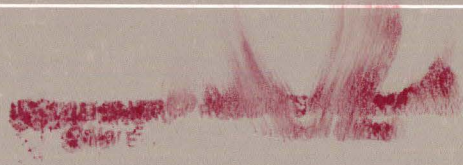


\*C.2

SERI/PR-635-672



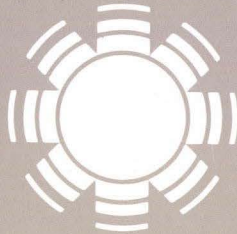
JUL 1 1978

GILBERT, COLORADO 80401

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# Wind Energy Systems Quarterly Review January 1, 1980 — March 31, 1980

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



# SERI

SERI/PR-635-672

c.2

Solar Energy Research Institute

1536 Cole Boulevard  
Golden, Colorado 80401

A Division of Midwest Research Institute

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PR-672  
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WIND ENERGY SYSTEMS  
QUARTERLY REVIEW  
JANUARY 1, 1980 - MARCH 31, 1980

MAY 21, 1980

SOLAR ENERGY RESEARCH INSTITUTE  
1617 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

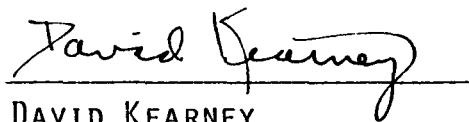
THE QUARTERLY REVIEW FOR THE WIND ENERGY SYSTEMS (WES) PROGRAM IS PREPARED BY THE SOLAR ENERGY RESEARCH INSTITUTE (SERI) AS AN OVERVIEW OF THE PROGRAM EFFORTS. THIS QUARTERLY REVIEW IS DELIVERED TO FULFILL SERI'S ANNUAL OPERATING PLAN (AOP) REPORTING REQUIREMENTS. THE REVIEW PRESENTS THE OBJECTIVES,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

PR-672  
MAY 21, 1980

REPORT No. SERI/PR-635-672  
DATE: MAY 1980  
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  
1617 COLE BOULEVARD  
GOLDEN, COLORADO 80401

APPROVED FOR:  
SOLAR ENERGY RESEARCH INSTITUTE



DAVID KEARNEY  
DIVISION MANAGER (ACTING)  
SOLAR THERMAL, OCEAN AND  
WIND DIVISION



IRWIN E. VAS  
BRANCH CHIEF (ACTING)  
WIND ENERGY BRANCH



IRWIN E. VAS  
PROGRAM COORDINATOR

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## SERI WIND ENERGY RELATED TASKS FY80

SEVENTEEN SUBTASKS IN THE SERI WIND ENERGY SYSTEMS PROGRAM AND THE FOLLOWING 5 SUBTASKS IN OTHER PROGRAM AREAS.

TECHNICAL INFORMATION DISSEMINATION <sup>A</sup>	P. WEIS
WIND INQUIRIES AND REFERRALS <sup>B</sup>	S. NORMANN
MASS PRODUCTIVITY OF SMALL HORIZONTAL <sup>C</sup> AXIS WIND TURBINE SYSTEMS	C. NORDQUEST
WIND RESOURCE ANALYSIS <sup>D</sup>	R. HULSTROM
WECS COMMERCIALIZATION <sup>E</sup>	D. FEASBY

<sup>A</sup>COMMERCIALIZATION ACTIVITIES - PROGRAM AREA 15.

<sup>B</sup>INFORMATION SYSTEMS - PROGRAM AREA 12

<sup>C</sup>BASIC AND APPLIED RESEARCH - PROGRAM AREA 11.

<sup>D</sup>ADVANCED SOLAR ENERGY RESEARCH - PROGRAM AREA 10.

<sup>E</sup>COMMERCIALIZATION ACTIVITIES - PROGRAM AREA 15.

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PROGRAM OVERVIEW

IRWIN E. VAS

A TOTAL OF 17 TASKS ARE CURRENTLY IDENTIFIED IN THE WIND ENERGY SYSTEM PROGRAM AREA 3.

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

THE WORK BREAKDOWN STRUCTURE FOR THE WIND ENERGY SYSTEMS SUBTASKS IN THE RESEARCH AND ANALYSIS ELEMENT OF THE FEDERAL WIND ENERGY PROGRAM IS PROVIDED TO SHOW THE RELATIONSHIP OF THE SERI TASKS IN ELEMENT 1.0.

Work Breakdown Structure - SERI (proposed)

Research and Analysis 1.0

Market and Impact Studies 1.1

Innovative Concepts 1.2

Information Dissemination 1.3

Market and Economic Analyses 1.1.1

Operations and Applications Requirements 1.1.2

Institutional/Environmental Analyses 1.1.3

Program Development 1.1.4

Innovative Systems 1.2.1

Materials Development 1.3.1

Dispersed 1.1.1.1

Dispersed 1.1.2.1

Environmental 1.1.3.1

Mission Analysis 1.1.4.1

Research Studies 1.2.1.1

Dissemination 1.3.2

Market Characterization 1.1.1.1.1

Small User Decision Analysis 1.1.1.1.2

Economics of WECS owned by the end user 1.1.1.1.3

Agricultural 1.1.1.2

Power Networks 1.1.1.3

Utility Analytical Modelling 1.1.1.3.1

Selected Value Analysis 1.1.1.3.2

Economics of SWECS/Utility 1.1.1.3.3

Economics of WECS/Utility 1.1.1.3.4

Agricultural 1.1.2.2

Power Networks 1.1.2.3

Utility Guide 1.1.2.3.1

Environmental Impact Assessment of SWECS 1.1.3.1.1

Ecological-Environmental Assessment 1.1.3.1.2

Television Interference Studies 1.1.3.1.3

Noise Field Studies 1.1.3.1.4

Legal/Regulatory 1.1.3.2

Products Liability with SWECS 1.1.3.2.1

Land Use 1.1.3.2.2

Standards 1.1.3.3

Strategy Analysis 1.1.4.1.1

Venture Analysis 1.1.4.2

Technology Overview/Planning/Studies 1.1.4.3

Wind Systems Coord 1.1.4.3.1

WECS Cost Study 1.1.4.3.2

Program Administration 1.1.4.8

Cost and Assessment Studies 1.2.1.2

Concept R and D 1.2.2

TABLE 1. WIND ENERGY SYSTEMS SUBTASK BUDGET SUMMARY

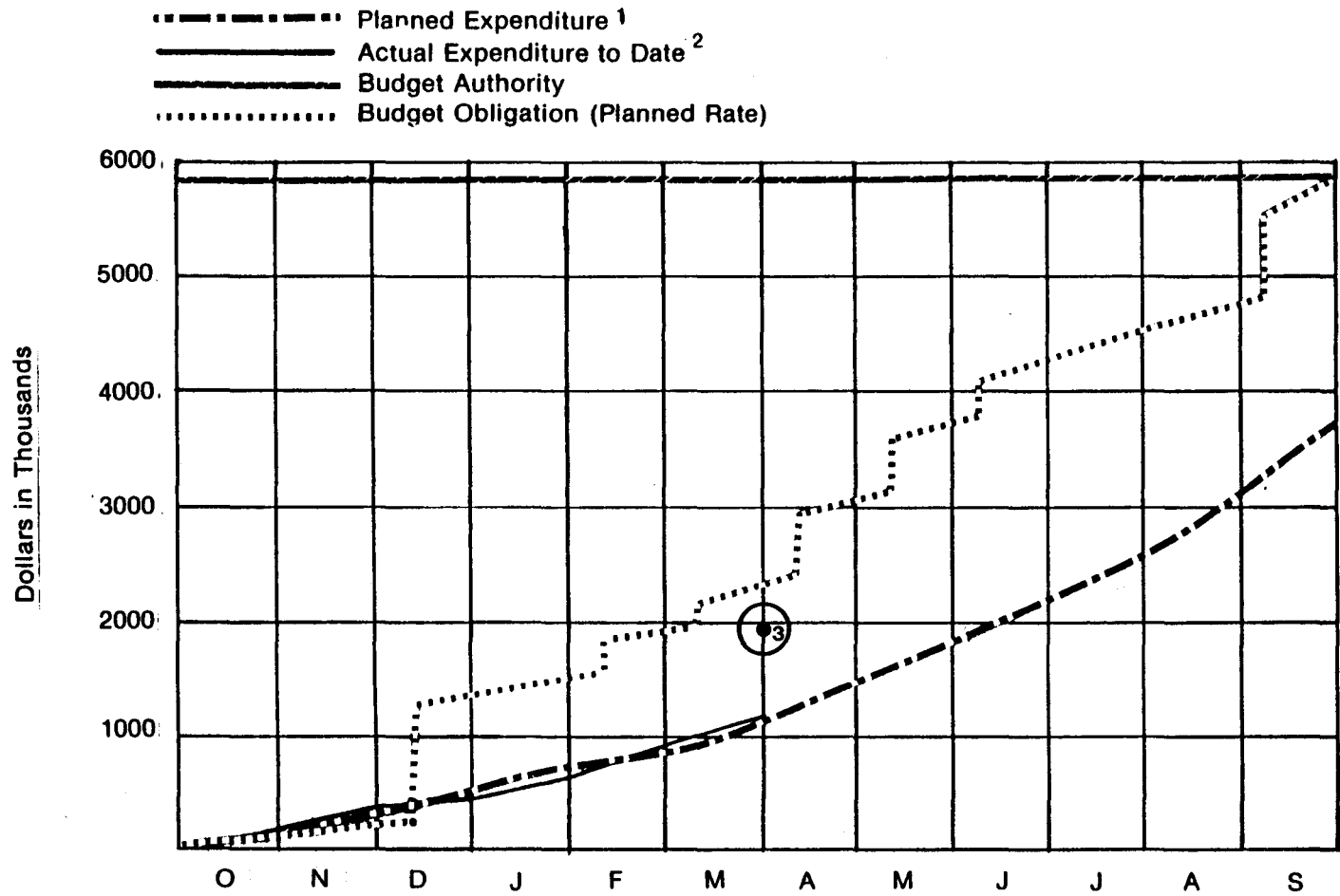
SUBTASK	WSB/DOE(1)	FILE TOTAL	BURDENED SALARIES	ODC'S, FEES, ETC.	FY80(2)	FY80(3)	FY/9	TOTAL FY(4)	TOTAL FY(5)
	WORK BREAKDOWN STRUCTURE				SUBCONTRACTS	TOTAL	CARRYOVER FUNDS	SUBCONTRACTS	BUDGET
MARKET CHARACTERIZATION	1.1.1.1.1	2.35	155	100	545	800	-0-	545	800
SMALL USER DECISION ANALYSIS	1.1.1.1.2	0.80	38	72	40	150	-0-	40	150
ECONOMICS OF WECS OWNED BY THE END USER	1.1.1.1.3	1.00	72	44	149	265	36	185	301
WECS UTILITY ANALYTICAL MODELING	1.1.1.3.1	0.37	29	36	35	100	40	75	140
SELECTED UTILITIES VALUE ANALYSIS	1.1.1.3.2	1.10	77	81	442	600	470	912	1070
ECONOMICS OF WECS TIED TO THE UTILITY	1.1.1.3.4	0.60	44	11	-0-	55	-0-	-0-	55
A COMPREHENSIVE GUIDE, WECS CONNECTED TO ELECTRIC UTILITIES	1.1.2.3.1	1.40	91	79	-0-	-0-	230	60	230
ECOLOGICAL, SOCIO-ENVIRON- MENTAL ASSESSMENT OF WIND SYSTEMS	1.1.3.1.2	0.97	55	12	-0-	60	38	31	98
TELEVISION INTERFERENCE AND WECS	1.1.3.1.3	0.35	30	11	69	100	10	69	110
NOISE MEASUREMENTS AT SELECTED WIND SYSTEM SITES	1.1.3.1.4	0.55	36	75	25	50	145	84	195
LAND USE ISSUES	1.1.3.2.2	0.90	52	28	55	125	10	55	135
STRATEGY ANALYSIS	1.1.4.1.1	0.70	45	50	-0-	75	-0-	-0-	75
WIND SYSTEMS COORDINATION	1.1.4.3.1	1.40	85	176	169	450	-0-	169	450
WECS COST STUDY	1.1.4.3.2	0.60	34	12	4	50	-0-	4	50

TABLE 1. WIND ENERGY SYSTEMS SUBTASK BUDGET SUMMARY (CONCLUDED)

PROGRAM REVIEW AND PLANNING	1.1.4.8	1.11	84	141	-0-	230	(5)	-0-	225
WIND ENERGY INNOVATIVE SYSTEMS	1.2.1.1	1.30	72	167	751	990	447	1198	1437
ENGINEERING ANALYSIS AND COST ESTIMATING OF INNOVATIVE WECS	1.2.1.2	$\frac{1.45}{16.95}$	$\frac{99}{1098}$	$\frac{60}{1135}$	$\frac{191}{2475}$	$\frac{350}{4430}$	$\frac{17}{1438}$	$\frac{208}{3635}$	$\frac{367}{5868}$

- (1) WIND SYSTEMS BRANCH/DOE WORK BREAKDOWN STRUCTURE NUMBER.
- (2) FY80 FUNDS PLANNED TO BE OBLIGATED FOR SUBCONTRACTS DURING FY80.
- (3) TOTAL FY80 FUNDS AUTHORIZED FOR THE SUBTASK.
- (4) TOTAL FUNDS PLANNED TO BE OBLIGATED FOR SUBCONTRACTS DURING FY80 (INCLUDES FY79 FUNDS, COMMITTED OR UNCOMMITTED) FOR SUBCONTRACTS.
- (5) TOTAL FUNDS AUTHORIZED FOR THE SUBTASK IN FY80 INCLUDING FY79 CARRYOVER FUNDS.





Analysis of Variance as of March 31, 1980

1. 1216K
2. 1208K
3. Budget Obligation (actual)  
(1208 + 751 (committed) = 1959K)

TABLE 2. WIND ENERGY SYSTEMS PROGRAM (ACTUAL) EXPENDITURES - 1ST AND 2ND QUARTERS FY80

<u>TASK</u>	<u>LEAD BRANCH</u>	<u>BURDENED SALARIES</u>	<u>ODC'S FEE'S ETC.</u>	<u>SUBCONTRACTS</u>	<u>TOTAL EXPENDED*</u>	<u>COMMITTED**</u>	<u>PLANNED TOTAL EXPENDITURES</u>
MARKET CHARACTERIZATION	UTILITY APPLICATIONS AND POLICY	94	8	-0-	102	4	106
SMALL USER DECISION ANALYSIS	INDUSTRIAL APPLICATIONS AND POLICY	21	1	-0-	22	-0-	21
ECONOMICS OF WECS OWNED BY THE END USER	INDUSTRIAL APPLICATIONS AND POLICY	50	5	-0-	55	10	42
WECS UTILITY ANALYTICAL MODELING	UTILITY APPLICATIONS AND POLICY	15	51	-0-	66	-0-	48
SELECTED UTILITIES VALUE ANALYSIS	UTILITY APPLICATIONS AND POLICY	57	9	204	250	570	249
ECONOMICS OF WECS TIED TO THE UTILITY	UTILITY APPLICATIONS AND POLICY	11	2	-0-	15	-0-	23
A COMPREHENSIVE GUIDE, WECS CONNECTED TO ELECTRIC UTILITIES	UTILITY APPLICATIONS AND POLICY	57	5	-0-	40	-0-	36
ECOLOGICAL, SOCIO-ENVIRONMENTAL ASSESSMENT OF WIND SYSTEMS	ENVIRONMENTAL AND SOCIAL IMPACTS GROUP	50	2	-0-	52	1	58
TELEVISION INTERFERENCE AND WECS	WIND ENERGY BRANCH	7	1	-0-	8	-0-	20
NOISE MEASUREMENTS AT SELECTED WIND SYSTEM SITES	WIND ENERGY BRANCH	80	26	8	114	29	64
LAND USE ISSUES	ENVIRONMENTAL AND SOCIAL IMPACTS GROUP	50	5	-0-	55	-0-	58

TABLE 2- WIND ENERGY SYSTEMS PROGRAM FUNDING (CONCLUDED)

STRATEGY ANALYSIS	WIND ENERGY BRANCH	5	-0-	-0-	5	-0-	14
WIND SYSTEMS COORDINATION	WIND ENERGY BRANCH	19	5	-0-	22	29	38
WECS COST STUDY	SYSTEMS DEVELOPMENT	15	2	-0-	17	5	19
PROGRAM REVIEW AND PLANNING	WIND ENERGY BRANCH	56	9	-0-	45	25	55
WIND ENERGY INNOVATIVE SYSTEMS	WIND ENERGY BRANCH	48	19	2/4	541	196	555
ENGINEERING ANALYSIS AND COST ESTIMATES OF INNOVATIVE WECS	WIND ENERGY BRANCH	<u>58</u>	<u>5</u>	<u>-0-</u>	<u>41</u>	<u>-0-</u>	<u>46</u>
		575	149	486	1208	751	1216

\*As of 3-29-80 COMPUTER ACCOUNTING REPORTS, SOME EXPENDITURES AND/OR COMMITMENTS MAY NOT YET BE PUNCHED INTO COMPUTER.  
\*\*OBLIGATED BUT NOT YET COSTED.

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FY80 WES PROGRAM SUBCONTRACT SUMMARY

	<u>NUMBER</u>	<u>(\$ x K) AMOUNT</u>
PLANNED SUBCONTRACTS	51	3655
PURCHASE REQUESTS APPROVED	14	1563
SUBCONTRACTS AWARDED/\$ COMMITTED	7	729

TABLE 5. FY80 WECS PROGRAM SUBCONTRACT SCHEDULE

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CONTRACTOR	WORK TITLE	PLANNED					ACTUAL		
		AMOUNT \$K	PR. COMPL. DATE	START DATE	END DATE	AMOUNT TO BE COSTED DURING FY80	AMOUNT \$K	START DATE	AMOUNT TO BE COSTED \$K
<u>3531.15 MARKET CHARACTERIZATION</u>									
TBD (SOLE SOURCE)	WIND DATA ANALYSIS	46	1/80	5/80	9/80	46	--	--	--
TBD (LIMITED COMPETITIVE)	DEMOGRAPHIC PROFILE	150	1/80	5/80	9/80	150	--	--	--
TBD (BOA)	COMPUTER DATA ANALYSIS	70	2/80	5/80	1/81	42	--	--	--
TBD (BOA)	MARKET RESEARCH	150	2/80	5/80	1/81	75	--	--	--
TBD (BOA)	PROJECT INTEGRATION	129	3/80	5/80	7/81	66	--	--	--
<u>3531.25 SMALL USER DECISION ANALYSIS</u>									
TBD (BOA)	SMALL USER DECISION ANALYSIS	40	1/80	5/80	10/80	40	--	--	--
<u>3532.25 ECONOMIC OF WECS OWNED BY THE END USER</u>									
TBD (RENEWAL)	WECS FOR RECS	157	5/80	7/80	3/81	120	--	--	--
TBD (COMPETITIVE)	ECONOMICS OF WECS	28	1/80	8/80	11/80	9	--	--	--
<u>3532.15 WECS UTILITY ANALYTICAL MODELING</u>									
EMA	PROMOD LEASE	75	--	10/79	9/81	50	75	10/79	50
<u>3532.20 SELECTED UTILITIES VALUE MODELING</u>									
JBF CORP.	SITE VALUE ANALYSIS	370	--	11/79	11/80	500	555	12/79	296
AEROSPACE CORP.	SITE VALUE ANALYSIS	210	--	11/79	11/80	176	212	12/79	177
JBF CORP.	LADMP vs SCI ANALY.	20	2/80	4/80	6/80	20	--	--	--
JBF CORP.	SITE ANALYSIS EXT.	172	9/80	11/80	5/81	-0-	--	--	--
AEROSPACE CORP.	SITE ANALYSIS EXT.	150	9/80	11/80	5/81	-0-	--	--	--
<u>3532.60 A COMPREHENSIVE GUIDE: WECS CONNECTED TO ELECTRIC UTILITIES</u>									
TBD (SOLE SOURCE)	LARGE WECS ASSESSMENT	60	1/80	5/80	-0-	--	--	--	--

TABLE 3. FY80 WES PROGRAM SUBCONTRACT SCHEDULE (CONTINUED)

CONTRACTOR	WORK TITLE	PLANNED					ACTUAL		
		AMOUNT \$K	PR. COMPL. DATE	START DATE	END DATE	AMOUNT TO BE COSTED DURING FY80	AMOUNT \$K	START DATE	AMOUNT TO BE COSTED \$K
<u>3531.35 ECOLOGICAL/SOCIO-ENVIRONMENT ASSESSMENT</u>									
TBD (COMPETITIVE)	FIELD NOISE MEASUREMENT	31	6/80	9/80	3/81	4	--	--	--
<u>3532.50 TELEVISION INTERFERENCE AND WECS</u>									
TBD (SOLE SOURCE)	TVI HANDBOOK	50	2/80	4/80	10/80	50	--	--	--
TBD (SOLE SOURCE)	TVI GHOST SUPPRESSION	19	2/80	6/80	10/80	19	--	--	--
<u>3532.55 NOISE MEASUREMENT AT SELECTED SITES</u>									
BATTELLE PNL	TETHER SOUND MEASUREMENTS	25	2/80	5/80	7/81	25	32	3/80	32
TBD (COMPETITIVE)	SYSTEMATIC MEASUREMENTS	59	2/80	9/80	12/80	20	--	--	--
MIT	AERODYNAMIC NOISE						18	4/80	18
PENN STATE UNIV.	NOISE PROPAGATION						27	12/79	27
<u>3531.30 LAND USE ISSUES</u>									
TBD (SOLE SOURCE)	LAND USE CONSTRAINTS	50	2/80	4/80	9/80	50	--	--	--
UNIVERSITY OF DENVER	LEGAL SUPPORT	5	1/80	1/80	10/80	5	10	1/80	10
<u>3532.10 WIND PROGRAM COORDINATION</u>									
TBD (SOLE SOURCE)	COORDINATION	169	2/80	6/80	12/80	109	--	--	--
<u>3532.45 WECS COST STUDY</u>									
TBD (SOLE SOURCE)	CONFIGURATION STUDY	4	2/80	4/80	6/80	4	--	--	--
<u>3533.35 WECS</u>									
WEST VIRGINIA UNIV.	INNOVATIVE WECS	120	1/80	4/80	4/81	60	--	--	--
GRUMMAN	DAWT	120	2/80	5/80	1/81	95	--	--	--



TABLE 3. FY80 WES PROGRAM SUBCONTRACT SCHEDULE (CONCLUDED)

CONTRACTOR	WORK TITLE	PLANNED					ACTUAL		
		AMOUNT \$K	PR. COMPL. DATE	START DATE	END DATE	AMOUNT TO BE COSTED DURING FY80	AMOUNT \$K	START DATE	AMOUNT TO BE COSTED \$K
DAYTON UNIV.	EFT STUDIES	120	3/80	6/80	6/81	85	--	--	--
GRUMMAN	TORNADO	200	2/80	5/80	5/81	75	--	--	--
TBD (COMPETITIVE)	ASSESSMENT OF SPECIFIC WEIS	191	2/80	9/80	8/81	15	--	--	--
<u>3533.40 ENGINEERING ANALYSIS AND COST ESTIMATING OF IMECS</u>									
TBD (COMPETITIVE)	DEVELOPMENT COSTING METHODOLOGY	25	1/80	6/80	10/80	25	--	--	--
TBD (COMPETITIVE)	PRE-PRODUCTION COSTING METHODOLOGY	185	2/80	9/80	3/81	30	--	--	--

Wind Energy Systems — Milestones

Task or Subtask Activities	Fy 80											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Market Characterization												1△2△
Small User Decision Analysis					3▲							4△
Economics of WECS Owned by the End User									5△			6△
WECS Utility Analytical Modeling								7△				
Selected Utilities Value Analysis									8△			9△
Economics of WECS Ties to the Utility					10▲							11△
A Comprehensive Guide, WECS Connected to Electric Utilities											12△	
Ecological, Socio-Environmental Assessment of Wind Systems					13▲							△14
Television Interference and WECS	15●							16○				

△ Milestone

○ Start or Scheduled Intermediate Event

▲ Milestone Complete

● Completed Intermediate Event

1. Planned completion of Phase I
2. Planned completion of Draft Report Phase I
3. Develop decision model
4. Draft report on small user decision analysis
5. Complete computer program
6. Complete preliminary rate structure studies
7. Complete draft methodology report and users manual
8. Complete analysis of San Gorgonio site

9. Complete analysis for the first 11 sites
10. Complete computer models for study
11. Complete analysis of economics of WECS tied to utilities
12. Draft final report
13. Draft final report on environmental assessment of SWECS
14. Draft final report
15. Systematic measurements on Block Island, R. I.
16. Systematic measurements at Boone, N. C.

**Wind Energy Systems — Milestones (continued)**

Task or Subtask Activities		Fy 80											
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Noise Measurements at Selected Wind System Sites Land Use Issues Strategy Analysis Wind Systems Coordination WECS Cost Study Program Review and Planning Wind Energy Innovative Systems Engineering Analysis and Cost Estimating of Innovative WECS		17 ●				18 ●			19 ○				
											21 △		
			—————										
											22 ○	23 ○	
			24 ●								25 ○		
				26 ●									26 ○
						27 ●							28 ○
													30 ○
Cumulative Accrued Costs \$ X1000	Planned	45.0	287.0	504.0	729.0	943.0	1218	1518	1862	2247	2682	3174	3721
	Actual	130.1	297.6	481.4	696.1	966.2	1231						
	Variance	14.9	(10.6)	22.6	32.9	(23.2)	(13)						

△ Begin Milestone

○ Start or Scheduled Intermediate Event

▲ Milestone Complete

● Completed Intermediate Event

- 17. Preliminary measurements at Boone, N.C.
- 18. Systematic measurements at Boone, N.C.
- 19. Progress report on noise measurements
- 21. Draft final report on land use issues
- 22. Preliminary data base format
- 23. Centralization and consolidation of the data base
- 24. Prepared base cost estimate for Millville 10kW system
- 25. Perform sensitivity analysis for WECS

- 26. Complete draft summary program development plan.
- 27. Issue letters of interest for assessment studies
- 28. Award contracts on assessment
- 30. Draft report on engineering analysis of innovative WECS

TABLE B. SUBTASK ADVISORY BOARD MEMBERS  
MARKET CHARACTERIZATION

<u>NAME</u>	<u>ORGANIZATION</u>
RICHARD WILLIAMS	ROCKWELL INTERNATIONAL
DR. LEO H. SODERHOLM	U.S. DEPARTMENT OF AGRICULTURE
DR. EDGAR DEMEO	EPRI
DR. W. R. BARCHET	BATTELLE PACIFIC NORTHWEST LAB.
DR. DONALD VINSON	UNIVERSITY OF SOUTHERN CALIFORNIA
ROBERT L. SCHEFFLER	SOUTHERN CALIFORNIA EDISON
MARSHALL F. MERRIAM	UNIVERSITY OF CALIFORNIA
BILL REDDICK	WSB/DOE

SMALL USER DECISION ANALYSIS

LLOYD WALKER	CSU AGRICULTURE EXTENSION SERVICE
REX TYNES	MORGAN COUNTY REA
BRUCE HUTTON	UNIVERSITY OF DENVER

ECONOMICS OF WECS BY THE END USER

JUDY PORPOTOG	ROCKWELL INTERNATIONAL
RICHARD BARCHET	BATTELLE PNL
EDGAR DEMEO	EPRI
TOM REDDOCK	UNIVERSITY OF TENNESSEE
FRANKLIN STERMOLE	COLORADO SCHOOL OF MINES

SELECT UTILITY VALUE ANALYSIS

DR. FELIX WU	UNIVERSITY OF CALIFORNIA
DR. ROBERT SULLIVAN	UNIVERSITY OF FLORIDA
OLIVER GILDERSLEEVE	EPRI
DR. GEORGE GROSS	PACIFIC GAS & ELECTRIC
DR. TOM REDDOCK	UNIVERSITY OF TENNESSEE
DR. JEFF RUMBAUGH	DOE

NOISE MEASUREMENT AT SELECTED  
WIND SYSTEM SITES

<u>NAME</u>	<u>ORGANIZATION</u>
DR. FRED H. SCHMITZ	AMES RESEARCH CENTER
PROFESSOR DENNIS W. THOMSON	PENNSYLVANIA STATE UNIVERSITY
SCOTT A. TURNER	PORTLAND GENERAL ELECTRIC
DR. WESLEY HARRIS	M.I.T.

LAND USE ISSUES

BILL OSTRANDER	SOUTHERN CALIFORNIA EDISON
DONALD BAIN	OREGON DEPARTMENT OF ENERGY
JEFF PEARSON	COLORADO CONSUMER ADVOCATE
GERRY FARBER	PENNSYLVANIA POWER AND LIGHT
JIM WELCH	CONSULTANT
GEORGE PRING	ATTORNEY

WIND SYSTEMS COORDINATION

PETER MORETTI	OKLAHOMA STATE UNIVERSITY
TERRY HEALY	ROCKWELL INTERNATIONAL
LOU LILJEDAHL	USDA - BELTSVILLE, VA
TOM REDDOCK	UNIVERSITY OF TENNESSEE
ROBERT THRESHER	OREGON STATE UNIVERSITY
RON THOMAS	NASA-LEWIS RESEARCH CENTER
BILL REDDICK	DOE
MARSHALL MERRIAM	UNIVERSITY OF CALIFORNIA

WECS COST STUDY

<u>NAME</u>	<u>ORGANIZATION</u>
MR. NICK PATAPOFF	SOUTHERN CALIFORNIA EDISON
DR. AARON ROSE	UNIVERSITY OF SOUTHERN CALIFORNIA
MR. GEORGE SCOTT	HUGHES AIRCRAFT
MR. ARLYAN FEIGHT	ROCKWELL INTERNATIONAL
MR. RON BOONE	FIRST BANK OF DENVER
MR. STU CAMERON	FLUOR ENGINEERS AND CONSTRUCTORS
MS. KATHERINE SEELMAN	NATIONAL COUNCIL OF CHURCHES
MS. BETTY HUNTER	ECOLOGY CENTER OF LOUISIANA
MR. KEN WILLIAMSON	LOS ALAMOS LABORATORY

WEIS

RON THOMAS	NASA/LERC
OREE DYES	DOE
DUANE CROMAK	UNIVERSITY OF MASSACHUSETTS
PETER MORETTI	OKLAHOMA STATE UNIVERSITY
BOB THRESHER	OREGON STATE UNIVERSITY
AL MILLER	BATELLE PNL
PAUL KLIMAS	ROCKWELL INTERNATIONAL



TABLE C. WECS PROGRAM PUBLICATIONS

<u>SUBTASK</u>	<u>TITLE AND AUTHOR</u>	<u>STATUS</u>
ECONOMICS OF SWECS TIED TO THE UTILITY (FY79 SUBTASK)	"THE EFFECT OF THE SUBSTITUTION OF WIND POWER FOR CONVENTIONAL POWER ON THE END USER'S RATE OF RETURN ON INVESTMENT" - MICHAEL EDESESS	DRAFT
LAND USE ISSUES	"PRODUCT LIABILITY AND SMALL WIND ENERGY CONVERSION SYSTEMS (SWECS) AN ANALYSIS OF SELECTED ISSUES AND POLICY ALTERNATIVES." - ROBERT NOUN	FINAL
PROGRAM REVIEW AND PLANNING	WIND ENERGY SYSTEMS QUARTERLY REVIEW, OCTOBER 1, 1979- DECEMBER 31, 1979	FINAL
WIND ENERGY INNOVATIVE SYSTEMS	"A REVIEW OF THE CURRENT STATUS OF THE WIND ENERGY INNOVATIVE SYSTEMS PROJECTS" - IRWIN E. VAS	FINAL
WIND ENERGY INNOVATIVE SYSTEMS	"WIND ENERGY INNOVATIVE SYSTEMS CONFERENCE PROCEEDINGS" EDITED BY IRWIN E. VAS	FINAL
UTILITY ANALYTICAL MODELING	"ELECTRIC UTILITY VALUE DETERMINATION - WIND: VOLUME 1, METHODOLOGY; VOLUME 2, USER'S GUIDE."	DRAFT
ECOLOGICAL/SOCIO-ENVIRONMENTAL ASSESSMENT OF WIND SYSTEMS	"ENVIRONMENTAL ASSESSMENT OF SMALL WIND SYSTEM PROGRESS REPORT" LAWRENCE/STROJAN	DRAFT
ENGINEERING ANALYSIS AND COST ESTIMATING OF INNOVATIVE WECS	"A SCREENING METHODOLOGY FOR WIND ENERGY CONVERSION SYSTEMS," ROBERT D. MCCONNELL	FINAL
UTILITY ANALYTICAL MODELING	"PLANNING FOR ELECTRIC UTILITY SOLAR APPLICATIONS: THE EFFECTS ON RELIABILITY AND PRODUCTION COST ESTIMATES OF THE VARIABILITY IN DEMAND." GEORGE R. FEGAN, C. DAVID PERCIVAL	FINAL
UTILITY ANALYTICAL MODELING	"INTEGRATION OF INTERMITTENT SOURCES INTO BALERIAUX- BOTH PRODUCTION COST MODELS." GEORGE R. FEGAN, C. DAVID PERCIVAL	FINAL

<u>SUBTASK</u>	<u>TITLE AND AUTHOR</u>	<u>STATUS</u>
UTILITY ANALYTICAL MODELING	"PROBLEMS IN THE INTEGRATION OF INTERMITTENT SOURCES INTO UTILITY PRODUCTION COSTING MODELS." GEORGE R. FEGAN, C. DAVID PERCIVAL	FINAL
WIND ENERGY INNOVATIVE SYSTEMS	"THIRD ANNUAL PROGRESS REPORT ON THE ELECTROFLUID DYNAMIC WIND GENERATOR" MINARDI, J. E., ET. AL., UNIVERSITY OF DAYTON	FINAL
WIND ENERGY INNOVATIVE SYSTEMS	"AN ANALYSIS OF THE MADARAS ROTOR POWER PLANT - AN ALTERNATE METHOD FOR EXTRACTING LARGE AMOUNTS OF POWER FROM THE WIND" WHITFORD, D. H., ET. AL., UNIVERSITY OF DAYTON	FINAL
WIND ENERGY INNOVATIVE SYSTEMS	"VERTICAL AXIS WIND TURBINE DEVELOPMENT" WALTERS, R. E., ET. AL., WEST VIRGINIA UNIVERSITY	FINAL
WIND ENERGY INNOVATIVE SYSTEMS	"ENERGY FROM THE AIR" OLIVER, T. K., ET. AL., SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY	FINAL
ENGINEERING ANALYSIS AND COST	"SCREENING METHODOLOGY FOR INNOVATIVE WIND SYSTEMS" MOORE, E., ET. AL., SCIENCE APPLIATIONS, INC.	FINAL
WIND ENERGY INNOVATIVE SYSTEMS	"TECHNICAL DEVELOPMENT OF THE DIFFUSER AUGMENTED WIND TURBINE (DAWT) CONCEPT" FOREMAN, K. M., GILBERT, B. L., GRUMMAN AEROSPACE	FINAL
WIND ENERGY INNOVATIVE SYSTEMS	"A DEFINITIVE GENERIC STUDY OF AUGMENTED HORIZONTAL AXIS WIND ENERGY SYSTEMS" LISSAMAN, P. B. S., ET. AL., AEROVIRONMENT INC.	FINAL
WIND ENERGY INNOVATIVE SYSTEMS	"DEFINITIVE GENERIC STUDY FOR THE EFFECT OF HIGH LIFT AIRFOILS ON WIND TURBINE COST EFFECTIVENESS" LISSAMAN, P. B. S., ET. AL., AEROVIRONMENT INC.	FINAL
WIND ENERGY INNOVATIVE SYSTEMS	"AUGMENTED HORIZONTAL AXIS WIND ENERGY SYSTEMS ASSESSMENT" HARPER, M. R., ET. AL., TETRA-TECH INC.	FINAL

