PLANNED ACTIVITIES

COMPLETE ISSUE PAPER ON THE LIABILITY ISSUES

INITIATE THE DEVELOPMENT AND ANALYSIS OF POLICY ALTERNATIVES

OUTPUT

WORKING PAPER ON POLICY ALTERNATIVES

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

ENVIRONMENTAL IMPACT ASSESSMENT FOR SMALL SYSTEMS

OBJECTIVE

IDENTIFY AND ANALYZE THE LIFE-CYCLE ENVIRONMENTAL IMPACTS ASSOCIATED WITH DEPLOYING SMALL (LESS THAN 100 kW) UTILITY CONNECTED AND NON-UTILITY CONNECTED WECS, WITH AND WITHOUT ENERGY STORAGE SUBSYSTEMS

ACCOMPLISHMENTS

REVISED TASK PLAN TO INCORPORATE DOE COMMENTS EXPRESSED AT THE PREVIOUS QUARTERLY REVIEW

PERFORMED TWO COMPUTER LITERATURE SEARCHS ON ENVIRONMENTAL EFFECTS OF WIND SYSTEMS AND INITIATED TABULATION OF POTENTIAL HEALTH AND ECOLOGICAL EFFECTS DATA

INITIATED DEFINITION OF SWECS DESIGNS AND DEPLOYMENT OPTIONS TO BE ASSESSED

ISSUED SUBCONTRACT TO THE UNIVERSITY OF MICHIGAN RADIATION LABORATORY FOR PREPARATION OF COLOR VIDEOCASSETTE ON POTENTIAL INTERFERENCE BY THE BLOCK ISLAND WTG

PLANNED ACTIVITIES

CONTACT CONTRACTORS WITH SMALL MACHINE EXPERIENCE TO DETERMINE ENVIRONMENTAL PROBLEMS

DEFINE WIND SYSTEMS FOR DETAILED STUDY AND APPROPRIATE STORAGE SUBSYSTEMS; MAKE FINAL SELECTION OF DEPLOYMENT OPTIONS

MAKE SELECTED WECS ON-SITE VISITS TO COLLECT MOST RECENT ECOLOGICAL AND HEALTH RISK INFORMATION

COLLECT AND SYNTHESIZE ENVIRONMENTAL IMPACT DATA FOR SELECTED WIND SYSTEMS AND ENERGY STORAGE SUBSYSTEMS

OUTPUT

A 15 MINUTE COLOR VIDEOCASSETTE WHICH PRESENTS POTENTIAL TV INTERFERENCE BY THE BLOCK ISLAND WTG

INTERIM REPORT SUMMARIZING THE POTENTIAL HEALTH RISKS OF THE SWECS AND STORAGE SYSTEMS SELECTED

FINAL REPORT WHICH PRESENTS AN ANALYSIS OF THE POTENTIAL HEALTH AND ECOLOGICAL EFFECTS OF SWECS FOR EACH LIFE-CYCLE PHASE (SYSTEM FABRICATION THROUGH DECOMMISSION)

AN EVALUATION OF THE CURRENT STATUS OF ENVIRONMENTAL EFFECTS RESEARCH AND RECOMMENDATION OF ADDITIONAL RESEARCH NEEDS

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 draft task descriptions for Research and Analysis element of Federal Wind Energy Program

Supported Wind Systems Branch in planning and budget exercises

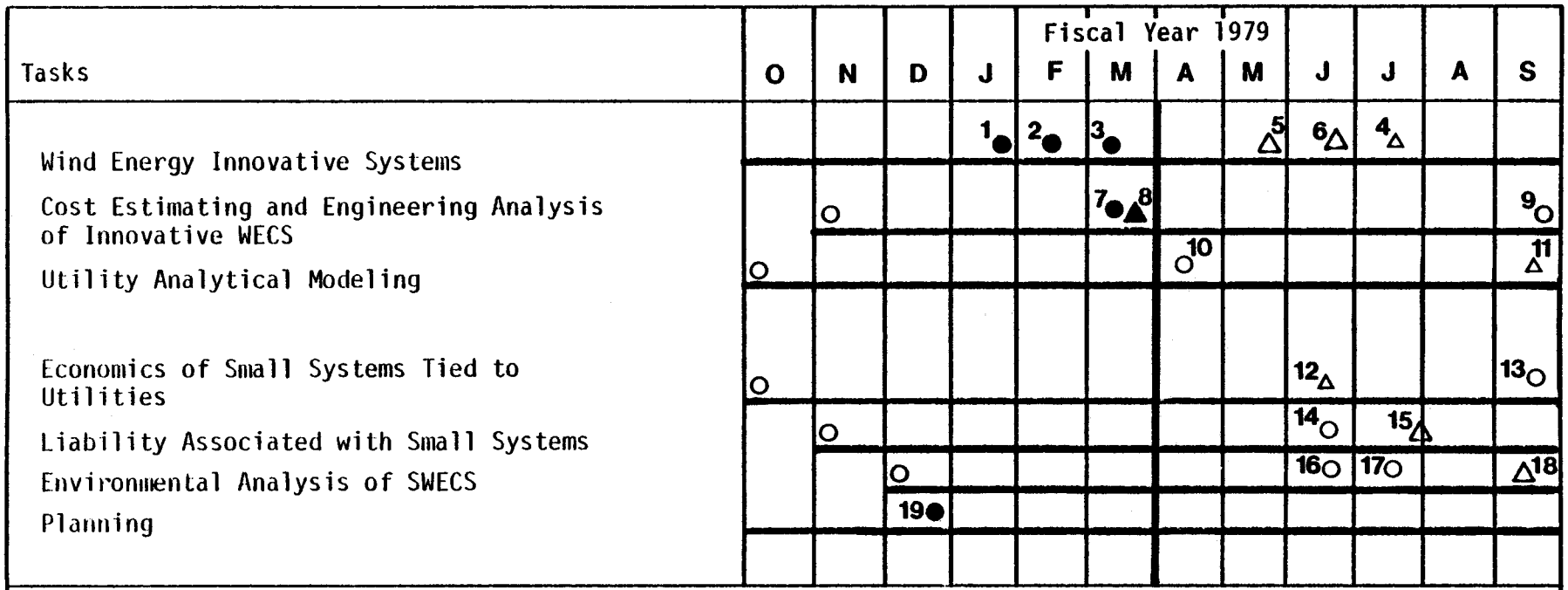
Planned Activities

Complete SERI Institutional Plan for wind activities

Complete SERI Annual Operating Plan (AOP) for FY80

Develop task plans for FY80 and FY81 for WSB

Milestones



1. Award of generic study contracts
2. RFP released on R & D studies
3. Contract renewal effort completed - Dayton EFD
4. Award of new R & D studies
5. WEIS Conference
6. Completion of generic studies
7. Survey completed of cost studies
8. Draft report of reliability study completed
9. Preliminary aerodynamic, mechanical, electrical studies completed
10. Survey completed
11. Model operational
12. Methodology defined
13. Final report completed
14. Critical issues defined
15. Analysis of alternatives completed
16. Complete definition of WECS
17. Environmental impact data collected and compiled
18. Completion of interim report
19. Draft program Development Plan completed

Legend:

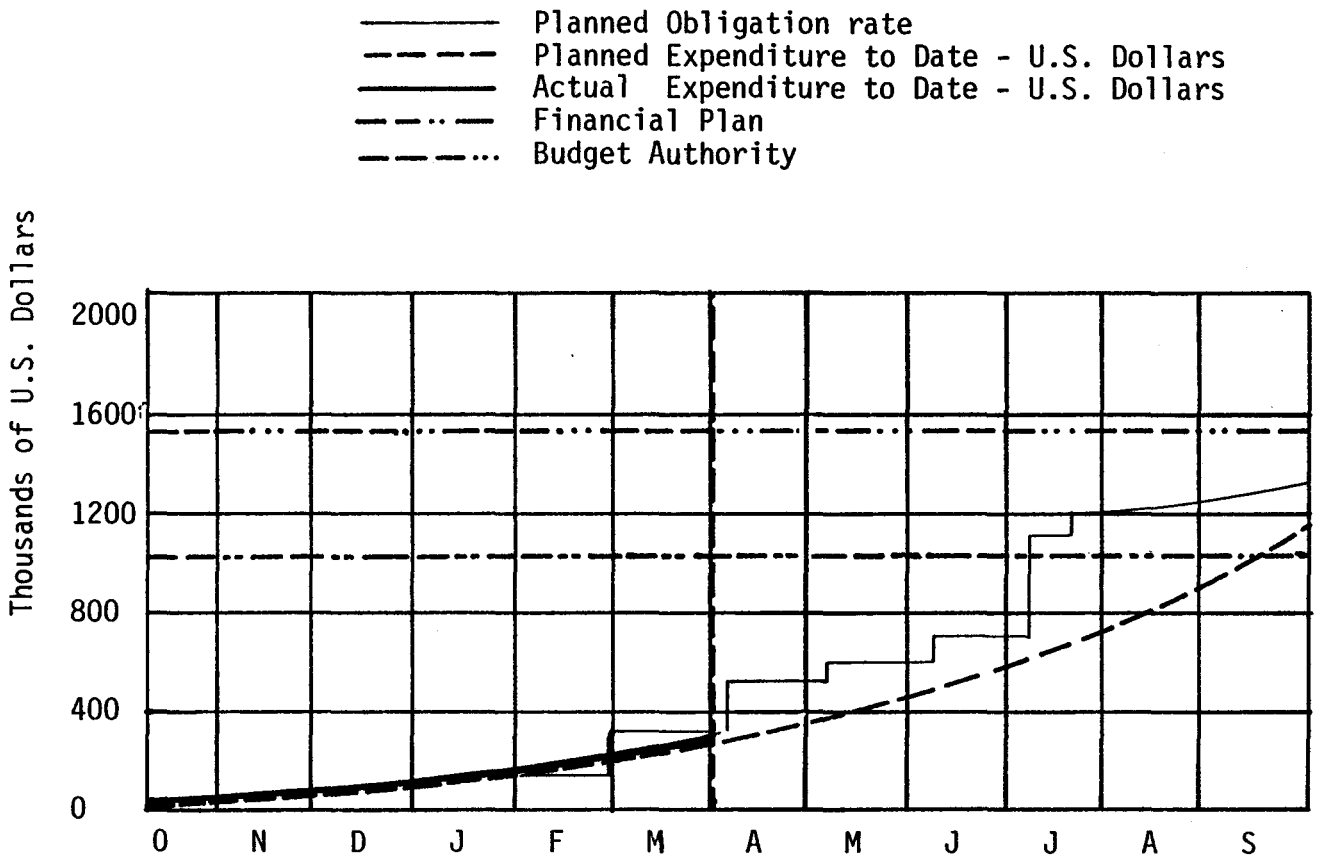
- ○ Start or Scheduled Intermediate Event
- ● Completed Intermediate Event
- △ Scheduled Milestone
- ▲ Completed Milestone