<u>SUBTASK</u>	<u>TITLE AND AUTHOR</u>	<u>STATUS</u>
WIND ENERGY INNOVATIVE SYSTEMS	"A DEFINITIVE GENERIC STUDY FOR SAIL WING WIND ENERGY SYSTEMS" HOHENEMSER, K. H., ET. AL., WASHINGTON UNIVERSITY TECHNOLOGY ASSOC.	FINAL
WIND ENERGY INNOVATIVE SYSTEMS	"FURTHER INVESTIGATIONS OF DIFFUSER AUGMENTED WIND TURBINES" FOREMAN, K. M., GILBERT, B. L., GRUMMAN AEROSPACE CORP.	FINAL
WIND ENERGY INNOVATIVE SYSTEMS	"A REVIEW OF THE CURRENT STATUS OF THE WIND ENERGY INNOVATIVE SYSTEMS PROJECTS" IRWIN E. VAS, SOLAR ENERGY RESEARCH INSTITUTE	FINAL
WIND ENERGY INNOVATIVE SYSTEMS	"WIND ENERGY INNOVATIVE SYSTEMS CONFERENCE PROCEEDINGS" DOE/SOLAR ENERGY RESEARCH INSTITUTE, JBF SCIENTIFIC	FINAL
WIND ENERGY INNOVATIVE SYSTEMS	"GIROMILL OVERVIEW" MCCONNELL, R. D., SOLAR ENERGY RESEARCH INSTITUTE	FINAL
WIND ENERGY INNOVATIVE SYSTEMS	"A REVIEW OF THE WIND PROGRAM AT SERI" IRWIN E. VAS, SOLAR ENERGY RESEARCH INSTITUTE	FINAL
WIND ENERGY INNOVATIVE SYSTEMS	"TORNADO-TYPE WIND ENERGY SYSTEM" YEN, J. T., GRUMMAN AEROSPACE CORP.	DRAFT
WIND ENERGY INNOVATIVE SYSTEMS	"WIND POWER CHARGED AEROSOL GENERATOR" MARKS, A. M., MARKS POLARIZED CORP.	DRAFT
WIND ENERGY INNOVATIVE SYSTEMS	"AUGMENTED VERTICAL AXIS WIND ENERGY SYSTEMS EVALUATION" HOFFERT, M. I., MILLER, G., NEW YORK UNIVERSITY	DRAFT
WIND ENERGY INNOVATIVE SYSTEMS	"PRELIMINARY TECHNICAL AND ECONOMIC EVALUATION OF VORTEX EXTRACTION DEVICES" KORNREICH, T. R., JBF SCIENTIFIC CORP.	DRAFT
WIND ENERGY INNOVATIVE SYSTEMS	"VERTICAL AXIS WIND TURBINE EXPERIMENTS AND ANALYSIS - SOME EFFECTS OF FLOW CURVATURE ON THE AERODYNAMICS OF DARRIEUS WIND TURBINES" MIGLIORE, P. G., WOLFE, W. P., WEST VIRGINIA UNIVERSITY	DRAFT

<u>SUBTASK</u>	<u>TITLE AND AUTHOR</u>	<u>STATUS</u>
SELECTED UTILITY VALUE ANALYSIS	"ELECTRIC UTILITY VALUE ANALYSIS METHODOLOGY FOR WIND ENERGY CONVERSION SYSTEMS" KEITH, C. CRETCHER, TED H. DAVEY, THE AREOSPACE CORP.	DRAFT
SELECTED UTILITY VALUE ANALYSIS	"METHODOLOGY FOR DETERMINING THE VALUE OF WIND ENERGY CONVERSION SYSTEMS (WECS) FOR SPECIFIC UTILITY SYSTEMS," JBF SCIENTIFIC CORP.	DRAFT
WIND ENERGY INNOVATIVE SYSTEMS	"THE CIRCULATION CONTROL VERTICAL AXIS WIND TURBINE" WALTERS, R. E., ET. AL., WEST VIRGINIA UNIVERSITY	DRAFT
WIND ENERGY INNOVATIVE SYSTEMS	"A FREE-VORTEX MODEL WITH NUMERICAL SOLUTION FOR THE UNSTEADY LIFTING CHARACTERISTICS OF STRAIGHT BLADED DARRIEUS WIND TURBINES" MIGLIORE, P. G., ET. AL., WEST VIRGINIA UNIVERSITY	DRAFT
WIND ENERGY INNOVATIVE SYSTEMS	"VERTICAL AXIS WIND TURBINE DEVELOPMENT" WALTERS, R. E., ET. AL., WEST VIRGINIA UNIVERSITY	DRAFT
WIND TID	"PROCEEDINGS - PANEL ON INFORMATION DISSEMINATION FOR WIND ENERGY" - WEIS	FINAL
WIND TID	"CAPITAL FORMATION FOR SMALL WIND ENERGY CONVERSION SYSTEM MANUFACTURERS - A GUIDE TO METHODS AND SOURCES," AWEA	FINAL
WIND TID	"WIND ENERGY INFORMATION DIRECTORY," WEIS/MOONEY	FINAL
WIND TID	PAMPHLET - "WIND" AN ENERGY ALTERNATIVE," WEIS/EVANS	FINAL
WIND TID	"WINDPOWER - MOD 2," (PAMPHLET FOR DEDICATION), WEIS	FINAL
WIND TID	POSTER - "THE DOE WIND ENERGY PROGRAM," WEIS	FINAL
WIND TID	FILM - "WIND: AN ENERGY ALTERNATIVE," WEIS/EVANS	FINAL
WIND TID	VIDEOTAPE - "WIND ENERGY THEATER," WEIS	FINAL

<u>SUBTASK</u>	<u>TITLE AND AUTHOR</u>	<u>STATUS</u>
WIND TID	"DOE LARGE WIND TURBINE DEVELOPMENT PROGRAM" (TECHNICAL BRIEF)	DRAFT
WIND TID	"DOE LARGE WIND TURBINE PROGRAM" (TECHNICAL SUMMARY)	DRAFT
WIND TID	"MOD 2 WIND TURBINE DEVELOPMENT PROJECT" (TECHNICAL BRIEF)	DRAFT
WIND TID	"COMMUNITY APPLICATIONS OF WECS, HANDBOOK FOR PRELIMINARY FEASIBILITY STUDIES, SERI/RSSG	DRAFT

## MARKET CHARACTERIZATION

MARTIN DEUTSCH  
(HARRY REEVE)

### ACCOMPLISHMENTS

A MEETING OF THE SUBTASK ADVISORY COMMITTEE WAS HELD AT SERI ON MARCH 28, 1980 TO FAMILIARIZE THEM WITH THE TASK OBJECTIVES AND TO REVIEW THE PROPOSED SUBCONTRACTS

PURCHASE REQUESTS AND STATEMENTS OF WORK FOR ALL PHASE II SUBTASK SUBCONTRACTS HAVE BEEN COMPLETED, REVIEWED BY THE ADVISORY BOARD AND SENT TO THE APPROPRIATE FIRMS FOR RESPONSE. --ALL PROPOSALS ARE PRESENTLY BEING HELD UP PENDING PHASE I COMPLETION.

ALL APPROVED CONTRACTORS IN BOA AREA FIVE (MARKET STUDIES) WERE VISITED TO ACQUAINT THEM WITH THE REQUIRED ACCELERATED MARKET RESEARCH EFFORTS. (PHASE I).

MANUFACTURERS AND PROMINENT INDIVIDUALS IN THE WIND FIELD WERE CONTACTED TO DETERMINE SPECIFIC OUTPUT REQUIREMENTS FROM THE COUNTY LEVEL, DETAILED WECS MARKET CHARACTERIZATION STUDY.

DEVELOPED A PRELIMINARY LISTING OF ALL WECS MANUFACTURERS AND MACHINES WITH COST/PERFORMANCE DATA. MACHINES RANGE IN RATED OUTPUT FROM 7 W TO 3 MW.

AFTER A MEETING WITH DOE/WSD PERSONNEL IN WASHINGTON ON MAY 8, TASK WILL BE REPLANNED WITH MARTY DEUTSCH ASSUMING RESPONSIBILITY FOR THE EFFORT.

#### PLANNED ACTIVITIES

SERI PROJECT MANAGEMENT AND DOE PROGRAM MANAGERS WILL MEET IN MAY, 1980 TO REVIEW PROJECT OBJECTIVES AND PLANS.

NEGOTIATIONS FOR ALL SUBTASK CONTRACTS FOR THE MARKET CHARACTERIZATION PROJECT HAVE BEEN DELAYED PENDING COMPLETION OF A REVISED WORK PLAN AND SCHEDULE REFLECTING COMMENTS RECEIVED FROM DOE PROGRAM MANAGER.

COMPLETE WECS APPLICATION IDENTIFICATION AND ANALYSIS.

COMPLETE LISTING OF WECS MANUFACTURERS AND PRODUCTS.

COMPLETE DETAILED WORK PLAN INCORPORATING ACTIVITIES FOR A NEAR-TERM, HIGH POTENTIAL MARKET ANALYSIS PROJECT (FY80) AND THE COUNTY LEVEL, MARKET CHARACTERIZATION PROJECT (FY81).

PR-672  
MAY 21, 1980

BUDGET SUMMARY

BUDGET FOR FY80	1ST AND 2ND	PLANNED 1ST AND	
800K	QUARTERS	2ND QUARTERS	
	EXPENDITURES	EXPENDITURES	COMMITMENTS
	102.5K	105.7K	4.2K



SUBCONTRACT SUMMARY

	<u>NUMBER</u>	<u>(\$ x K) AMOUNT</u>
PLANNED SUBCONTRACTS	5	545
PURCHASE REQUESTS APPROVED	5	545
SUBCONTRACTS AWARDED/\$ COMMITTED	0	0

SMALL USER DECISION ANALYSIS

J. GRESHAM

ACCOMPLISHMENTS

SELECTED AN EXTERNAL REVIEW GROUP CONSISTING OF:

R. BRUCE HUTTON  
ASSISTANT PROFESSOR OF MARKETING  
UNIVERSITY OF DENVER

REX TYNES  
CONSULTING ENGINEER  
MORGAN COUNTY, COLO. REA

LLOYD WALKER  
EXTENSION AGRICULTURAL ENGINEER  
COLORADO STATE UNIVERSITY

DEVELOPED INITIAL DECISION MODEL FOR THE AGRICULTURAL, BUSINESS, AND INSTITUTIONAL MARKETS AND ASSOCIATED DECISION CRITERIA. THE RELEVANT CRITERIA INCLUDE SIMPLE PAYBACK PERIOD, CAPITAL COST (TIED TO THE AVAILABILITY OF

FINANCING), FREQUENCY OF MAINTENANCE AND REPAIR, AVAILABILITY OF SERVICE/PARTS,  
AND DEGREE OF ENERGY INDEPENDENCE ACHIEVED OR PERCENTAGE OF ENERGY NEEDS MET.

BEGAN USER CONTACTS.

PLANNED ACTIVITIES

BEGIN SUBCONTRACT WORK.

CONTINUE USER CONTACTS, EVALUATE DECISION MODEL, AND MAKE NECESSARY CHANGES.

BUDGET SUMMARY

TOTAL BUDGET (FY80)	1ST AND 2ND QUARTERS	PLANNED 1ST AND 2ND QUARTERS	COMMITMENTS
150K	EXPENDITURES 21.6K	EXPENDITURES 26.8K	0

SUBCONTRACT SUMMARY

	<u>NUMBER</u>	<u>(\$ x K) AMOUNT</u>
PLANNED SUBCONTRACTS	1	40
PURCHASE REQUESTS APPROVED	1	40
SUBCONTRACTS AWARDED/\$ COMMITTED	0	0

## ECONOMICS OF WECS OWNED BY THE END USER

ROGER TAYLOR  
(GEORGE FEGAN)

### ACCOMPLISHMENTS

A DRAFT OF A REPORT ENTITLED "THE EFFECT OF THE SUBSTITUTION OF WIND POWER FOR CONVENTIONAL ELECTRIC POWER" (FOR FY79 SUBTASK) WAS DISTRIBUTED FOR SERI IN-HOUSE REVIEW.

ISSUED RFP FOR STUDY ENTITLED "GUIDES FOR REPRESENTING ELECTRIC UTILITY RATE STRUCTURES AND RATES" TO A SELECTED LIST OF 20 BIDDERS.

BEGAN DRAFTING A STATEMENT OF WORK FOR WECS FOR RECS CARRY ONS.

### PLANNED ACTIVITIES

- O COMPLETE REDEFINITION OF TASK. (AS A RESULT OF THE UTILITY MEETING HELD WITH THE ADVISORY COMMITTEE AND DOE/WSD PERSONNEL).
- O REVIEW AND SUBMIT COMMENTS ON RSSG DRAFT REPORT.

O REDRAFT RSSG EXTENSION STATEMENT OF WORK TO BE CONSISTENT WITH REVISED TASK PLAN.

PROBLEMS

AS A RESULT OF SERI REORGANIZATION AND SUBSEQUENT REASSIGNMENT OF KEY STAFF OF THIS SUBTASK (DEAN NORDMAN) THERE WERE NO SIGNIFICANT ACCOMPLISHMENTS. AS A RESULT OF A SUBTASK REVIEW MEETING THIS TASK HAS BEEN REEVALUATED AND IT APPEARS THAT THERE WILL BE A REVISED PLAN FOR IT DURING THE COMING QUARTER.

BUDGET SUMMARY

BUDGET FOR FY80			
265K			
TRANSFER FROM FY79		PLANNED 1ST AND	
36K	1ST AND 2ND QUARTERS	2ND QUARTERS	
TOTAL BUDGET	EXPENDITURES	EXPENDITURES	COMMITMENTS
301K	33.5K	41.8K	10.4K

SUBCONTRACT SUMMARY

	<u>NUMBER</u>	<u>(\$ x K) AMOUNT</u>
PLANNED SUBCONTRACTS	2	185
PURCHASE REQUESTS APPROVED	1	28
SUBCONTRACTS AWARDED/\$ COMMITTED	0	0

## UTILITY ANALYTICAL MODELING

DAVID PERCIVAL

### ACCOMPLISHMENTS

FINALIZED COMPUTER MODELS DEVELOPED BY AND AVAILABLE FROM SERI. ALL MODELS OPERATIONAL.

INSTALLED AND TESTED UTILITY EXPANSION MODEL, A NONPROPRIETARY MODEL OBTAINED FROM RENSSELAER POLYTECHNIC INSTITUTE, ON SERI'S COMPUTER FACILITY.

COMPLETED INITIAL DRAFT OF DELIVERABLE REPORTS: "ELECTRIC UTILITY VALUE DETERMINATION--WIND: VOLUME 1, METHODOLOGY; VOLUME 2, USER'S GUIDE."

DISTRIBUTED VOLUME 1 FOR INTERNAL SERI REVIEW.

FIRST STEPS OF COMPLETE PACKAGE TESTING BEGUN FOR SOUTHERN CALIFORNIA EDISON IN CONNECTION WITH SELECTED UTILITY VALUE ANALYSIS.



PLANNED ACTIVITIES

FINALIZE DELIVERABLE REPORTS.

BEGIN EXTENSION TO INCLUDE WECS OTHER THAN HORIZONTAL AXIS IN VALUE DETERMINATION CAPABILITY.

COMPLETE VALUE DETERMINATION FOR SCE AS PART OF SELECTED UTILITY VALUE ANALYSIS.

BUDGET SUMMARY

BUDGET FOR FY80			
100K			
TRANSFER FROM FY79	1ST AND 2ND	PLANNED 1ST AND	
40K	QUARTERS	2ND QUARTERS	
TOTAL BUDGET	EXPENDITURES	EXPENDITURES	COMMITMENTS
140K	65.9K	47.5K	0.4K

SUBCONTRACT SUMMARY

	<u>NUMBER</u>	<u>(\$ x K) AMOUNT</u>
PLANNED SUBCONTRACTS	1	75
PURCHASE REQUESTS APPROVED	1	75
SUBCONTRACTS AWARDED/\$ COMMITTED	1	75

## SELECTED UTILITIES VALUE ANALYSIS

ROGER TAYLOR  
(GEORGE FEGAN)

### ACCOMPLISHMENTS

A MEETING HELD WITH SOUTHERN CALIFORNIA EDISON (SCE) HAS RESULTED IN GOING TO STONE AND WEBSTER FOR THE SYSTEM DESCRIPTION AS REQUESTED BY SCE. THE BASIC SYSTEM DATA HAVE BEEN RECEIVED, PUNCHED ON CARDS AND SENT TO THE TWO SUBCONTRACTORS. DATA ARE CURRENTLY BEING SCREENED FOR NEEDED IMPROVEMENTS.

A MEETING BETWEEN SERI AND PACIFIC GAS AND ELECTRIC (PG&E) WAS HELD CONCERNING THE PT. ARENA, CALIF., SITE. IT WAS DECIDED THAT THIS SITE WILL NOT BE THE OTHER SITE ANALYZED BY BOTH SUBCONTRACTORS. THE LUDINGTON, MICH., CONSUMERS POWER CO. SITE WILL REPLACE IT.

THE METHODOLOGY REPORTS FROM THE TWO SUBCONTRACTORS HAVE BEEN RECEIVED AND SENT OUT FOR REVIEW.

### PLANNED ACTIVITIES

COMPLETE THE VALUE ANALYSIS OF THE SAN GORGONIO SITE ON THE SCE SYSTEM.

COMPLETE THE VALUE ANALYSIS OF THE LUDINGTON SITE ON THE CONSUMERS POWER Co.  
SYSTEM.

BUDGET SUMMARY

BUDGET FOR FY80		PLANNED 1ST	
600K		AND 2ND	
TRANSFER FROM FY79	1ST AND 2ND	QUARTERS	
470K	QUARTERS	EXPENDITURES	COMMITMENTS
TOTAL BUDGET	EXPENDITURES	249.4K	369.8K
1070K	249.9K		

SUBCONTRACT SUMMARY

	<u>NUMBER</u>	<u>(\$ x K) AMOUNT</u>
PLANNED SUBCONTRACTS	5	922
PURCHASE REQUESTS APPROVED	2	567
SUBCONTRACTS AWARDED/\$ COMMITTED	2	567

## ECONOMICS OF WECS TIED TO UTILITIES

DAVID PERCIVAL  
(GEORGE FEGAN)

### ACCOMPLISHMENTS

MODELS FOR USE IN THIS TASK HAVE BEEN COMPLETED BY THE UTILITY ANALYTICAL MODELING TASK.

SOURCES OF REGIONAL DATA HAVE BEEN INVESTIGATED. SYNTHETIC UTILITY DATA FOR THE SIX EPRI REGIONS SHOULD BE AVAILABLE IN JUNE.

### PLANNED ACTIVITIES

SELECT TWO REGIONS FOR DETAILED ANALYSIS.

ACQUISITION OF REGIONAL UTILITY DATA.

COMMENCE REGIONAL ANALYSIS.

BUDGET SUMMARY

FY80 BUDGET	1ST AND 2ND QUARTERS EXPENDITURES	PLANNED 1ST AND 2ND QUARTERS EXPENDITURES	COMMITMENTS
55K	13.5K	23.2K	0

SUBCONTRACT SUMMARY

NONE

A COMPREHENSIVE GUIDE: WECS CONNECTED TO ELECTRIC UTILITIES

ROGER TAYLOR

ACCOMPLISHMENTS

PREPARED DRAFT OF THE SECTION ON THE FEDERAL WIND ENERGY PROGRAM. INCLUDES DESCRIPTION OF THE LARGE HORIZONTAL AXIS MACHINE PROGRAM, THE SMALL WIND MACHINE PROGRAM AND THE EMERGING AND ADVANCED TECHNOLOGY PROGRAM.

PLANNED ACTIVITIES

BEGIN WORK ON REMAINING SECTIONS.

PROBLEMS

MAJOR DELAYS DUE TO INVOLVEMENT IN SAWHILL PROJECT. EXPECT APPROXIMATELY 3 MONTH SLIPPAGE.



BUDGET SUMMARY

BUDGET	1ST AND 2ND QUARTERS EXPENDITURES	PLANNED 1ST AND 2ND QUARTERS EXPENDITURES	COMMITMENTS
230K	40.1K	36.2	0

SUBCONTRACT SUMMARY

	<u>NUMBER</u>	<u>(\$ x K) AMOUNT</u>
PLANNED SUBCONTRACTS	1	60
PURCHASE REQUESTS APPROVED	0	0
SUBCONTRACTS AWARDED/\$ COMMITTED	0	0

## ECOLOGICAL, SOCIO-ENVIRONMENTAL ASSESSMENT OF WIND SYSTEMS

CARL STROJAN

### ACCOMPLISHMENTS

COMPLETED ANALYSIS OF DATA FROM SWECS AESTHETICS STUDY.

PREPARED A STATEMENT OF WORK FOR A TECHNICAL SERVICES PURCHASE ORDER TO PROVIDE ESTIMATES OF AIR AND WATER POLLUTANTS EMITTED AND ENERGY CONSUMED DURING PRODUCTION OF RAW MATERIALS USED FOR WECS.

COMPLETED A REPORT ENTITLED "ENVIRONMENTAL ASSESSMENT OF SMALL WIND SYSTEMS: PROGRESS REPORT" (SERI/PR-354-420) FOR FY79 CARRY OVER SUBTASK.

PREPARED A TECHNICAL PAPER ENTITLED "ENVIRONMENTAL EFFECTS OF SMALL WIND ENERGY CONVERSION SYSTEMS," WHICH WAS PRESENTED AT THE SECOND U.S. DOE ENVIRONMENTAL CONTROL SYMPOSIUM ON MARCH 18, IN RESTON, VA.

PREPARED A TECHNICAL PAPER ENTITLED "A FIELD STUDY ON THE AESTHETICS OF SMALL WIND MACHINES: PRELIMINARY REPORT," WHICH WAS PRESENTED AT THE AIAA/SERI WIND ENERGY CONFERENCE ON APRIL 11, IN BOULDER, COLO.

PLANNED ACTIVITIES

COMPLETE DRAFT FINAL REPORT ON THE ENVIRONMENTAL EFFECTS OF SWECS AND DELIVER TO WSB/DOE AND OUTSIDE REVIEWERS FOR CRITICAL EVALUATION.

CONTINUE DATA COLLECTION ON THE ENVIRONMENTAL ASPECTS OF THE PRODUCTION AND DEPLOYMENT OF MEDIUM AND LARGE SCALE WECS FOR INCORPORATION INTO FY80 SUBTASK.

BUDGET SUMMARY

BUDGET	1ST AND 2ND QUARTERS	PLANNED 1ST AND 2ND QUARTERS	COMMITMENTS
\$98K (INCLUDES 38K FY79 CARRY OVER)	EXPENDITURES 52.4	EXPENDITURES 37.9K	1.0K

SUBCONTRACT SUMMARY

	<u>NUMBER</u>	<u>(\$ x K) AMOUNT</u>
PLANNED SUBCONTRACTS	1	31
PURCHASE REQUESTS APPROVED	0	0
SUBCONTRACTS AWARDED/\$ COMMITTED	0	0

## TELEVISION INTERFERENCE AND WECS

N. KELLEY

### ACCOMPLISHMENTS

UNIVERSITY OF MICHIGAN RECOMMENDED SPECIAL ANTENNAS BE TESTED AT VARIOUS LOCATIONS NEAR THE MOD-1.

UNIVERSITY OF MICHIGAN RECOMMENDED INSTALLATION LOCATIONS OF SPECIAL ANTENNAS (BREMCO WILL PURCHASE AND INSTALL).

INITIATED NEGOTIATIONS FOR CONTINUING OF UNIVERSITY OF MICHIGAN SUBCONTRACT.

RECEIVED DRAFT OF TVI SITING HANDBOOK AND DRAFT OF BLOCK ISLAND TVI REPORT.

### PLANNED ACTIVITIES

COMPLETE SYSTEMATIC TVI MEASUREMENTS AT THE MOD-1 SITE AFTER INSTALLATION OF SPECIAL ANTENNAS.

COMPLETE REVIEW OF DRAFT REPORT OF BLOCK ISLAND MEASUREMENTS AND NEW VERSION OF THE LARGE WIND TURBINE SITING HANDBOOK.

PURSUE POSSIBLE FUNDING OF UNSOLICITED PROPOSAL SUBMITTED BY POLYTECHNIC INSTITUTE OF NEW YORK FOR DEVELOPMENT OF AN ELECTRONIC TECHNIQUE FOR DETECTION AND SUPPRESSION OF WIND TURBINE TVI SIGNALS.

COMPLETE CONTRACT PROCEDURE FOR EXTENSION OF UNIVERSITY OF MICHIGAN TVI STUDIES TO INCLUDE SMALL WIND TURBINES.

BUDGET SUMMARY

BUDGET	1ST AND 2ND QUARTERS EXPENDITURES	PLANNED 1ST AND 2ND QUARTERS EXPENDITURES	COMMITMENTS
110K	7.8K	20.2K	0

SUBCONTRACT SUMMARY

	<u>NUMBER</u>	<u>(\$ x K) AMOUNT</u>
PLANNED SUBCONTRACTS	2	69
PURCHASE REQUESTS APPROVED	0	0
SUBCONTRACTS AWARDED/\$ COMMITTED	0	0



## NOISE MEASUREMENTS AT SELECTED WIND SYSTEM SITES

N. KELLEY

### ACCOMPLISHMENTS

CONSULTED WITH DR. FRED SCHMITZ OF THE U.S. ARMY RESEARCH AND TECHNOLOGY LABS ON POSSIBLE WTG NOISE GENERATING MECHANISMS.

AT SCHMITZ'S SUGGESTION, ADDITIONAL PRELIMINARY MEASUREMENTS WERE MADE AT MOD-1 FEBRUARY 5 AND 7 TO IDENTIFY IF THE NOISE WAS RANDOM OR A PERIODIC IMPULSE--  
RESULT: PERIODIC IMPULSE.

HELD WIND TURBINE NOISE WORKSHOP AT SERI FEBRUARY 21-22.

MODIFIED SUBCONTRACT WITH PENN STATE UNIVERSITY TO INCLUDE INSTALLATION OF TWO ACOUSTIC SOUNDERS NEAR MOD-1 AND TO MAKE SUPPLEMENTAL SEISMIC AND ACOUSTIC MEASUREMENTS DURING THE SYSTEMATIC FIELD MEASUREMENTS AT BOONE.

AWARDED SUBCONTRACT TO PNL FOR TETHERSONDE SUPPORT FOR SYSTEMATIC FIELD STUDY AT BOONE.

ATTENDED MOD-1 NOISE REVIEW MEETING WITH DOE/WSB ON MARCH 10.

INITIATED SYSTEMATIC MEASUREMENT PROGRAM IN BOONE, MARCH 17 (THROUGH APRIL 5).

AWARDED SUBCONTRACT TO MIT FOR CALCULATIONS OF WTG (MOD-1) NOISE AT 35 AND 23 RPM.

PLANNED ACTIVITIES

COMPLETE DATA REDUCTION AND INTERPRETATION OF SERI--MEASUREMENTS TAKEN DURING INTENSIVE PERIOD.

MAKE NOISE MEASUREMENTS OF MOD-0 OPERATION IN BOTH DOWNWIND AND UPWIND CONFIGURATIONS WITH SUBSEQUENT REDUCTION AND INTERPRETATION OF THE DATA.

MAKE NOISE MEASUREMENTS OF VAWT AND SANDIA LABS.

RECEIVE REDUCED TETHERSONDE DATA FROM PNL AND SUPPLEMENTAL ACOUSTIC AND PROPAGATION DATA FROM PENN. STATE COVERING SYSTEMATIC BOONE MEASUREMENTS.

DEVELOP REVISED TASK PLAN BASED ON CURRENT KNOWLEDGE OF THE LARGE SCALE WECS NOISE GENERATION PROCESS AND IMPACT.

BUDGET SUMMARY

	1ST AND 2ND QUARTERS	PLANNED 1ST AND 2ND QUARTERS	
BUDGET	EXPENDITURES	EXPENDITURES	COMMITMENTS
195K	116.2K	63.6K	28.6K

SUBCONTRACT SUMMARY

	<u>NUMBER</u>	<u>(\$ x K) AMOUNT</u>
PLANNED SUBCONTRACTS	2	84
PURCHASE REQUESTS APPROVED	3	77
SUBCONTRACTS AWARDED/\$ COMMITTED	3	77

LAND USE ISSUES

ROBERT NOUN

ACCOMPLISHMENTS

ESTABLISHED ADVISORY COMMITTEE TO TASK.

COMPLETED IN-HOUSE LITERATURE REVIEW OF ENVIRONMENTAL IMPACTS.

COMPLETED INVENTORY OF STATE AND FEDERAL SITING AND LICENSING LAWS AND REGULATIONS RELATING TO WECS.

COMMENCED LITERATURE REVIEW OF WECS LAND AREA REQUIREMENTS.

SUBMITTED REQUESTS FOR PAUL FRIESEMA AS A CONSULTANT AND MIKE LOTKER (TSG) AS A SUBCONTRACTOR TO THE TASK.

PLANNED ACTIVITIES

COMPLETE ALL IN-HOUSE RESEARCH.

HOLD MEETING OF TASK ADVISORY COMMITTEE TO OBTAIN GUIDANCE ON SUBCONTRACTOR WORK AND OVERALL TASK PLAN.

AWARD CONTRACT FOR THE ASSESSMENT OF SITING DIFFERENCES BETWEEN WECS AND CONVENTIONAL POWER PLANTS.

BUDGET SUMMARY

BUDGET	1ST AND 2ND QUARTERS EXPENDITURES	PLANNED 1ST AND 2ND QUARTERS EXPENDITURES	COMMITMENTS
135K	33.2K	38.1K	0

SUBCONTRACT SUMMARY

	<u>NUMBER</u>	<u>(\$ x K) AMOUNT</u>
PLANNED SUBCONTRACTS	2	55
PURCHASE REQUESTS APPROVED	2	55
SUBCONTRACTS AWARDED/\$ COMMITTED	1	10

## STRATEGY ANALYSIS

DAVID SCHALLER

### ACCOMPLISHMENTS

SUBTASK WORK WAS BEING HELD IN ABEYANCE PENDING MODIFICATION TO STATEMENT OF OBJECTIVES AND THE SUBTASK WORK PLAN.

COMMENCED DEVELOPMENT OF REVISED SUBTASK WORK PLAN TO REFLECT THE CHANGE OF OBJECTIVES. REVISED PLAN IS TO ANALYZE THE IMPACT OF THE FEDERAL ENERGY REGULATORY COMMISSION (FERC) RULES UNDER PURPA ON THE WIND ENERGY PROGRAM.

### PLANNED ACTIVITIES

(UNDER REVISION AND INTERNAL REVIEW)

BEGIN DETAILING THE MANDATORY AND OPTIONAL PROVISIONS OF FERC'S 210 AND 201 RULES AS THEY AFFECT THE DEVELOPMENT OF WIND ENERGY.



BUDGET SUMMARY

	1ST AND 2ND QUARTERS	PLANNED 1ST AND 2ND QUARTERS	
BUDGET	EXPENDITURES	EXPENDITURES	COMMITMENTS
75K	4.7K	14.5K	0

SUBCONTRACT SUMMARY

NONE

## WIND SYSTEMS COORDINATION

IRWIN E. VAS

### ACCOMPLISHMENTS

REVISED MISSION STATEMENTS FOR THE WIND ENERGY SYSTEMS PROGRAM.

COMPLETED PURCHASE REQUEST (PR) FOR THE WIND PROGRAM COORDINATION SUBCONTRACT.  
PR HAS BEEN APPROVED AND SENT TO POTENTIAL BIDDERS.

COORDINATION MEETINGS WERE HELD WITH A NUMBER OF COMPANIES, AGENCIES AND UNIVERSITIES INCLUDING: RAYTHEON, SOUTHERN CALIFORNIA EDISON, GOLDEN GATE ENERGY CENTER, ROCKWELL (ROCKY FLATS), COLORADO STATE UNIVERSITY, GENERAL ELECTRIC, A. D. LITTLE, WASHINGTON UNIVERSITY, EXXON ENTERPRISES, KANSAS ENERGY OFFICE, AND PRINCETON UNIVERSITY.

### PLANNED ACTIVITIES

CONTINUE PLANNING/LIAISON ACTIVITIES WITHIN THE FEDERAL WIND ENERGY PROGRAM AND WITH OTHER FEDERAL, STATE, PUBLIC AND PRIVATE INSTITUTIONS.

BUDGET SUMMARY

BUDGET	1ST AND 2ND QUARTERS EXPENDITURES	PLANNED 1ST AND 2ND QUARTERS EXPENDITURES	COMMITMENTS
430K	21.8K	38.1K	29.0K

SUBCONTRACT SUMMARY

	<u>NUMBER</u>	<u>(\$ x K) AMOUNT</u>
PLANNED SUBCONTRACTS	1	169
PURCHASE REQUESTS APPROVED	1	169
SUBCONTRACTS AWARDED/\$ COMMITTED	0	0

WECS COST STUDY

JOE LAVENDER

ACCOMPLISHMENTS

COMPLETED BASE ESTIMATES FOR THE DESIGNATED SYSTEMS.

SPECIFIC WIND SYSTEMS THAT WILL BE INCLUDED IN THE TASK ARE:

- |   |                        |         |
|---|------------------------|---------|
| o | MILLVILLE              | 10 kW   |
| o | ENERGY DEVELOPMENT Co. | 40 kW   |
| o | DOE/SANDIA             | 100 kW  |
| o | MOD-2                  | 2500 kW |

COMPLETED SENSITIVITY ANALYSIS ON THE 10 kW AND 40 kW SYSTEMS.

COLLECTED COST AND PERFORMANCE INFORMATION ON ALL COMMERCIALY AVAILABLE SYSTEMS.

PLANNED ACTIVITIES

COMPLETE ROUGH DRAFT OF TASK REPORT BY LATE APRIL-MID MAY AND SUBMIT FOR REVIEW.

PERFORM COST REGRESSION ANALYSIS OF COMMERCIALY AVAILABLE WIND SYSTEM AT A SPECIFIED WIND VELOCITY.

- o TOTAL CAPITAL COST AS A FUNCTION OF KWH/YR.
- o HARDWARE COST AS A FUNCTION OF KWH/YR.

BUDGET SUMMARY

BUDGET	1ST AND 2ND QUARTERS EXPENDITURES	PLANNED 1ST AND 2ND QUARTERS EXPENDITURES	COMMITMENTS
50K	16.6K	19.4K	5.5K

SUBCONTRACT SUMMARY

	<u>NUMBER</u>	<u>(\$ x K) AMOUNT</u>
PLANNED SUBCONTRACTS	1	4
PURCHASE REQUESTS APPROVED	0	0
SUBCONTRACTS AWARDED/\$ COMMITTED	0	0

PROGRAM REVIEW AND ADMINISTRATION

IRWIN E. VAS

ACCOMPLISHMENTS

REVISED MISSION STATEMENTS FOR THE WIND ENERGY SYSTEMS PROGRAM AND THE WIND ENERGY BRANCH WERE COMPLETED AND SUBMITTED TO SERI MANAGEMENT.

THE WIND ENERGY SYSTEMS PROGRAM QUARTERLY REVIEW WAS PRESENTED TO WSB/DOE IN WASHINGTON.

COMPLETED THE FY79 SERI WIND SYSTEMS SUMMARY AND SUBMITTED TO DOE FOR INCLUSION IN THE FEDERAL WIND ENERGY PROGRAM SUMMARY FY79.

SUBMITTED MODIFICATIONS TO THE WSB/DOE SOLAR OBJECTIVES.

SUBMITTED SMALL/MINORITY BUSINESS REPORT ON FY79, FY80 SUBCONTRACTS.

MET WITH AND DISCUSSED THE SERI WIND PROGRAM WITH A NUMBER OF PEOPLE FROM FEDERAL, STATE, OTHER PUBLIC AND PRIVATE INSTITUTIONS.



PLANNED ACTIVITIES

CONTINUE REVIEW, PLANNING, AND REPORTING ACTIVITIES AS REQUIRED.

BUDGET SUMMARY

	1ST AND 2ND QUARTERS	PLANNED 1ST AND 2ND QUARTERS	
BUDGET	EXPENDITURES	EXPENDITURES	COMMITMENTS
225K	44.9K	54.7K	24.9

SUBCONTRACT SUMMARY

NONE

## WIND ENERGY INNOVATIVE SYSTEMS

IRWIN VAS

### ACCOMPLISHMENTS

HELD REVIEW OF THE GRUMMAN AEROSPACE CORPORATION CONTRACTS ON THE TORNADO-TYPE WECS AND THE DIFFUSER AUGMENTED WIND TURBINE.

COMPLETED A QUARTERLY REVIEW OF THE FOLLOWING CONTRACTS:

WASHINGTON UNIVERSITY - YAWING WITH BLADE CYCLIC PITCH.

AEROVIRONMENT - ON THE DYNAMIC INDUCER.

WEST VIRGINIA UNIVERSITY - CONTRACT ON THE INNOVATIVE WIND TURBINE.

COMPLETED TECHNICAL REVIEWS ON 27 UNSOLICITED PROPOSALS.

ISSUED TWO LETTERS OF INTEREST FOR ASSESSMENT STUDIES, ONE FOR TETHERED WIND ENERGY SYSTEMS, AND ONE FOR WIND ENERGY INNOVATIVE SYSTEMS.

ISSUED A CALL FOR PAPERS FOR THE SECOND WIND ENERGY INNOVATIVE SYSTEMS CONFERENCE.

TRANSMITTED THE FINAL GENERIC STUDY REPORTS BY AEROVIRONMENT (2), TETRA-TECH,  
AND WASHINGTON UNIVERSITY TECH. ASSOC. TO T.I.C. FOR DISTRIBUTION.

PLANNED ACTIVITIES

INITIATE REVIEW OF ABSTRACTS FOR SECOND WEIS CONFERENCE.

REVIEW AND RANK PROPOSALS RECEIVED IN RESPONSE TO THE TWO LETTERS OF INTEREST  
FOR TETHERED AND WEIS ASSESSMENTS.

REVIEW UNSOLICITED PROPOSALS.

REVIEW THREE SUBCONTRACTOR DRAFT FINAL REPORTS.

BUDGET SUMMARY

BUDGET FOR FY80			
990K			
TRANSFER FROM FY79	1ST AND	PLANNED 1ST AND	
447K	2ND QUARTERS	2ND QUARTERS	
TOTAL BUDGET	EXPENDITURES	EXPENDITURES	COMMITMENTS
1437K	340.7K	355.2K	196.5K

SUBCONTRACT SUMMARY

	<u>NUMBER</u>	<u>(\$ x K) AMOUNT</u>
PLANNED SUBCONTRACTS	5	751
PURCHASE REQUESTS APPROVED	0	0
SUBCONTRACTS AWARDED/\$ COMMITTED	0	0

## ENGINEERING ANALYSIS AND COST ESTIMATING OF INNOVATIVE WECS

PETER SOUTH

### ACCOMPLISHMENTS

PREPARED RFP TO MODIFY THE SAMICS (SOLAR ARRAY MANUFACTURING INDUSTRY COSTING STANDARDS) PROGRAM TO WORK FOR PRODUCTION COSTING OF WECS.

BEGAN PREPARING MANUAL DESCRIBING ESSENTIAL CHARACTERISTICS OF INNOVATIVE WECS AND THEIR SUBSYSTEMS FOR USE IN SCREENING PROPOSALS.

ISSUED A CONTRACT TO A CONSULTANT (ROBERT ALLEN) TO ANALYZE PRODUCTION COSTS OF MADARAS SYSTEM.

### PLANNED ACTIVITIES

CONTINUE AERODYNAMIC ANALYSES OF DAWT AND TORNADO WHILE INITIATING OTHER ANALYSES (E.G., CIRCULATION CONTROLLED VAWT).

DEVELOP SAMICS METHOD FOR PRODUCTION COSTING.

WRITE, ACQUIRE REVIEW FOR, AND SEND RFP FOR IWECS DEVELOPMENT COSTING.

CONTINUE WORK ON REPORT DESCRIBING FUNDAMENTAL AERODYNAMIC CHARACTERISTICS OF  
GENERIC IWECS.

BUDGET SUMMARY

	1ST AND 2ND QUARTERS EXPENDITURES	PLANNED 1ST AND 2ND QUARTERS EXPENDITURES	COMMITMENTS
FY80 BUDGET 362K	41.2K	46.4K	0

SUBCONTRACT SUMMARY

	<u>NUMBER</u>	<u>(\$ x K) AMOUNT</u>
PLANNED SUBCONTRACTS	2	195
PURCHASE REQUESTS APPROVED	0	0
SUBCONTRACTS AWARDED/\$ COMMITTED	0	0

WIND ENERGY INFORMATION DISSEMINATION

PATRICIA WEIS

ACCOMPLISHMENTS

COMPLETED FILM "WIND: AN ENERGY ALTERNATIVE."

PRODUCED VIDEOTAPE "WIND ENERGY THEATER."

COMPLETED DRAFT "CAPITAL FORMATION FOR SMALL WIND ENERGY CONVERSION SYSTEM MANUFACTURERS--A GUIDE TO METHODS AND SOURCES--AWEA."

COMPLETED DRAFTS OF TECHNICAL BRIEFS ON LARGE WIND TURBINE AND MOD 2--RDD CONSULTANTS.

COMPLETED DRAFT--PAMPHLET ON MOD 2--RDD CONSULTANTS.

COMPLETED PRELIMINARY DRAFT "PLANNING GUIDE FOR COMMUNITY APPLICATIONS OF WECS"--RSSG.



PLANNED ACTIVITIES

PUBLISH AND DISTRIBUTE CAPITAL FORMATION FOR SMALL WIND ENERGY CONVERSION SYSTEM MANUFACTURERS.

PUBLISH AND DISTRIBUTE

- o THE DOE LARGE WIND TURBINE DEVELOPMENT PROGRAM--TECHNICAL BRIEF.
- o THE DOE LARGE WIND TURBINE PROGRAM--TECHNICAL SUMMARY.
- o THE MOD-2 WIND TURBINE DEVELOPMENT PROGRAM--TECHNICAL BRIEF.
- o WIND POWER--MOD 2--PAMPHLET.

DRAFT COMPLETE--PLANNING GUIDE FOR COMMUNITY APPLICATIONS OF WECS.

UPDATE AND REPRINT--WIND ENERGY INFORMATION DIRECTORY.

PRELIMINARY DRAFT--SITING COURSE FOR SMALL WECS.

DISPLAY OF LARGE EXHIBITS ON WIND ENERGY--SERI/ROCKY FLATS.

PRELIMINARY DRAFT--A/V MATERIALS KIT.

BUDGET SUMMARY

FY80 BUDGET			
250K			
CARRY OVER FY79 BUDGET	1ST AND	PLANNED 1ST AND	
123K	2ND QUARTERS	2ND QUARTERS	
TOTAL BUDGET	EXPENDITURES	EXPENDITURES	COMMITMENTS
373K	118K	129K	13.7K

SUBCONTRACT SUMMARY

	<u>NUMBER</u>	<u>(\$ x K) AMOUNT</u>
PLANNED SUBCONTRACTS	3	98
PURCHASE REQUESTS APPROVED	3	98
SUBCONTRACTS AWARDED/\$ COMMITTED	2	48

SMALL WIND TURBINE PRODUCTION EVALUATION  
AND COST ANALYSIS

CARL NORDQUEST

ACCOMPLISHMENTS

RFP (FH-0-9049) ISSUED FEBRUARY 5, 1980.

THE PROPOSAL EVALUATION BOARD HAS REACHED A UNANIMOUS CONCLUSION IN SELECTING THE SUBCONTRACTOR. A CONTRACT WILL BE AWARDED BY JULY 1.

SMALL WIND TURBINE SELECTED FOR ANALYSIS.

WE ARE PREPARING A LIST OF QUESTIONS FOR THE FINAL NEGOTIATIONS WHICH SHOULD TAKE PLACE THE FIRST PART OF JULY 1980.

PLANNED ACTIVITIES

INITIATE CONTRACT WITH SELECTED MANUFACTURER.

PROVIDE WIND TURBINE TO CONTRACTOR FOR ANALYSIS/DESIGN.

BUDGET SUMMARY

	1ST AND 2ND QUARTERS EXPENDITURES	PLANNED 1ST AND 2ND QUARTERS EXPENDITURES	
	LABOR: \$41K	\$51K	
	MATERIAL: 1K	22K	
	OTHER DIRECT: ___	25K	
FY80 BUDGET \$279K (NOT WIND FUNDS)	<hr/> \$42K*	<hr/> \$98K	COMMITMENTS 0

\*ACTUALS LESS THAN PLANNED BECAUSE WIND TURBINE NOT PROCURED AND SUBCONTRACT NOT LET.

SUBCONTRACT SUMMARY

	<u>NUMBER</u>	<u>(\$ x K) AMOUNT</u>
PLANNED SUBCONTRACTS	1	130
PURCHASE REQUESTS APPROVED	1	130
SUBCONTRACTS AWARDED/\$ COMMITTED	0	0

PR-672  
MAY 21, 1980

MARKET CHARACTERIZATION

MARTIN DEUTSCH  
(HARRY R. REEVE)

OBJECTIVES

FY80

INVESTIGATE AND QUANTIFY 2-5 HIGH POTENTIAL SWECS MARKETS.

FY81

INVESTIGATE THE MARKET VARIABLES FOR WECS, DETERMINE POTENTIAL IN SELECTED MARKETS, AND DEVELOP A COMPREHENSIVE MARKETING PLAN FOR WECS.

ACCOMPLISHMENTS

A PROJECT REVIEW MEETING HELD AT THE DOE WASHINGTON PROGRAM OFFICES HAS RESULTED IN A REVISION TO FY80 AND 81 ACTIVITIES FOR THIS TASK. A PHASE I EFFORT WILL BE DIRECTED AT DETERMINING 2-5 NEAR TERM, HIGH POTENTIAL MARKET FOR SWECS. THE ACTIVITIES OF PHASE I TERMINATE WITH A DRAFT FINAL REPORT SUBMITTED BY SEPTEMBER 30, 1980. PHASE II EFFORTS INCORPORATE A MORE COMPREHENSIVE, DETAILED WECS MARKET STUDY AND PLANNING DOCUMENT. SPECIFIC LONG-TERM PHASE II ACTIVITIES WILL COMMENCE DURING FY80 WITH A DRAFT FINAL SUBMITTED SEPTEMBER 30, 1981.

PHASE I - NEAR-TERM, HIGH POTENTIAL SWECS MARKET ANALYSIS.



- o A BOA SUBCONTRACTOR HAS BEEN SELECTED TO PERFORM COMPUTERIZED ECONOMIC PERFORMANCE MODELING.
- o NEGOTIATIONS FOR ANOTHER BOA CONTRACTOR TO PROVIDE THE MARKET RESEARCH IS NEAR COMPLETION.

PHASE II - COUNTY LEVEL, DETAILED WECS MARKET ANALYSIS.

- o SUBCONTRACT AWARDS FOR COUNTY LEVEL WIND REGIME DATA ANALYSIS; DEMOGRAPHIC PROFILE BY COUNTY; PROJECT INTEGRATION AND MARKET RESEARCH HAVE BEEN DELAYED PENDING REVISIONS TO DETAILED WORK PLAN AND SCHEDULING.

CONTACTED SEVERAL PROMINENT INDIVIDUALS IN THE WIND FIELD--DICK WILLIAMS (ROCKY FLATS); LEO SODERHOLM (USDA); DICK KATZENBURG (NATIONAL POWER COMPANY); BOB SHERWIN (ENERTECH); AND HANS MEYER (WINDWORKS)--TO DETERMINE THE INFORMATION FROM THE WECS MARKET CHARACTERIZATION STUDY WHICH WOULD BE MOST USEFUL TO THEM.

CONTINUED THE CLOSE LIAISON WITH ROCKY FLATS WITH A TOUR OF THE ROCKY FLATS TEST CENTER.

ESTABLISHED A COMPLETE LIST OF WIND MACHINE MANUFACTURERS AND MACHINES PRODUCED, AND THEIR PERFORMANCE AND COST DATA.

HELD A MEETING OF THE WECS MARKET CHARACTERIZATION TASK ADVISORY BOARD AT SERI ON MARCH 28, 1980. SUBJECT WAS THE DETAILED EVALUATION OF THE FIVE WORK STATEMENTS BEING ISSUED THIS MONTH. THE MEETING WAS VERY PRODUCTIVE. ATTENDEES

INCLUDED: BILL TOLBERT (DOD LIAISON); JOE BARROW DOE/CS); RICH BARCHET (PNL); ED MAYFIELD (RAYTHEON); AL GONZALES (RAYTHEON); LEO SODERHOLM (USDA-SEA/AR); MARSHALL MERRIAM (UNIV. OF CALIF.); AND FRANK GOODMAN (EPRI).

### PLANNED ACTIVITIES

#### PHASE I - NEAR-TERM HIGH POTENTIAL MARKET ANALYSIS

APPLICATION DATA--CONTINUE IDENTIFYING HIGH POTENTIAL APPLICATIONS BY MARKET SECTOR BY GEOGRAPHIC LOCATION, POWER REQUIREMENTS, CURRENT ENERGY SOURCE, CONVENTIONAL ENERGY COSTS AND MARKET SIZE.

WIND MACHINE DATA--CONTINUE TO EXPAND THE LIST OF MANUFACTURERS, DISTRIBUTORS, DESIGNERS AND THEIR WECS. DEVELOP A SCREENING METHODOLOGY TO DETERMINE SEVERAL REPRESENTATIVE SWECS FOR USE IN THE ECONOMIC PERFORMANCE MODEL.

- O WIND REGIME DATA AT THE STATE LEVEL USING EXISTING SOURCES WILL BE DEVELOPED FOR USE IN SCREENING MARKET/APPLICATION POTENTIAL
- O DEVELOP AND IMPLEMENT A COMPUTERIZED DATA ANALYSIS MODEL WHICH DETERMINES ECONOMIC VIABILITY FOR PRIMARY SWECS MARKETS.
- O INTEGRATE SUBTASK ACTIVITIES TO ESTIMATE HIGH POTENTIAL SWECS MARKETS AND PREPARE FINAL REPORT.

PHASE II - COUNTY LEVEL DETAILED WECS MARKET ANALYSIS.

- o AWARD OF PENDING SUBCONTRACTS FOR WIND REGIME DATA ANALYSIS, DEMOGRAPHIC PROFILE BY COUNTY; COMPUTERIZED DATA BASE/ANALYSIS MODEL MARKET RESEARCH AND PROJECT INTEGRATION AFTER REVISION AND APPROVAL OF DETAILED WORK PLAN.

DEVELOP A DETAILED WORK PLAN THAT WILL INCLUDE DETAILED SUBTASK DESCRIPTIONS, INTERRELATIONSHIPS, LEVELS OF EFFORT, SCHEDULE, MILESTONES, AND CRITICAL PATH.

OUTPUT

PHASE I - NEAR-TERM, HIGH POTENTIAL SWECS MARKET ANALYSIS

- o IDENTIFY AND QUANTIFY 2-4 HIGH POTENTIAL MARKETS IN THE UNITED STATES.

PHASE II - COUNTY LEVEL DETAILED WECS MARKET ANALYSIS

IDENTIFY DETERMINING FACTORS AFFECTING THE DECISION TO INVEST IN WECS.

PRESENT A COMPLETE REVIEW OF EACH IDENTIFIED WECS APPLICATION.

SUMMARIZE MARKET DEMAND FACTORS AND IDENTIFY COST AND BENEFIT FACTORS BY APPLICATION.

PRESENT A FINAL MARKET ANALYSIS OF APPLICATIONS WITH THE GREATEST POTENTIAL.

IDENTIFY PRESENT AND FUTURE POTENTIAL IN PRIMARY MARKETS BASED ON SALES CRITERIA.

BUDGET SUMMARY

BUDGET (BA)	1ST AND 2ND QUARTERS EXPENDITURES	PLANNED 1ST AND 2ND QUARTERS EXPENDITURES	COMMITMENTS
800K	102.5K	105.7K	4.2K

TABLE 4. SUBCONTRACTS

CONTRACTOR	WORK TITLE	PLANNED					ACTUAL		
		AMOUNT \$K	PR. COMPL. DATE	START DATE	END DATE	AMOUNT TO BE COSTED DURING FY80	AMOUNT \$K	START DATE	AMOUNT TO THE COSTED \$K
<u>3531.15 MARKET CHARACTERIZATION</u>									
TBD (SOLE SOURCE)	WIND DATA ANALYSIS	46	3/80	5/80	9/80	46	--	--	--
TBD (LIMITED COMPETITIVE)	DEMOGRAPHIC PROFILE	150	3/80	5/80	9/80	150	--	--	--
TBD (BOA)	COMPUTER DATA ANALYSIS	70	3/80	5/80	1/81	42	--	--	--
TBD (BOA)	MARKET RESEARCH	150	4/80	5/80	1/81	75	--	--	--
TBD (BOA)	PROJECT INTEGRATION	130	4/80	5/80	7/81	66	--	--	--

# WECS Market Characterization (3531.15)

PR-672  
MAY 21, 1980

Task or Subtask Activities	Fy 80												Fy 81						
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	
<b>Phase I — Near term high potential SWECS market analysis</b>																			
Applications analysis/screening								▽											
Wind machine data analysis/screening								▽											
Computerized economic performance model								▽											
Wind regime data development								▽											
Primary market analysis/data integration								△											
Draft final report								△											
<b>Phase II — County level detailed WECS market analysis</b>																			
Detailed work plan								▽											
Applications analysis (preliminary screening)								△											
Wind machine data analysis/screening								△											
Computerized data base/analysis model								△											
County level wind regime data analysis								△											
Demographic profile by county								△											
Market research and analysis								△											
Project integration								△											
Draft final report								△											
Project Management								△											
Subtask Management								△											
Accrued Costs	b. Planned	12.4	28.0	46.5	62.9	79.4	105.7	129.3	164.4	254.9	344.9	591.1							
	c. Actual	10.5	26.1	45.0	66.6	84.6	102.5												
	d. Variance	1.9	1.9	1.5	(3.7)	(5.2)	3.2												

- △ Begin Milestone                      ○ Equipment Arrival                      □ Draft Final Report                      ◆ Workshop or Special Meeting
- ▼ Milestone Complete                      ● Progress Report                      ■ Final Report

PR-6/2  
MAY 21, 1980

SMALL USER DECISION ANALYSIS

JAMES GRESHAM

OBJECTIVE

DEVELOP A QUANTITATIVE DESCRIPTION OF THE SMALL USER DECISION PROCESS WITH REGARD TO PURCHASE OF A SMALL WIND ENERGY CONVERSION SYSTEM.

ACCOMPLISHMENTS

SELECTED AN EXTERNAL REVIEW COMMITTEE

o R. BRUCE HUTTON

ASSISTANT PROFESSOR OF MARKETING  
UNIVERSITY OF DENVER

DR. HUTTON HAS EXTENSIVE EXPERIENCE IN MARKETING AND CONSUMER CONCERNS RELATED TO PURCHASING AND OPERATING ALTERNATIVE ENERGY SYSTEMS. HIS DUTIES INCLUDE ADVISING ON THE SUBCONTRACT WHICH PRODUCES THE DECISION MODEL FOR THE INDIVIDUAL CONSUMER.

o REX TYNES

CONSULTING ENGINEER  
MORGAN COUNTY (CO) REA

MR. TYNES HAS HAD 40 YEARS OF EXPERIENCE AS AN ENGINEER FOR ALL TYPES OF UTILITY SYSTEMS, SPECIALIZING IN PLANNING, RATE STUDIES, AND FEASIBILITY REPORTS. MR. TYNES WILL ENSURE THAT THE DECISION MODEL FAIRLY AND



COMPLETELY REPRESENTS THE VIEWPOINT OF THE SMALL (MUNICIPAL OR REA) UTILITY.

o LLOYD WALKER  
EXTENSION AGRICULTURAL ENGINEER  
COLORADO STATE UNIVERSITY

MR. WALKER IS AN AGRICULTURAL ENERGY SPECIALIST AND IS WELL ACQUAINTED WITH NOT ONLY THE ENERGY CONCERNS BUT ECONOMIC AND INVESTMENT ISSUES AS WELL.

DEVELOPED FIRST ESTIMATION OF THE DECISION MODEL FRAMEWORK FOR AGRICULTURAL, COMMERCIAL, SMALL UTILITY AND INSTITUTIONAL USERS--THE RELEVANT CRITERIA INCLUDE 1) CAPITAL COST (TIED TO THE AVAILABILITY OF FINANCING), 2) PAYBACK PERIOD, 3) FREQUENCY OF MAINTENANCE AND REPAIR, 4) AVAILABILITY OF SERVICE/PARTS, 5) PERCENTAGE OF NEEDS DISPLACED, AND DIFFICULTY OF OBTAINING INFORMATION. FOR SMALL UTILITY APPLICATIONS, THE RATE OF RETURN CRITERIA MAY BE MORE APPROPRIATE THAN SIMPLE PAYBACK PERIOD. LIFE CYCLE COSTS ARE NOT CONSIDERED IMPORTANT CRITERIA BY THIS GROUP OF POTENTIAL PURCHASERS. SOME CRITERIA MAY YET BE COMBINED OR DROPPED FROM THE MODEL AS IT IS REFINED. THE FINAL GOAL IS A MODEL (OR SET OF MODELS IF NECESSARY) THAT IS BOTH SIMPLE AND COMPREHENSIVE IN DESCRIBING THE PURCHASE DECISION PROCESS FOR A SWECS.

BEGAN USER CONTACTS CONSISTING OF DISCUSSIONS COVERING ENERGY-RELATED CONCERNS AND RELEVANT DECISION CRITERIA. IN THE THIRD QUARTER THE CONTACTS WILL BE CONCERNED WITH EVALUATING AND TESTING THE DECISION MODEL.

A PR\* WAS ISSUED UTILIZING THE BOA METHOD TO DEVELOP THE SECOND MODEL, THE RESIDENTIAL USER DECISION MODEL. ARTHUR D. LITTLE WAS THE ONLY RESPONDENT AND WILL RECEIVE THE CONTRACT WITH MINOR MODIFICATIONS TO THEIR PROPOSAL.

PLANNED ACTIVITIES

BEGIN SUBCONTRACT WORK.

CONTINUE USER CONTACTS, EVALUATE DECISION MODEL, AND REVISE AS NECESSARY.

OUTPUT

PREPARE DRAFT REPORT DURING THIRD QUARTER FY80.

PREPARE FINAL REPORT DURING FOURTH QUARTER FY80.

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\*THE STATEMENT OF WORK WAS REVIEWED BY SERI STAFF DENNIS COSTELLO, HARRY REEVE, AND TOM KRIZ.

BUDGET SUMMARY

BUDGET	1ST AND 2ND QUARTERS EXPENDITURES	PLANNED 1ST AND 2ND QUARTERS EXPENDITURES	COMMITMENTS
150K	21.6K	26.8K	0

TABLE 5. SUBCONTRACTS

CONTRACTOR	WORK TITLE	PLANNED					ACTUAL		
		AMOUNT \$K	PR. COMPL. DATE	START DATE	END DATE	AMOUNT TO BE COSTED DURING FY80	AMOUNT \$K	START DATE	AMOUNT TO BE COSTED \$K
<u>3531.25 SMALL USER DECISION ANALYSIS</u>									
TBD (BOA)	SMALL USER DECISION ANALYSIS	40	1/80	5/30	10/80	40	--	--	--

Small User Decision Analysis (3531.25)

Task or Subtask Activities	Fy 80												Fy 81					
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Develop Decision Criteria	▲-----▼																	
Obtain User and System Related Inputs				▲-----▼				▼										
Evaluate Data and Develop Final Report								▼		▲-----▼								
Project Management								▼		◆-----▼								
Subtask Management	▲-----▼							▼										
Cumulative Accrued Costs \$ X1000	Planned	3.7	7.4	11.1	14.8	17.7	26.8	45.2	68.8	92.4	113.2	128.0	140.2					
	Actual	1.8	3.3	7.7	13.1	16.5	21.6											
	Variance	1.9	4.1	3.4	1.7	1.2	5.2											

- ▲ Begin Milestone
- ▼ Milestone Complete
- Equipment Arrival
- Progress Report
- Draft Final Report
- Final Report
- ◆ Workshop or Special Meeting

PR-6/2  
MAY 21, 1980

ECONOMICS OF WECS OWNED BY THE END USER

ROGER TAYLOR  
(GEORGE FEGAN)

OBJECTIVE

DETERMINE THE ECONOMIC VIABILITY OF DISPERSED WIND TURBINE GENERATORS TO THE CONSUMER.

ACCOMPLISHMENTS

PREPARED DRAFT STATEMENT OF WORK FOR POSSIBLE SUBCONTRACT, "DISPERSED WIND SYSTEMS APPLICATION TO A GENERAL ELECTRIC UTILITY."

PREPARED DRAFT DESCRIPTION OF PROPOSED COMPUTER CODE FOR SIZING AND ECONOMICALLY EVALUATING WECS.

DISTRIBUTED A DRAFT OF A REPORT (FOR FY79 SUBTASK) "THE EFFECT OF THE SUBSTITUTION OF WIND POWER FOR CONVENTIONAL ELECTRIC POWER" FOR IN-HOUSE SERI REVIEW.

ISSUED AN RFP FOR A STUDY TITLE "GUIDES FOR REPRESENTING ELECTRIC UTILITY RATE STRUCTURES AND RATES" TO A SELECTED LIST OF 20 BIDDERS. FIVE PROPOSALS WERE RECIEVED IN RESPONSE TO THE RFP FROM THE FOLLOWING FIRMS: TEMPLE, BARKER, SLOANE. INC., ASSOCIATED UTILITY SERVICES INC.; EBASCO BUSINESS CONSULTING CO.; RANSOM AND CASAZZA INC.; AND CHAS T. MAIN, INC. THIS SUBCONTRACT IS PRESENTLY BEING HELD IN ABEYANCE PENDING TASK PLAN REVISION.

COMMENCED DRAFTING A STATEMENT OF WORK FOR WECS FOR RECS CARRY ONS.

#### PLANNED ACTIVITIES

THIS TASK IS CURRENTLY UNDERGOING REEVALUATION IN LIGHT OF THE RECENT FEDERAL REGULATIONS WHICH IMPACT USER-OWNED ELECTRIC GENERATION EQUIPMENT AND TO ENSURE CONSISTENCY WITH OTHER "USER-OWNERSHIP ECONOMIC" TASKS CURRENTLY ONGOING AT SERI AND ELSEWHERE.

THE RSSG CONTRACT EXTENSION IS ALSO BEING HELD UP PENDING THIS PROCESS.

A MEETING OF SERI PROJECT STAFF, DOE PERSONNEL AND TASK ADVISORS WILL BE HELD DURING THE THIRD QUARTER TO PROVIDE INPUT TO THE TASK REVISION.

#### PROBLEMS

AS A RESULT OF SERI REORGANIZATION AND SUBSEQUENT STAFF REASSIGNMENTS THIS SUBTASK LOST KEY PERSONNEL (DEAN NORDMAN). SINCE THAT TIME THIS TASK IS BEING REEVALUATED.



OUTPUT

(BEING REVISED.)

BUDGET SUMMARY

BUDGET (BA)	1ST AND 2ND QUARTERS EXPENDITURES	PLANNED 1ST AND 2ND QUARTERS EXPENDITURES	COMMITMENTS
301K	33.5K	41.8K	10.4

TABLE 6. SUBCONTRACTS  
(BEING REVISED)

CONTRACTOR	WORK TITLE	PLANNED				ACTUAL		
		AMOUNT \$K	PR. COMPL. DATE	START DATE	END DATE	AMOUNT \$K	START DATE	AMOUNT TO BE COSTED \$K
<u>3532.25 ECONOMICS OF WECS OWNED BY THE END USER</u>								
TBD (RENEWAL)	WECS FOR RECS	157	5/80	7/80	3/81	120	--	--
TBD (COMPETITIVE)	ECONOMICS OF WECS	28	1/80	8/80	11/80	9	--	--

Economics of WECS Owned by the End User (3532.25)

Task or Subtask Activities		Fy 80											Fy 81						
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Subtask Redefinition								△	▽	▽									
RFP Preparation									△	→	▽								
Contract Solicitation and Negotiation											△	→	▽						
Contract Award													▽						
Project Management													△	◆					
Subtask Management			◆		◆			◆	▽			◆		◆				◆	
Accrued Costs	Planned	5.1	10.3	16.7	27.5	33.7	41.8	53.5	62.1	70.6	70.6	103.7	141.7	179.7					
	Actual	3.4	10.5	17.8	24.1	30.2	33.5												
	Variance	1.7	(0.2)	(1.1)	3.4	3.5	8.3												

- △ Begin Milestone
- ▽ Milestone Complete
- Equipment Arrival
- Progress Report
- Draft Final Report
- Final Report
- ◆ Workshop or Special Meeting

PR-672  
MAY 21, 1980

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.

ACCOMPLISHMENTS

FINALIZE MODELS DEVELOPED BY AND AVAILABLE FROM SERI. ALL MODELS OPERATIONAL.

INSTALLED AND TESTED UTILITY EXPANSION MODEL, A NONPROPRIETARY MODEL OBTAINED FROM RENSSELAER POLYTECHNIC INSTITUTE.

COMPLETED INITIAL DRAFT OF DELIVERABLE REPORTS: "ELECTRIC UTILITY VALUE DETERMINATION--WIND: VOLUME 1, METHODOLOGY; VOLUME 2, USER'S GUIDE."

DISTRIBUTED VOLUME 1 FOR INTERNAL SERI REVIEW.

FIRST STEPS OF COMPLETE PACKAGE TESTING BEGAN FOR SOUTHERN CALIFORNIA EDISON IN CONNECTION WITH 16 SITE STUDY.

PLANNED ACTIVITIES

FINALIZE DELIVERABLE REPORTS.

BEGIN EXTENSION TO INCLUDE OTHER THAN HORIZONTAL AXIS WECS IN VALUE DETERMINATION CAPABILITY.

COMPLETE VALUE DETERMINATION FOR SCE AS PART OF 16 SITE STUDY.

OUTPUT

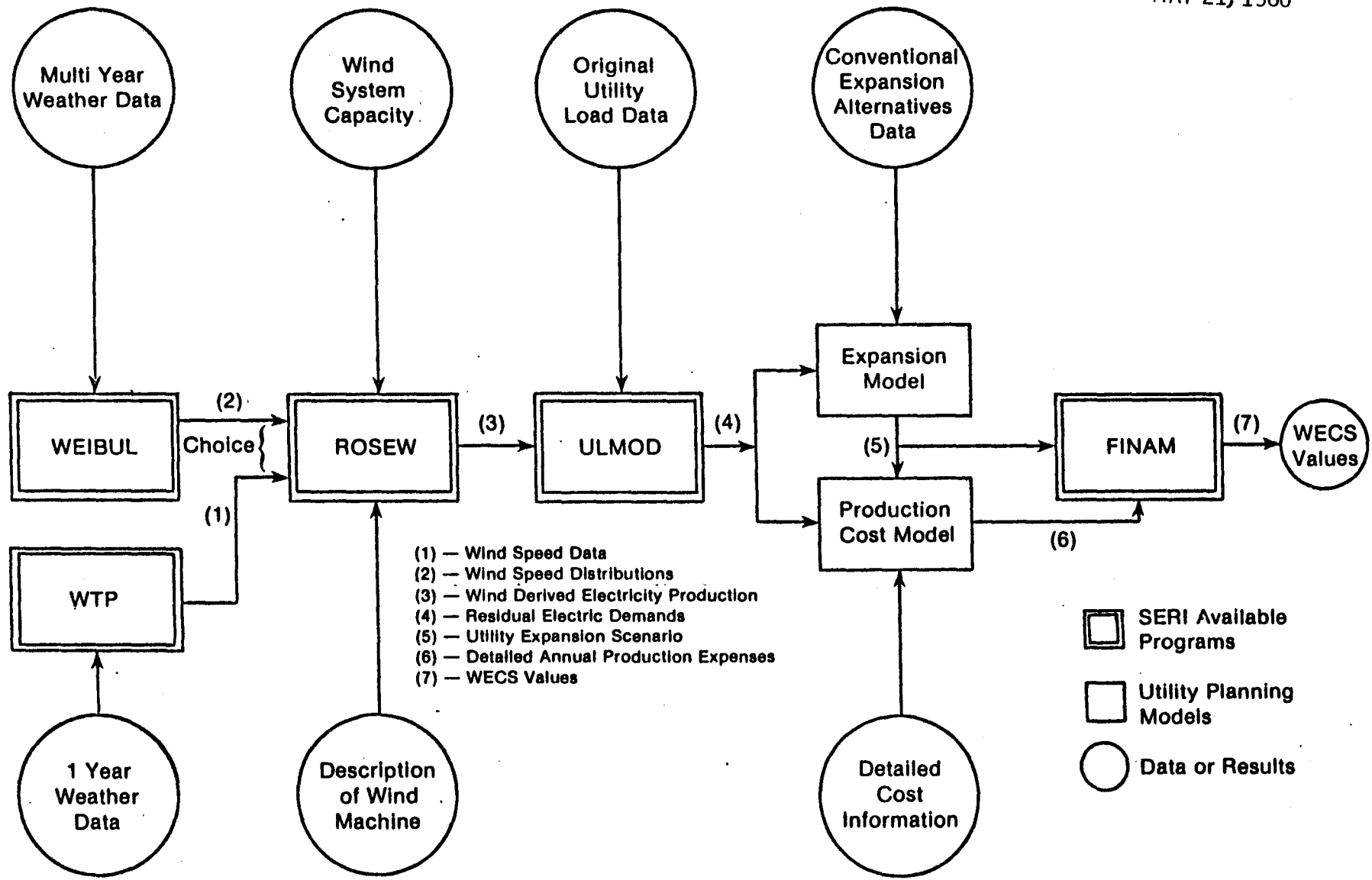
REPORT ON UTILITY PRODUCTION COST MODEL EVALUATIONS.