Wind Energy Systems (WES) Program Funding

Task	Lead Branch	Subcontracts	Total
Wind Energy Innovative Systems Program	Special Programs	631	744
Cost Estimating & Engineering Analysis	Systems Analysis	0	124
Utility Analytical Modeling	Systems Analysis	45	145
Economics of Small Systems Tied to Utilities	Systems Analysis	50	195
Liability Associated with Small Systems	Institutional & Environmental Assess.	0	67
Environmental Analysis of Small Systems	Institutional & Environmental Assess.	0	143
Planning & Administration	Systems Analysis	- -	32
Wind Resources Analysis[A]	Energy Resource	45	140
Technical Information[B] Dissemination	Communications	186	303

A Basic and Applied Research (Program Area 14)
B Commercialization Activities (Program Area 18)

WIND ENERGY SYSTEMS



Analysis of Variance as of 3/31/79

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PR-291
JUNE 4, 1979

WIND ENERGY INNOVATIVE SYSTEMS

IRWIN E. VAS

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

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	EY-76-C-02-2616 A001	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	EG-77-C-01-2774	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
The Madaras Rotor Power Plant Phase I (Madaras)	University of Dayton Research Institute	UDM	EX-76-S-01-2554	Dale H. Whitford
Vortex Augmentors for Wind Energy Conversion (Vortex)	Polytechnic Institute of New York	PINY	E(49-18)2358	Pasquale M. Sforza

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

	TASK NUMBER
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

ACCOMPLISHMENTS

DESIGN COMPLETED ON THE FOLLOWING COMPONENTS

- CIRCULATION CONTROLLED BLADE
- INSTRUMENTATION REQUIRED FOR TESTS

FABRICATION INITIATED/COMPLETED ON THE FOLLOWING COMPONENTS

- MAIN SHAFT
- HUB
- SUPPORT STAND ASSEMBLY
- SLIP RING ASSEMBLY
- CIRCULATION CONTROLLED BLADES

CALIBRATION COMPLETED ON THE FOLLOWING COMPONENTS

- SHAFT TORQUE CELL
- RPM TACHOMETER GENERATOR
- LOAD CELLS
- ANALOG DIGITAL CONVERSION BOARD
- BLADE SUPPORT BALANCE
- BLADE SUPPORT ARM DEFLECTION

INDOOR TESTING WAS INITIATED

PRESENTED A TECHNICAL PAPER AT THE AIAA MEETING, JANUARY 1979

PLANNED ACTIVITIES

COMPLETE FABRICATION OF EXPERIMENTAL SYSTEM

COMPLETE INDOOR TESTS

COMPLETE FINAL DRAFT REPORT FOR TASKS 1.1 TO 1.6

ASSESSMENT

NO PROBLEMS ON CURRENT WORK ARE FORESEEN AT THIS TIME

PROJECT SHOULD BE COMPLETED ON SCHEDULE, AUGUST 15, 1979

DRAFT FINAL REPORT TO BE DELIVERED IN AUGUST 1979

DIFFUSER AUGMENTED WIND TURBINE

GRUMMAN AEROSPACE CORPORATION
EY-76-C-02-2616.A001
(KEN FOREMAN, P.I.)

OBJECTIVE

ESTABLISH THE PERFORMANCE AND ENGINEERING DESIGN OF A DIFFUSER AUGMENTED WIND TURBINE AND DETERMINE ITS POTENTIAL FOR COMMERCIAL SIZED MACHINES

APPROACH

PERFORM WIND TUNNEL TESTS; DEVELOP ENGINEERING DESIGN AIMED AT INCREASING THE POWER COEFFICIENT OF THE DAWT; AND COMPLETE PRODUCIBILITY ANALYSIS

DETERMINE APPROXIMATE COST FOR FIELD DEMONSTRATION AND COMMERCIALIZATION

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

PLANNED ACTIVITIES

COMPLETE THE REVIEW OF THE DRAFT FINAL REPORT (SERI)

COMPLETE THE CONTRACT NEGOTIATIONS FOR THE RENEWAL PROPOSAL (SERI)

ASSESSMENT

THE CURRENT EFFORT HAS BEEN COMPLETED AND A DRAFT FINAL REPORT HAS BEEN SUBMITTED FOR REVIEW

A RENEWAL PROPOSAL SUBMITTED BY GRUMMAN HAS BEEN REVIEWED AND RECOMMENDED FOR FUNDING. THE PROPOSAL IS FOR A PERIOD OF 12 MONTHS AND AN ESTIMATED COST OF $90,440

TORNADO TYPE WIND ENERGY SYSTEMS

GRUMMAN AEROSPACE CORPORATION
EX-76-C0-01-2555
(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

TASKS

	TASK NUMBERS
FLOW FIELD ANALYSIS OF VORTEX SYSTEMS	3.1
THREE FOOT MODEL TEST	3.2
TEN-FOOT SPIRAL DESIGN AND FABRICATION	3.3
ONE-FOOT TURBINE DESIGN AND FABRICATION	3.4
TEN-FOOT DIAMETER VANED MODEL, DESIGN, AND FABRICATION	3.5
TESTS OF SPIRAL AND VANED MODELS	3.6
STRUCTURAL AND COST ANALYSIS	3.7

ACCOMPLISHMENTS

COMPLETED DATA TAKING AND DETERMINED THE POWER COEFFICIENT FOR DIFFERENT CONFIGURATIONS (BEST TOTAL $C_p \sim 0.11$ AT 18 MPH.)

COMPLETED DATA FOR DIFFERENT CONFIGURATIONS OF OUTWARD FACING VANES AND INWARD FACING FLAPS. (THE BEST RESULTS WERE FOR THE VANES AT ANGLES LARGER THAN TANGENTIAL. THE OPPOSITE WAS TRUE FOR THE FLAPS.)

DESIGNED AND CONSTRUCTED 18 FT HIGH WIND TUNNEL MODEL WITH 30 IN. DIAMETER TURBINE

COMPLETED A COST ANALYSIS FOR A COMPARABLE CAPACITY TORNADO-TYPE SYSTEM AND COMPARED IT TO MOD ØA, 1, AND 2 WIND TURBINES. (3¢/KWH IS ESTIMATED BY GRUMMAN FOR A MATURE PRODUCTION UNIT)

PLANNED ACTIVITIES

COMPLETE SOME ALTERATIONS TO THE TURBINE

ASSEMBLE MID-SCALE (18 FT HIGH) MODEL AND TEST

ASSESSMENT

THE CURRENT EFFORT IS PROCEEDING AS SCHEDULED

GRUMMAN HAS SUGGESTED AN EXPANDED TEST PROGRAM TO INCLUDE WIND TUNNEL TESTING REQUIRING ADDITIONAL FUNDING

TEST AND DEVICES FOR WIND/ELECTRIC POWER CHARGED AEROSOL GENERATOR

MARKS POLARIZED CORPORATION
EG-77-C-01-2774
(ALVIN M. MARKS, P.I.)

OBJECTIVE

EXPERIMENTALLY EVALUATE FOUR METHODS OF PRODUCING CHARGED DROPLETS AND COMPARE THE EXPERIMENTAL RESULTS WITH AVAILABLE PREDICTIONS

APPROACH

DEVELOP ANALYTICAL METHODS TO DETERMINE THE PERFORMANCE OF "CHARGING" METHODS

DESIGN, CONSTRUCT, AND TEST THE CHARGING METHODS OVER A RANGE OF CONDITIONS

EVALUATE THE CHARGING METHODS AND COMPARE THE EXPERIMENTAL RESULTS WITH THE ANALYTICAL PREDICTIONS

TASKS

	TASK NUMBERS
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

PLANNED ACTIVITIES

COMPLETE AND SUBMIT FOR REVIEW A DRAFT FINAL REPORT ON TASKS 4.1 TO 4.5

ASSESSMENT

THE CURRENT EFFORTS HAVE NOT ALL BEEN COMPLETED AS PLANNED

A RENEWAL PROPOSAL HAS BEEN SUBMITTED BY MARKS POLARIZED CORPORATION AT A FUNDING LEVEL OF $65K

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

TASKS

	TASK NUMBERS
LABORATORY COLLOID GENERATING EXPERIMENT	5.1
EXPERIMENTAL CONFIGURATION	5.2
COLLOID GENERATION EXPERIMENTS	5.3
EFD GENERATOR PERFORMANCE	5.4
CRITICAL PROBLEM AREAS	5.5

ACCOMPLISHMENTS

DRAFT FINAL REPORT FOR THIS PROJECT WAS REVIEWED AND COMMENTS RETURNED

A RENEWAL CONTRACT HAS BEEN AWARDED AT A FUNDING LEVEL OF $117,523 FOR 12 MONTHS

PLANNED ACTIVITIES

CONTINUE THEORETICAL STUDIES TO DEVELOP METHODS OF PRODUCING CHARGED WATER PARTICLES ECONOMICALLY

CONDUCT TESTS ON AND OPTIMIZE THE BI-POLAR METHOD OF PRODUCING LOW MOBILITY CHARGE DROPLETS

DEVELOP AND TEST OPTIMUM SHAPED ATTRACTOR AND COLLECTOR ELECTRODE GEOMETRIES

PROVIDE A PLAN FOR IMPLEMENTATION OF AN EFD WIND POWERED GENERATOR

ASSESSMENT

THE CURRENT EFFORTS HAVE BEEN SATISFACTORILY COMPLETED

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

TASKS

	TASK 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

ACCOMPLISHMENTS

TASKS 6.1 TO 6.4 HAVE BEEN COMPLETED AND A DRAFT FINAL REPORT SUBMITTED FOR REVIEW

A RENEWAL CONTRACT HAS BEEN AWARDED AT A FUNDING LEVEL OF $68,975 FOR 12 MONTHS

PLANNED ACTIVITIES

REVISE THE DRAFT FINAL REPORT AND RESUBMIT FOR REVIEW

WORK ON THE RENEWAL CONTRACT WILL NOT BEGIN UNTIL JUNE 1979

AN ANALYSIS OF THE MADARAS ROTOR POWER PLANT

UNIVERSITY OF DAYTON RESEARCH INSTITUTE
EX-76-S-01-2554
(DALE H. WHITFORD, P.I.)