REPORT ON METHODOLOGY AND USERS MANUAL FOR THE WECS REPRESENTATION.

UTILITY PLANNING PACKAGE INCORPORATING WECS SUCH THAT DOE/SERI STUDIES MAY BE PERFORMED. MODELS DEVELOPED WILL ALSO BE AVAILABLE FOR DISTRIBUTION TO UTILITIES, PUCs, STATE PLANNING OFFICES, ETC.

PLANNED COMPLETION OF DOCUMENTATION--MAY 1980.

DOCUMENTATION AND COMPUTER MODEL MODIFICATIONS TO INCORPORATE VERTICAL AXIS AND INNOVATIVE DESIGNS.



Value Model Overview

PLANNED COMPLETION OF EXTENSION--SEPTEMBER 1980.

COMPUTER MODEL DESCRIPTIONS

WEIBUL  
(PUBLIC DOMAIN)

PRODUCE A SET OF WEIBULL PARAMETERS FOR 24 TYPICAL HOURS OF EACH DAY FOR EACH MONTH [2]. BEST TO USE SEVERAL YEARS OF WEATHER DATA IF AVAILABLE.

ROSEW  
(PUBLIC DOMAIN)

(REPRESENTATION OF SOLAR ELECTRICS - WIND) PRODUCE THE HOURLY PRODUCTION OF ELECTRICITY FROM WIND MACHINES [3]. THE FORM OF THIS RESULT DEPENDS ON THE FORM OF WEATHER DATA INPUT. RESULT CAN BE THE FOLLOWING:

- o A SET OF ELECTRIC POWER-PROBABILITY PAIRS FOR EACH OF THE 24 TYPICAL HOURS FOR EACH MONTH. REQUIRES [2] AS INPUT.
- o THE DERIVED WIND ELECTRIC POWER FOR EACH HOUR OF A SINGLE YEAR OF WEATHER DATA. ASSUMES WIND SPEED IS CONSTANT OVER THE HOUR AT THE INPUT VALUE.
- o EITHER ONE, TWO, OR THREE SETS OF 24 TYPICAL OR AVERAGE WIND-DERIVED ELECTRICAL PRODUCTION FOR EACH MONTH. USES A SINGLE YEAR OF WEATHER DATA.



COMPUTER MODEL DESCRIPTIONS (CONTINUED)

ULMOD  
(PUBLIC DOMAIN)

(UTILITY LOAD MODIFICATION) WILL PRODUCE THE RESIDUAL UTILITY LOAD [4] REQUIRED AS INPUT TO THE UTILITY PLANNING MODELS THAT FOLLOW. THE FORM OF THESE RESULTS WILL BE VARIED AND WILL DEPEND ON THE TYPES OF UTILITY PLANNING MODELS USED AND THE FORM OF THE RESULTS FROM ROSEW. RESULTS ARE DESIGNED TO BE USABLE WITH A VARIETY OF UTILITY PLANNING MODELS, INCLUDING THOSE USED BY SERI AND OTHERS.

EXPANSION  
MODEL  
(PUBLIC DOMAIN)

DEVELOPS AN ESTIMATE OF THE AMOUNT OF EACH CONVENTIONAL EXPANSION ALTERNATIVE THAT SHOULD BE ADDED TO A UTILITY SYSTEM [5]. AN EXISTING EXPANSION MODEL HAS BEEN ACQUIRED AND INSTALLED ON SERI'S COMPUTER.

PROMOD  
(COMMERCIAL)

(PRODUCTION COST MODEL) DEVELOPS A DETAILED ESTIMATE OF THE OPERATION OF EACH GENERATING UNIT, THE AMOUNT AND COST OF EACH FUEL REQUIRED, AND A MEASURE OF THE RELIABILITY OF THE UTILITY SYSTEM [6].

FINAM  
(PUBLIC DOMAIN)

(FINANCIAL ANALYSIS MODEL) USING THE RESULTS OF THE BASE CASE (NO WIND MACHINES) AND SEVERAL WIND PENETRATION CASES, FINAM DETERMINES THE TOTAL VALUE OF EACH PENETRATION TO A UTILITY [7]. THIS VALUE HAS BOTH ENERGY AND CAPACITY

COMPONENTS. VARIOUS SENSITIVITY STUDIES CAN BE PERFORMED FROM THESE STARTING CONDITIONS.

## ELECTRIC UTILITY VALUE DETERMINATION--WIND

### VOLUME 1, METHODOLOGY

1. INTRODUCTION
  2. OVERVIEW--BRIEF DESCRIPTION OF ALL MODELS NEEDED FOR VALUE DETERMINATION, HOW EACH MAY BE USED, AND THE FLOW OF INFORMATION.
  3. WTP
  4. WEIBUL
  5. ROSEW
  6. ULMOD
  7. FINAM
- DETAILED DISCUSSION, CALCULATIONS, AND OPTIONS FOR EACH PROGRAM.

## VOLUME 2, USER'S GUIDE

FOR EACH OF THE FIVE SERI AVAILABLE PROGRAMS DISCUSSED IN VOLUME 1, DETAILED USER INFORMATION IS PROVIDED IN THE FOLLOWING AREAS:

- o COMPUTER FACILITY SPECIFICS
- o INPUT REQUIREMENTS
- o OUTPUT EXPLANATION
- o SAMPLE RUNSTREAMS.

PR-672  
MAY 21, 1980

BUDGET SUMMARY

BUDGET FOR FY80			
100K			
TRANSFER FROM FY79	1ST AND	PLANNED 1ST AND	
40K	2ND QUARTERS	2ND QUARTERS	
TOTAL BUDGET	EXPENDITURES	EXPENDITURES	COMMITMENTS
140K	65.9K	47.5K	0.4K

TABLE 7. SUBCONTRACTS

CONTRACTOR	WORK TITLE	PLANNED					ACTUAL		
		AMOUNT \$K	PR. COMPL. DATE	START DATE	END DATE	AMOUNT TO BE COSTED DURING FY80	AMOUNT \$K	START DATE	AMOUNT TO BE COSTED \$K
<u>3532.15 WECS UTILITY ANALYTICAL MODELING</u>									
EMA	PROMOD LEASE	75	--	10/79	9/81	50	75	10/79	50

**WECS Utility Analytical Modeling (3532.15)**

Task or Subtask Activities		Fy 80											Fy 81					
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Integrated WECS Value Model		△	—	—	—	▽	▽											
Probabilistic Wind Enhancement Methodology Report		△	—	—	—	▽	▽											
Program Users Manual				△	—	□	▽	—	□	—	—	—	—	—	—	—	—	—
Innovative WECS Inclusion				△	—	▽	□	—	—	—	—	—	—	—	—	—	—	—
Subtask Management		△	◆	—	◆	—	—	◆	▽	—	—	—	—	—	—	—	—	—
Validation of Models										△	—	▽						
Cumulative Accrued Costs \$ X1000	Planned	5.7	11.7	20.7	28.6	36.5	47.5	55.9	64.4	76.4	85.4	94.4	106.5					
	Actual	6.2	33.8	54.8	57.6	63.3	66.0											
	Variance	(0.5)	(22.1)	(34.1)	(29.0)	(26.8)	(18.5)											

- △ Begin Milestone
- ▽ Milestone Complete
- Equipment Arrival
- Progress Report
- Draft Final Report
- Final Report
- ◆ Workshop or Special Meeting

PR-672  
MAY 21, 1980

SELECTED UTILITIES VALUE ANALYSIS

ROGER TAYLOR  
(GEORGE FEGAN)

OBJECTIVE

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

ACCOMPLISHMENTS

A MEETING HELD WITH SOUTHERN CALIFORNIA EDISON (SCE) HAS RESULTED IN GOING TO STONE AND WEBSTER FOR THE SYSTEM DESCRIPTION AS REQUESTED BY SCE. THE BASIC SYSTEM DATA HAVE BEEN RECEIVED, PUNCHED ON CARDS, AND SENT TO THE TWO SUBCONTRACTORS. DATA ARE CURRENTLY BEING SCREENED FOR NEEDED IMPROVEMENTS.

A MEETING BETWEEN SERI AND PACIFIC GAS AND ELECTRIC (PG&E) WAS HELD CONCERNING THE PT. ARENA, CALIF., SITE. IT HAS BEEN DECIDED THAT THIS SITE WILL NOT BE THE OTHER SITE ANALYZED BY BOTH SUBCONTRACTORS. THE LUDINGTON, MICH., CONSUMERS POWER CO. SITE WILL REPLACE IT.

THE METHODOLOGY REPORT FROM THE TWO SUBCONTRACTORS HAVE BEEN RECEIVED AND SENT OUT FOR REVIEW. REVIEW COMMITTEE MEMBERS ARE:

DR. FELIX WU, ENGINEERING PROFESSOR, UNIVERSITY OF CALIFORNIA  
DR. ROBERT SULLIVAN, ENGINEERING PROFESSOR, UNIVERSITY OF FLORIDA  
OLIVER GILDERSLEEVE, EPRI  
DR. GEORGE GROSS, MODELING EXPERT, PG&E



DR. TOM REDDOCH, ENGINEERING PROFESSOR, UNIVERSITY OF TENNESSEE  
DR. JEFF RUNBAUGH, DOE (EX-OFFICIO)

PLANNED ACTIVITIES

COMPLETE THE VALUE ANALYSIS OF THE SAN GORGORIO SITE ON THE SCE SYSTEM.

COMMENCE THE VALUE ANALYSIS OF THE LUDINGTON SITE ON THE CONSUMERS POWER CO. SYSTEM.

OUTPUT

AT THE END OF JUNE DRAFT REPORTS FOR THE SAN GORGORIO SITE ARE DUE FROM BOTH SUBCONTRACTORS AND A COMPARISON OF THOSE ANALYSES WILL BE CARRIED OUT.

BUDGET SUMMARY

BUDGET FOR FY80			
600K			
TRANSFER FROM FY79	1ST AND	PLANNED 1ST AND	
470K	2ND QUARTERS	2ND QUARTERS	
TOTAL BUDGET	EXPENDITURES	EXPENDITURES	COMMITMENTS
1070K	249.9K	249.4K	369.8K

TABLE 8. SUBCONTRACTORS SCHEDULE OF STUDY SITES

AEROSPACE CORP.		JBF SCIENTIFIC, INC.	
<u>SITE</u>	<u>UTILITY</u>	<u>SITE</u>	<u>UTILITY</u>
SAN GORGONIO PASS, CA	SOUTHERN CALIFORNIA EDISON	SAN GORGONIO PASS, CA	SOUTHERN CALIFORNIA EDISON
LUDINGTON, MI	CONSUMERS POWER Co.	LUDINGTON, MI	CONSUMERS POWER Co.
MONTAUK POINT, NY KINGSLEY DAM, NE	LONG ISLAND LIGHTING Co. CENTRAL NEB. PUBLIC POWER	PT. ARENA, CA HOLYOKE, MA	PACIFIC GAS AND ELECTRIC CITY OF HOLYOKE GAS AND ELECTRIC Co.
COLD BAY, AK	ALASKA BUSSELL ELECTRIC	AMARILLO, TX	SOUTHWESTERN PUBLIC SER- VICE Co.
BOONE, NC	BLUE RIDGE ELECTRIC MEMBER- SHIP CORP.	CULEBRA, PR	PUERTO RICO WATER RESOURCES AUTHORITY
BOARDMAN, OR RUSSELL, KS HURON, SD	PORTLAND GENERAL ELECTRIC Co. CITY OF RUSSELL EAST RIVER POWER COOPERATIVE	CLAYTON, NM KAENA PT., HI BLOCK ISLAND, RI	TOWN OF CLAYTON HAWAIIAN ELECTRIC Co. BLOCK ISLAND POWER Co.

TABLE 9. SUBCONTRACTS

CONTRACTOR	WORK TITLE	PLANNED				ACTUAL			
		AMOUNT \$K	PR. COMPL. DATE	START DATE	END DATE	AMOUNT TO BE COSTED DURING FY80	AMOUNT \$K	START DATE	AMOUNT TO BE COSTED \$K
<u>3532.20 SELECTED UTILITIES VALUE ANALYSES</u>									
JRF CORP.	SITE VALUE ANALYSIS	370	--	11/79	11/80	296	355	12/79	300
AEROSPACE	SITE VALUE ANALYSIS	210	--	11/79	11/80	175	212	12/79	175
JRF CORP.	LADWP VS SCI ANALY.	20	4/80	6/80	6/80	--	--	--	--
JRF CORP.	SITE ANALYSIS EXT.	172	4/80	11/80	5/81	--	--	--	--
AEROSPACE CORP.	SITE ANALYSIS EXT.	150	4/80	11/80	5/81	--	--	--	--

**Selected Utilities Value Analysis (3532.20)**

Task or Subtask Activities		Fy 80											Fy 81					
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Analysis of San Gorgonio Site			▲	—	●	—	—	—	▼	□	▼							
Analysis of Ludington Site						▼	▲	▼	□	▼								
Analysis of Next 4 Sites by Each Methodology Report							▲	▼	—	□	—	■	—	—	—	—	—	—
Analysis of Last 3 Sites														▲	—	●	—	—
Project Management		▲	◆	—	—	—	◆	—	—	—	◆	—	◆	—	—	—	—	▼
Subtask Management		▲	◆	—	◆	—	◆	—	—	—	◆	—	●	◆	—	—	◆	—
Cumulative Accrued Costs \$ X1000	Planned	5.9	11.8	69.4	129.1	189.8	249.4	318.1	389.9	448.3	507.7	568.6	628.0					
	Actual	9.2	16.6	20.4	71.1	173.5	249.9											
	Variance	(3.3)	(4.8)	49.0	58.0	16.3	(0.5)											

- ▲ Begin Milestone
- ▼ Milestone Complete
- Equipment Arrival
- Progress Report
- Draft Final Report
- Final Report
- ◆ Workshop or Special Meeting

PR-6/2  
MAY 21, 1980

ECONOMICS OF WECS TIED TO UTILITIES

DAVID PERCIVAL  
(GEORGE FEGAN)

### OBJECTIVES

DETERMINE CAPITAL COST GOALS FOR THE TWO MOST PROMISING REGIONS OF THE UNITED STATES USING THE TOOLS DEVELOPED FOR THE UTILITY ANALYTICAL MODELING TASK.

COMPARE EPRI UTILITY DATA TO DATA OBTAINED FROM UTILITIES IN 16 SITE VALUE STUDY.

DETERMINE THE SENSITIVITY OF WECS VALUE TO UTILITY OPERATIONAL AND ECONOMIC PARAMETERS.

### ACCOMPLISHMENTS

COMPLETED MODELS IN THE UTILITY ANALYTICAL MODELING TASK.

INVESTIGATED SOURCES OF REGIONAL DATA. DATA FOR THE SIX EPRI REGIONS SHOULD BE AVAILABLE IN JUNE AND THE TAPES CAN BE CONVERTED TO PROMOD FORMAT BY THE EXISTING ROUTINE.

### PLANNED ACTIVITIES

SELECT TWO REGIONS FOR DETAILED ANALYSIS BASED UPON CONVENTIONAL FUEL MIX AND WIND CHARACTERISTICS AND BEGIN ANALYSIS.

OUTPUT

DRAFT REPORT DUE SEPTEMBER 1980.

BUDGET SUMMARY

FY80 BUDGET	1ST AND 2ND QUARTERS EXPENDITURES	PLANNED 1ST AND 2ND QUARTERS EXPENDITURES	COMMITTMENTS
55K	13.5K	23.2K	0

SUBCONTRACTS

NONE

**Economics of WECS Tied To Utilities (3532.30)**

Task or Subtask Activities		Fy 80												Fy 81					
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Select Region for Analysis					△														
Perform Analysis						▽													
Subtask Management					△			◆	▽	△				□	▽	◆			
Cumulative Accrued Costs \$ X1000	Planned	3.5	7.0	10.5	14.0	18.1	23.2	28.4	33.0	37.6	42.1	46.6	52.1						
	Actual	3.1	5.7	7.7	8.6	12.5	13.5												
	Variance	0.4	1.3	2.8	5.4	5.6	9.7												

△ Begin Milestone

○ Equipment Arrival

□ Draft Final Report

◆ Workshop or Special Meeting

▽ Milestone Complete

● Progress Report

■ Final Report



PR-6/2  
MAY 21, 1980

A COMPREHENSIVE GUIDE: WECS CONNECTED TO ELECTRIC UTILITIES

ROGER TAYLOR

### 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 PAST AND CURRENT DEVELOPMENTS IN THE FIELD OF WIND ENERGY.

### ACCOMPLISHMENTS

COMPLETED DRAFT REPORT OF THE SECTION ON THE FEDERAL WIND ENERGY PROGRAM. INCLUDES A BRIEF DESCRIPTION OF THE LARGE HORIZONTAL AXIS MACHINE PROGRAM, THE SMALL WIND MACHINE PROGRAM, AND THE ADVANCED AND EMERGING TECHNOLOGIES PROGRAM.

### PLANNED ACTIVITIES

BEGIN WORK ON REMAINING SECTIONS:

- 2.0 THE WIND AS AN ENERGY SOURCE
- 3.0 TECHNICAL CHARACTERISTICS

4.0 INSTITUTIONAL ISSUES

6.0 THE COST OF WECS

REPROGRAM 60K OF SUBTASK FUNDS TO THE ECONOMICS OF WECS TIED TO THE UTILITY SUBTASK FOR USE ON A STUDY OF THE VALUE OF WECS TO THE UTILITY WHEN BACKED UP BY A HYDRO SYSTEM.

OUTPUT

PREPARE DRAFT REPORT DURING 4TH QUARTER FY80.

PREPARE FINAL REPORT END OF 1ST QUARTER FY81.

BUDGET SUMMARY

	1ST AND 2ND QUARTERS	PLANNED	1ST AND 2ND	
BUDGET	EXPENDITURES	QUARTERS	EXPENDITURES	COMMITMENTS
230K	40.1K		36.2K	0

SUBCONTRACTS

NONE

**A Comprehensive Guide, WECS Connected to Electric Utilities (3532.60)**

Task or Subtask Activities	Fy 80												Fy 81					
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Data Collection on: Technical Characteristics Institutional Issues Economic Assessment Resources and Siting WECS Guide to Utilities								▽	—	—	—	—	—	—				
								▽	—	—	—	—	—	—				
			△	—	—	—	—	▽	—	—	—	—	—	—	—			
							△▽	—	—	—	□	—	—	—	—			
Subtask Management		◆		◆			◆			◆				◆				
Cumulative Accrued Costs \$ X1000	Planned	6.2	11.8	17.6	21.5	25.1	36.2	47.6	63.1	78.6	94.0	109.2	124.2					
	Actual	5.5	10.2	18.6	27.0	31.4	40.1											
	Variance	0.7	1.6	(1.0)	(5.5)	(6.3)	(3.9)											

- △ Begin Milestone
- ▽ Milestone Complete
- Equipment Arrival
- Progress Report
- Draft Final Report
- Final Report
- ◆ Workshop or Special Meeting

PR-672  
MAY 21, 1980

ECOLOGICAL, SOCIO-ENVIRONMENTAL ASSESSMENT OF WIND SYSTEMS

CARL STROJAN

OBJECTIVES

IDENTIFY AND QUANTIFY THE LIFE-CYCLE ENVIRONMENTAL EFFECTS OF BOTH SMALL AND LARGE WIND ENERGY SYSTEMS.

ASSESS COMPARATIVELY THE ENVIRONMENTAL EFFECTS OF SMALL AND LARGE WIND ENERGY SYSTEMS UNDER SELECTED DEPLOYMENT OPTIONS; E.G., COMMUNITY SCALE USE OF MANY SMALL WECS COMPARED WITH FEWER LARGE WECS.

ACCOMPLISHMENTS

COMPLETED ANALYSIS OF DATA FROM SWECS AESTHETICS STUDY.

PREPARED A STATEMENT OF WORK FOR A TECHNICAL SERVICES PURCHASE ORDER TO PROVIDE ESTIMATES OF AIR AND WATER POLLUTANTS EMITTED AND ENERGY CONSUMED DURING PRODUCTION OF RAW MATERIALS USED FOR WECS.

COMPLETED A REPORT ENTITLED "ENVIRONMENTAL ASSESSMENT OF SMALL WIND SYSTEMS: PROGRESS REPORT" FOR FY79 CARRY OVER SUBTASK.

PREPARED A TECHNICAL PAPER ENTITLED "ENVIRONMENTAL EFFECTS OF SMALL WIND ENERGY CONVERSION SYSTEMS," WHICH WAS PRESENTED AT THE SECOND U.S. DOE ENVIRONMENTAL CONTROL SYMPOSIUM ON MARCH 18, IN RESTON, VA.

PREPARED A TECHNICAL PAPER ENTITLED "A FIELD STUDY ON THE AESTHETICS OF SMALL WIND MACHINES: PRELIMINARY REPORT," WHICH WAS PRESENTED AT THE AIAA/SERI WIND ENERGY CONFERENCE ON APRIL 11, IN BOULDER, COLO.\*

### PLANNED ACTIVITIES

COMPLETE REVIEW OF DRAFT FINAL REPORT ON THE ENVIRONMENTAL EFFECTS OF SWECS BY WSB/DOE AND OUTSIDE REVIEWERS.\*\*

CONTINUE DATA COLLECTION ON THE ENVIRONMENTAL ASPECTS OF MEDIUM AND LARGE SCALE MACHINE PRODUCTION FOR INCORPORATION INTO FY80 SUBTASK.

### OUTPUT

A 15-MINUTE COLOR VIDEOCASSETTE PRESENTING POTENTIAL TV INTERFERENCE BY THE BLOCK ISLAND WTG. (COMPLETED)

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\*PRIOR TO THE INITIATION OF ANY SURVEY, THE SERI SURVEY REVIEW COMMITTEE (SRC) MAKES A DETERMINATION AS TO WHETHER THE SURVEY REQUIRES OMB APPROVAL. SRC DETERMINED THAT NO OMB APPROVAL WAS REQUIRED FOR THE AESTHETICS STUDY.

\*\*THE FOLLOWING PERSONS WILL RECEIVE DRAFT FINAL REPORTS FOR REVIEW: ROBERT FERBER, UNIV. ILL-SRL; THOMAS SENIOR, UNIV. MICH; BEN BLANEY, EPA/CINCINNATI; DAVID BERG, EPA/WASHINGTON, D.C.; JOHN HOLDREN, UNIV. CALIF./BERKELEY; SHARRON ROGERS, BATTELLE-COLUMBUS; THEODORE KORNREICH, SAI, INC.; ROCKY FLATS WIND SYSTEMS GROUP; LARRY WENDELL, BATTELLE PNL.



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. (COMPLETED)

FINAL REPORT THAT PRESENTS AN ANALYSIS OF THE POTENTIAL HEALTH AND ECOLOGICAL EFFECTS OF SWECS FOR EACH LIFE-CYCLE PHASE (SYSTEM FABRICATION THROUGH DECOMMISSION) AND AN ASSESSMENT OF THE NET ENVIRONMENTAL EFFECTS OF SWECS. (IN PREPARATION AND REVIEW)

TECHNICAL PAPER WHICH PRESENTS THE RESULTS OF THE AESTHETICS SURVEY OF SWECS. (COMPLETED)

ENVIRONMENTAL, HEALTH, AND SAFETY IMPACT DATA FOR INPUT INTO PLANNING PERFORMED FOR DOE.

FINAL REPORT FOR FY80 EFFORT THAT PRESENTS A COMPARATIVE ENVIRONMENTAL ASSESSMENT OF SMALL AND LARGE WECS UNDER SELECTED DEPLOYMENT OPTIONS.

BUDGET SUMMARY

BUDGET	1ST AND	PLANNED 1ST AND	
(INCLUDES 38K	2ND QUARTERS	2ND QUARTERS	
FY79 CARRYOVER)	EXPENDITURES	EXPENDITURES	COMMITMENTS
\$98K	52.3K	37.9K	1K

TABLE 10. SUBCONTRACTS

CONTRACTOR	WORK TITLE	PLANNED					ACTUAL		
		AMOUNT \$K	PR. COMPL. DATE	START DATE	END DATE	AMOUNT TO BE COSTED DURING FY80	AMOUNT \$K	START DATE	AMOUNT TO BE COSTED \$K
<u>3531.35 ECOLOGICAL/SOCIO-ENVIRONMENT ASSESSMENT</u>									
TBD (COMPETITIVE)	FIELD NOISE MEASUREMENT	21*	2/80	9/80	3/81	4	--	--	--
FRANKLIN ASSOC. (TECH. SERVICES)	POLLUTION ESTIMATES	10	4/80	5/80	8/80	10			

\*FUNDS MAY BE USED TO SUPPLEMENT ONGOING SERI NOISE MEASUREMENTS RATHER THAN TO BEGIN NEW ONES.

**Wind Ecological/Socio-Environmental Assessment (3531.35/3531.39)**

Task or Subtask Activities	Fy 80												Fy 81					
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
<u>3531.39</u> FY79 Activities Ecological Assessment of SWECS Technical Paper: SWECS Aesthetics Survey		●	△	△	▽		□	▽	■									
<u>3531.35</u> Determine Format For Standardized Environmental Impact Data Collect And Synthesize Environ- mental Impact Data Perform Environmental Impact Assessment Subtask Management			△	▽				▽	▽									
	△	◆		◆			●	◆	▽		◆	□		◆	■			
Cumulative Accrued Costs \$ X1000	Planned	8.4	17.7	28.1	30.7	34.2	37.9	40.6	50.1	59.1	71.1	82.6	100.4					
	Actual	5.6	13.2	23.4	32.4	43.8	52.4											
	Variance	2.8	4.5	4.7	(1.7)	(9.6)	(14.5)											

- △ Begin Milestone
- Equipment Arrival
- Draft Final Report
- ◆ Workshop or Special Meeting
- ▽ Milestone Complete
- Progress Report
- Final Report

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MAY 21, 1980

TELEVISION INTERFERENCE AND WECS

NEIL KELLEY

OBJECTIVE

DETERMINE THE EXTENT AND CAUSES OF THE INTERFERENCE TO TELEVISION SIGNALS IN THE VICINITY OF OPERATIONAL WIND TURBINES AND TO IDENTIFY METHODS OF ALLEVIATING OR ELIMINATING THAT INTERFERENCE.

ACCOMPLISHMENTS

UNIVERSITY OF MICHIGAN MADE RECOMMENDATIONS FOR SPECIAL ANTENNAS TO BE TESTED AT VARIOUS LOCATIONS NEAR THE MOD-1.

UNIVERSITY OF MICHIGAN MADE RECOMMENDATIONS FOR INSTALLATION LOCATIONS OF SPECIAL ANTENNAS (BREMCO WILL PURCHASE AND INSTALL).

INITIATED NEGOTIATIONS FOR CONTINUING OF UNIVERSITY OF MICHIGAN SUBCONTRACT TO INCLUDE TVI STUDIES FOR SMALL WIND TURBINES.

RECEIVED DRAFT OF TVI SITING HANDBOOK AND DRAFT OF BLOCK ISLAND TVI REPORT.

PLANNED ACTIVITIES

COMPLETE SYSTEMATIC TVI MEASUREMENTS AT THE MOD-1 SITE AFTER INSTALLATION OF SPECIAL ANTENNAS.

COMPLETE REVIEW OF DRAFT REPORT OF BLOCK ISLAND MEASUREMENTS AND NEW VERSION OF THE LARGE WIND TURBINE SITING HANDBOOK. DRAFT REPORT PROVIDED TO G. TENNYSON AND D. ANCONA (WSB/DOE) FOR REVIEW AND COMMENT.

PURSUE POSSIBLE FUNDING OF UNSOLICITED PROPOSAL SUBMITTED BY POLYTECHNIC INSTITUTE OF NEW YORK FOR DEVELOPMENT OF AN ELECTRONIC TECHNIQUE FOR DETECTION AND SUPPRESSION OF WIND TURBINE TVI SIGNALS.

COMPLETE CONTRACT PROCEDURE FOR EXTENSION OF UNIVERSITY OF MICHIGAN TVI STUDIES TO INCLUDE SMALL WIND TURBINES.

OUTPUT

SYSTEMATIC TVI MEASUREMENTS AT LARGE WIND TURBINE SITES.

AN UPDATED TVI SITING HANDBOOK FOR LARGE WIND SYSTEMS.

A TVI SITING HANDBOOK FOR SMALL WIND SYSTEMS.

BUDGET SUMMARY

	1ST AND 2ND QUARTERS EXPENDITURES	PLANNED 1ST AND 2ND QUARTERS EXPENDITURES	COMMITMENTS
BUDGET 110K	7.8K	20.2K	0

TABLE 11. SUBCONTRACTS

CONTRACTOR	WORK TITLE	PLANNED					ACTUAL		
		AMOUNT \$K	PR. COMPL. DATE	START DATE	END DATE	AMOUNT TO BE COSTED DURING FY80	AMOUNT \$K	START DATE	AMOUNT TO BE COSTED \$K
<u>3532.50 TELEVISION INTERFERENCE AND MECS</u>									
TBD (SOLE SOURCE)	TVI HANDBOOK	50	2/80	4/30	10/80	50	--	--	--
TBD (SOLE SOURCE)	TVI GHOST SUPPRESSION	19	2/80	6/80	5/81	19	--	--	--



Television Interference and WECS (3532.50)

Task or Subtask Activities	Fy 80												Fy 81				
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Complete TVI Site Survey at Block Island, RI	▼			□						■	▼						
TVI Site Survey at Boone, NC								▼	▼	●							
Small WECS TVI Test								▼	▼	▼							
Update TVI Handbook for Large WECS			□				▼		■								
Develop TVI Handbook for Small WECS									▲	▲	●			□			■
TVI Suppression Study	▲						◆		▲		●				□		
Project Management	▲	◆		◆			◆			◆			◆				◆
Subtask Management	▲	◆		◆			◆			◆			◆				◆
Cumulative Accrued Costs \$ X1000	Planned	2.1	4.2	8.5	14.0	16.8	20.2	27.8	35.4	43.8	51.4	62.5	73.1				
	Actual	1.6	2.5	3.9	5.4	7.7	7.8										
	Variance	0.5	1.7	4.6	8.6	9.1	12.4										

▲ Begin Milestone

○ Equipment Arrival

□ Draft Final Report

◆ Workshop or Special Meeting

▼ Milestone Complete

● Progress Report

■ Final Report

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MAY 21, 1980

NOISE MEASUREMENTS AT SELECTED WIND SYSTEM SITES

NEIL KELLEY

### OBJECTIVES

DOCUMENT AND QUANTIFY THE NOISE ASSOCIATED WITH THE OPERATION OF EXISTING LARGE WIND TURBINES AND IDENTIFY THE PRINCIPLE MECHANISMS WHICH ARE RESPONSIBLE FOR THE GENERATION, PROPAGATION, AND HUMAN ANNOYANCE BY UTILIZING FIELD MEASUREMENTS AND EXISTING ANALYTICAL TOOLS.

FORMULATE RECOMMENDATIONS FOR METHODS TO MINIMIZE THE NOISE GENERATED BY MOD-1 AND ITS IMPACT ON THE PUBLIC.

### ACCOMPLISHMENTS

CONSULTED WITH DR. FRED SCHMITZ OF THE U.S. ARMY AVIATION RESEARCH AND TECHNOLOGY LABS ON POSSIBLE WECS NOISE GENERATING MECHANISMS.

AT SCHMITZ'S SUGGESTION, ADDITIONAL PRELIMINARY MEASUREMENTS WERE MADE AT MOD-1 FEB. 5 AND 7 TO IDENTIFY IF THE NOISE WAS RANDOM OR A PERIODIC IMPULSE--  
RESULT: PERIODIC IMPULSE.

HELD WIND TURBINE NOISE WORKSHOP AT SERI, FEB. 21-22.

MODIFIED SUBCONTRACT WITH PENN STATE UNIVERSITY TO INCLUDE INSTALLATION OF TWO ACOUSTIC SOUNDERS NEAR MOD-1 AND TO MAKE SUPPLEMENTAL SEISMIC AND ACOUSTIC MEASUREMENTS DURING THE SYSTEMATIC FIELD MEASUREMENTS AT BOONE.

AWARDED SUBCONTRACT TO PNL FOR TETHERSONDE SUPPORT FOR SYSTEMATIC FIELD STUDY AT BOONE.

ATTENDED MOD-1 NOISE REVIEW MEETING WITH DOE/WSB ON MARCH 10.

INITIATED SYSTEMATIC MEASUREMENT PROGRAM IN BOONE MARCH 17 (THROUGH APRIL 5).

AWARDED SUBCONTRACT TO MIT FOR CALCULATIONS OF WTG (MOD-1) NOISE AT 35 AND 23 RPM.

#### PLANNED ACTIVITIES

COMPLETE DATA REDUCTION AND INTERPRETATION OF SERI-MEASUREMENTS TAKEN DURING INTENSIVE PERIOD.

MAKE NOISE MEASUREMENTS OF MOD-0 OPERATION IN BOTH DOWNWIND AND UPWIND CONFIGURATIONS WITH SUBSEQUENT REDUCTION AND INTERPRETATION.

MAKE NOISE MEASUREMENT OF VAWT AT SANDIA LABS.

RECEIVE REDUCED TETHERSONDE DATA FROM PNL AND SUPPLEMENTAL ACOUSTIC AND PROPAGATION DATA FROM PENN STATE COVERING SYSTEMATIC BOONE MEASUREMENTS.

DEVELOP REVISED TASK PLAN BASED ON CURRENT KNOWLEDGE OF THE LARGE SCALE WECS NOISE GENERATION PROCESS AND IMPACT.

OUTPUT

SPECIFIC RECOMMENDATIONS AND OPTIONS REGARDING THE NOISE ASSOCIATED WITH THE OPERATION OF THE MOD-1 WTG AT BOONE, NC.

FINAL SUMMARY REPORT WHICH DOCUMENTS THE NOISE ASSOCIATED WITH THE OPERATION OF LARGE WECS (BOTH HAWT AND VAWT) INCLUDING THE PRINCIPAL CAUSES OF GENERATION AND PROPAGATION OF INFRASOUND.

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SERI POSITION ON MOD-1 NOISE SITUATION

AS PRESENTED AT MEETING WITH DOE/WSB

MARCH 10, 1980

IN WASHINGTON, D.C.

PRESENTED AT DOE/WSB MEETING MARCH 10, 1980.

CONCLUSION REACHED TO DATE FROM AVAILABLE PRELIMINARY MEASUREMENTS AND DISCUSSIONS WITH A WIDE RANGE OF TECHNICAL EXPERTS. . .

#### GENERATION

THE PRINCIPLE GENERATING MECHANISM APPEARS TO BE THE PERIODIC LOADING AND UNLOADING OF THE WECS BLADES AS THEY PASS IN THE TOWER WAKE. BY SUCH ACTION, A PRESSURE IMPULSE IS DEVELOPED WHICH CONTAINS A LARGE CONTRIBUTION OF INFRASONIC ENERGY AT FREQUENCIES PRINCIPALLY BELOW 10 Hz. BOTH TEMPORAL AND FREQUENCY ANALYSIS SEEMS TO CONFIRM THE EXISTENCE OF THIS PULSE BUT MEASUREMENTS TAKEN TO DATE DO NOT HAVE SUFFICIENT LOW FREQUENCY RESPONSE TO COMPLETELY VALIDATE THE CONCLUSION.