OBJECTIVES

DETERMINE THE COST EFFECTIVENESS OF THE MADARAS ROTOR POWER PLANT IN THE 100 MW TO 200 MW RANGE

APPROACH

CONDUCT THEORETICAL AND EXPERIMENTAL STUDIES OF ROTATING CYLINDERS

EVALUATE THE STRUCTURAL, ELECTRIC, AND MECHANICAL COMPONENTS OF THE SYSTEMS UTILIZING MODERN TECHNOLOGY

PERFORM AN ECONOMIC EVALUATION AND PERFORMANCE SIMULATION OF THE SYSTEM FOR VARIOUS PLANT SIZES

Tasks

	Task Numbers
Vortex Analysis of Madaras Rotor	7.1
Model Design, Fabrication, and Tests	7.2
Data Evaluation	7.3
Electrical/Mechanical Studies	7.4
Performance Analysis	7.5
Conduct Economic Studies	7.6

ACCOMPLISHMENTS

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

PLANNED ACTIVITIES

FINAL REPORT IS TO BE SUBMITTED BY THE PRINICIPAL INVESTIGATOR

NO ADDITIONAL STUDIES CURRENTLY CONSIDERED IN THIS AREA

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 WIND VORTEX AUGMENTOR

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

DEVELOP PERFORMANCE CHARACTERISTICS OF THE PROTOTYPE SYSTEM

TASKS

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

ACCOMPLISHMENTS

CONDUCTED TESTS OF FLAPPED VERSION OF PROTOTYPE IN THE ENVIRONMENTAL WIND TUNNEL

PERFORMED MEASUREMENTS OF THE FIELD TEST BLADES IN THE ROTOR TEST FACILITY TO EVALUATE BLADE CHARACTERISTICS

COMPLETED THE SYSTEM DEFINITION FOR THE ECONOMIC ANALYSIS. THIS IS TO BE USED AS INPUT INTO THE ECONOMIC STUDY

INITIATED FIELD TESTS

A TECHNICAL PAPER WAS PRESENTED AT THE ASME MEETING IN SAN FRANCISCO

PLANNED ACTIVITIES

PERFORM FIELD TESTS AND EVALUATE THE VORTEX AUGMENTOR CONCEPT (VAC) PROTOTYPE

PERFORM FIELD TESTS AND EVALUATE THE VAC WITH FLAP ADDITION

ASSESS AND OPTIMIZE FLAP POSITION USING WIND TUNNEL TESTS

DEVELOP THE ECONOMIC MODEL FOR THE VAC

ASSESSMENT

THE PROJECT IS PLANNED FOR COMPLETION DURING JUNE 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 LIGHT)	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 KORNREICH	THEODORE R.

"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 REVIEW OF LITERATURE AND CURRENT RESEARCH

COMPLETED THE SYSTEM ANALYSIS OF THE PERFORMANCE OF THE DUCTED ROTOR AND DYNAMIC INDUCER

INITIATED THE SYSTEM ANALYSIS OF THE PERFORMANCE OF THE DELTA WING AND COST ANALYSIS OF THE AUGMENTED HORIZONTAL-AXIS SYSTEMS

PLANNED ACTIVITIES

A PAPER IS TO BE GIVEN AT THE WEIS CONFERENCE IN COLORADO SPRINGS, MAY 23-25, 1979

THE DRAFT FINAL REPORT IS TO BE COMPLETED MAY 1979

ASSESSMENT

THE CURRENT EFFORT IS PROCEEDING AS SCHEDULED

"A DEFINITIVE GENERIC 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 ENEGY 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

	TASKS NUMBERS
PERFORM A CRITICAL TECHINICAL 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

INITIATED SYSTEM DESIGN CONFIGURATION REVIEWS

DEVELOPED ANALYTICAL MODELS TO ASSESS HIGH LIFT EFFECTS

DEVELOPED COMPUTER PROGRAMS TO DETERMINE PERFORMANCE CHARACTERISTICS

PLANNED ACTIVITIES

A PAPER IS TO BE GIVEN AT THE WEIS CONFERENCE IN COLORADO SPRINGS, MAY 23-25, 1979

THE FINAL DRAFT REPORT IS TO BE COMPLETED MAY 1979

ASSESSMENT

THE CURRENT EFFORT IS PROCEEDING AS SCHEDULED

"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

TASKS

	TASK NUMBERS
PERFORM A CRITICAL TECHNICAL REVIEW OF THE GENERIC GROUP AUGMENTED HORIZONTAL-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

INITIATED THE ACQUISITION OF PUBLISHED INFORMATION AND DATA

PLANNED ACTIVITIES

A PAPER IS TO BE GIVEN AT THE WEIS CONFERENCE IN COLORADO SPRINGS, MAY 23-25, 1979

THE DRAFT FINAL REPORT IS TO BE COMPLETED MAY 1979

ASSESSMENT

THE CURRENT EFFORT IS PROCEEDING AS SCHEDULED

"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

Tasks

	Task Numbers
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

TECHNICAL STATUS REPORTS HAVE NOT BEEN RECEIVED ON THIS PROJECT

PLANNED ACTIVITIES

A PAPER IS TO BE GIVEN AT THE WEIS CONFERENCE IN COLORADO SPRINGS, MAY 23-25, 1979

THE DRAFT FINAL REPORT IS TO BE COMPLETED MAY 1979

ASSESSMENT

THE CURRENT EFFORT IS PROCEEDING AS SCHEDULED

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

WASHINGTON UNIVERSITY TECHNICAL 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

ACCOMPLISHMENT

INITIATED THE ACQUISITION OF PUBLISHED INFORMATION AND DATA

PLANNED ACTIVITIES

A PAPER IS TO BE GIVEN AT THE WEIS CONFERENCE IN COLORADO SPRINGS, MAY 23-25, 1979

THE DRAFT FINAL REPORT IS TO BE COMPLETED MAY 1979

ASSESSMENT

THE CURRENT EFFORT IS PROCEEDING AS SCHEDULED

"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

	TASK NUMBERS
PERFORM A CRITICAL TECHNICAL REVIEW OF THE GENERIC GROUP VORTEX EXTRACTION WIND ENERGY SYSTEMS	14.1
COMPARE THE VARIOUS TYPES OF VORTEX EXTRACTION WIND ENERGY SYSTEMS WITH UNAUGMENTED CONVENTIONAL WIND ENERGY SYSTEMS	14.2

ACCOMPLISHMENTS

THE PROJECT HAS JUST BEEN INITIATED

PLANNED ACTIVITIES

A PAPER IS TO BE GIVEN AT THE WEIS CONFERENCE IN COLORADO SPRINGS, MAY 23-25, 1979

THE DRAFT FINAL REPORT IS TO BE COMPLETED JUNE 1979

ASSESSMENT

THE CURRENT EFFORT IS PROCEEDING AS SCHEDULE

PROGRAM MANAGEMENT

ACCOMPLISHMENTS

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

AWARDED SIX CONTRACTS FOR GENERIC WES STUDIES

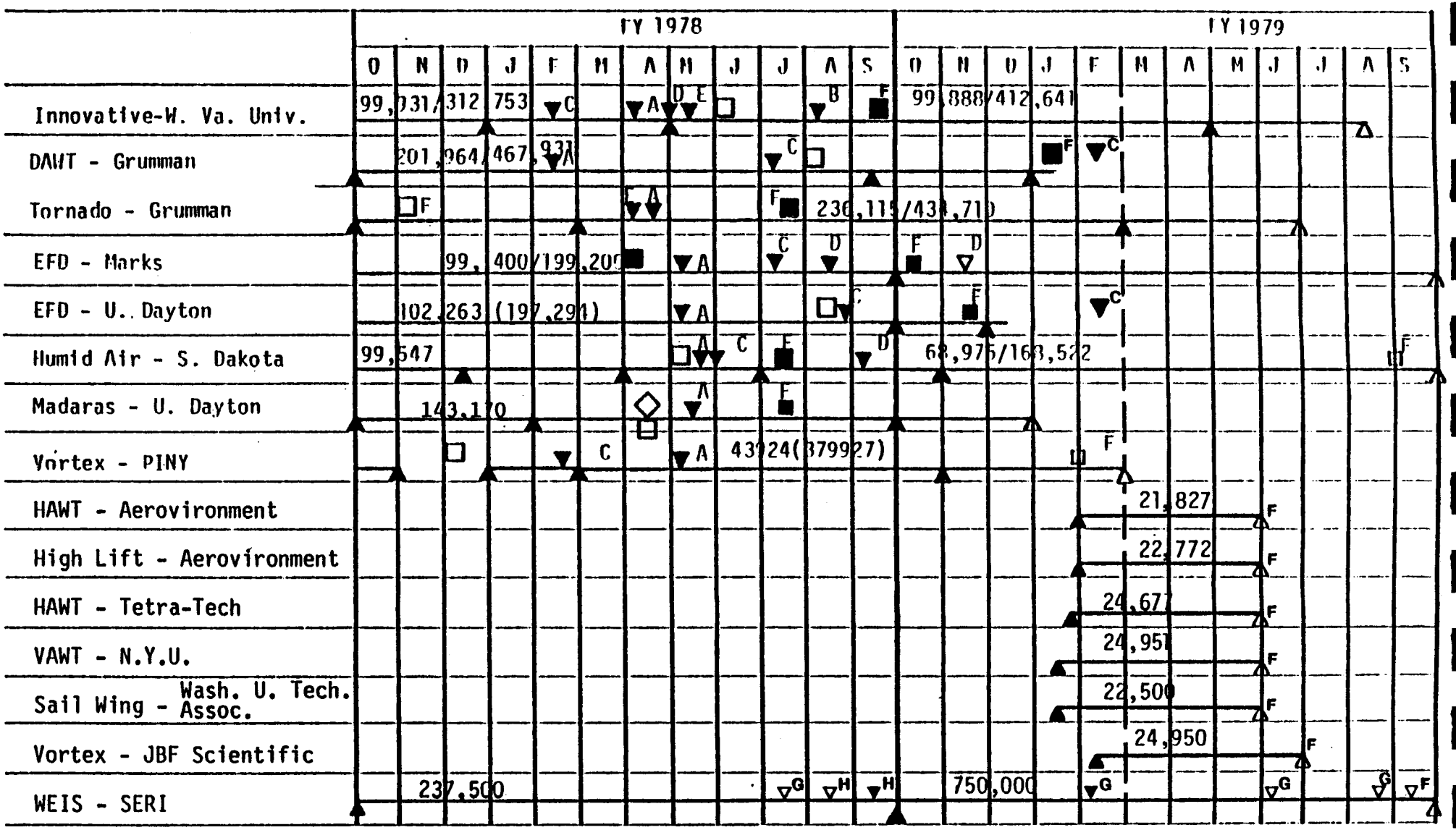
ISSUED AN RFP ENTITLED "ADVANCED AND INNOVATIVE WIND ENERGY CONCEPT DEVELOPMENT" TO 250 SOURCES. A TOTAL OF 37 PROPOSALS WERE SUBMITTED IN RESPONSE TO THE RFP. TECHNICAL EVALUATION AND RANK ORDERING IS BEING PERFORMED BY A SERI PANEL AND MEMBERS OF THE ADVISORY COMMITTEE (OR THEIR REPRESENTATIVES)

COMPLETED AN AGENDA AND IDENTIFIED SPEAKERS FOR THE WEIS CONFERENCE TO BE HELD MAY 23-25 AT COLORADO SPRINGS, COLORADO. THIS EFFORT IS BEING COORDINATED WITH RICK KOTTLER, JBF, AND THE SERI CONFERENCE GROUP

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

JUNE 4, 1979



A Contract Review, Site Visit

B Semi-Annual Report

C Proposal Submission

D Proposal Resubmission

E Procurement Initiation

F Draft Final Report

G Quarterly Report

H Draft Program Management Plan

EXPLANATION

◇Change in Schedule
▽Intermediate Event
△Milestone
□Final Report
○Progress Report

Delivered-Filled Symbol
Planned-Open Symbol

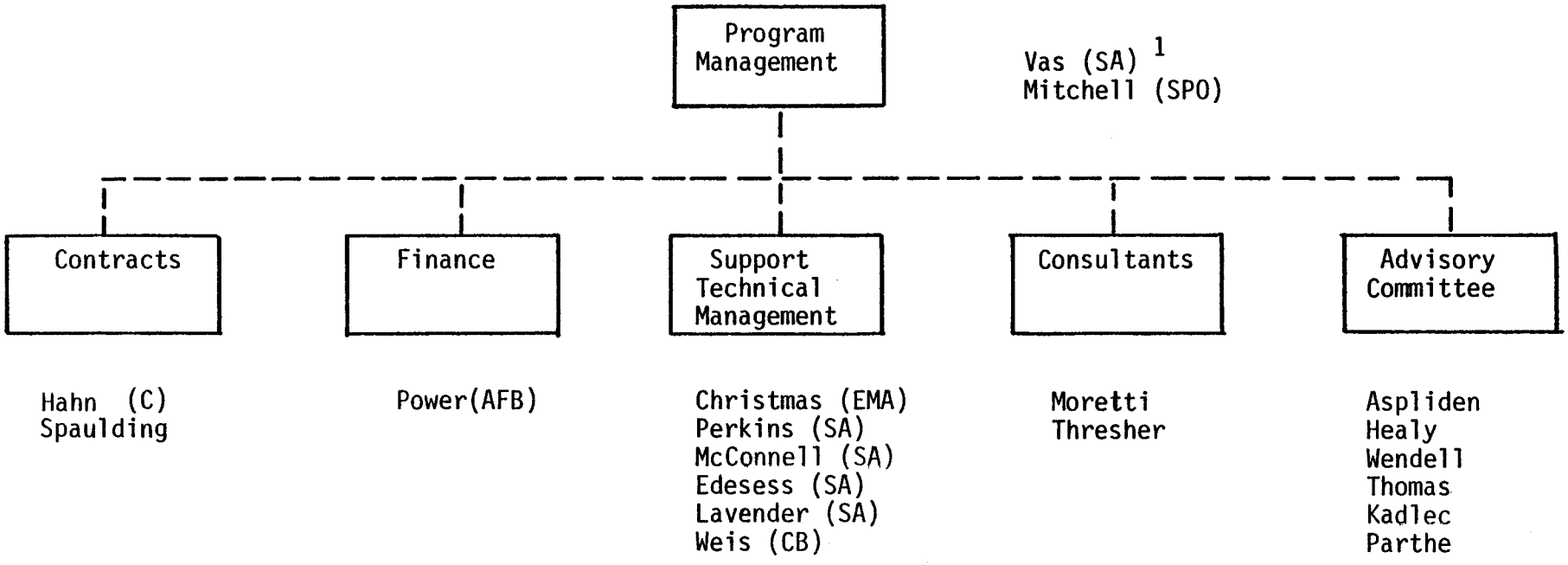
R&D SUBCONTRACTED PROJECTS, FY78 AND 79

TITLE/SUBCONTRACTOR	TERMINATION DATE PROPOSED TERMINATION DATE)	FUNDING STATUS		
		FUNDING FY78	ADDITIONAL FUNDING REQUESTED FY79	PROJECTED FUNDING FY80
INN. - W. VA. UNIV.	AUGUST 15, 1979	99,888	N/A	100,000
DAWT - GRUMMAN	DECEMBER 31, 1978 (MARCH 31, 1980)	201,964	90,440	102,000
TORNADO - GRUMMAN	JUNE 30, 1979	236,115	N/A	200,000
EFD - MARKS	SEPTEMBER 27, 1978 (MARCH 31, 1980)	99,448	65,000	N/A
EFD - U. DAYTON	MARCH 31, 1980	102,264	117,523	110,000
HUM. AIR - S. DAKOTA	MARCH 12, 1980	99,547	68,975	N/A
MADARAS - U. DAYTON	DECEMBER 31, 1978	$143,171	N/A	N/A
VORTEX - PINY	MAY 31, 1979	43,924	N/A	N/A

GENERIC SUBCONTRACTED PROJECTS FY79

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

WEIS PROGRAM MANAGEMENT CHART



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[1] Office/Branch abbreviations are defined below:

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

PLANNED ACTIVITIES

CONTINUE AND COMPLETE ACTIVITIES RELATING TO CURRENT R&D STUDIES AS INDICATED PREVIOUSLY

INITIATE REVIEW OF THE R&D PROPOSALS RECEIVED AND MAKE MULTIPLE AWARDS

HOLD THE WEIS CONFERENCE ON MAY 23-25 IN COLORODO SPRINGS, COLORADO

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

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

PR-291
JUNE 4, 1979

COST ESTIMATING AND ENGINEERING ANALYSIS OF INNOVATIVE WECS

ROBERT MCCONNELL

COST ESTIMATING AND ENGINEERING ANALYSIS OF INNOVATIVE WECS

OBJECTIVE

ESTIMATE THE COST OF ENERGY PRODUCED BY INNOVATIVE WECS

ACCOMPLISHMENTS

REQUESTED PROPOSALS FOR A LOW BUDGET ($10K) SHORT TERM (6 WEEKS) DEVELOPMENT OF A METHODOLOGY FOR ESTIMATING COST OF ENERGY FOR INNOVATIVE SYSTEMS IN THEIR CONCEPT STAGE

CONTRACT GIVEN TO SCIENCE APPLICATIONS, INC. FOR DEVELOPMENT OF A SCREENING METHODOLOGY FOR INNOVATIVE WECS AND APPLICATION OF THE METHODOLOGY TO THE GRUMMAN DAWT

COMPLETED DRAFT REPORT ENTITLED "A GENERAL RELIABILITY AND SAFETY METHODOLOGY AND ITS APPLICATION TO WIND ENERGY CONVERSION SYSTEMS"

PLANNED ACTIVITIES

REVIEW AND REQUEST REVIEWS OF SCREENING METHODOLOGY FOR INNOVATIVE WECS

REQUEST REVIEWS OF RELIABILITY AND SAFETY METHODOLOGY REPORT

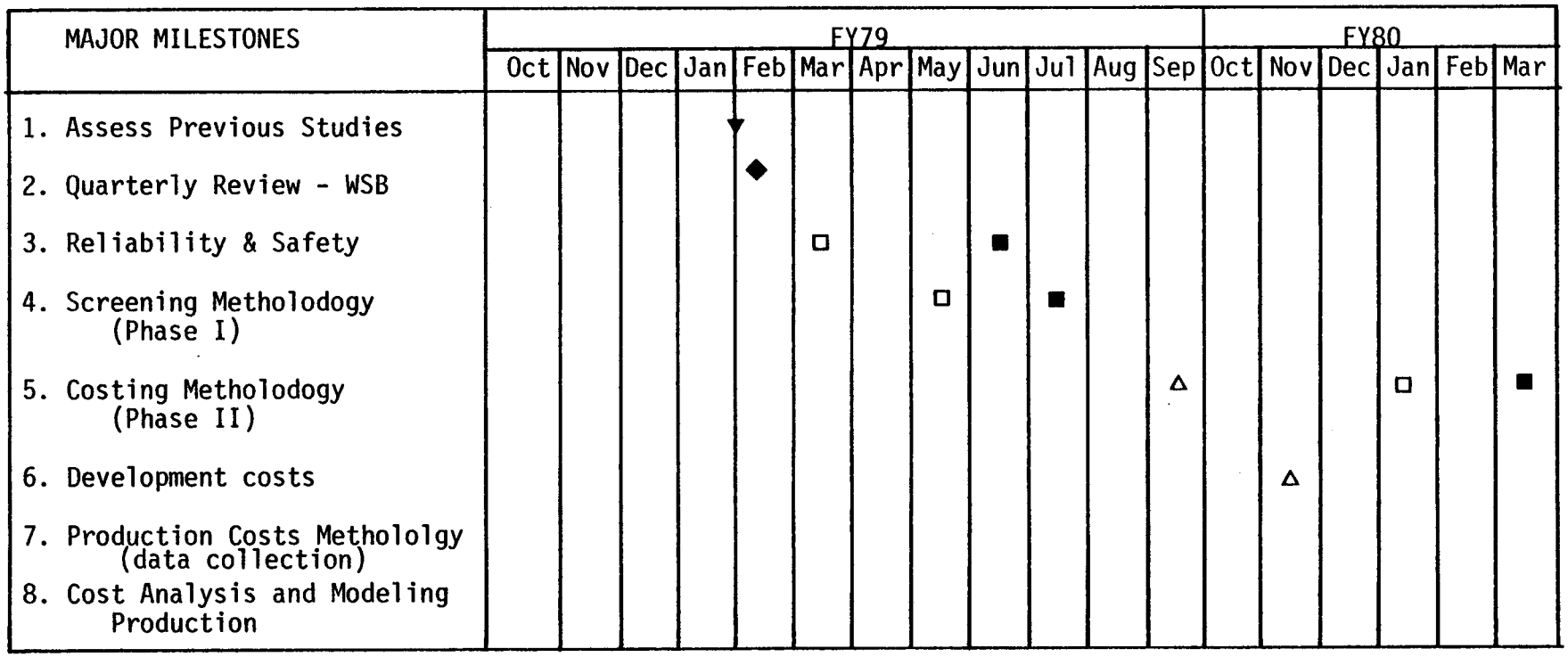
BEGIN EXPLORATORY SUBCONTRACT ON DETAILS OF COSTS OF DEVELOPMENT PHASE IN WEIS LIFE CYCLE

OUTPUT

TECHNICAL REPORT DESCRIBING A METHODOLOGY FOR EVALUATING AN INNOVATIVE WEC'S RELIABILITY AND SAFETY AND ITS ASSOCIATED OPERATION AND MAINTENANCE COSTS

TECHNICAL REPORT DESCRIBING A METHODOLOGY FOR ESTIMATING THE COST OF ENERGY OF INNOVATIVE WECS IN THEIR CONCEPT PHASE

TECHNICAL REPORT ESTIMATING THE IMPACT OF DEVELOPMENT COSTS ON THE LIFE CYCLE COSTS OF INNOVATIVE WECS



△ Begin Milestone

▼ Milestone Complete

◆ Workshop or Special Meeting

□ Draft Final Report

■ Final Report

HOW WE DO IT

PARAMETRIC COST ESTIMATING APPROACH (STATISTICAL, TOP-DOWN)

DEVELOP COST ESTIMATING RELATIONSHIPS (CER'S)

DEVELOP SYSTEM LIFE CYCLE COST MODELS

SPECIFIC DESIGN OF CRITICAL COMPONENTS (DETAIL, BOTTOM UP)