#### PROPAGATION

PRELIMINARY ANALYSIS OF THE SOUND PROPAGATING FROM THE MOD-1 SITE INDICATES THE COMBINATION OF LOCAL TERRAIN AND STATE OF THE ATMOSPHERE ARE THE PRINCIPLE FACTORS CONTROLLING WHERE AND WHEN SUFFICIENT ENERGY WILL BE TRANSPORTED TO CAUSE ANNOYANCE OF THE LOCAL RESIDENTS. ANALYSIS OF THE FIRST THREE WEEKS OF ACOUSTIC SOUNDER DATA HAS SHOWN THE POTENTIAL EXISTS FOR FAVORABLE CONDITIONS TO CAUSE INFRASONIC PROPAGATION INTO SURROUNDING HOMES ON THE ORDER OF 15%-20% OF

THE TIME (BASED ON FEB. 1980 DATA). WHEN ALL CONDITIONS ARE INCLUDED (I.E., MECHANICAL, WIND VELOCITY, ETC.) THIS NUMBER PROBABLY FALLS TO 5%-10% ANNOYANCE PROBABILITY, AS A FUNCTION OF TIME.

PRELIMINARY ANALYSIS HAS ALSO SHOWN THAT THE CONDITIONS MOST LIKELY TO SUPPORT PROPAGATION TO ANNOYANCE LEVELS ARE ALSO THE ONES WHICH PROVIDE SUFFICIENT WIND FLOW ATOP HOWARDS KNOB FOR POWER GENERATION. THIS IS PARTICULARLY TRUE FOR THE PERIODS FROM JUST AFTER SUNSET TO ABOUT MIDNIGHT AND AGAIN FOR A PERIOD OF 2 OR 3 HOURS AFTER SUNRISE. SUCH CONDITIONS ARE VERY COMMON TO ELEVATED LOCATIONS DUE TO THE DIURNAL HEATING AND COOLING CYCLE OF THE EARTH AND ATMOSPHERE.

### IMPACT

AT PRESENT IT IS NOT KNOWN WHETHER THE ANNOYANCE MECHANISM IS DUE TO AIRBORNE OR GROUND BORNE PROPAGATION OF INFRASONIC ENERGY. IT IS SUSPECTED THAT THE AIRBORNE PATH IS THE MOST LIKELY BUT THE COUPLING TO PEOPLE AND STRUCTURES MAY INVOLVE A COMBINATION OF PROPAGATION MECHANISMS. MEASUREMENTS MADE BY GE INDICATE THAT INTERNAL RESONANCES MAY INCREASE INFRASONIC LEVELS WITHIN STRUCTURES AND PORTIONS OF STRUCTURES.



REVIEW AND STATUS OF  
NOISE MEASUREMENTS AND WECS

SERI Task 3532.55

PRESENTED TO

WIND SYSTEMS BRANCH  
DOE

BY

N.D. KELLEY  
WIND ENERGY BRANCH  
SERI

MAY 21, 1980

AGENDA

- I. REVIEW OF CURRENT TASK STATUS.
- II. REVIEW OF CURRENT SERI RESULTS ON  
MOD-1 NOISE SITUATION.
- III. CURRENT TASK PLANNING OUTLOOK.

PART I

CURRENT TASK STATUS

PLEASE REFER TO WIND PROGRAM QUARTERLY  
REVIEW DOCUMENT

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PART II

SERI RESULTS ON MOD-1 NOISE

THE RESULTS DISCUSSED HEREIN HAVE BEEN BASED ON A PRELIMINARY ANALYSES OF DATA GATHERED DURING A SYSTEMATIC NOISE STUDY MADE IN AND NEAR THE MOD-1 TURBINE ON MARCH 23-APRIL 2, 1980 AND SUPPORTED BY MEASUREMENTS MADE AT THE MOD-0 TURBINE IN THE DOWNWIND CONFIGURATION ON APRIL 23-27, 1980.

THE COOPERATION OF THE STAFF OF THE NASA LEWIS RESEARCH CENTER, ITS SUBCONTRACTORS, AND THE BLUE RIDGE ELECTRIC MEMBERSHIP CORPORATION IS GREATLY APPRECIATED AND WITHOUT WHOSE HELP THE MEASUREMENTS MADE WOULD NOT HAVE BEEN POSSIBLE.

GENERAL CONCLUSIONS:

- THE ANNOYANCE ASSOCIATED WITH THE MOD-1 OPERATION IS CHIEFLY DUE TO THE IMPULSIVE SOUNDS GENERATED AT THE BLADE PASSAGE FREQUENCY.
- THE PROPAGATION OF THE TURBINE NOISE IS STRONGEST IN THE DIRECTION OF THE WIND (DOWNWIND) AND IS LARGELY CONTROLLED BY THE STRONG WIND SHEAR EXISTING DUE TO THE LANDFORM ON WHICH THE MACHINE IS SITED.
- MEASUREMENTS INDICATE THE PRIMARY PROPAGATION MECHANISM IS AIRBORNE SOUND WHICH CARRIES THE ANNOYANCE TO NEARBY HOMES. THE COVELL AND McCONNELL HOMES ARE ANNOYED MOST OFTEN DUE TO THE PREVAILING WIND DIRECTION AND THE SHARP LANDFORM IMMEDIATELY DOWNWIND OF THE TURBINE.
- INDOOR SOUND AND STRUCTURAL MOTION MEASUREMENTS INDICATE A STRONG COUPLING OF THE IMPULSIVE SOUND TO THE RESIDENCES WHICH PRODUCES A COMPLEX STIMULUS CONSISTING OF VIBRATIONS AND AUDIBLE SOUNDS.
- THE PRIMARY GENERATION MECHANISM APPEARS TO BE THE BLADES CUTTING THROUGH STREAMS OF INTENSE VORTICES BEING SHED FROM EACH DOWNWIND LEG OF THE SUPPORTING TOWER STRUCTURE.

ANALYSIS OF THE ACOUSTIC RADIATION FROM BOTH THE MOD-1 AND MOD-0 TURBINES IN THE NEAR FIELD HAS REVEALED THE EXISTENCE OF PRESSURE IMPULSES BEING GENERATED IMMEDIATELY DOWNWIND OF THE SUPPORTING TOWER LEGS. THE MAJOR DIFFERENCES BETWEEN THE TWO MACHINES APPEARS TO BE VERY INTENSE AND HIGHLY REGULAR IMPULSES ASSOCIATED WITH EVERY BLADE PASSAGE OF THE MOD-1.

WITH THIS EVIDENCE IN MIND, AN AERODYNAMIC SOURCE WAS SOUGHT AND THE FLOW REGIME SURROUNDING THE LEGS WAS INVESTIGATED. THE RESULTS SHOW THAT UNDER MOST OPERATING CONDITIONS, THE FLOW AROUND THE CYLINDRICAL LEGS CAN BE CONSIDERED IN THE TRANSITIONAL REGIME; I.E., FLOW WITH THE SHEDDING OF INTENSE, COHERENT VORTICES DUE TO THE ALTERNATING BETWEEN LAMINAR AND TURBULENT SEPARATION OF THE FLOW AROUND THE CYLINDER. CALCULATIONS INDICATE A SHEDDING FREQUENCY UNDER THESE CONDITIONS OF 3-6 VORTICES PER SECOND, HIGH ENOUGH TO BE INTERSECTED BY A BLADE AT EACH PASSAGE. THIS THEORY SUPPORTS THE FEW CASES DOCUMENTED DURING WHICH NO IMPULSIVE OR "THUMPING" SOUNDS WERE HEARD THOUGH THE TURBINE WAS OPERATING UNDER LOAD. THE APPARENT EXPLANATION IS THE LOCAL FLOW AROUND THE TOWER WAS SUBCRITICAL; I.E., BELOW THE TRANSITIONAL REGION, IN WHICH FEWER AND MUCH LESS INTENSE EDDIES ARE SHED.

THE FOLLOWING GRAPHS ILLUSTRATE THE TRANSITIONAL FLOW CONCLUSIONS. THE MOD-0 APPEARS NOT TO BE A PROBLEM DUE TO TWO REASONS: (1) THE FLOW AROUND THE TOWER LEGS REMAINS SUBCRITICAL AT NORMAL OPERATING WIND SPEEDS, AND (2) ITS TIP VELOCITY IS ONLY A THIRD OF THE MOD-1 THUS REDUCING THE RATE OF CHANGE IN THE PRESSURE FIELD AS THE BLADE CUTS THROUGH AN EDDY.

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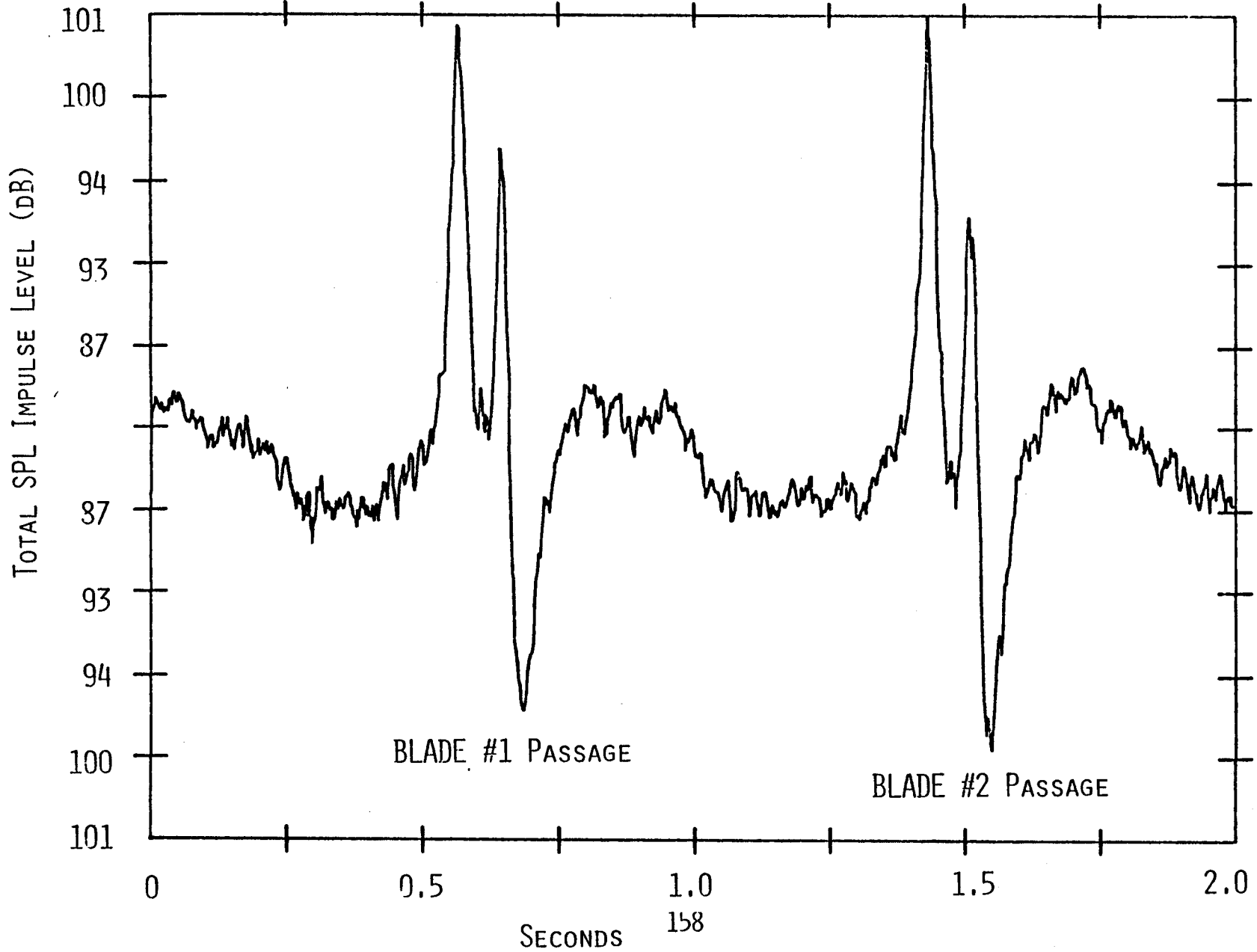
TIME DOMAIN ANALYSIS

OF

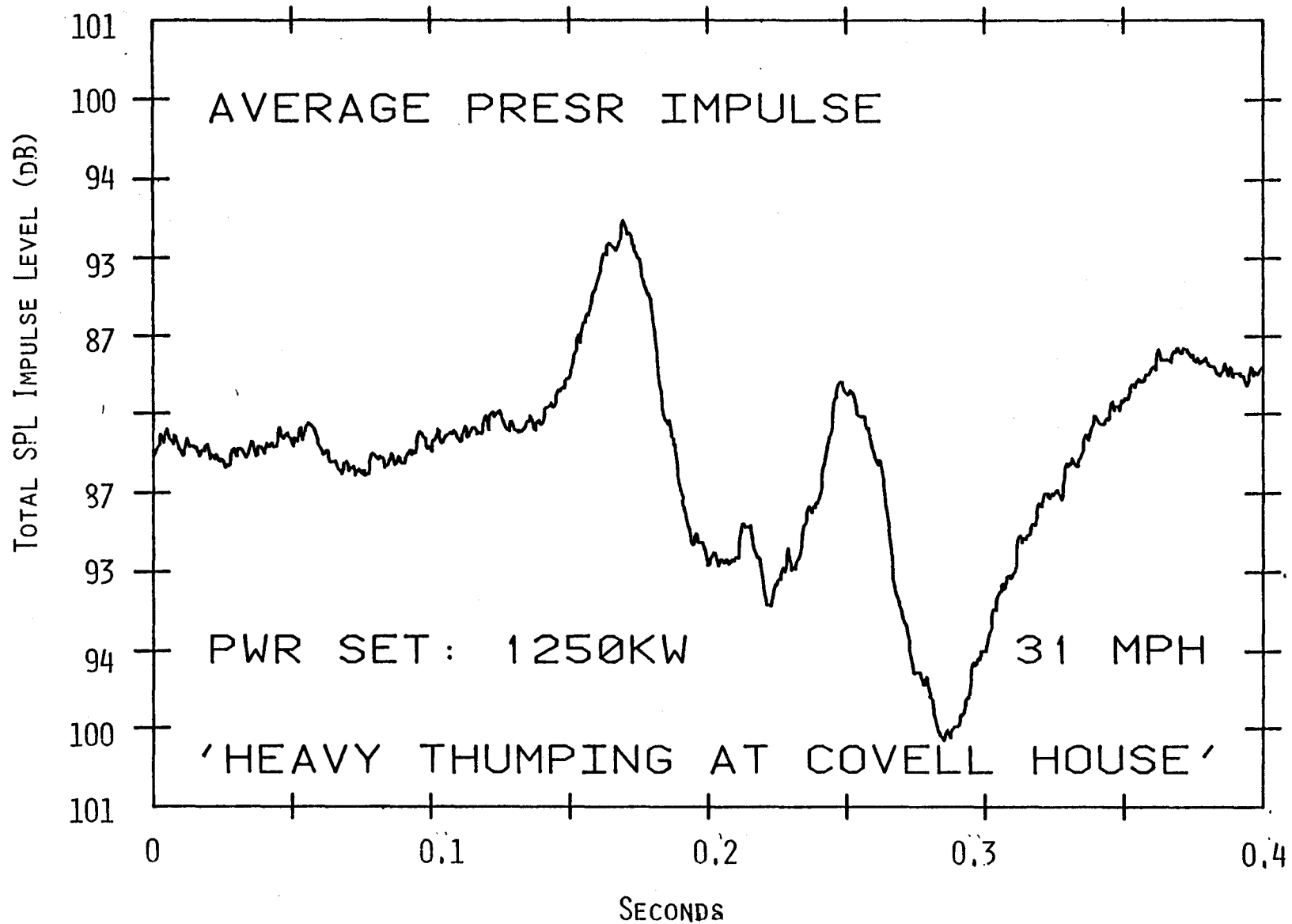
MOD-1 NEAR FIELD DATA



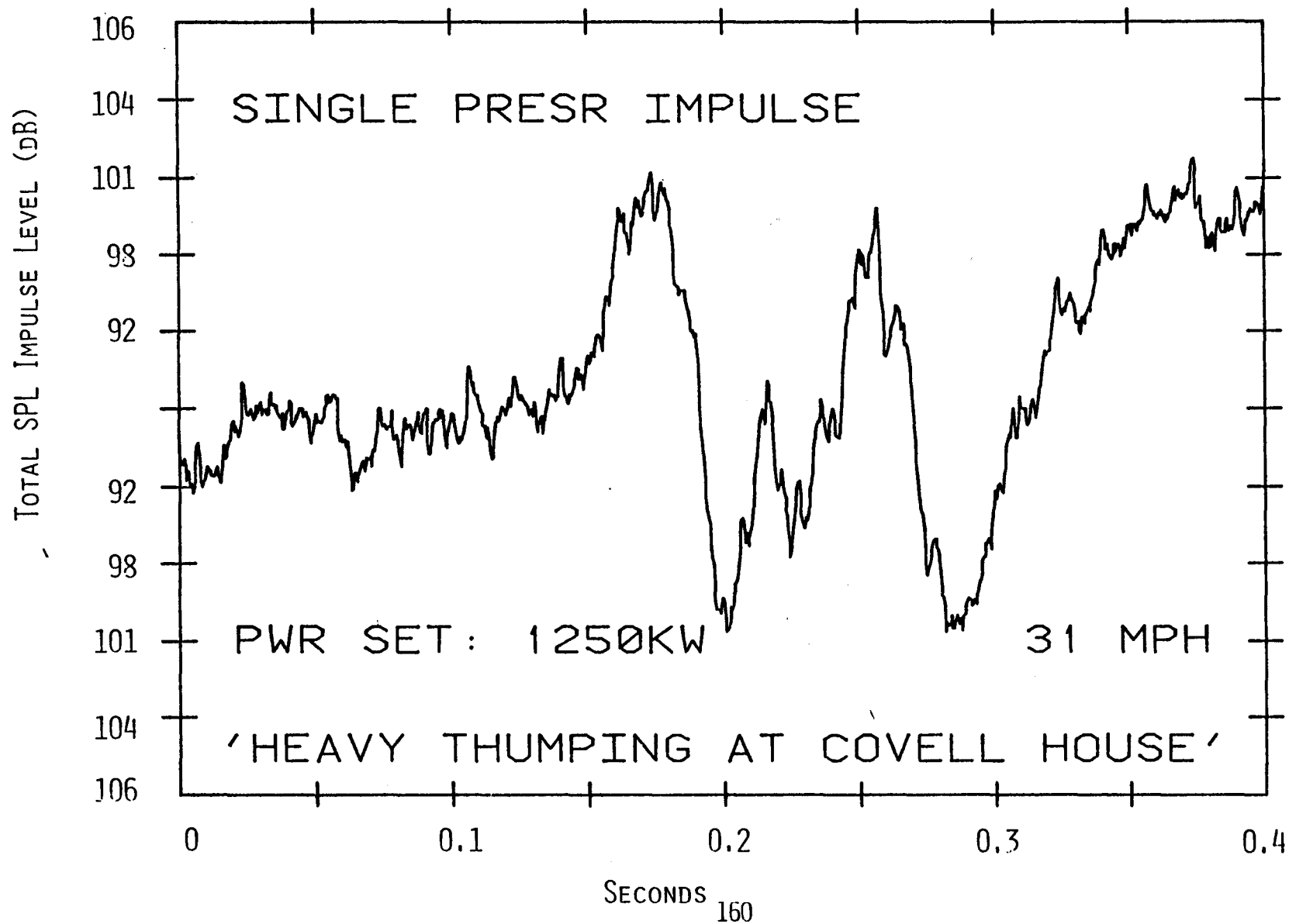
MOD-1 NOISE TESTS - MARCH 31, 1980 - NEAR FIELD DATA



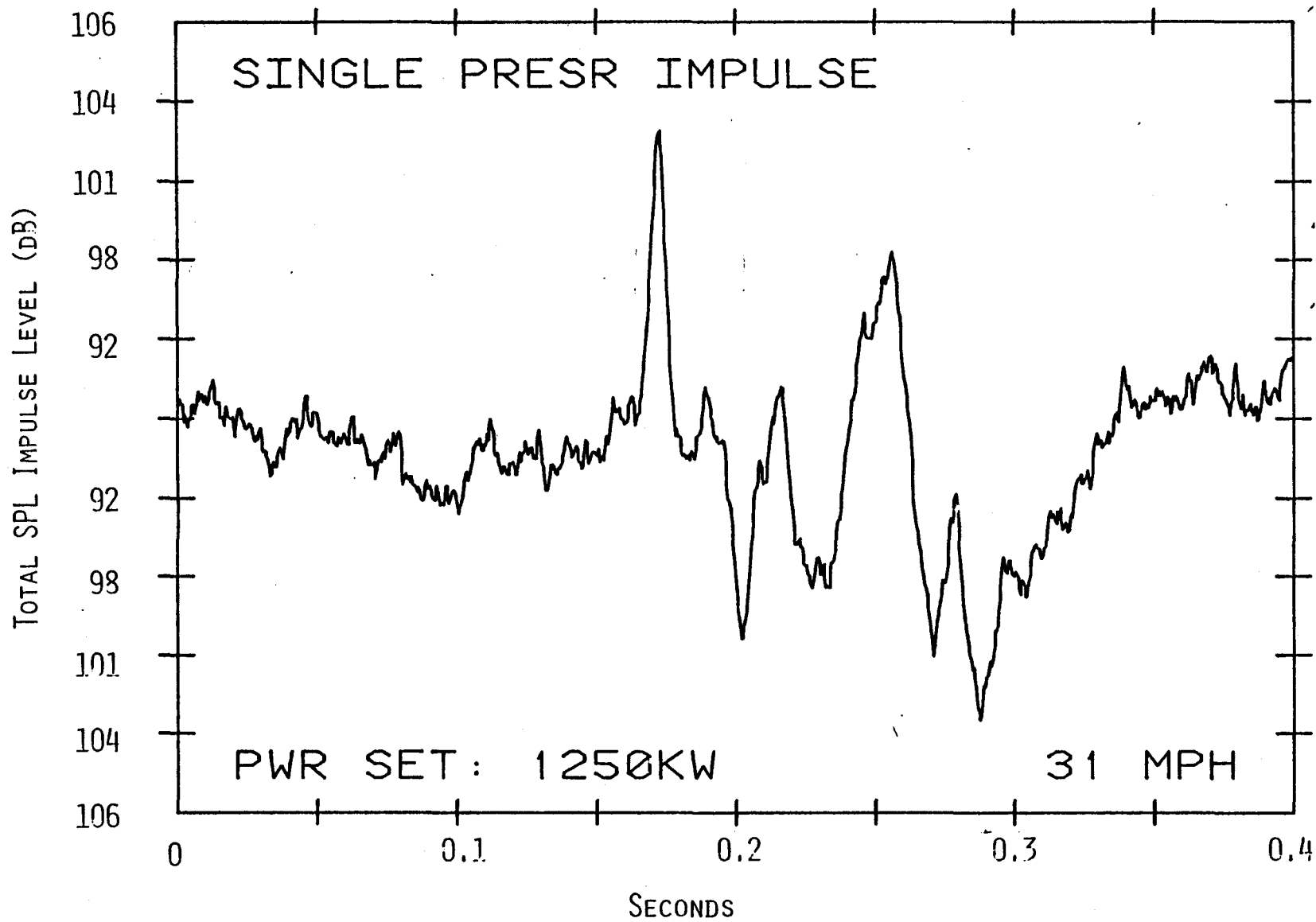
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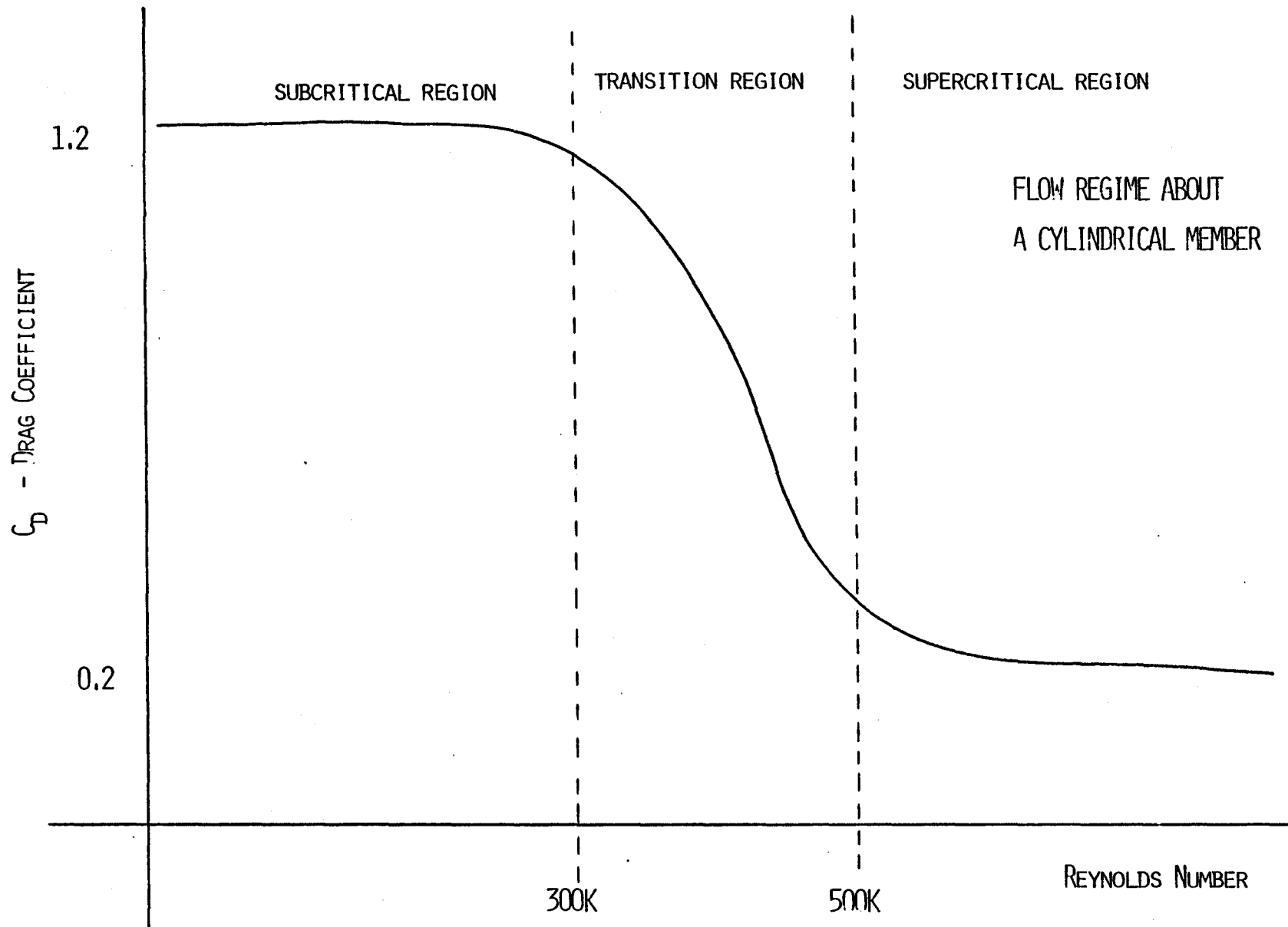
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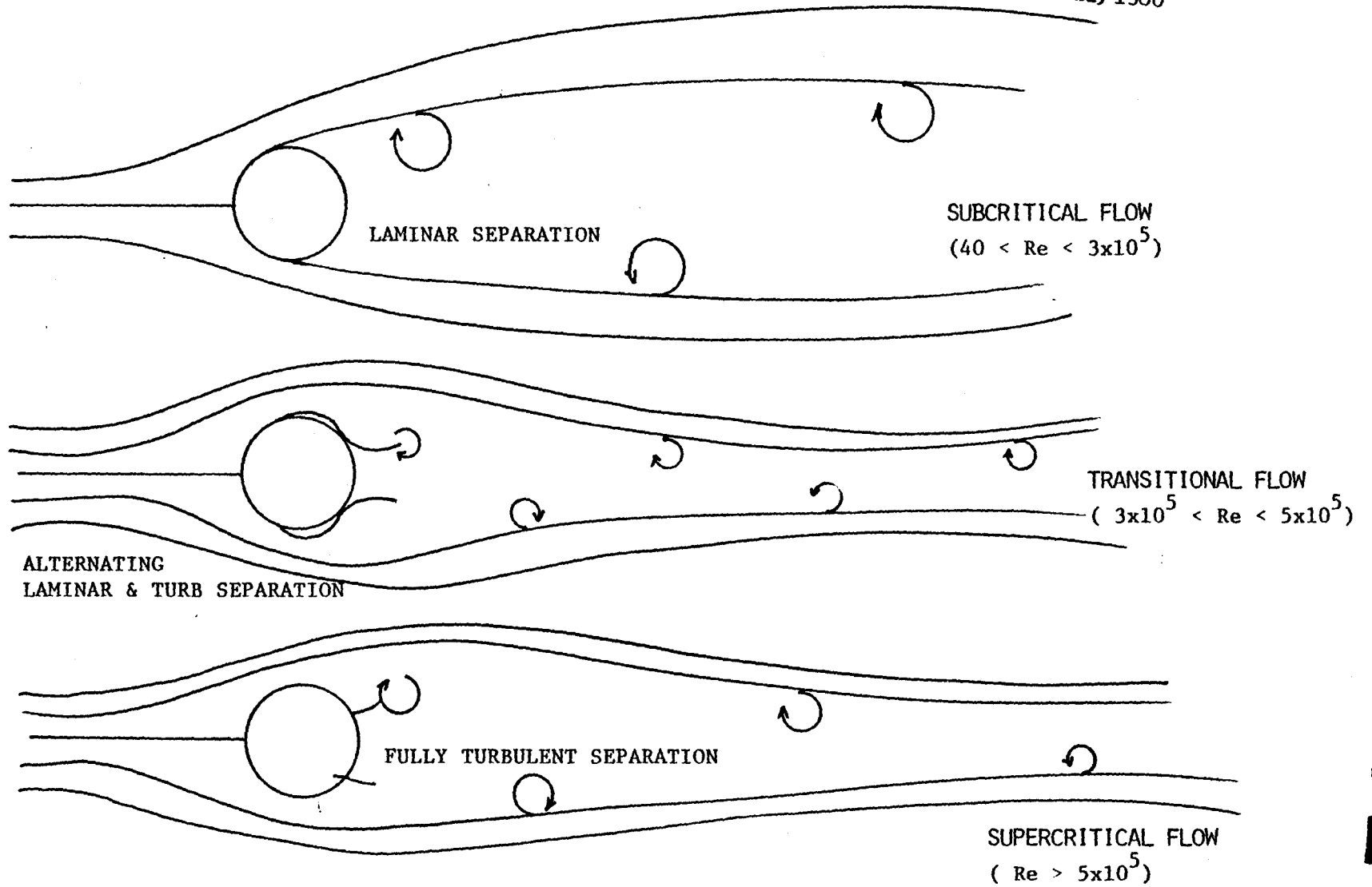


MOD-1 NOISE TESTS - MARCH 31, 1980 - NEAR FIELD DATA

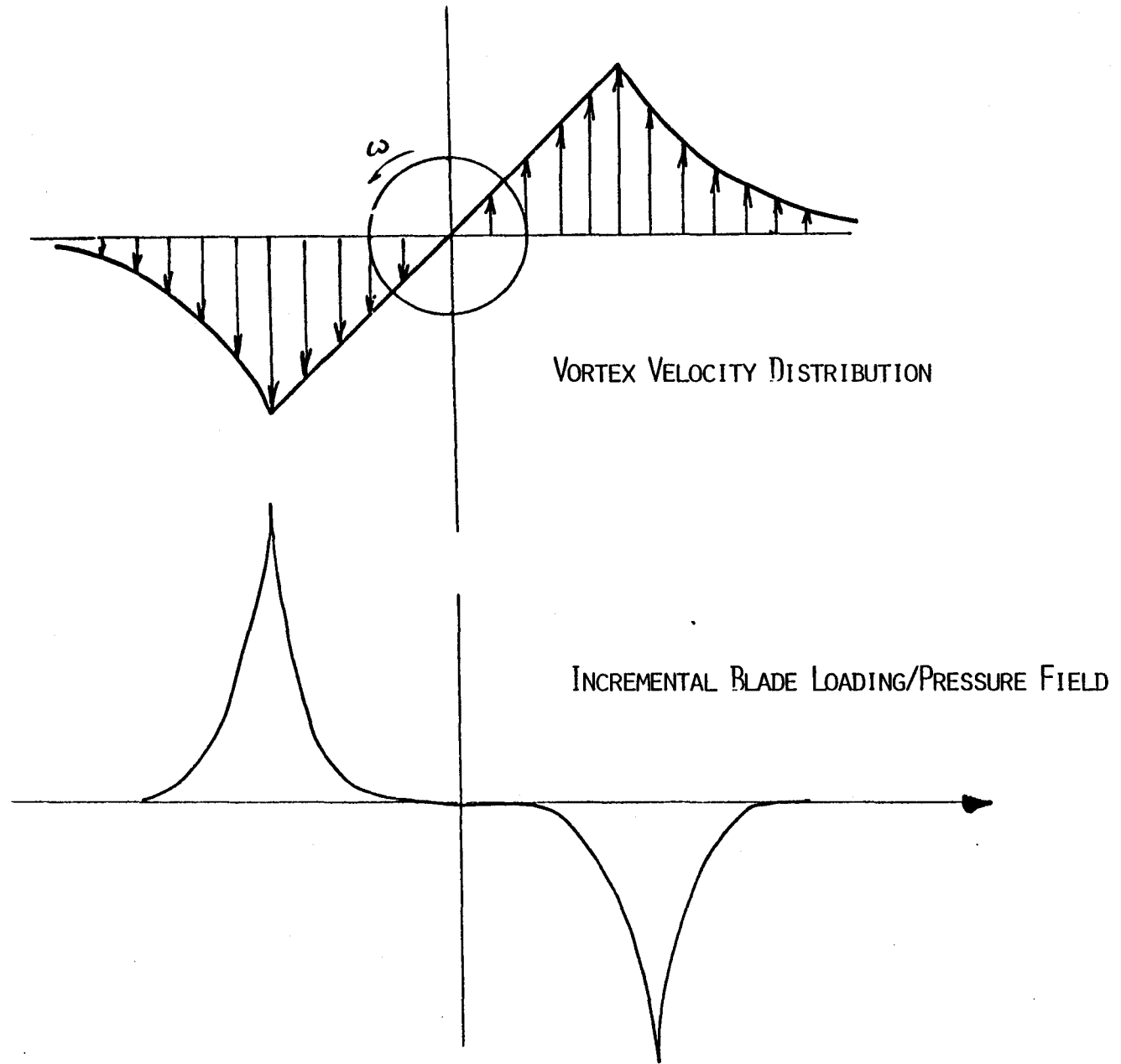


AERODYNAMIC INTERPRETATION OF  
RADIATED ACOUSTIC FIELD

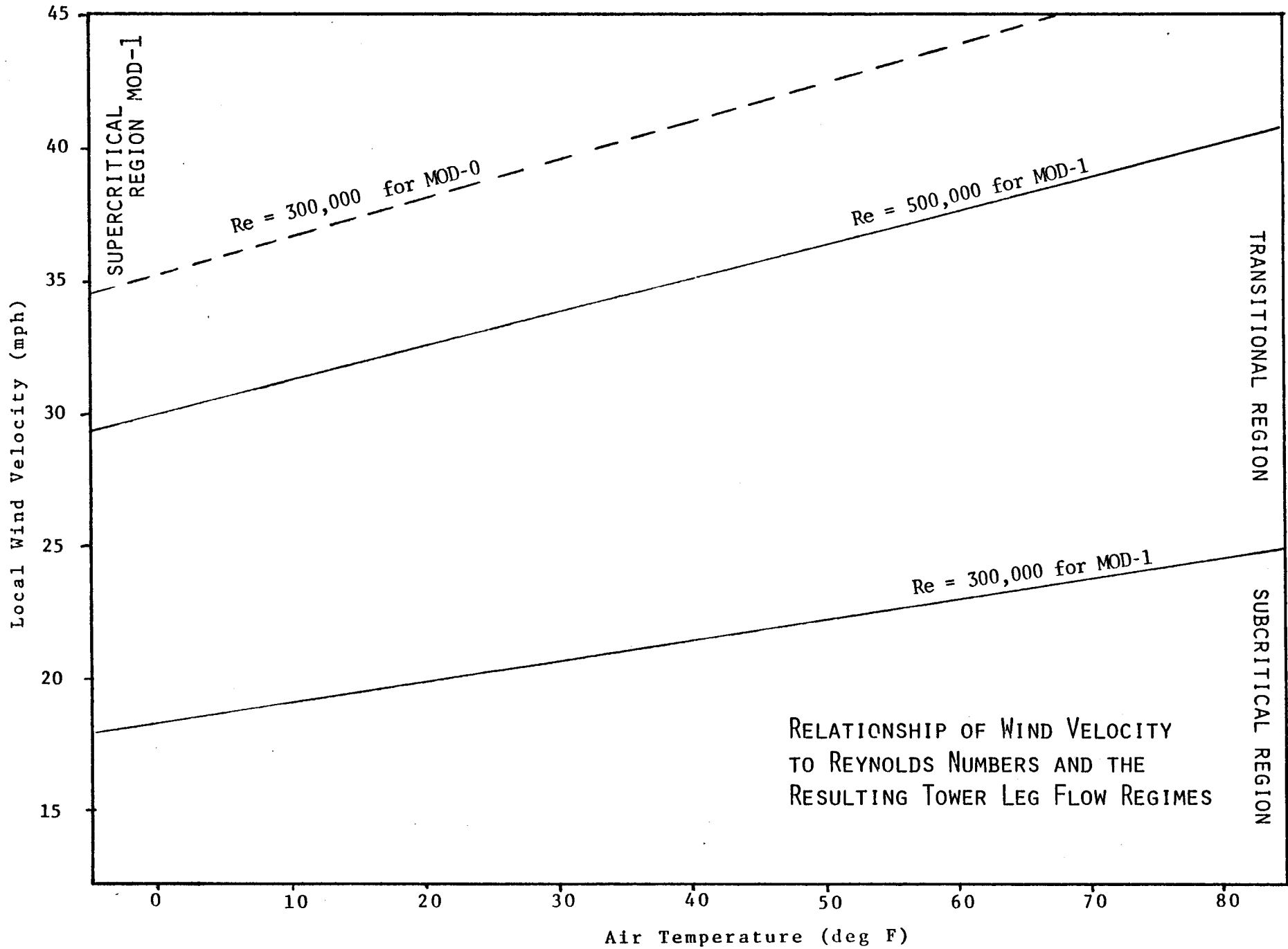




FLOW REGIMES AROUND CYLINDRICAL MEMBERS





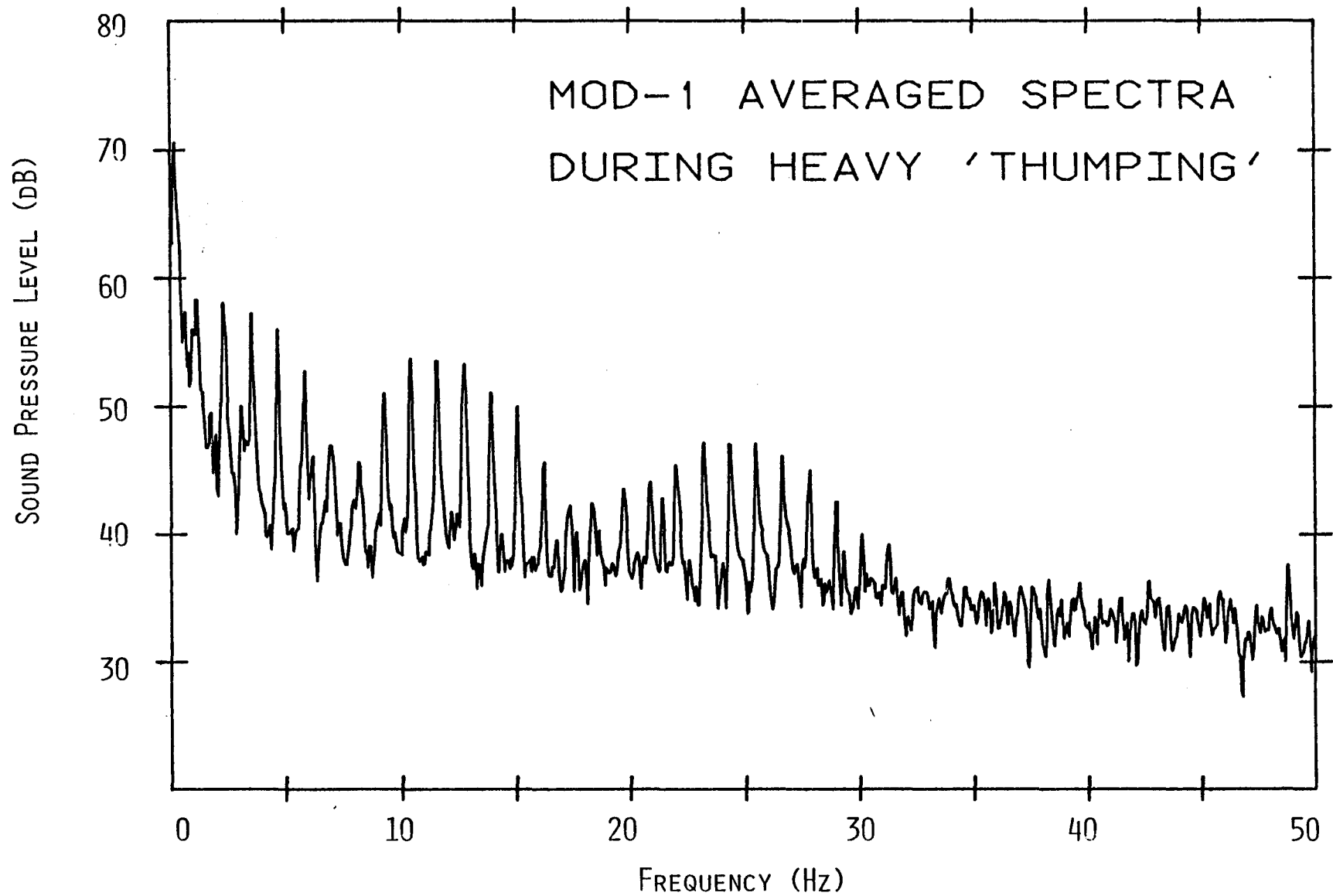


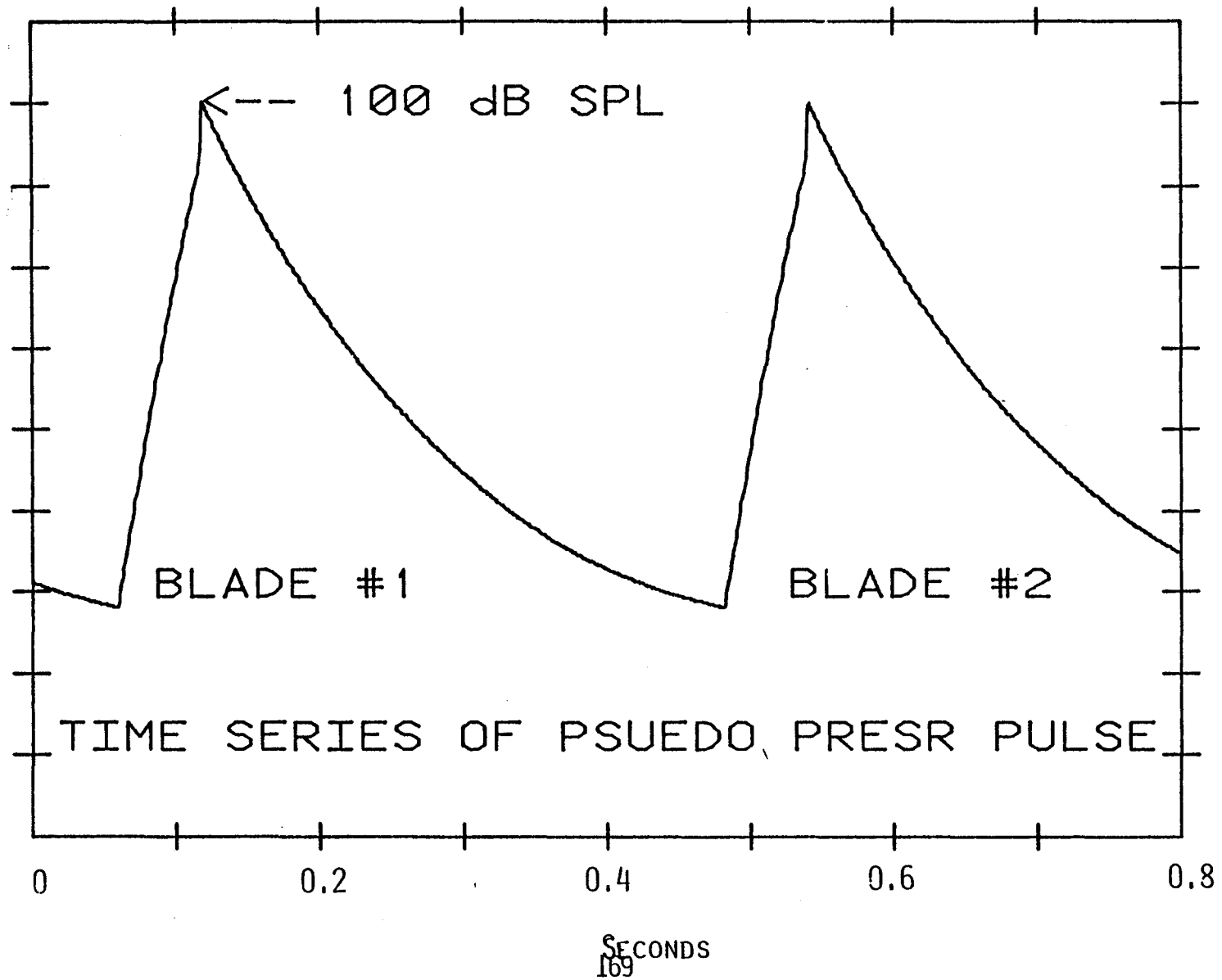
RELATIONSHIP OF WIND VELOCITY  
TO REYNOLDS NUMBERS AND THE  
RESULTING TOWER LEG FLOW REGIMES

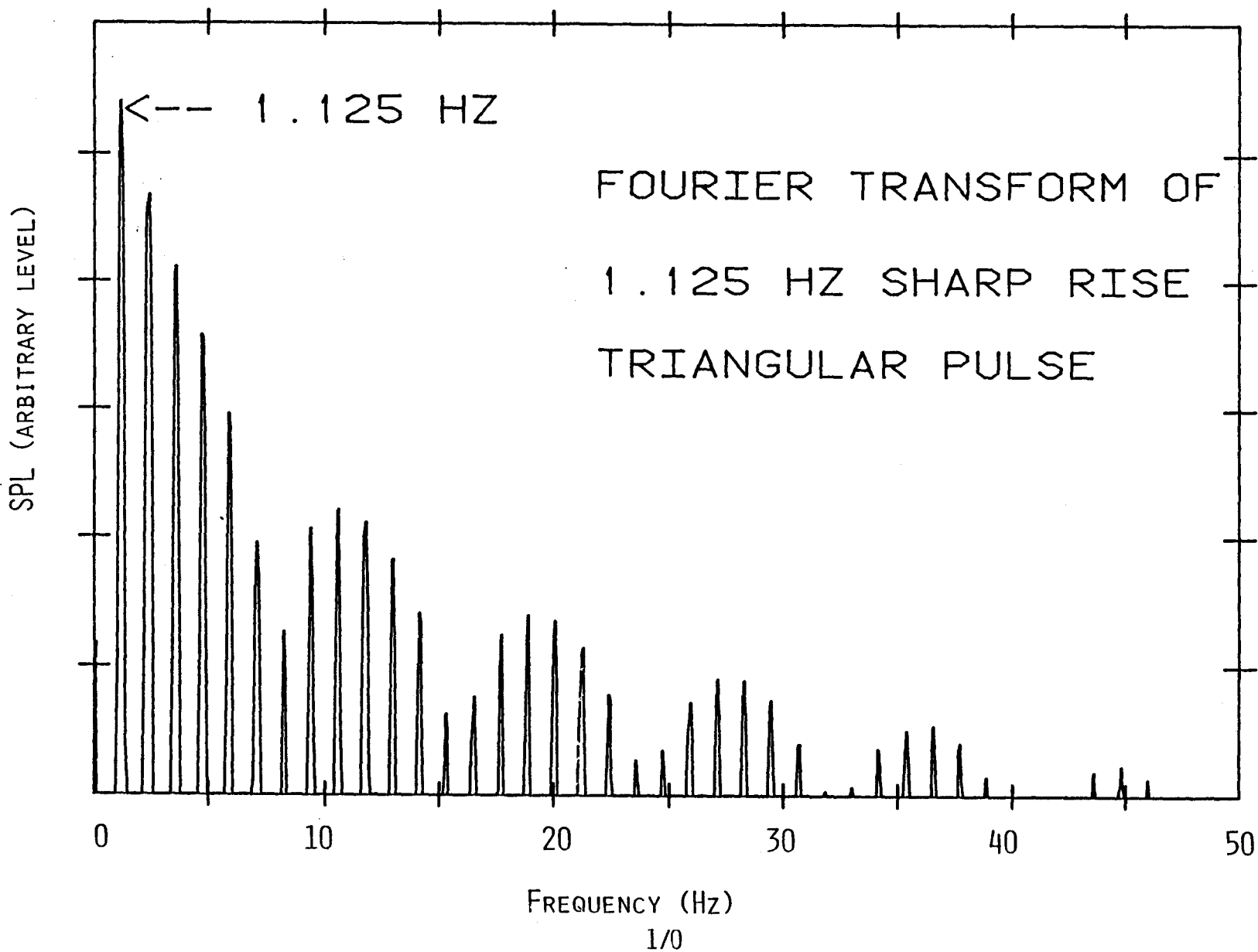
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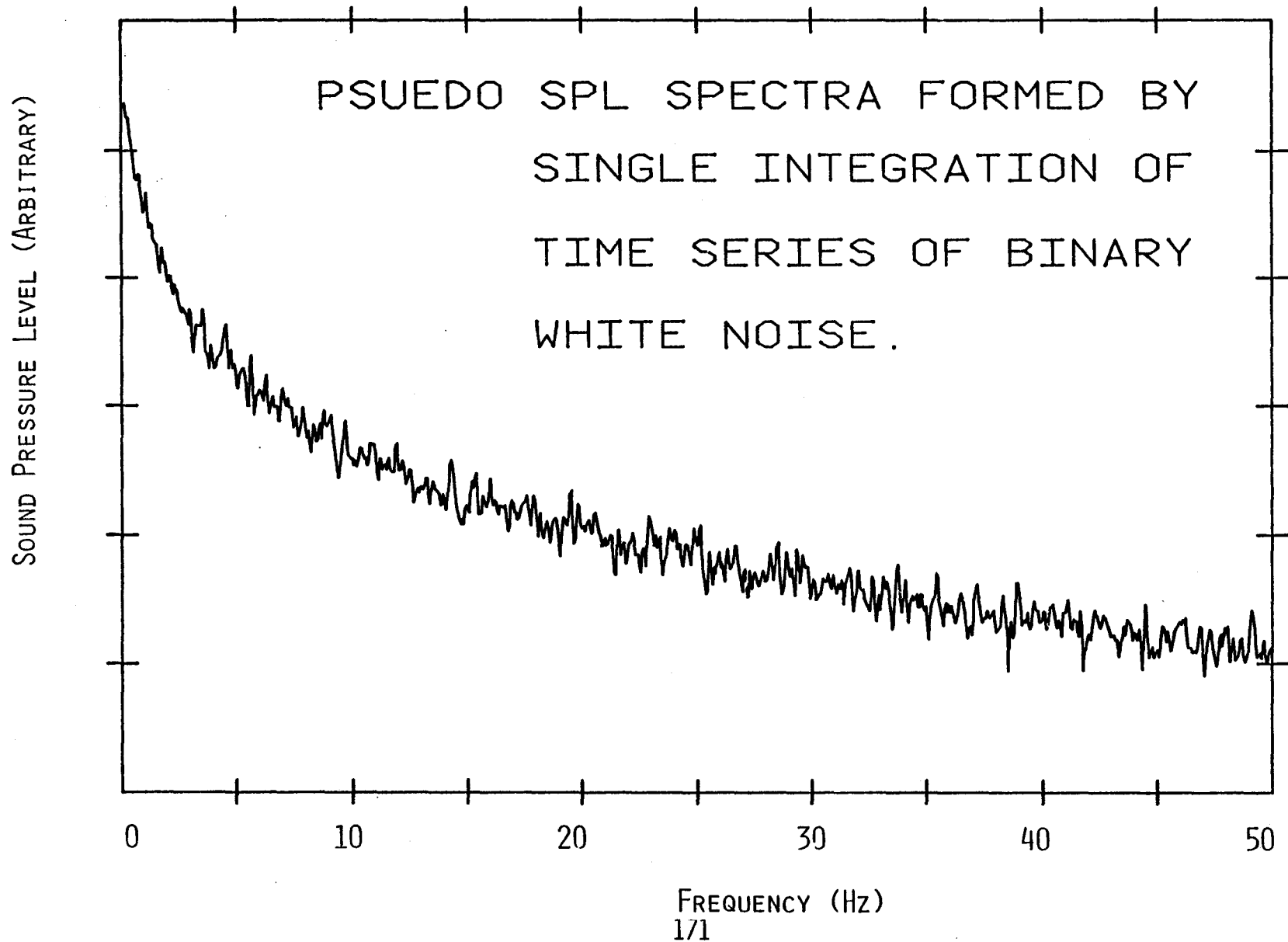
INTERPRETATION OF NEAR FIELD  
ACOUSTIC MEASUREMENTS  
IN  
FREQUENCY DOMAIN

MOD-1 NOISE TESTS - MARCH 31', 1980 - NEAR FIELD DATA

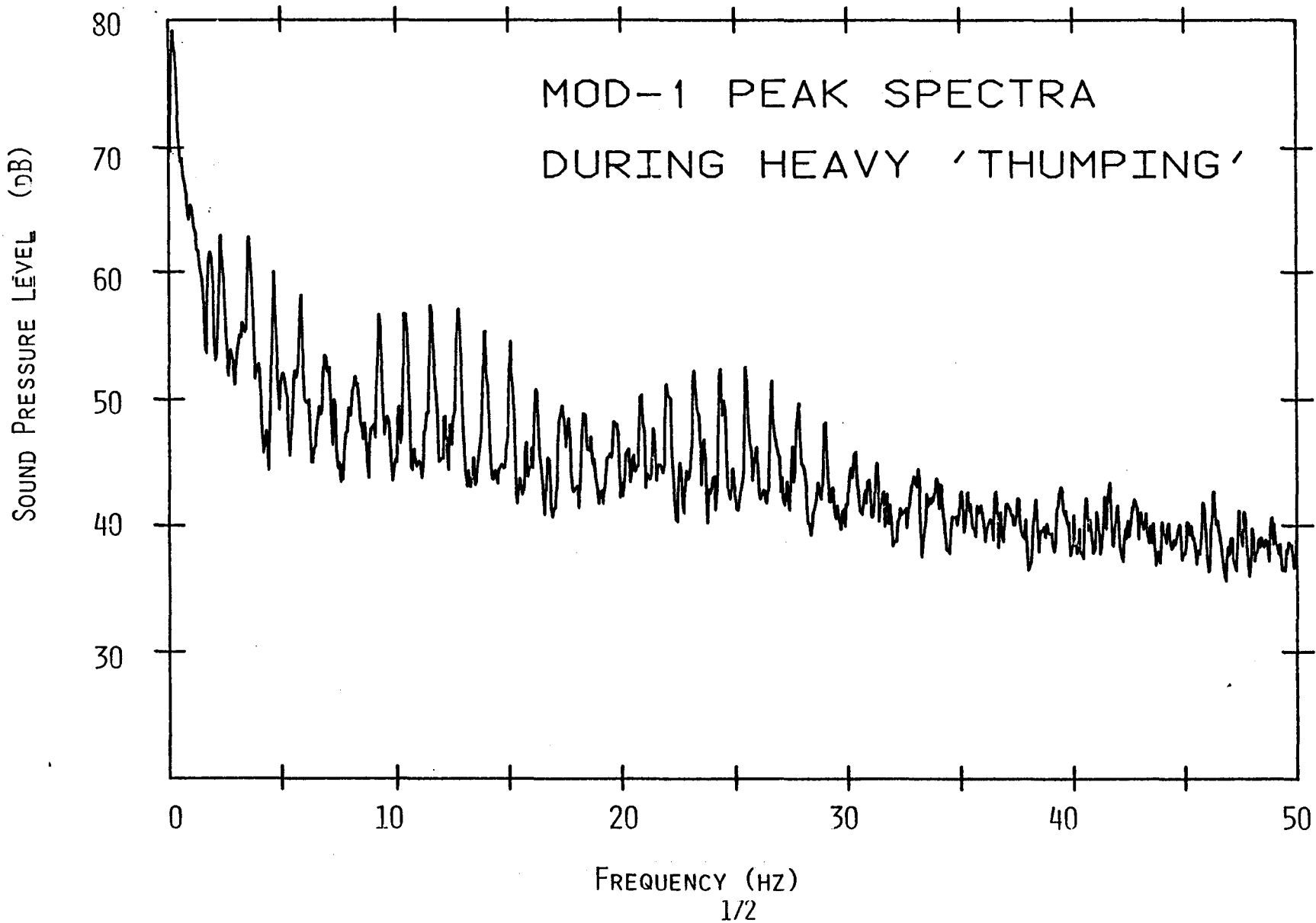








MOD-1 NOISE TESTS - MARCH 31, 1980 - NEAR FIELD

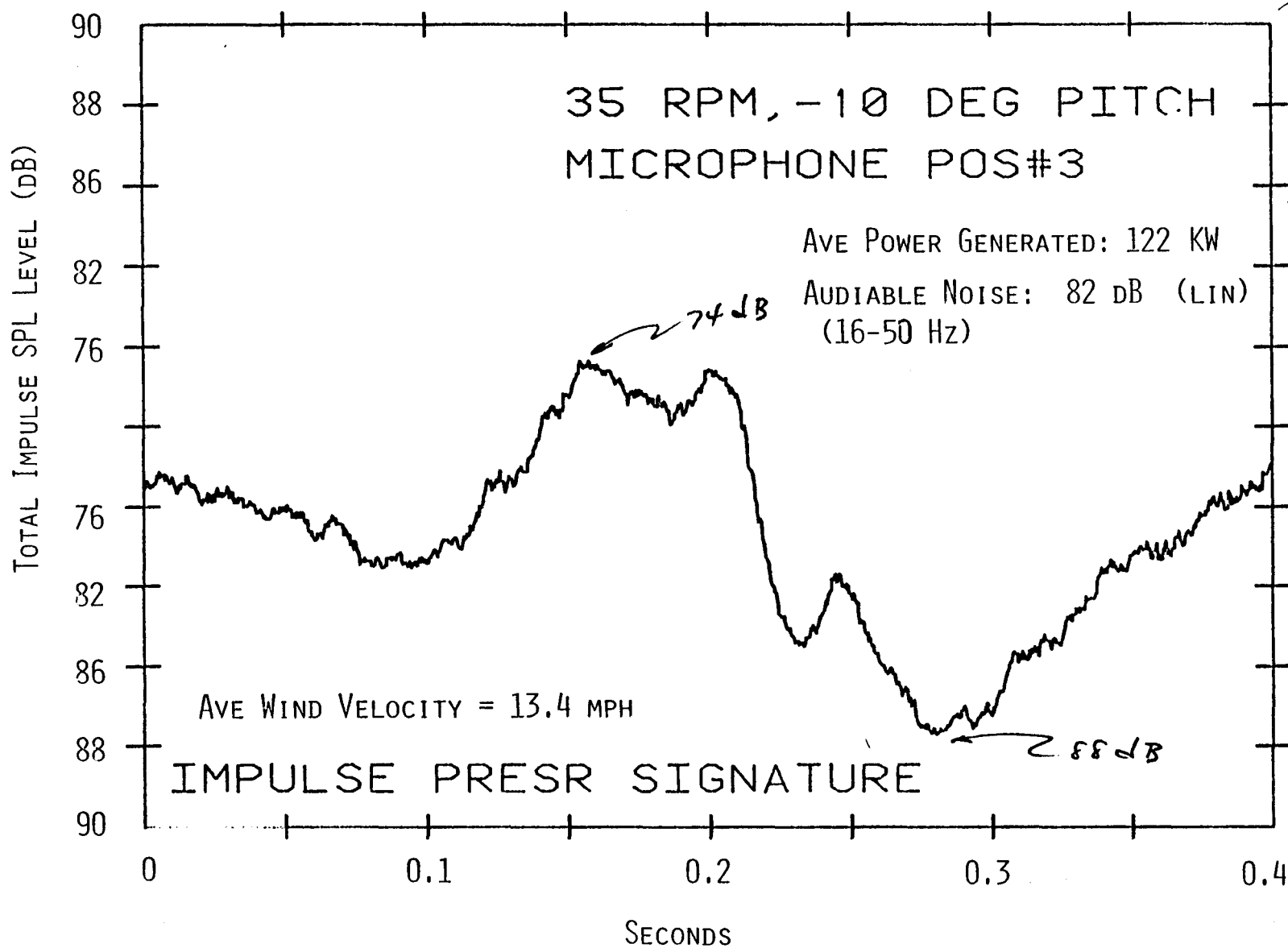


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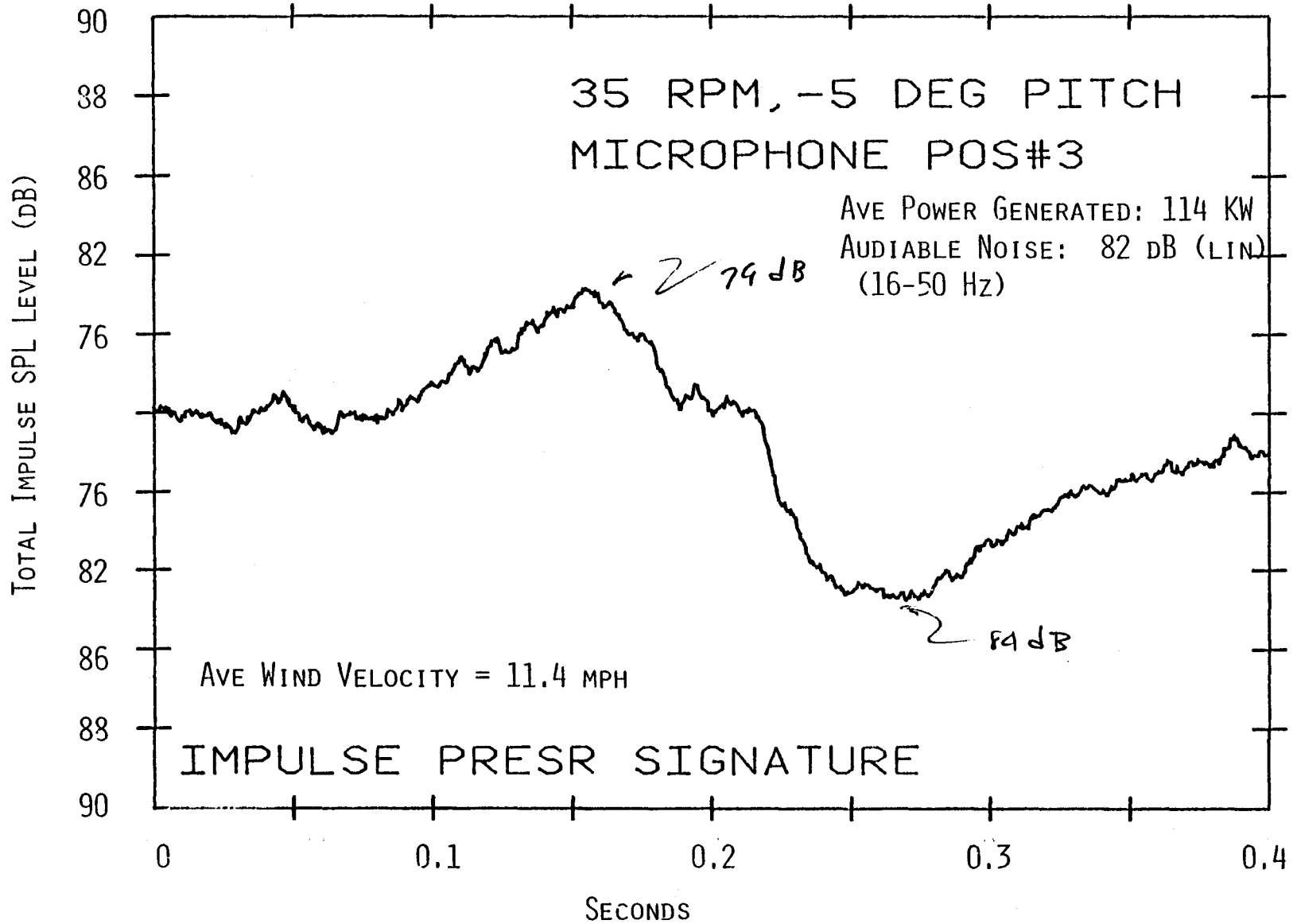
COMPARISON WITH MOD-0 RESULTS