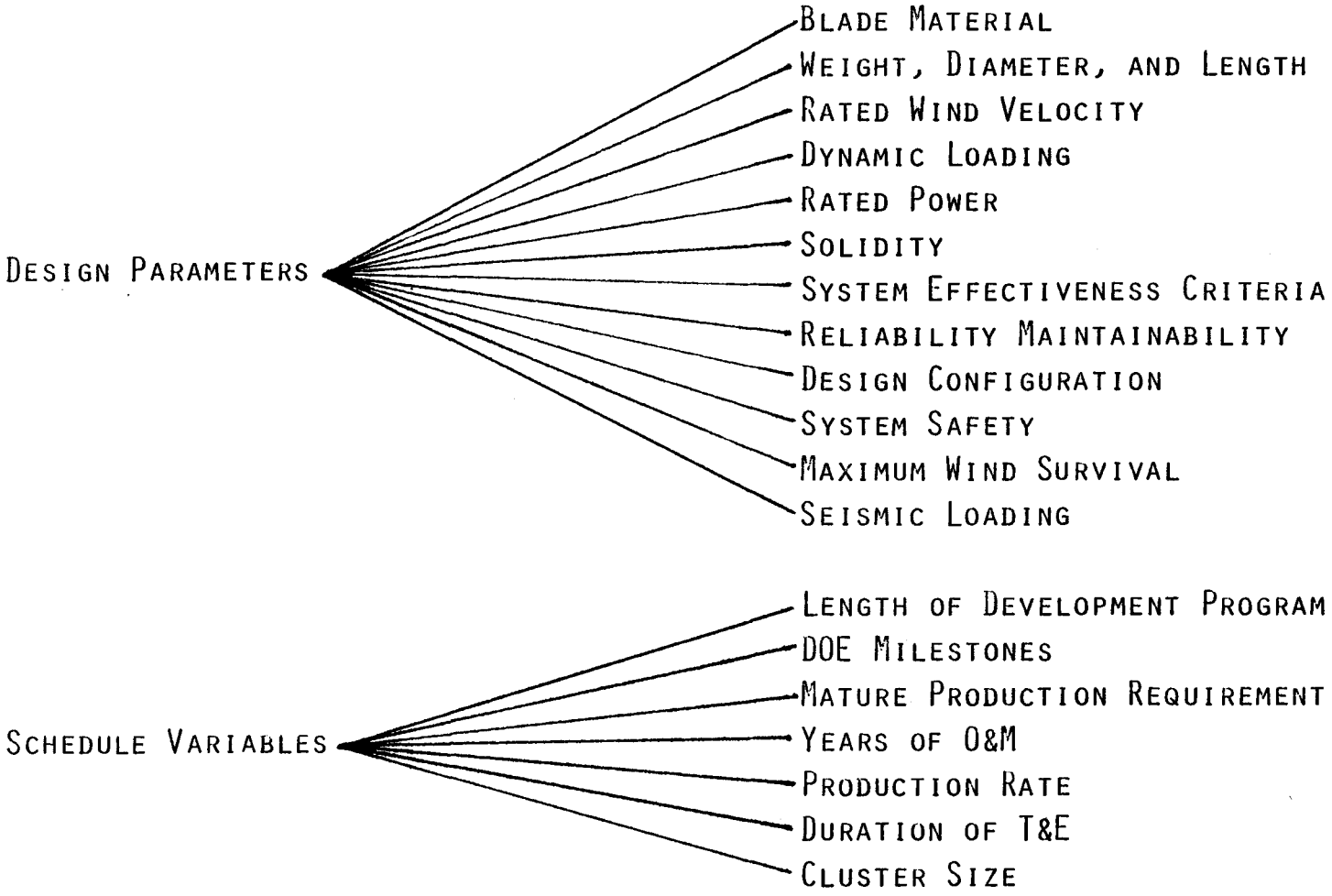
PARAMETRIC COST ESTIMATING

AN ESTIMATE BASED ON THE PARAMETERS OF THE SYSTEM BEING COSTED - -

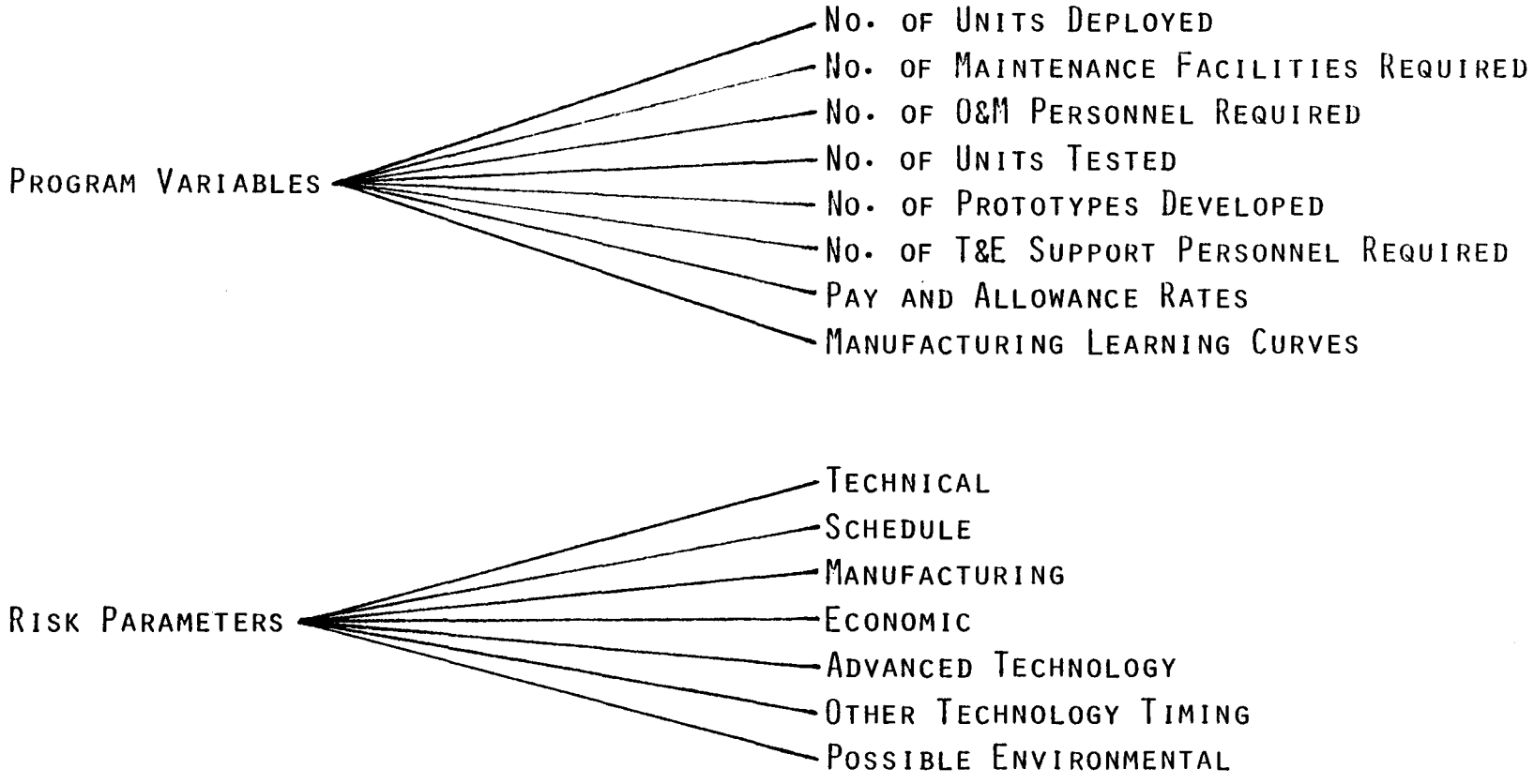
PHYSICAL AND PERFORMANCE CHARACTERISTICS	
WEIGHT	SPEED
MATERIAL	FORCE
VOLUME	POWER
O	O
O	O
O	O

COST ESTIMATING RELATIONSHIPS (CER's)

WIND ENERGY CONVERSION SYSTEM



WIND ENERGY CONVERSION SYSTEM



COST ESTIMATING RELATIONSHIP (CER)

AN ANALYTIC EQUATION USED TO COMPUTE THE COST OF A PARTICULAR ELEMENT OF A SYSTEM, OR THE TOTAL SYSTEM, BASED ON SYSTEM CHARACTERISTICS.

$$COST = A\ W$$

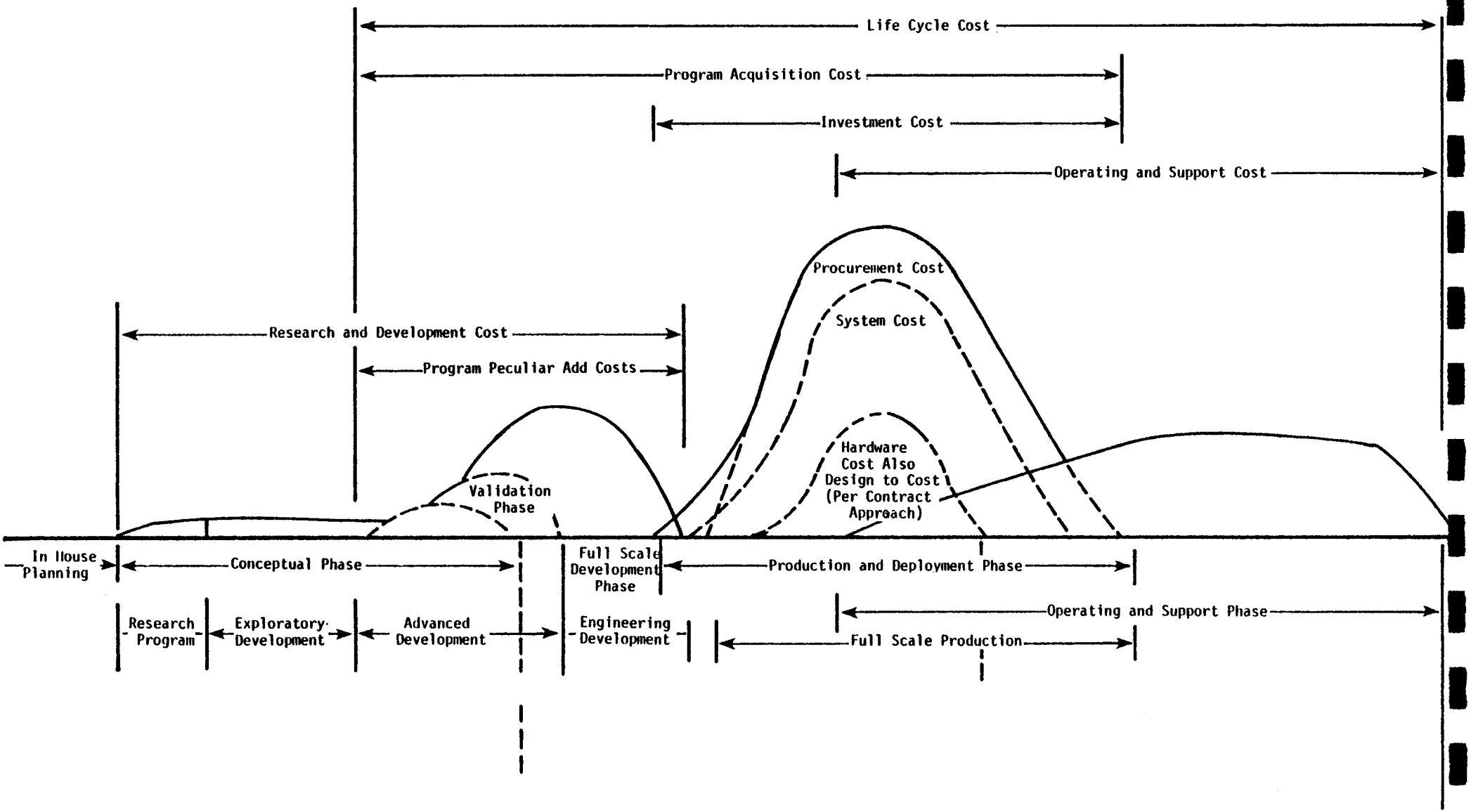
$$COST = A\ P + B\ W$$

$$COST = A\ T^{\theta}$$

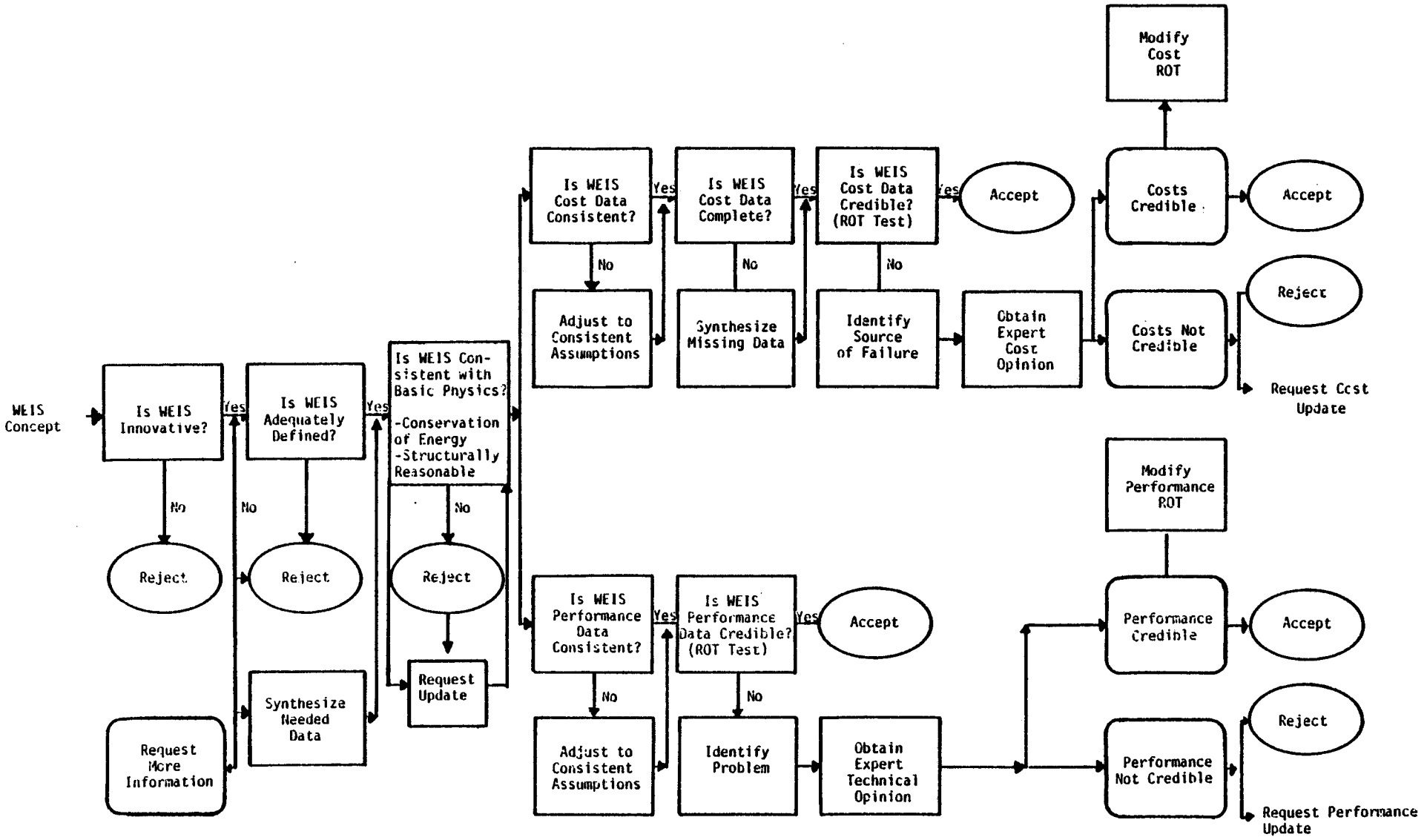
A, B, θ = CONSTANTS TO BE DETERMINED

P, W, T = SYSTEM PARAMETERS SUCH AS POWER, WEIGHT, ETC.

LIFE CYCLE COSTS OF A SYSTEM



WEIS CONCEPT SCREENING METHODOLOGY



Cost/Performance Evaluation Sheet

System Name: _____ _____ Modular Factors 100th _____ Date _____
1000th _____ PR-291

Rated kw's: _____ @ _____ mph Mills/kwhr _____ JUNE 4, 1979

	Reported Cost	Normalized Cost	Adjusted Cost	% Mfg'd Equip	Weight	% Mfg'd Equip	$/lb
Year and Quantity		1979 100th Unit	1979 100th Unit				
Manufactured Equipment							
Wind Generator							
Rotor							
Drive							
Electrical							
Controls							
Enclosure							
Tower							
Other Materials							
Labor Direct Field							
Installation (manhours)							
Site Prep							
Total Direct Field Cost							
Indirect (OH)							
Interest							
Spares							
Contingency							
Fee (8%)							
Total Capital							
Operation & Maintenance							
Carrying Charges							
Total Annual							

ROT Ratios

	WTG	Tower	M&E	Fi
$/Swept Area				
$/Rated Power				
$/Avg Power				
Watts/#				
Kwhr/#				
#/Area				
watts/area				
Annual Energy / Rated Power				

Physical Description/Dimensions:

Swept Area _____ Eff. Hub Height _____

V_i= _____ V_R= _____ V_o= _____ V_s= _____

Average Output	Reported	Adjusted
CF		
Kw avg		
Kw hrs		

Comments

Reference

COST CONSIDERATIONS FOR INSTALLED WIND SYSTEMS

ITEM	DEFINITION
TURBINE & SITE	
MANUFACTURED EQUIPMENT	TOTAL OF WIND SYSTEM COMPONENTS
WIND GENERATOR	ROTOR AND DRIVE
ROTOR	SPEED INCREASER, SHAFTS
DRIVE	BLADES, HUB, PITCH AND YAW SYSTEM
ELECTRICAL	GENERATOR, POWER CONDITIONING
CONTROLS	RPM CONTROL SYSTEM, SAFETY SYSTEMS
ENCLOSURE	E.G., FAIRINGS
TOWER	SUPPORT STRUCTURE, TIE DOWNS, ETC.
SITE SPEICFIC COSTS	LAND, TRANSMISSION LINES, ACCESS ROADS
FOUNDATION	CONCRETE, ANCHORS

COST CONSIDERATIONS FOR INSTALLED WIND SYSTEMS (CONTINUED)

ITEM	DEFINITION
	INSTALLATION
MATERIALS	TRANSPORT, FENCING, LIGHTS, CONDUIT, WIRE, SITE PREPARATION
INSTALLATION	ALL LABOR COSTS TO SITE, ASSEMBLE, ERECT AND CHECK OUT THE SYSTEM
MANHOURS	LABOR HOURS FOR INSTALLATION
SITE PREPARATION	EXCAVATION, CLEANING, DEWATERING, FILL
TOTAL DIRECT FIELD	SUM OF ALL DIRECT COSTS, WHICH IS EVERYTHING LISTED PREVIOUSLY
INDIRECT FIELD	INDIRECT FIELD AND OFFICE COSTS ACCRUED DURING INSTALLATION; E.G., TEMPORARY CONSTRUCTION FACILITIES, CRAFT BENEFITS, PAYROLL BURDENS, CONSTRUCTION EQUIPMENT

COST CONSIDERATIONS FOR INSTALLED WIND SYSTEMS (CONTINUED)

ITEM	DEFINITION
CAPITAL	
INTEREST	COST OF CAPITAL DURING INSTALLATION
SPARES	INITIAL REPLACEMENT PARTS
CONTINGENCY	RESERVE FUND
FEE	FEE FOR INSTALLATION FIRM
TOTAL CAPITAL	TOTAL OF ALL OF COSTS
OPERATIONS AND MAINTENANCE (O&M)	NORMAL AND UNSCHEDULED MAINTENANCE PLUS NORMAL OPERATING COSTS
LEVELIZED O&M	ANNUITIZED O&M COSTS, 30 YEAR LIFE
CARRYING CHARGES	ANNUAL FINANCIAL CHARGES ON TOTAL CAPITAL
TOTAL ANNUAL	TOTAL OF CARRYING CHARGES AND O&M

COST ESTIMATIONS

ITEM	ESTIMATES	
ROTOR	$5 TO $37/KG	$2.50 TO $17/POUND
DRIVE	$3 TO $11/KG	$1.50 TO $5/POUND
ELECTRICAL	$5 TO $22/KG	$2.25 TO $10/POUND
CONTROLS	$24 TO $79/KG	$11 TO $36/POUND
ENCLOSURE	$1 TO $13/KG	$0.5 TO $6/POUND
TOWER	$1 TO $4/KG	$0.5 TO $2/POUND
FOUNDATIONS	$300/M^3	$230/CUBIC YARD

COST ESTIMATIONS (CONTINUED)

ITEM	ESTIMATES
TOTAL DIRECT FIELD	LARGER OF WIND GENERATOR COST X 2.5 MANUFACTURED EQUIPMENT X 1.2
INDIRECT FIELD	16% OF TOTAL DIRECT FIELD
INTEREST	2% OF TOTAL DIRECT AND INDIRECT FIELD
SPARES	5% OF WIND GENERATOR COST
CONTINGENCY	10% OF TOTAL DIRECT FIELD
FEE	10% OF TOTAL DIRECT FIELD AND SPARES
COST	
TOTAL CAPITAL	TOTAL OF DIRECT FIELD, INDIRECT,
INTEREST	SPARES, CONTINGENCY AND FEE
ANNUAL O&M	2% OF TOTAL DIRECT FIELD
LEVELIZED O&M	2 X ANNUAL O&M
CARRYING CHARGES	0.18 X TOTAL CAPITAL
TOTAL ANNUAL	O&M PLUS CARRYING CHARGES

ANNUAL WIND ENERGY ESTIMATES

WIND SYSTEM	SWEPT AREA (M^2)	WIND SHEAR EXPONENT	PEAK POWER (kW_E)	RATED WIND SPEED (M/S) (CENTER LINE HEIGHT)	ANNUAL ELECTRICAL ENERGY (MWH)
SANDIA DARRIEUS (A)*	84	0.17	30	13.4	60
GIROMILL	226	0.14	40	8.9	190
SANDIA DARRIEUS(K)*	279	0.17	120	15.0	221
MAGDALEN ISLANDS DARRIEUS	595	0.13	224	15.0	387
HUTTER	915	0.13	90	9.0	365
MOD 0A	1,140	0.13	200	9.5	892
MOD X	1,140		200	9.5	950

* (A) DENOTES A POINT DESIGN COMPLETED BY ALCOA LABORATORIES FOR SANDIA LABORATORIES WHILE (K) REFERS TO A POINT DESIGN COMPLETED BY A. T. KEARNEY.