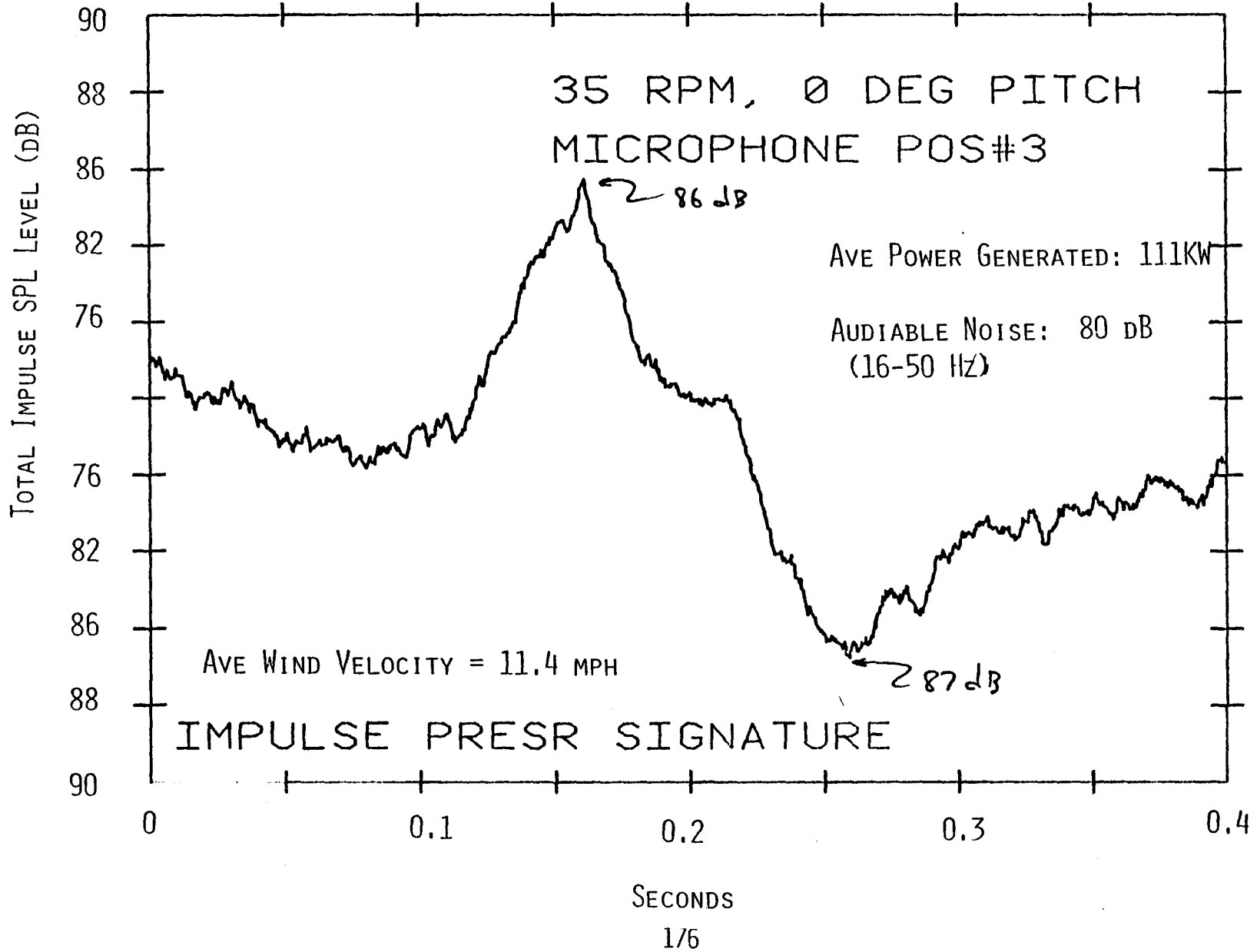
MOD-0 DOWNWIND TESTS - APRIL 27, 1980

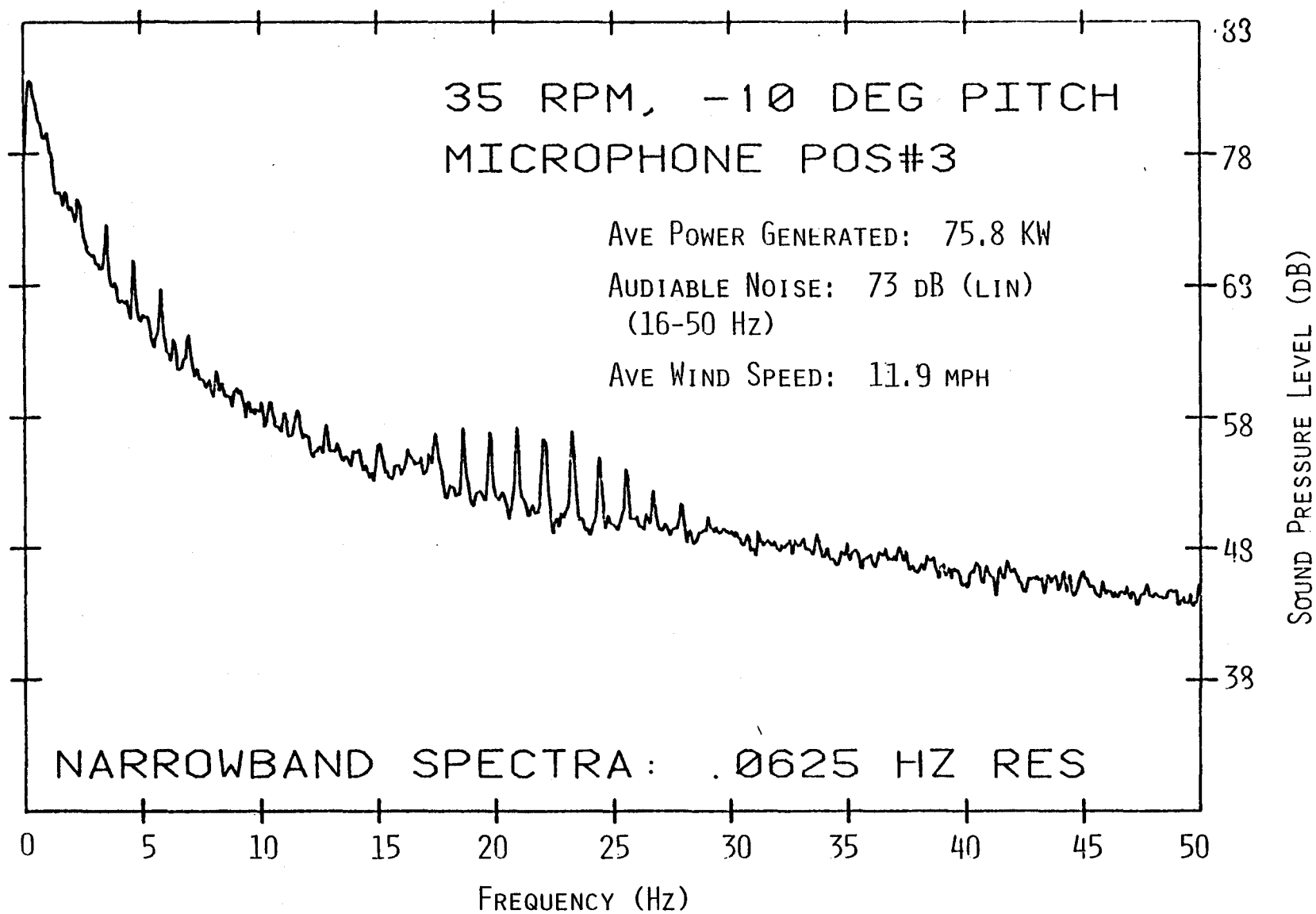


MOD-0 DOWNWIND TESTS - APRIL 27, 1980

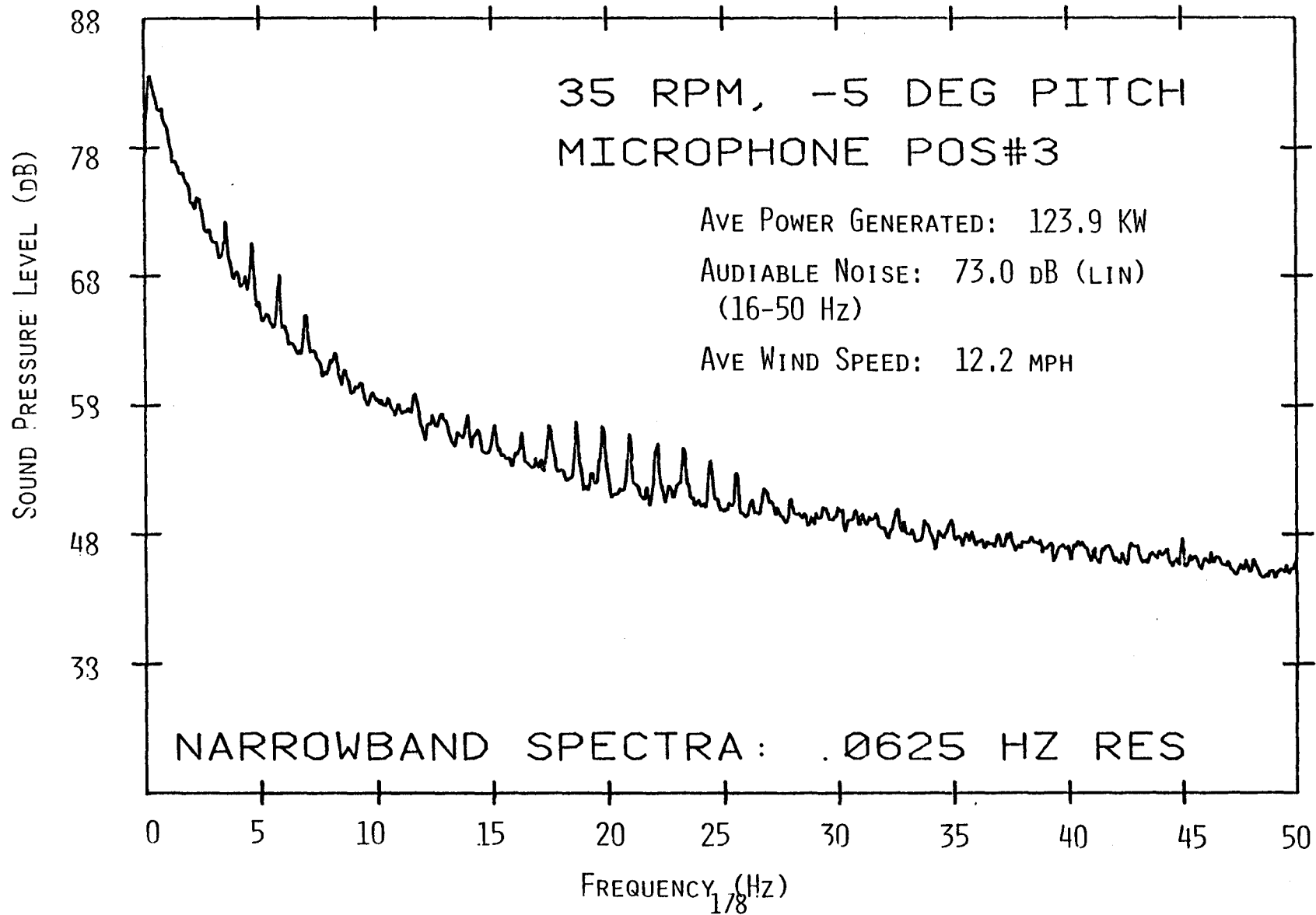


MOD-0 DOWNWIND TESTS - APRIL 27, 1980



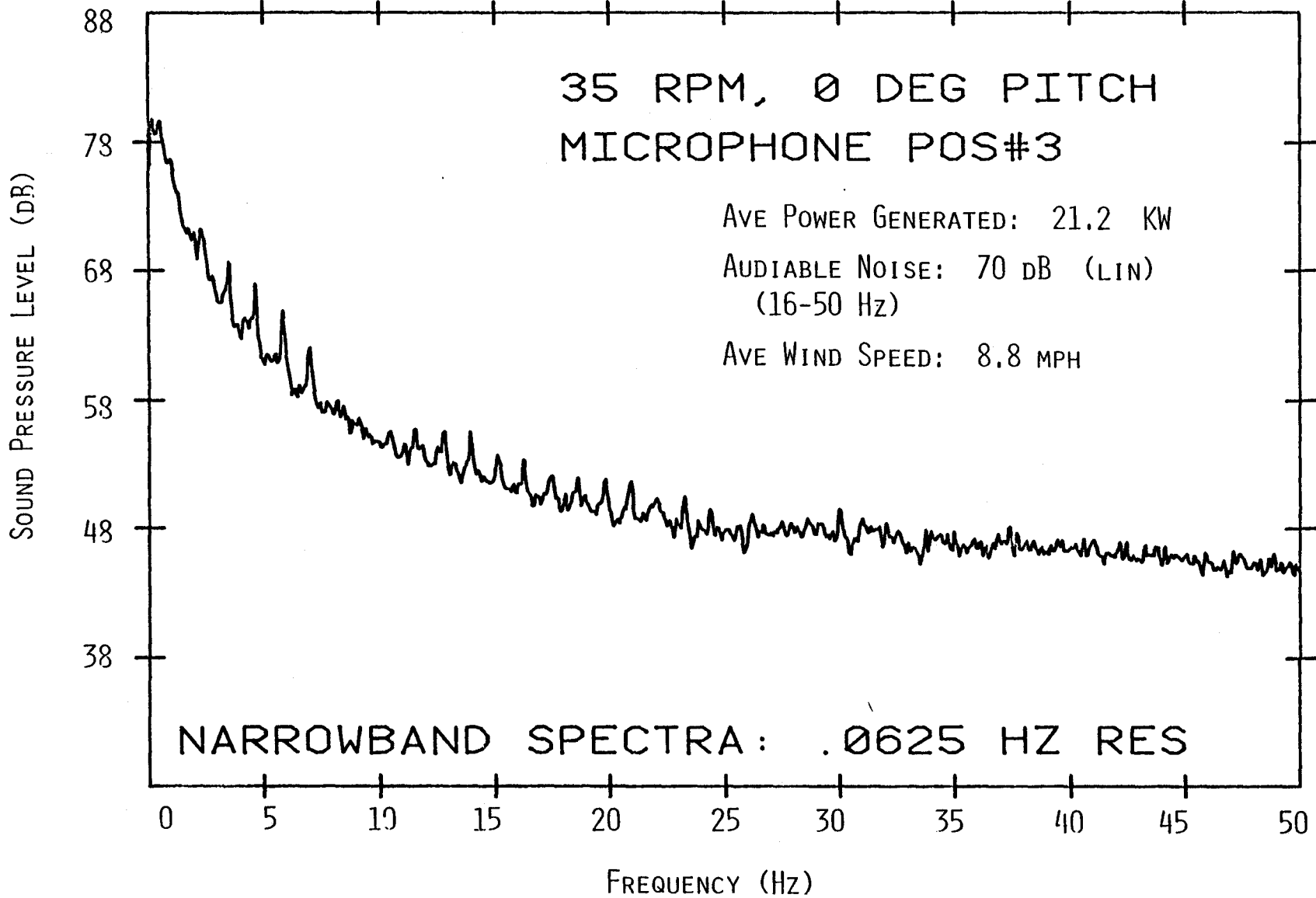


MOD-0 DOWNWIND TESTS - APRIL 27, 1980



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MOD-0 DOWNWIND TESTS - APRIL 27, 1980

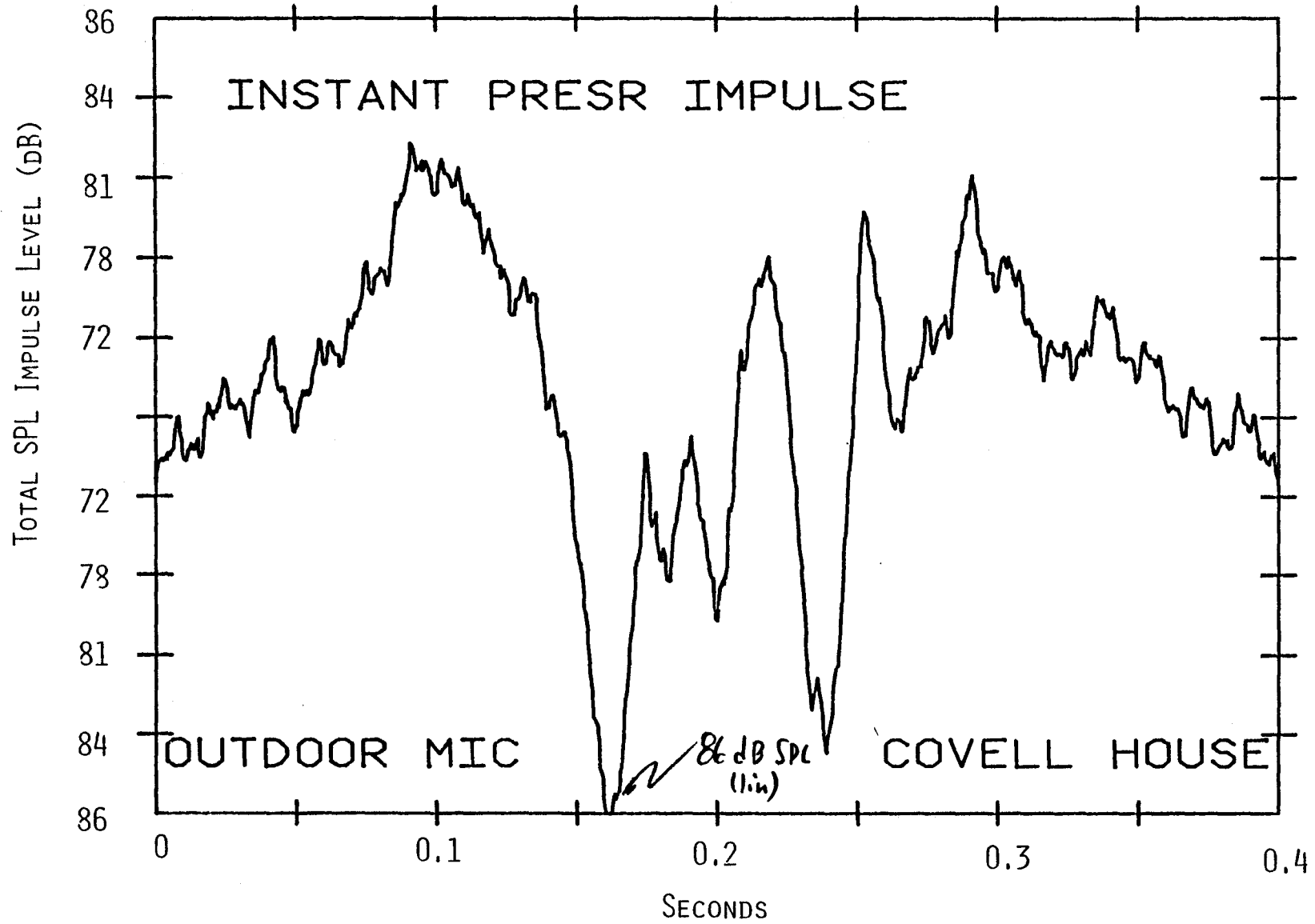


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CONSEQUENCES IN FAR FIELD

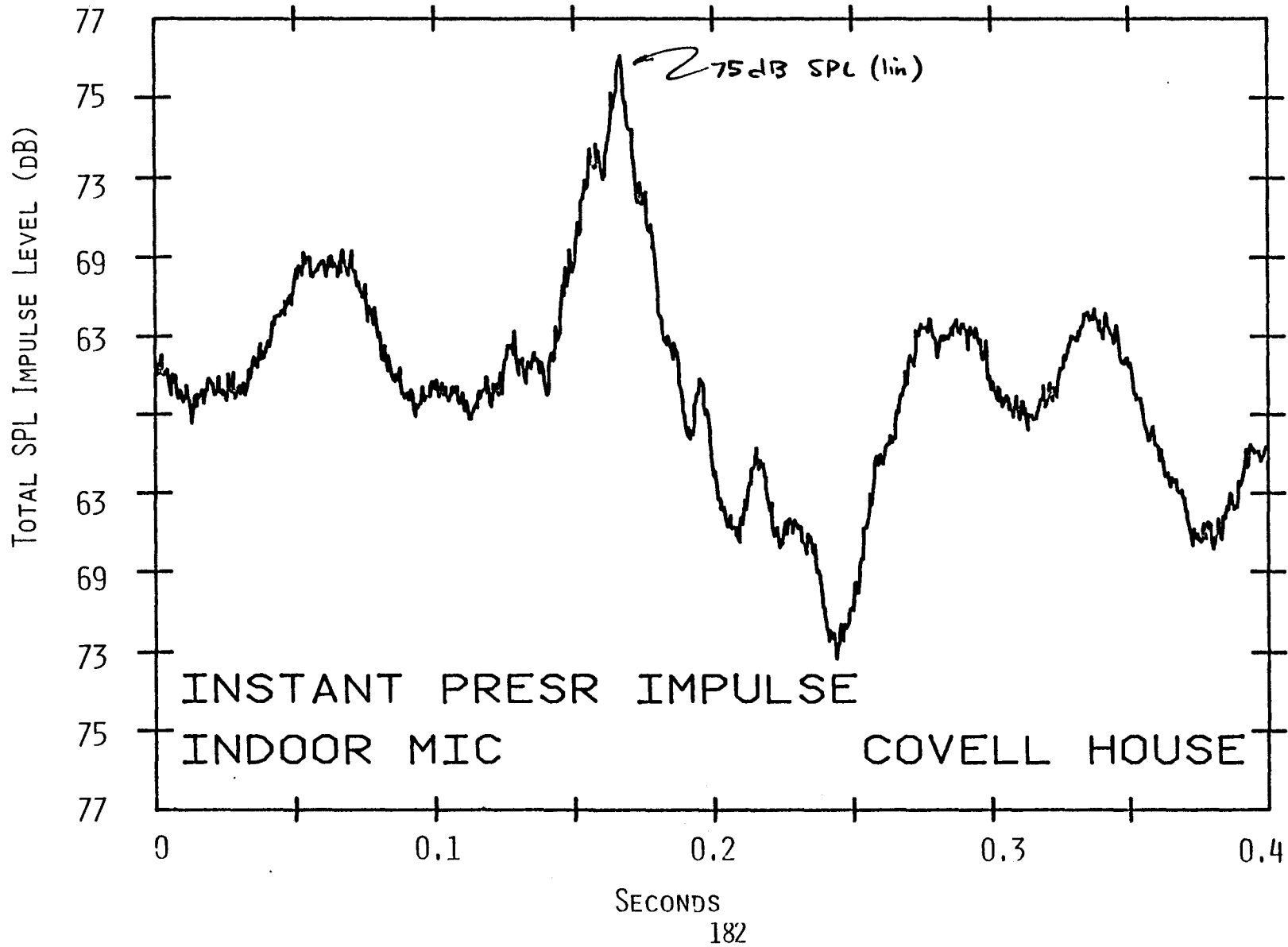
MEASUREMENTS AT COVELL RESIDENCE, BOONE, NC

MOD-1 NOISE TESTS - MARCH 31, 1980 - FAR FIELD DATA

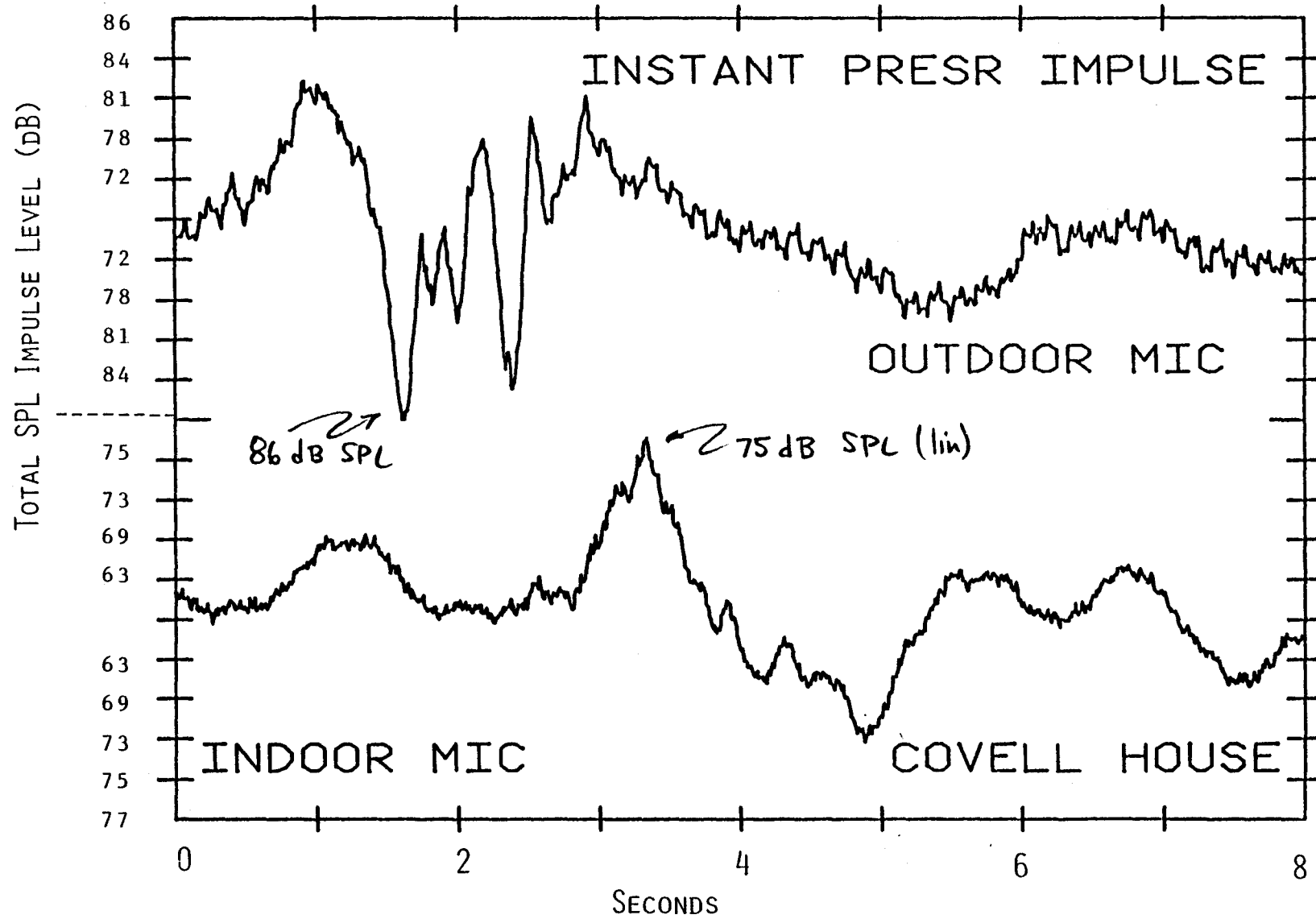




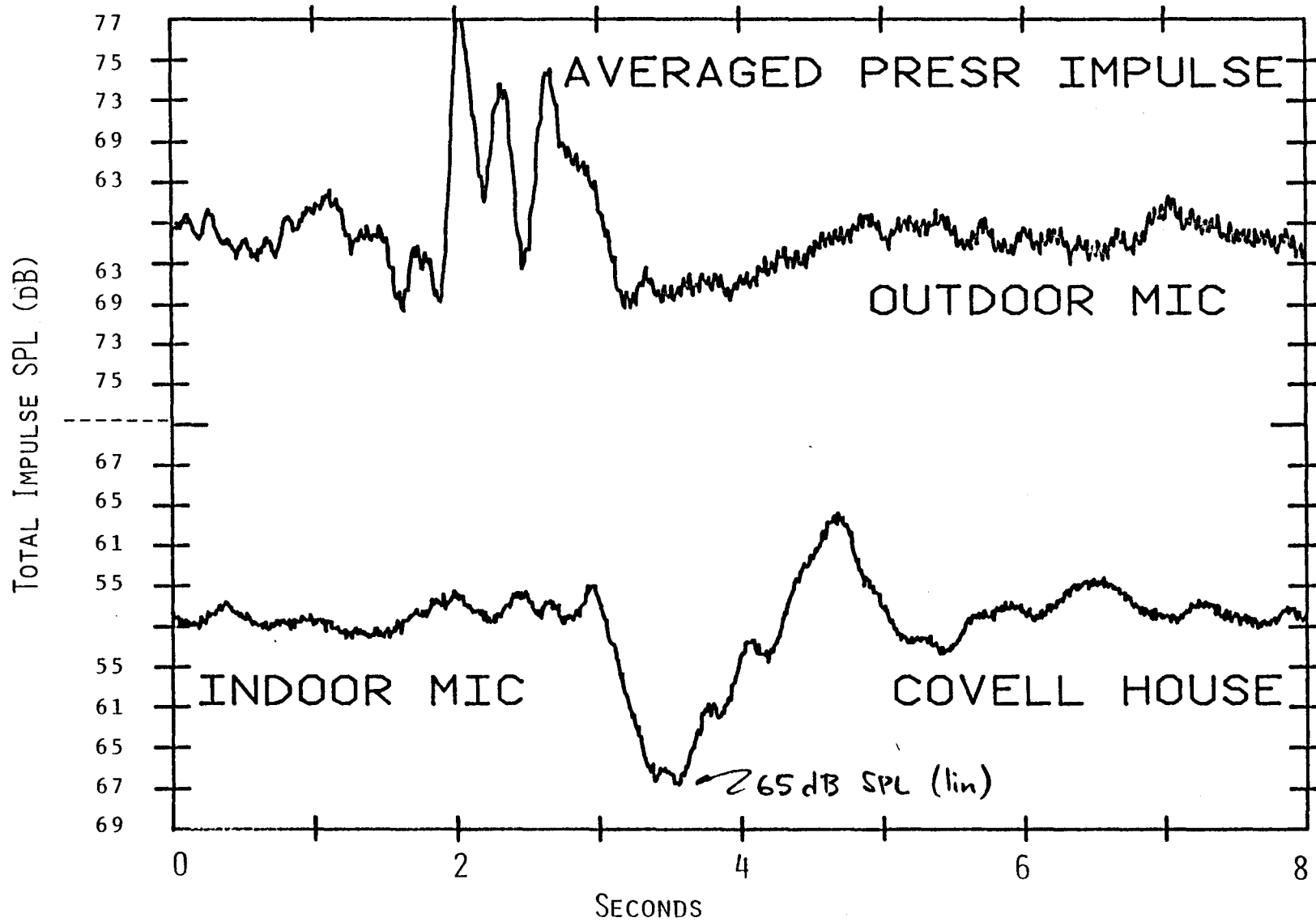
MOD-1 NOISE TESTS - MARCH 31, 1980 - FAR FIELD DATA



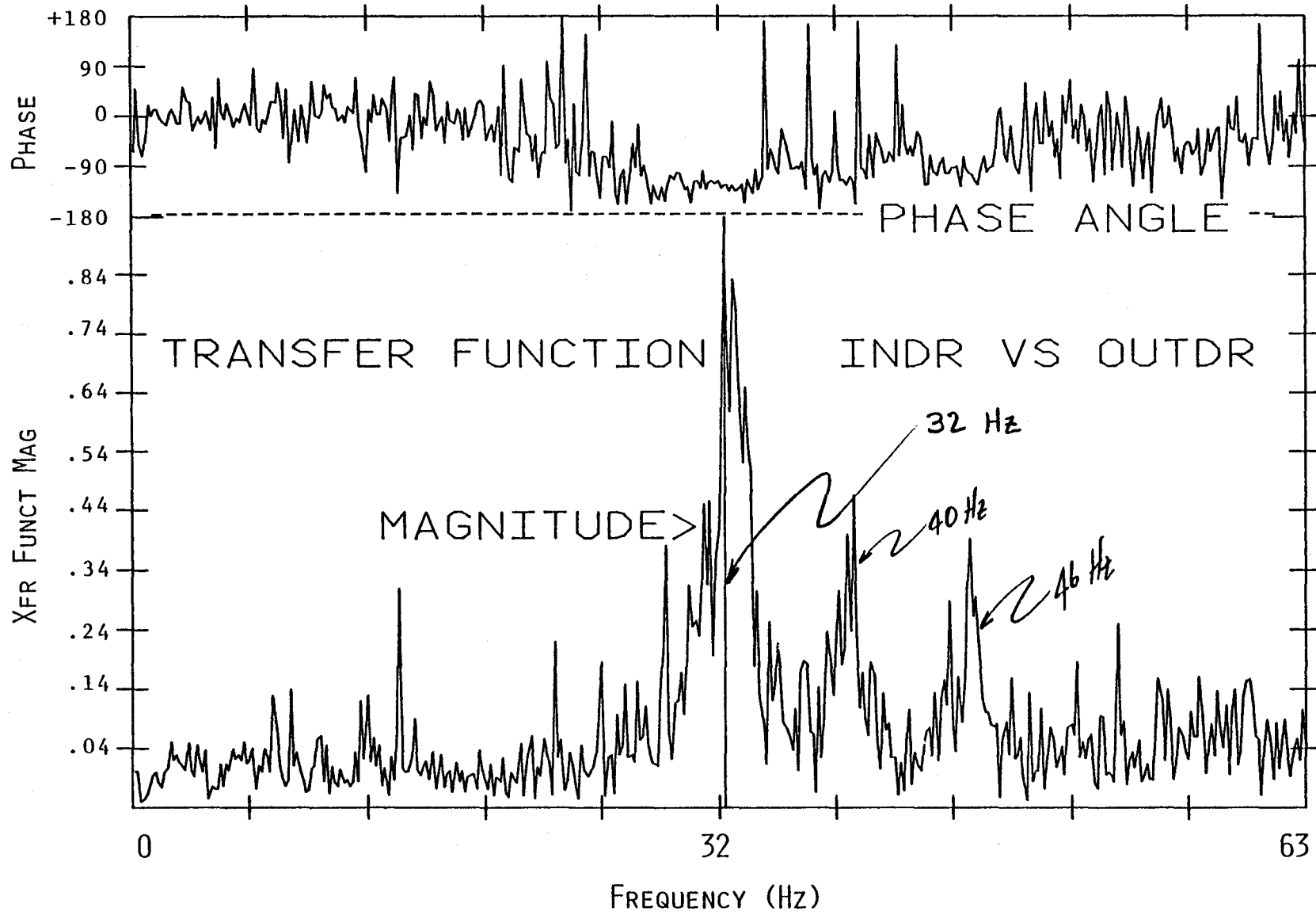
MOD-1 NOISE TESTS - MARCH 31, 1980 - FAR FIELD



MOD-1 NOISE TESTS - MARCH 31, 1980 - FAR FIELD DATA



MOD-1 NOISE TESTS - MARCH 31, 1980 - FAR FIELD DATA



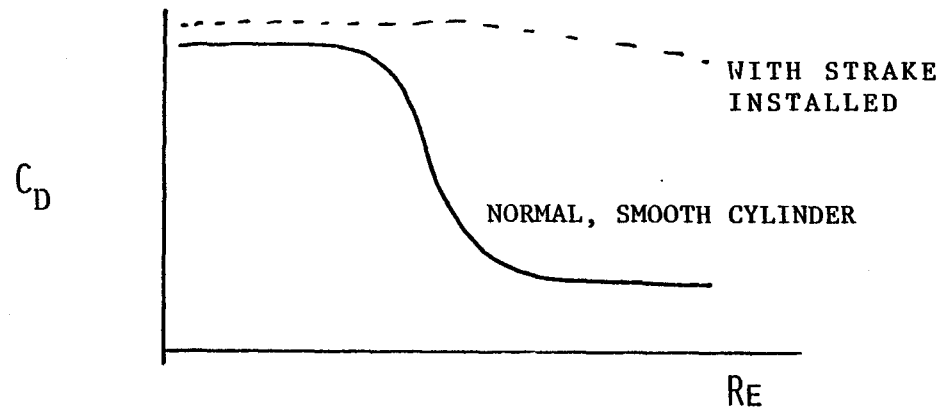
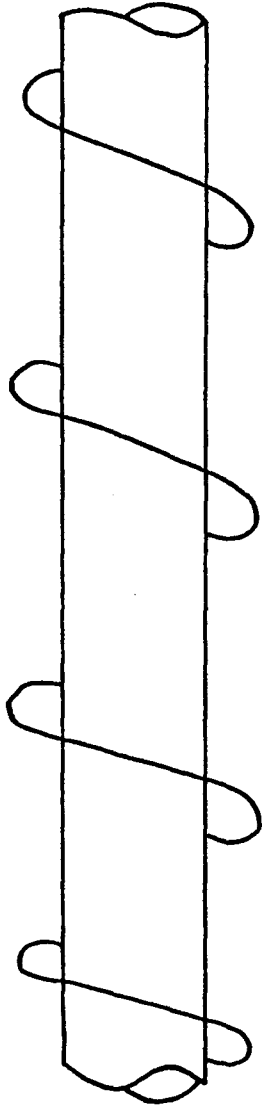
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ONE POSSIBLE SOLUTION

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## HELICAL STRAKE SPOILER DEVICE

PROMOTES COMPLETE TURBULENT  
SEPARATION TO OCCUR AND THUS  
INCREASES DRAG WHILE BREAKING  
UP HIGHLY COHERENT SHEAR VORTICES.



## SUMMARY

THE PRELIMINARY ANALYSES OF MOD-1 AND MOD-0 ACOUSTIC DATA TAKEN IN DOWNWIND CONFIGURATIONS INDICATE THE SO-CALLED "TOWER SHADOW" IS ACTUALLY COMPOSED OF SEVERAL COMPLEX WAKE FLOWS WHOSE CHARACTER DEPENDS ON THE SHAPE AND DIAMETER OF UPSTREAM STRUCTURAL ELEMENTS (LEGS AND CROSS MEMBERS). WHEN THESE FLOWS ARE OPERATING WITHIN THE TRANSITION REGION OF FLOW SEPARATION AND WHEN COUPLED WITH A HIGH RELATIVE BLADE VELOCITY, AS IS THE CASE WITH THE MOD-1, FORM STRONG PRESSURE OR ACOUSTIC PULSES AS THE BLADE CUTS THROUGH THE SHED VORTICES BY CAUSING A RAPID READJUSTMENT IN THE BLADE LOADING PRESSURE FIELD.

A LOWERING OF THE MOD-1 RPM WITHOUT OTHER MEASURES NOW SEEMS TO BE A STEP IN THE RIGHT DIRECTION BUT IT ALSO APPEARS THIS ALONE WILL NOT BE SUFFICIENT TO ENSURE A REDUCTION IN THE IMPULSES BELOW ANNOYANCE LEVEL UNDER ALL CONDITIONS. IT IS SUGGESTED SOME FORM OF A SPOILER DEVICE, SUCH AS THE HELICAL STRAKE, BE INSTALLED ON THE TOWER LEGS WHICH ARE UPSTREAM OF AT LEAST 50% OF THE BLADE SPAN. THE PURPOSE OF SUCH A DEVICE WILL BE TO FORCE THE TRANSITIONAL FLOW ASSOCIATED WITH THE 20 INCH DIAMETER LEGS INTO FULLY TURBULENT, RANDOM SHED EDDIES AND THEREFORE REMOVING THE PERIODIC SOURCE.

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PART III

TASK PLANNING



QUESTIONS THAT NEED ANSWERS FOR WECS PLANNING AND SITING PURPOSES . . .