MASS AND WIND ENERGY RATIOS

WIND SYSTEM	MASS (MG)	WEIGHT (LB)	ENERGY/MASS (WH/G)	MASS/SWEPT AREA (KG/M^2)	ENERGY/YR/POWER (KWH/YR/KW)	PEAK POWER/M^2 (W/M^2)
SANDIA DARRIEUS (A)	3.82	(8,417)	15.7	45.7	2,000	357
GIROMILL	9.07	(20,000)	20.9	40.1	4,750	177
SANDIA DARRIEUS(K)	11.51	(25,383)	19.2	41.3	1,842	430
MAGDALEN ISLANDS DARRIEUS	22.00	(48,500)	17.6	37.0	1,728	376
HUTTER	13.15	(29,000)	27.8	14.4	4,056	98.4
MOD OA	40.37	(89,000)	22.1	35.4	4,460	175
MOD X	33.08	(72,920)	28.7	29.0	4,750	175

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PR-291
JUNE 4, 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

ACCOMPLISHMENTS

UTILITY MODELS:

VERIFIED THAT SELECTED PROGRAM PROMOD MAY BE USED IN WECS VALUE DETERMINATION

PURCHASE REQUEST FOR PROMOD ISSUED FOR USE ON TYMSHARE

DRAFT REPORT "PRODUCTION COST MODEL EVALUATIONS" COMPLETED

REVIEWED INFORMATION ON UTILITY EXPANSION PLANNING MODELS

WECS REPRESENTATIONS:

AVAILABLE WRITTEN DOCUMENTATION REVIEWED

COMPUTER TAPES WITH JBF MODELS RECEIVED AND VERIFICATION OF INCLUDED CASES BEGUN

TAPES OF STONE & WEBSTER AND G.E./EPRI PROGRAMS REQUESTED

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 - - FEBRUARY 1980

TWELVE UTILITY MODELS WERE IDENTIFIED

ORGANIZATION	CODE NAME	COMMERCIAL STATUS		
		FREE	BUY OR LEASE	PROPRIETARY
Δ AEROSPACE	- -			
Δ ARGONNE NATL. LAB. (ANL)	SYSREL			
* ENERGY MANAGEMENT ASSOC. (EMA)	PROMOD	NO	LEASE	YES
Δ*GENERAL ELECTRIC CO. (GE)		NO	BUY	YES
Δ*J B F	PROCOST	YES	- -	NO
* MASS. INSTIT. OF TECH. (MIT)	SYSGEN	YES	- -	NO
PHILADELPHIA ELECTRIC CO.	- -			
* POWER TECHNOLOGY, INC. (PTI)	- -	NO	BUY	YES
SANDIA LIVERMORE (SLL)	- -			
* SYSTEM CONTROL, INC. (SCI)	PROCOS	NO	BUY	YES
* TENN. VALLEY AUTH. (TVA)	POWER SYM	YES	- -	NO
* WESTINGHOUSE ELEC. CORP.	- -	NO	BUY	YES

*SURVIVED INITIAL SCREENING PROCESS

ΔCONTAINS WIND-DERIVED GENERATION REPRESENTATION

WHY PROMOD?

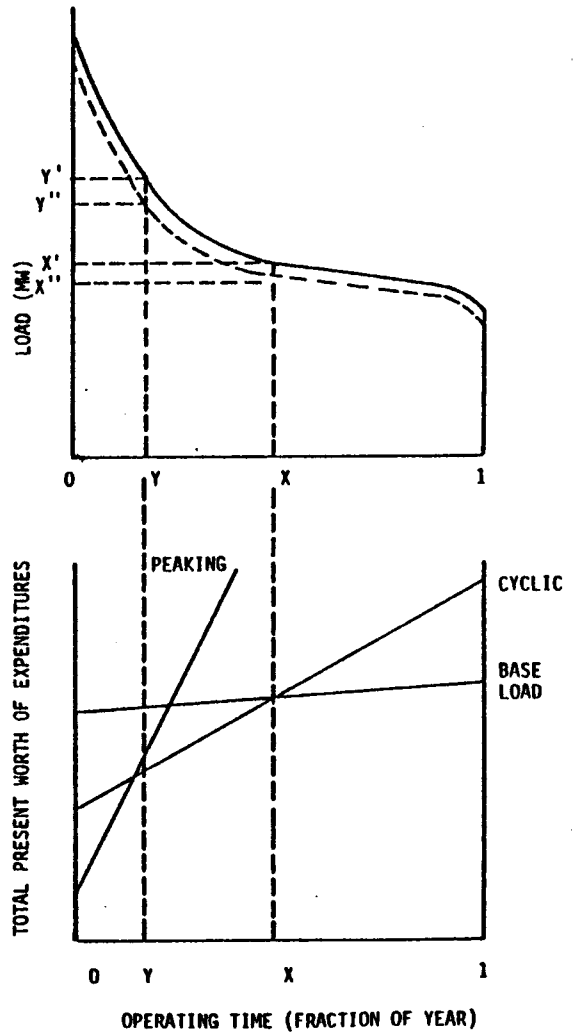
- MOST WIDELY USED ~ 33
- ALL GENERATOR TYPES
- FULL DOCUMENTATION AND MAINTENANCE
- VALIDATED DATA FILE
- SPECIAL FUEL HANDLING PROCEDURES
- HOURLY MARGINAL COST REPORTING
- OUTPUT FLEXIBILITY-DIAGNOSTICS
- PROPER SPINNING RESERVE TREATMENT
- SCHEDULED MAINTENANCE
- DOE DATA FILE FOR ~ 200 UTILITIES

WHY PROMOD ON TYMSHARE

FRONT END SAVINGS ($43K VS. $74K)

PRIME TIME POTENTIAL

ACCESS TO ALL OPTIONS EXCEPT MULTI AREA



Screening Curve Approach to Determine Optimal Generation Mix

EXPANSION PLANNING MODELS

	ORGANIZATION	CODE NAME	COMMERCIAL STATUS	PROPRIETARY
	SYSTEMS CONTROL INC.	PUPS	BUY OR LEASE	YES
D.P.	TVA/ORNL	WASP	FREE	NO
D.P.	STONE & WEBSTER	OPTGEN	BUY OR LEASE	YES
	G.E.	OGP	BUY OR LEASE	YES
L.P.	WESTINGHOUSE	GENOP	BUY OR LEASE	YES
L.P.	SAN ANTONIO	--	BUY	YES
L.P.	MIT	GEM	FREE	NO
L.P.	WORLD BANK	ELPS	FREE	NO

WIND MODEL STATUS

J B F	REVIEWED NEGEA VOLS. 1 & 2	TAPES IN HOUSE-VERIFICATION BEGUN
G.E./EPRI	REVIEWED USER'S GUIDE	TAPE REQUESTED
STONE & WEBSTER	REVIEWED USER'S GUIDE	TAPE REQUESTED
BOEING (SIMWEST)	MANUALS BEING REVIEWED	STILL BEING CONSIDERED
AEROSPACE	ONLY PROGRAM LISTINGS AVAILABLE	NOT CONSIDERED FURTHER
ANL	NO DOCUMENTATION AVAILABLE	NOT CONSIDERED FURTHER
MICH. STATE UNIV.	HART, MICH. STUDY LESS DETAILED REPRESENTATION	NOT CONSIDERED FURTHER

FUTURE PLANS

COMPLETE REPORT ON UTILITY PRODUCTION COST MODEL EVALUATIONS

BEGIN TRAINING ON PROMOD

COMPLETE INSTALLATION AND BEGIN TESTING ON JBF, STONE & WEBSTER AND GENERAL ELECTRIC WIND MODELS. ALSO BEGIN TESTING OF SIMWEST

REQUEST A UTILITY EXPANSION PLANNING TOOL

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PR-291
JUNE 4, 1979

ECONOMICS OF SWECS TIED TO THE UTILITY GRID

MICHAEL EDESESS

(PRESENTED BY DAVID PERCIVAL)

OBJECTIVES

PERFORM ANALYSES IN PROBLEM AREAS PERTAINING TO THE INTERCONNECTION OF SWECS WITH THE UTILITY GRID

INVESTIGATIONS ARE TO COMPLEMENT AND BE COORDINATED WITH "WECS FOR RECS" TASK BEING PERFORMED BY RSSG, INC.

THIS REPRESENTS A CHANGE IN DIRECTION FOR THIS TASK AS COMPARED WITH STATUS AT LAST QUARTERLY REPORT

ACCOMPLISHMENTS

DISCUSSIONS, RESEARCH OF PRIOR STUDIES, AND REVIEW OF WECS FOR RECS PROPOSAL PROMPTED REDIRECTION OF TASK EFFORT INTO THE FOLLOWING AREAS:

ASSESSMENT OF VALUE OF ELECTRICITY SUPPLIED FROM GRID TO SWECS USER AS BACK-UP, VERSUS VALUE OF ELECTRICITY SUPPLIED FROM SWECS TO GRID AS OVERFLOW

STUDY OF SENSITIVITY OF DEMAND AND ENERGY COSTS TO WIND-LOAD CORRELATION

PLANNED ACTIVITIES

RESEARCH AND IF NECESSARY DERIVE NEW METHODS FOR ASSESSING VALUE OF "BUY-BACK" AND "BACK-UP" ELECTRICITY

TEST ANALYTICALLY AND, TO THE EXTENT POSSIBLE, EMPIRICALLY, THE SENSITIVITY OF DEMAND AND ENERGY COSTS TO DEGREES OF CORRELATION BETWEEN WIND AND LOAD

OUTPUT

REPORT DESCRIBING METHODS AVAILABLE, RECOMMENDED METHODS AND SAMPLE RESULTS

ISSUES NEEDING ATTENTION

QUESTIONS FOR THE UTILITY:

WHAT WILL BE THE REDUCTION IN FUEL REQUIREMENTS AS A RESULT OF SWECS INTERCONNECTED WITH THE GRID?

WHAT WILL BE THE REDUCTION IN PLANNED GENERATING CAPACITY?

WHAT, THEREFORE, WILL BE THE REDUCTION IN COST OF SERVICE?

WHAT WILL BE THE ADDITIONAL MEASURES, AND THEIR COSTS, REQUIRED TO INSTALL AND SERVICE CUSTOMERS WHO ALSO HAVE SWECS?

WHAT POSSIBLE RATE STRUCTURES COULD APPORTION COSTS AMONG SWECS USERS AND NON-USERS?

WHAT SHOULD BUY-BACK RATES BE?

WHAT WILL BE THE EFFECT ON UTILITY FINANCES?

SHOULD THE UTILITY ITSELF BE A SWECS OWNER?

ISSUES NEEDING ATTENTION

QUESTIONS FOR THE CUSTOMER:

WITH RESPECT TO POTENTIAL RATE STRUCTURES, AT WHAT COST IS IT WORTH OWNING A SWECS?

WHAT IS THE OPTIMAL SIZE OF THE SWECS?

ISSUES ADDRESSED

QUESTIONS FOR THE UTILITY-USER AGGREGATE:

DO SWECS INTERCONNECTED WITH THE UTILITY GRID RESULT IN OVERALL COST OR SAVINGS AS COMPARED WITH ALL-CONVENTIONAL GENERATION?

WHAT PENETRATION OF SWECS PROVIDES THE OPTIMAL SAVINGS?

FISCAL YEAR '79 TASK GOAL

ADDRESS A MANAGEABLE SUBSET OF THE ISSUES LISTED IN SUCH A WAY AS TO COMPLEMENT AND INTERACT WITH THE STUDY, "AN ANALYSIS OF THE ECONOMICS IMPACT OF DISPERSED WIND TURBINE GENERATORS ON THE OPERATION OF A RURAL ELECTRIC DISTRIBUTION COOPERATIVE" ("WECS FOR RECS"), BEING PERFORMED BY REGIONAL SYSTEMS SERVICES GROUP, INC.

CHARACTERISTICS OF "WECS FOR RECS" TECHNICAL APPROACH

SIMPLIFIED WIND AVAILABILITY MODEL (POWER DURATION CURVE) TO BE USED

REC COST OF SERVICE ADJUSTMENTS FOR VARIOUS WECS PENETRATIONS TO BE DERIVED

WECS BREAKEVEN COST ESTIMATED, BASED ON REDUCTION IN COST OF SERVICE

COST OF SERVICE TO BE ALLOCATED TO DEMAND, ENERGY AND CUSTOMER CATEGORIES AND TO EACH CUSTOMER CLASS

LIKELY RATE STRUCTURES TO BE APPLIED TO WECS USER/CUSTOMER AND INDIVIDUAL WECS BREAKEVEN COST INFERRED

COMPARE REQUIRED BREAKEVEN COSTS WITH ACTUAL WECS COSTS FOR ECONOMIC VIABILITY ASSESSMENT

ISSUE COMPLEMENTARY TO THOSE ADDRESSED BY "WECS FOR RECS"

WHAT FIGURE OR FIGURES-OF-MIND BEST ASSESS THE VALUE OF WECS TO THE USER? TO THE UTILITY?

THIS IS THE ISSUE TO BE ADDRESSED BY THE SERI TASK

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PR-291
JUNE 4, 1979

LIABILITY ISSUES ASSOCIATED WITH SMALL WIND SYSTEMS

ROBERT ODLAND

OBJECTIVE

PROVIDE POLICY OPTIONS FOR

DEPARTMENT OF ENERGY

WIND ENERGY INDUSTRY

OTHERS

TO ASSURE THAT LIABILITY ISSUES ASSOCIATED WITH SMALL WIND SYSTEMS DO NOT IMPEDE THEIR INCREASED USE

SUBTASK 1 - FORMULATE CRITICAL ISSUES

STEPS

HISTORICAL ANALYSIS OF WIND MACHINES

HISTORICAL ANALYSIS OF OTHER TECHNOLOGIES

ANALYSIS OF CONTEMPORARY LAW

STATUS

DRAFT COMPLETED

PRODUCT

ISSUE PAPER TO BE CIRCULATED IN JUNE

PURPOSE

PROVIDE BASIS FOR ANALYSIS OF POLICY ALTERNATIVES

QUALITY CONTROL

INTERNAL SERI REVIEW

EXTERNAL REVIEW GROUP

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

STATUS

PRELIMINARY WORK HAS BEGUN

PRODUCT

ISSUE PAPER BY END OF JULY

PURPOSE

PROVIDE ALTERNATIVES FOR DISCUSSION

QUALITY CONTROL

INTERNAL SERI REVIEW

EXTERNAL REVIEW GROUP

WORKSHOP

SUBTASK 3 - REFINEMENT OF POLICIES

ACTIVITIES

CONSIDER COMMENTS

FURTHER ANALYSIS

RELATIONSHIP AMONG POLICIES

STATUS

SCHEDULED TO BEGIN JULY 15; EXPECTED TO BE ON SCHEDULE

PRODUCT

INTEGRATED SET OF ISSUES AND ALTERNATIVE SOLUTIONS BY END OF SEPTEMBER

PURPOSE

PROVIDE BASIS FOR FURTHER ACTION

QUALITY CONTROL

INTERNAL SERI REVIEW

EXTERNAL REVIEW GROUP

COMPARISON OF TWO STUDIES

SERI	ROCKY FLATS
Liability Issues Associated with Small Wind Machines	SWECS Product Liability Insurance Assessment
Product Liability Plus Owner/ Operator Liability	Product Liability Only
Provide Policy Options	Identify Data Requirements
Provide Basic Legal and Policy Background	Build Upon SERI Task

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PR-291
JUNE 4, 1979

ENVIRONMENTAL IMPACT ASSESSMENT FOR SMALL SYSTEMS

KATHRYN LAWRENCE

(PRESENTED BY CARL STROJAN)

OBJECTIVES

IDENTIFY POTENTIAL LIFE-CYCLE ECOLOGICAL AND HEALTH RISKS OF SMALL WECS (LESS THAN 100 kW) DEPLOYED AS STAND-ALONE SYSTEMS AND INTERCONNECTED TO UTILITY GRIDS

DETERMINE THE ENVIRONMENTAL IMPLICATIONS OF ECOLOGICAL AND HEALTH RISKS

DEFINE POTENTIAL ENVIRONMENTAL BARRIERS TO SMALL WECS DEPLOYMENT

SUBTASK 1: HEALTH EFFECTS ASSESSMENT

STEPS

QUANTIFY MATERIALS REQUIRED FOR SYSTEM MANUFACTURE AND OPERATION

CALCULATE EMISSIONS FROM MATERIALS ACQUISITION AND PROCESSING

ESTIMATE HEALTH RISK FROM EMISSIONS

DETERMINE INJURY AND ACCIDENT 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; RELEASE OF TOXIC SUBSTANCES FROM STORAGE SYSTEMS; ETC.)

SUM RISKS TO DERIVE ESTIMATE OF SMALL WECS LIFE-CYCLE HEALTH EFFECTS

STATUS

WORK HAS BEGUN; THE CONSULTANT (GERALD WEINGART OF LBL) HAS BEEN OBTAINED TO INDEPENDENTLY VERIFY SERI RISK ASSESSMENTS

PR-291
JUNE 4, 1979

PRODUCT

SUMMARY OF LIFE-CYCLE HEALTH EFFECTS TO BE PRESENTED IN THE INTERIM REPORT, SEPTEMBER 15, 1979

PURPOSE

PROVIDE HEALTH RISK ESTIMATES TO BE INTEGRATED WITH ECOLOGICAL EFFECTS ESTIMATES

QUALITY CONTROL

INTERNAL SERI REVIEW

REVIEW BY SELECTED, EXTERNAL PROFESSIONALS

DOE REVIEW OF INTERIM REPORT

SUBTASK 2: ECOLOGICAL EFFECTS ASSESSMENT

STEPS

REVIEW EXISTING SWECS ECOLOGICAL EFFECTS AND TECHNOLOGICAL DATA

MAKE ON-SITE VISITS TO EXPERIMENTAL AND OPERATING SWECS, AND TO SELECTED SWECS MANUFACTURES, TO COLLECT ADDITIONAL 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

WORK HAS BEGUN; GRADUATE SUMMER INTERN JOINED SUBTASK TEAM JUNE 1, 1979

PRODUCT

QUANTIFICATION OF LIFE-CYCLE ECOLOGICAL EFFECTS OF SWECS; EFFECTS WILL BE INTEGRATED WITH HEALTH RISK ESTIMATES AND PRESENTED IN THE DRAFT FINAL REPORT, DECEMBER 15, 1979

PURPOSE

PROVIDE ECOLOGICAL EFFECTS ESTIMATES TO BE INTEGRATED WITH HEALTH RISK ESTIMATES

QUALITY CONTROL

INTERNAL SERI REVEIW

REVEIW BY SELECTED, EXTERNAL PROFESSIONALS

SUBTASK 3: LIFE-CYCLE ENVIRONMENTAL ASSESSMENT

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

SCHEDULED TO BEGIN OCTOBER 1, 1979

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JUNE 4, 1979

PRODUCT

INTEGRATED SWECS LIFE-CYCLE ENVIRONMENTAL EFFECTS ESTIMATES TO BE PRESENTED IN THE DRAFT FINAL REPORT, DECEMBER 15, 1979

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

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; A SUBCONTRACT WAS ISSUED APRIL 30, 1979 (PO No. AM-9-8186-1)

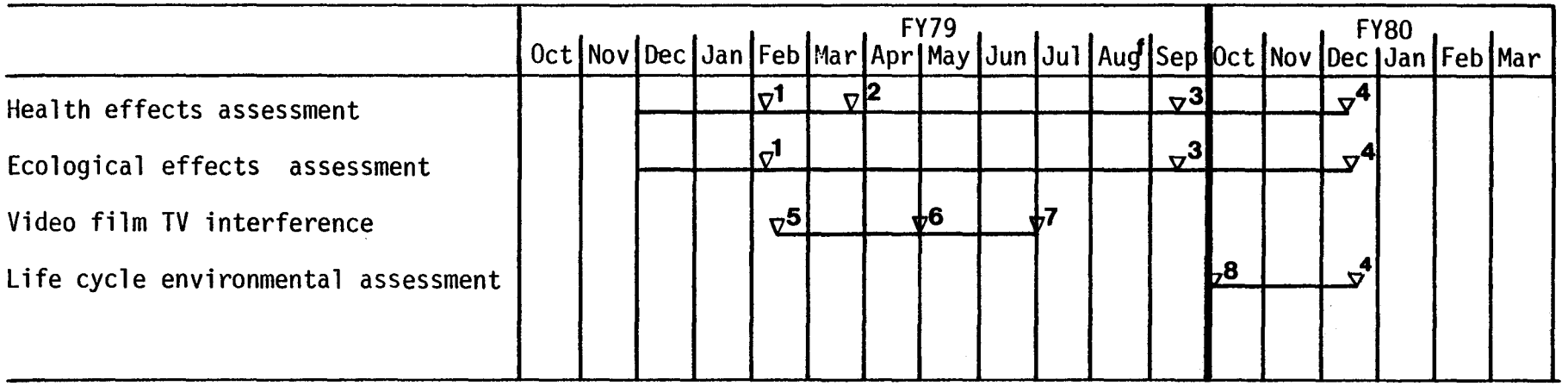
PRODUCT

A 15-MINUTE COLOR VIDEOCASSETTE PRESENTING POTENTIAL TV INTERFERENCE OF THE BLOCK ISLAND WTG WAS PROVIDED TO SERI AND DOE/WSB ON JUNE 1, 1979

QUALITY CONTROL

FILM REVIEW AND APPROVAL BY SERI AND DOE

ENVIRONMENTAL IMPACT ASSESSMENT FOR SMALL SYSTEMS*



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

1. Collect data
2. Make tentative selection of SWECS designs and deployment options for study
3. Interim Report
4. Draft final report
5. Initiate plan study
6. Issue subcontract
7. Complete study