1. WHAT TYPE OF NOISE IS GENERATED BY A GENERIC TYPE OF WECS OR A SERIES OF WECS? WHAT IS ITS FREQUENCY CONTENT? ARE THE NOISE AMPLITUDES RANDOM, SINUSOIDAL, OR IMPULSIVE? WHAT LEVELS ARE PRODUCED? IS THE NOISE PERIODIC OR APERIODIC?
2. WHAT DESIGN AND OPERATING PARAMETERS ARE RESPONSIBLE FOR NOISE GENERATION AND HOW CAN SUCH GENERATION BE PREDICTED AND THE RESULTING LEVELS BE MINIMIZED? IN THE DESIGN PHASE? IN TURBINE OPERATION? IN RETROFIT?
3. WHAT CURRENT OR PROPOSED LOCAL, STATE, AND FEDERAL (EPA) NOISE ORDINANCES MAY INCLUDE WECS-GENERATED NOISE?
4. HOW DOES WECS NOISE AFFECT SURROUNDING COMMUNITIES? WHAT ARE THE PSYCHOACOUSTIC EFFECTS ON LOCAL RESIDENTS NEAR A LARGE WECS INSTALLATION?
5. GIVEN A SPECIFIC WECS NOISE CHARACTERISTIC, WHAT ARE THE PARAMETERS WHICH CONTROL THE AERIAL EXTENT OF NOISE THAT MAY REACH ANNOYANCE LEVELS?
6. WHAT SITING CRITERIA SHOULD BE INVOKED IN PLANNING FOR A GIVEN WECS INSTALLATION IN ORDER TO MINIMIZE LAND USAGE?

TASK PLANNING . . .

OVERALL OBJECTIVES

1. ESTABLISH AND VALIDATE A SUITABLE NOISE PREDICTION METHODOLOGY FOR BOTH SINGLE AND MULTIPLE WECS INSTALLATIONS WHICH WILL BE UTILIZED AS A TOOL FOR THE FUTURE SITING OF WIND TURBINES.
  
2. ESTABLISH THE PARAMETERS CONTROLLING THE GENERATION, PROPAGATION, AND COMMUNITY ANNOYANCE OF WECS-GENERATED SOUND AND WHAT STEPS ARE AVAILABLE FOR IMPACT MINIMIZATION IN BOTH THE DESIGN PHASE AND AS RETROFITS.

A PROPOSED SERI/NASA PROGRAM TO ADDRESS THESE QUESTIONS . . .

SERI

1. DEVELOP INSTRUMENTATION AND DATA REDUCTION TECHNIQUES TO DETERMINE THE CHARACTERISTICS OF WECS-GENERATED NOISE; I.E., TIME-PRESSURE SIGNATURES, FREQUENCY CONTENT, ACOUSTIC POWER LEVELS, DIRECTIVITY FACTORS. ESTABLISH A DATA BANK OF SUCH INFORMATION FOR A RANGE OF GENERIC WECS DESIGN TYPES. (FY80) (SERI)
2. ESTABLISH DESIGN AND OPERATIONAL PARAMETERS RESPONSIBLE FOR NOISE GENERATION AND DETERMINE SUITABLE SCALING PARAMETERS FOR PREDICTING ACOUSTIC OUTPUT. (FY80-81) (SERI/SC)
3. STUDY AND EVALUATE ENVIRONMENTAL PARAMETERS CONTROLLING THE PROPAGATION OF WECS SOUND IN ORDER TO ESTABLISH SPATIAL LIMITS FOR POTENTIAL COMMUNITY ANNOYANCE. (FY81) (SC)
4. IDENTIFY AND VALIDATE SUITABLE NOISE PREDICTORS AND SCALING PARAMETERS FOR USE IN THE NASA MODELING EFFORTS BY THE EXTENSION AND ADAPTATION OF CURRENT METHODOLOGIES, PREVIOUSLY COLLECTED FIELD DATA, AND ADDITIONAL FIELD MEASUREMENTS. (FY81) (SERI/SC)
5. STUDY AND ESTABLISH POTENTIAL PSYCHOACOUSTIC EFFECTS AND IMPACTS OF WECS-GENERATED NOISE. (FY81-82) (SC)
6. ESTABLISH POTENTIAL COMMUNITY IMPACT OF WECS-GENERATED NOISE. (FY81-82) (SC)

SERI PROGRAM - CONT'D

7. DEVELOP A COMPREHENSIVE HANDBOOK FOR BOTH WECS DESIGNERS AND USERS ON THE ENGINEERING ASPECTS OF PLANNING AND CONTROLLING WECS NOISE GENERATION. (FY82) (SERI/SC)

SERI/NASA

1. CONTINUE TO SUPPORT THE CURRENT WECS DEVELOPMENT EFFORTS; I.E., MOD-0, MOD-1, MOD-2, MOD-5, WPRS, WITH REQUESTED FIELD MEASUREMENTS FOR ENVIRONMENTAL COMPLIANCE AND MODEL VALIDATION. (FY80-82) (SERI/SC)
2. MAKE MACHINE TIME AVAILABLE IN SUPPORT OF SERI DATA COLLECTION EFFORTS RELATED TO GENERIC ISSUES AT ALL SITES. (NASA/SC) (FY80-82)
3. TO HOLD PERIODIC NASA/SERI INTERGROUP MEETINGS AND WORKSHOPS TO DISCUSS CURRENT PROGRESS IN RESPECTIVE AREAS WITH APPROPRIATE SUBCONTRACTORS IN ATTENDANCE. (FY80-82) (NASA/SERI/SC)

NASA

1. TO ESTABLISH A NOISE PREDICTION CAPABILITY UTILIZING EXISTING COMPUTER CODES FOR EXISTING WECS DESIGNS. (NASA/SC)
2. ESTABLISH A PREDICTIVE CODE CAPABILITY WHICH UTILIZES NEW INFORMATION GENERATED BY THE SERI GENERIC EFFORT. (NASA/SC)

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PROPOSED SERI FY81 BUDGET

SERI LABOR (3.35 FTEs)	\$237.7K
OTHER DIRECT COSTS	200.0K
SUBCONTRACTS	<u>250.0K</u>
TOTAL TASK BUDGET	\$723.7K
CAPITAL EQUIPMENT	\$150.0K

ADVISORY GROUP

GENERATION: DR. FRED H. SCHMITZ  
AEROMECHANICS LAB.  
U.S. ARMY RESEARCH & TECHNOLOGY LAB.  
AMES RESEARCH CENTER

DR. WESLEY HARRIS  
DEPT. OF AERONAUTICS & ASTRONAUTICS  
M.I.T.

PROPAGATION: PROFESSOR DENNIS W. THOMSON  
DEPARTMENT OF METEOROLOGY  
THE PENNSYLVANIA STATE UNIVERSITY

TOLERANCE LEVELS: SCOTT A. TURNER, P.E.  
ENVIRONMENTAL SCIENCES DEPT.  
PORTLAND GENERAL ELECTRIC

BUDGET SUMMARY

	1ST AND 2ND QUARTER EXPENDITURES	PLANNED 1ST AND 2ND QUARTER EXPENDITURES	COMMITMENTS
BUDGET 195K	113.9 K	63.6 K	28.6 K

TABLE 12. SUBCONTRACTS

CONTRACTOR	WORK TITLE	PLANNED				ACTUAL			
		AMOUNT \$K	PR. COMPL. DATE	START DATE	END DATE	AMOUNT TO BE COSTED DURING FY80	AMOUNT \$K	START DATE	AMOUNT TO BE COSTED \$K
<u>3532.55 NOISE MEASUREMENT AT SELECTED SITES</u>									
PNL	TETHER SONDE MEASUREMENTS	25	2/80	5/80	7/80	25	32	3/80	32
PENN STATE U.	STUDIES OF INFRASOUND PROPAGATION	27	12/79	12/79	6/80	27	27	12/79	27
MIT	WTG NOISE ESTIMATES	18	2/80	3/80	9/80	18	18	3/80	18



Noise Measurements at Selected WECS Sites (3532.55)

Task or Subtask Activities	Fy 80												Fy 81							
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar		
<b>MOD-1 SPECIFIC</b>																				
Preliminary Noise Studies at MOD-1 Site (SERI)	△					▽														
Infrasonic Propagation Studies Near MOD-1 Site (Penn State Univ)		△						▽		▽										
Tethersonde Measurements Near MOD-MOD-1 Site (PNL)					△			▽		▽										
Systematic Noise Survey Near MOD-1 (SERI, PNL, Penn State Univ)						△		▽	▽											
Aerodynamic Noise Studies (MIT)					△			▽		●				▽						
MOD-O Upwind/Downwind Noise Study (SERI)						△		▽	▽											
MOD-1/0 Data Reduction & Interpretation (SERI)		△						▽					●		□					
MOD-1 Recommendations/Options (SERI)										△			●		□					
<b>MOD-2 SPECIFIC</b>																				
MOD-2 Background Noise Study (SERI)								△	▽		▽									
MOD-2 Noise Propagation Assessment (TBD)												△						▽		
MOD-2 Wake Noise Generation Study (SERI/SC)													△							
MOD-2 Multiple WTG Noise Study (SERI/SC)																△				
<b>WTG GENERIC</b>																				
VAWT Noise Study (SERI)										△			●					●		
Cumulative Accrued Costs \$ X1000	Planned	5.9	9.9	17.8	36.7	45.1	63.6	83.5	110.5	131.6	147.6	156.5	164.9							
	Actual	10.5	21.2	32.6	54.1	87.3	114.0													
	Variance	(4.6)	(11.3)	(14.8)	(17.4)	(42.2)	(50.4)													

- △ Begin Milestone
- Equipment Arrival
- Draft Final Report
- ◆ Workshop or Special Meeting
- ▽ Milestone Complete
- Progress Report
- Final Report

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LAND USE ISSUES

ROBERT NOUN

OBJECTIVES

DETERMINE LAND AREA REQUIREMENTS, SITING SCENARIOS, REGULATORY ENVIRONMENT, PUBLIC ATTITUDES TOWARD, AND POSSIBLE MULTIPLE LAND USE OPTIONS FACING, WIDESPREAD DEPLOYMENT OF WECS.

ACCOMPLISHMENTS

SUBTASK I. - COMPLETION OF FY79 PRODUCT LIABILITY STUDY.

STATUS

FINAL REPORT PUBLISHED IN DECEMBER 1979; TASK CLOSED IN DECEMBER 1979.

SUBTASK 2 - ESTABLISHMENT OF TASK ADVISORY COMMITTEE

ACTIVITIES

INVITE SELECTED CANDIDATES TO SERVE ON ADVISORY COMMITTEE.

STATUS

ADVISORY COMMITTEE HAS BEEN ESTABLISHED AND WILL MEET AT SERI ON APRIL 18, 1980. MEMBERS ARE:

BILL OSTRANDER, SOUTHERN CALIFORNIA EDISON  
GERRY FARBER, PENNSYLVANIA POWER AND LIGHT  
DONALD BAIN, OREGON DEPARTMENT OF ENERGY  
JIM WELCH, CONSULTANT  
JEFF PEARSON, COLORADO CONSUMER ADVOCATE  
GEORGE PRING, ATTORNEY

PURPOSE

TO OBTAIN ADVICE AND GUIDANCE FROM REPRESENTATIVES OF GROUPS TO WHICH TASK WORK IS DIRECTED (E.G., COMMITTEE WILL INCLUDE UTILITY PLANNERS).

SUBTASK 3 - SELECTION OF REPRESENTATIVE WECS

ACTIVITIES

SELECT SEVERAL REPRESENTATIVE WECS OF VARYING FUNCTION AND SCALE TO ANALYZE.

PREPARE TECHNOLOGY CHARACTERIZATIONS.

STATUS

MEETINGS HELD WITH SYSTEMS ANALYSIS BRANCH TO EXAMINE APPROPRIATE SELECTION OF WECS FOR ANALYSIS. FINAL DECISION WILL BE MADE AT THE TASK ADVISORY COMMITTEE MEETING ON APRIL 18, 1980.

PRODUCT

A WORKING LIST OF REPRESENTATIVE WECS FOR ANALYSIS.

PURPOSE

TO LIMIT ANALYSIS TO ONLY REPRESENTATIVE WECS.

QUALITY CONTROL

INTERNAL SERI REVIEW

ADVISORY COMMITTEE

SUBTASK 4 - SUMMARY OF ENVIRONMENTAL IMPACTS

ACTIVITIES

ENVIRONMENTAL IMPACTS OF REPRESENTATIVE WECS WILL BE IDENTIFIED AND SUMMARIZED  
BASED UPON CURRENT LITERATURE AND SERI SUBTASKS.

STATUS

LITERATURE SEARCH COMPLETED.

PRODUCT

AN ANNOTATED BIBLIOGRAPHY OF EXISTING LITERATURE ON ENVIRONMENTAL IMPACTS OF WECS WILL BE INCLUDED IN FINAL REPORT.

PURPOSE

SUMMARY OF WECS ENVIRONMENTAL IMPACTS WILL PROVIDE BASIS FOR ANALYSIS OF LAND USE LAWS AND REGULATIONS AFFECTING WECS SITING IN SUBTASK 5.

QUALITY CONTROL

INTERNAL SERI REVIEW

ADVISORY COMMITTEE

SUBTASK 5. - INVENTORY OF ENERGY FACILITY SITING AND LICENSING LAWS AND PROCEDURES AFFECTING WECS

ACTIVITIES

BASED ON THE ENVIRONMENTAL IMPACTS OF REPRESENTATIVE WECS, IDENTIFY SPECIFIC FEDERAL AND GENERAL CATEGORIES OF STATE AND LOCAL LAND USE LAWS AND REGULATIONS AFFECTING THE SITING OF WECS.

STATUS

COMPLETED INVENTORY OF FEDERAL LAWS AND REGULATIONS RELATING TO WECS SITING AND LICENSING. INITIATED INVENTORY OF ALL STATE SITING AND LICENSING LAWS AND PROCEDURES.

PRODUCT

THE FINAL REPORT WILL CONTAIN A SURVEY OF FEDERAL AND STATE SITING AND LICENSING LAWS AND PROCEDURES AFFECTING WECS, BASED UPON TECHNOLOGY CHARACTERIZATIONS AND SUMMARIES OF ENVIRONMENTAL IMPACTS.

PURPOSE

THIS INFORMATION WILL PROVIDE THE BASIS FOR THE COMPARATIVE ASSESSMENT OF THE DIFFERENCES IN SITING WECS AND CONVENTIONAL POWER PLANTS, TO BE UNDERTAKEN IN SUBTASK 10.



QUALITY CONTROL

SERI INTERNAL REVIEW

ADVISORY COMMITTEE

SUBTASK 6. - DETERMINATION OF LAND AREA REQUIREMENTS  
AND SITING SCENARIOS FOR WECS

ACTIVITIES

DETERMINE LAND AREA REQUIREMENTS FOR REPRESENTATIVE WECS AND DEVELOP SITING SCENARIOS BASED UPON LIKELY RESOURCE AREAS AND LOCATIONS OF DISTRIBUTION NETWORKS.

ONGOING SERI RESEARCH WILL BE USED IN THIS AREA.

STATUS

RESEARCH IN PROGRESS.

PRODUCT

INFORMATION REGARDING LAND AREA REQUIREMENTS AND SITING SCENARIOS WILL BE INCLUDED IN FINAL REPORT.

PURPOSE

THIS INFORMATION WILL PROVIDE A BASIS FOR THE COMPARATIVE ASSESSMENT OF THE DIFFERENCES IN SITING WECS AND CONVENTIONAL POWER PLANTS, TO BE UNDERTAKEN IN SUBTASK 10.

QUALITY CONTROL

INTERNAL SERI REVIEW.

ADVISORY COMMITTEE.

SUBTASK 7. - SUMMARY OF PUBLIC ATTITUDES

ACTIVITIES

SUMMARIZE EXISTING LITERATURE REGARDING PUBLIC ATTITUDES TOWARD WECS SITING OR SIMILAR SITING PROBLEMS; E.G., TELEVISION ANTENNAE, ELECTRIC AND TELEPHONE TRANSMISSION LINES.

STATUS

RESEARCH IN PROGRESS.

PRODUCT

INFORMATION REGARDING PUBLIC ATTITUDES TOWARD WECS SITING WILL BE INCLUDED IN FINAL REPORT.

PURPOSE

THIS INFORMATION WILL BE INPUT TO THE COMPARATIVE ASSESSMENT OF THE DIFFERENCES IN SITING WECS AND CONVENTIONAL POWER PLANTS IN SUBTASK 10.

QUALITY CONTROL

INTERNAL SERI REVIEW.

ADVISORY COMMITTEE.

SUBTASK 8. - DETERMINATION OF MULTIPLE LAND USE OPTIONS FOR WECS

ACTIVITIES

GIVEN ENVIRONMENTAL IMPACTS, LAND USE REGULATIONS, AND PUBLIC ATTITUDES:  
DETERMINE WHAT LAND USES ARE COMPATIBLE WITH WECS.

COMPATIBILITY IS LIKELY TO BE A MATTER OF DEGREE; THIS ANALYSIS WILL ESTABLISH A  
SCALE OF COMPATIBILITY BETWEEN WECS AND OTHER LAND USES.

STATUS

PRELIMINARY RESEARCH HAS BEGUN.

PRODUCT

INFORMATION REGARDING MULTIPLE LAND USE OPTIONS FOR WECS WILL BE INCLUDED IN FINAL REPORT.

SUBTASK 9. - DETERMINE LAND ACQUISITION MECHANISMS

ACTIVITIES

DETERMINE THE VARIOUS LAND ACQUISITION MECHANISMS AVAILABLE FOR WECS SITING.

STATUS

WORK HAS NOT YET BEGUN.

PRODUCT

INFORMATION REGARDING LAND ACQUISITION MECHANISMS FOR WECS WILL BE INCLUDED IN FINAL REPORT.

SUBTASK 10. - ASSESSMENT OF SITING DIFFERENCES FOR WECS  
AND CONVENTIONAL POWER PLANTS

ACTIVITIES

SUBCONTRACTOR SUPPORT HAS BEEN SOUGHT FOR THE ASSESSMENT OF SITING DIFFERENCES BETWEEN WECS AND CONVENTIONAL POWER PLANTS AND BETWEEN SMALL AND LARGE WECS ARRAYS.

BASED ON INFORMATION OBTAINED IN SUBTASKS 4, 5, AND 7, ANALYSIS OF THE RELATIVE LAND USE CONSTRAINTS AND LICENSING REQUIREMENTS IN THE SITING OF WECS AND CONVENTIONAL POWER PLANTS WILL BE CONDUCTED BY SUBCONTRACTOR.

ANALYSIS WILL INCLUDE DETERMINATION OF POSSIBLE ADVANTAGES OF SITING SMALL WECS ARRAYS.

STATUS

A PURCHASE REQUEST (PR) PACKAGE HAS BEEN SUBMITTED TO OBTAIN MIKE LOTKER (TSG) AS A SUBCONTRACTOR.

PRODUCT

A FINAL REPORT CONTAINING AN ASSESSMENT OF THE SITING DIFFERENCES BETWEEN WECS AND CONVENTIONAL POWER PLANTS AND BETWEEN SMALL AND LARGE WECS ARRAYS.

PURPOSE

TO PROVIDE USEFUL INFORMATION TO DOE, UTILITIES, AND OTHERS ABOUT THE SITING DIFFERENCES BETWEEN WECS AND CONVENTIONAL POWER PLANTS, AND BETWEEN SMALL AND LARGE WECS ARRAYS.

TO ASSIST UTILITY PLANNERS BY PROVIDING INFORMATION FOR ANALYZING AND COMPARING THE POTENTIAL COSTS ASSOCIATED WITH THE SITING OF WECS AND TIME CONSTRAINTS COMPARED TO CONVENTIONAL POWER PLANTS.

QUALITY CONTROL

INTERNAL SERI REVIEW

ADVISORY COMMITTEE

SUBTASK 11. - PREPARATION OF FINAL REPORT

ACTIVITIES

PREPARE FINAL REPORT CONTAINING INFORMATION GATHERED IN SUBTASKS 4-9.

STATUS

WORK HAS NOT YET BEGUN.

QUALITY CONTROL

INTERNAL SERI REVIEW

ADVISORY COMMITTEE

SUBTASK OUTPUT

REPORT SUMMARIZING LAND AREA REQUIREMENTS, SITING SCENARIOS, LAND USE REGULATIONS, PUBLIC ATTITUDES TOWARD WECS SITING, MULTIPLE LAND USE OPTIONS AND A COMPARATIVE ANALYSIS OF LAND USE CONSTRAINTS REGARDING THE SITING OF WECS AND CONVENTIONAL POWER PLANTS AND SMALL AND LARGE WECS ARRAYS.



BUDGET SUMMARY

BUDGET	1ST AND 2ND QUARTER EXPENDITURES	PLANNED 1ST AND 2ND QUARTER EXPENDITURES	COMMITMENTS
135K	33.2 K	38.1K	0

TABLE 13. SUBCONTRACTS

CONTRACTOR	WORK TITLE	PLANNED					ACTUAL		
		AMOUNT \$K	PR. COMPL. DATE	START DATE	END DATE	AMOUNT TO BE COSTED DURING FY80	AMOUNT \$K	START DATE	AMOUNT TO BE COSTED \$K
<u>3531.30 LAND USE ISSUES</u>									
TSG (MIKE LOTKER)	WECS/UTILITY SITING ANALYSIS	24.9	3/80	5/80	9/80	24.9	--	--	--
UNIVERSITY OF DENVER LAW SCHOOL	LEGAL SUPPORT	10	1/80	1/80	10/80	10	10	1/80	10

Land Use Issues (3531.30)

Task or Subtask Activities		Fy 80											Fy 81							
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	
Summarize Environmental Impacts Land Area Requirements, Regulations and Acquisitions Mechanisms Public Attitudes Multiple Land Use Options Land Use Constraints Subtask Management Advisory Committee Project Management		△	—	—	—	▽	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		—	—	△	—	—	—	—	▽	—	—	—	—	—	—	—	—	—	—	—
		—	—	—	△	—	—	—	—	▽	—	—	—	—	—	—	—	—	—	—
		—	△	—	—	—	—	—	—	▽	—	—	—	—	—	—	—	—	—	—
		△	◆	△	—	—	—	—	—	▽	—	—	—	—	—	—	—	—	—	—
		—	—	—	—	—	△	—	—	—	▽	—	—	—	—	—	—	—	—	—
Cumulative Accrued Costs \$ X1000	Planned	6.5	12.3	17.3	24.4	30.5	38.1	45.7	55.9	64.2	84.6	98.4	115.2							
	Actual	6.5	11.5	15.3	22.0	30.3	33.2													
	Variance	0	0.8	2.0	2.4	0.2	4.9													

- △ Begin Milestone
- ▽ Milestone Complete
- Equipment Arrival
- Progress Report
- Draft Final Report
- Final Report
- ◆ Workshop or Special Meeting

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MAY 21, 1980

STRATEGY ANALYSIS

DAVID SCHALLER

OBJECTIVES

DETERMINE THE IMPACT OF THE FEDERAL ENERGY REGULATORY COMMISSION'S RULES UNDER PURPA ON THE DEVELOPMENT OF WIND ENERGY.

ACCOMPLISHMENTS

SUBTASK WORK WAS BEING HELD IN ABEYANCE PENDING MODIFICATION TO STATEMENT OF OBJECTIVES AND THE SUBTASK WORK PLAN.

COMMENCED DEVELOPMENT OF REVISED SUBTASK WORK PLAN PACKAGE.

PLANNED ACTIVITIES

(UNDER REVISION AND INTERNAL REVIEW)

COMPLETE REVISION OF SUBTASK WORK PLAN.

COMMENCE INVESTIGATION ON THE EFFECTS OF PURPA ON PUBLIC UTILITY COMMISSIONS AND UTILITIES.

OUTPUT

(UNDER REVISION AND INTERNAL REVIEW)

A REPORT TO WSB/DOE ANALYZING THE EXPECTED EFFECT OF THE FINAL PURPA RULES ON PUC'S AND UTILITIES.

A GUIDEBOOK FOR AFFECTED PUC'S AND UTILITIES DETAILING THEIR RESPONSIBILITIES AND OPTIONS FOR REGULATORY COMPLIANCE.

BUDGET SUMMARY

BUDGET	1ST AND 2ND	PLANNED 1ST	COMMITMENTS
75K	QUARTER	AND 2ND	
	EXPENDITURES	QUARTER EXPENDITURES	
	4.7K	14.5K	0

SUBCONTRACTS

NONE

Strategy Analysis (3531.20)

Task or Subtask Activities		Fy 80												Fy 81					
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Review PURPA Rulemaking							△	—	▽▽										
Identify PURPA Impacts									▽△	—	▽								
Develop PURPA Implementation Manual									△	—	▽								
Report to DOE/WSD									△	—	□	—	■						
Publication of Manual											△	—	●	—	■				
Subtask Management					△	—	—	◆	▽	—	—	—	—	—	—				
Accrued Costs	b. Planned	0.0	0.0	0.0	1.1	7.7	14.5	21.3	33.3	45.3	52.1	57.5	57.7						
	c. Actual	0.0	0.2	0.6	0.6	1.5	4.8												
	d. Variance	0.0	(0.2)	(0.6)	0.5	6.2	9.7												

- △ Begin Milestone
- ▽ Milestone Complete
- Equipment Arrival
- Progress Report
- Draft Final Report
- Final Report
- ◆ Workshop or Special Meeting



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WIND SYSTEMS COORDINATION

IRWIN E. VAS

OBJECTIVES

PROVIDE TECHNICAL COORDINATION OF THE FEDERAL WIND ENERGY PROGRAM RESEARCH AND ANALYSIS EFFORTS, INTEGRATION OF THE RESEARCH RESULTS INTO A DECISION DATA BASE, AND INTEGRATION OF ACTIVITIES WITH DOE MANAGEMENT AND PRIME CONTRACTORS.

ACCOMPLISHMENTS

DISCUSSED THE USE OF WIND TUNNEL FACILITIES FOR CURRENT AND NEAR-TERM SERI WIND SYSTEMS PROGRAM EFFORTS WITH LEN PETERSON, RAYTHEON, WHO WAS ASSEMBLING THE INFORMATION FOR LOU DIVONE, WSB/DOE.

REVISED THE MISSION STATEMENTS FOR THE WIND ENERGY SYSTEMS PROGRAM.

MET WITH STAFF OF SOUTHERN CALIFORNIA EDISON TO DISCUSS THEIR PROGRAM EFFORTS RELATING TO SITING, MACHINE DEPLOYMENT, ETC.

MET WITH TOM JAVITS OF THE GOLDEN GATE ENERGY CENTER AND DISCUSSED THE POSSIBILITY OF UTILIZING WIND MACHINES TO PROVIDE POWER FOR THAT COMPLEX OF BUILDINGS.

MET WITH ROCKY FLATS STAFF TO DISCUSS YAW CONTROL AND ITS POTENTIAL FOR REDUCING COSTS FOR SMALL MACHINES.

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MET WITH ROCKY FLATS STAFF TO DISCUSS THE SERI MARKET RESEARCH PLANS AND ITS RELATIONSHIP TO THE ROCKY FLATS MARKET STUDY PLANS.

MET WITH COLORADO STATE UNIVERSITY STAFF TO DISCUSS AVAILABILITY OF FACILITIES FOR TEST PURPOSES AND PARTICIPATION OF STUDENTS TO HELP IN RESEARCH STUDIES.

SENT THE STATEMENT OF WORK FOR THE WIND PROGRAM COORDINATION SUBCONTRACT TO POTENTIAL BIDDERS. AWARD OF SUBCONTRACT EXPECTED END OF MAY.

MET WITH STAFF FROM ROCKY FLATS TO DISCUSS PROPOSED INFORMATION DISSEMINATION BY ROCKY FLATS AND THE SERI SUBCONTRACT TO SUPPORT THIS EFFORT.

PARTICIPATED IN ADVISORY COMMITTEE MEETING AND REVIEW OF PROPOSED SUBCONTRACTS FOR THE MARKET CHARACTERIZATION SUBTASK.

DISCUSSED SERI WIND ACTIVITIES WITH STAFF OF; GENERAL ELECTRIC- R. BUTHMAN, ZIMMERMAN, MORELLI; A. D. LITTLE-W. VACHAN, N. MATASON, M. GLESK; WASHINGTON UNIVERSITY-PROFESSOR VITHAYATHIL; EXXON ENTERPRISES-T. GRIEB; KANSAS ENERGY OFFICE-DAVID MARTIN; PRINCETON UNIVERSITY-GORDON THOMPSON.

COMPLETED P. R. FOR THE SUBCONTRACT IN THIS SUBTASK.

A FULLTIME CONSULTANT (ELIZABETH KINGMAN) WAS HIRED TO SUPPORT THE EFFORTS IN THIS SUBTASK.

PLANNED ACTIVITIES

CONTINUE PLANNING/LIAISON ACTIVITIES WITHIN THE FEDERAL WIND ENERGY PROGRAM.

OUTPUT

REPORTS SUMMARIZING MEETINGS AND WORKSHOPS CONDUCTED IN SUPPORT OF THIS TASK.

UTILIZATION OF THE DATA BASE AND MODELS TO DETERMINE PROGRAM NEEDS AND TO SUPPORT PROGRAM PLANNING.

BUDGET SUMMARY

BUDGET	1ST AND 2ND QUARTER EXPENDITURES	PLANNED 1ST AND 2ND QUARTER EXPENDITURES	COMMITMENTS
430K	21.8K	38.1K	29K

TABLE 14. SUBCONTRACTS

CONTRACTOR	WORK TITLE	PLANNED				ACTUAL			
		AMOUNT \$K	PR. COMPL. DATE	START DATE	END DATE	AMOUNT TO BE COSTED DURING FY80	AMOUNT \$K	START DATE	AMOUNT TO BE COSTED \$K
<u>3532.10 WIND PROGRAM COORDINATION</u> TBD (SOLE SOURCE)	COORDINATION	169	2/80	6/80	12/80	109			

Wind Systems Coordination (3532.10)

Task or Subtask Activities		Fy 80											Fy 81					
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Coordination Meetings		△							▽									
Preliminary Data Base Format and Management System									▽									□
Preliminary Analysis Utilizing Data Base									▽									□
Project Management		△							▽		◆		◆					
Subtask Management		△	◆		◆			◆	▽		◆				◆			
Cumulative Accrued Costs \$ X1000	Planned	4.2	7.8	12.7	17.6	22.6	38.1	64.1	90.0	115.9	141.8	193.5	250.5					
	Actual	5.6	8.2	12.7	16.6	19.7	21.8											
	Variance	(1.4)	(.4)	0.0	1.0	2.9	16.3											

- △ Begin Milestone
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WECS COST STUDY

JOE LAVENDER

OBJECTIVES

TO PROVIDE UP-TO-DATE AND WELL-DOCUMENTED INFORMATION CONCERNING COSTS, PERFORMANCE, AND OTHER CHARACTERISTICS OF SPECIFIC WIND ENERGY SYSTEMS TO DOE DECISION MAKERS.

SCOPE

ENGINEERING PERFORMANCE/DESIGN INFORMATION AND COST (CAPITAL COST, O&M, LIFE CYCLE COSTS) SHALL BE INCLUDED INITIALLY IN SPECIFIED DESIGNS. COST SENSITIVITY TABLES THAT ARE DEPENDENT UPON PRODUCTION QUANTITIES AND SITE LOCATION SHALL BE INCLUDED DURING FY80.

SPECIFIC WIND SYSTEMS THAT WILL BE INCLUDED IN THE TASK ARE:

o MILLVILLE	10 kW
o ENERGY DEVELOPMENT	40 kW
o DOE/SANDIA	100 kW
o MOD 2	2500 kW



ACCOMPLISHMENTS

COMPLETED BASE COST ESTIMATES FOR THE FOUR DESIGNATED SYSTEMS.

COMPLETED SENSITIVITY ANALYSIS ON THE 10 AND 40 KW SYSTEMS.

OBTAINED COST AND PERFORMANCE INFORMATION ON ALL COMMERCIALY AVAILABLE SYSTEMS FROM MARKET CHARACTERIZATION SUBTASK.

PLANNED ACTIVITIES

COMPLETE ROUGH DRAFT OF TASK BY LATE APRIL - MID MAY AND WILL SUBMIT FOR INTERNAL SERI REVIEW. EXTERNAL REVIEW OF COST/PERFORMANCE SECTION SHOULD TAKE PLACE IN MID JUNE. REVIEW WILL INCLUDE NASA/LeRC, SANDIA, ROCKY FLATS, SUBTASK ADVISORY COMMITTEE, AND MANUFACTURERS INVOLVED IN THE STUDY.

PERFORM COST REGRESSION ANALYSIS OF COMMERCIALY AVAILABLE WIND SYSTEM AT A SPECIFIED WIND VELOCITY TO OBTAIN:

- o TOTAL CAPITAL COST AS A FUNCTION OF KWH/YR.
- o HARDWARE COST AS A FUNCTION OF KWH/YR.

PERFORM ECONOMIC AND SITE SENSITIVITY ANALYSIS OF THE FOUR SYSTEMS STUDIED.

OUTPUT

A TABULAR SECTION SUMMARIZING THE ANALYSIS OF THE SPECIFIED SYSTEMS.

CHARTS SHOWING THE RESULTS OF THE REGRESSION ANALYSIS.

A SECTION REVIEWING THE SOURCES OF THE INFORMATION AND JUSTIFYING COST AND PERFORMANCE INFORMATION THAT ARE EMPLOYED.

TABLES THAT WILL PROVIDE DETAILED COST AND PERFORMANCE INFORMATION WITH RESPECT TO "BASELINE" ASSUMPTIONS.

PROVIDE TABLES SHOWING THE SENSITIVITY OF THE RESULTS OF THE ANALYSIS TO SIGNIFICANT BUT REALISTIC CHANGES IN THE "BASELINE" ASSUMPTIONS.

BUDGET SUMMARY

BUDGET	1ST AND 2ND QUARTER EXPENDITURES	PLANNED 1ST AND 2ND QUARTER EXPENDITURES	COMMITMENTS
50K	16.6K	19.4K	5.3K

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TABLE 15. SUBCONTRACTS

CONTRACTOR	WORK TITLE	PLANNED				ACTUAL			
		AMOUNT \$K	PR. COMPL. DATE	START DATE	END DATE	AMOUNT TO BE COSTED DURING FY80	AMOUNT \$K	START DATE	AMOUNT TO BE COSTED \$K
<u>3532.45 WECS COST STUDY</u> TBD (SOLE SOURCE)	O&M GENERIC STUDY	4	2/80	4/80	6/80	4			

**WECS Cost Study (3532.45)**

Task or Subtask Activities		Fy 80												Fy 81							
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar		
Information Collection and Normalization WECS Cost Configuration Study Life Cycle Cost Base Analysis Prepare Data Tables Update Data with Externalities Update Data With New Information With Actuals Subtask Management		△		—		—		—		—		—		—		—		—		—	
		△		—		—		—		—		—		—		—		—		—	
		△		—		—		—		—		—		—		—		—		—	
		△		—		—		—		—		—		—		—		—		—	
Cumulative Accrued Costs \$ X1000	Planned	2.2	4.2	9.9	14.8	16.6	19.4	22.5	25.7	30.5	35.1	38.4	42.0								
	Actual	0.7	4.7	7.4	11.4	13.4	16.6														
	Variance	1.5	(0.5)	2.5	3.4	3.2	2.8														

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PROGRAM REVIEW AND PLANNING

IRWIN E. VAS

OBJECTIVES

PROVIDE THE PLANNING AND ADMINISTRATION FOR THE SERI WIND ENERGY SYSTEMS PROGRAM.

ACCOMPLISHMENTS

REVIEWED DR. THOMANN'S PAPER REGARDING THE CALCULATION OF ANNUAL ENERGY USING HAND HELD CALCULATORS FOR DENIS HAYES.

REVISED MISSION STATEMENTS FOR THE WIND ENERGY SYSTEMS PROGRAM AND THE WIND PROGRAM BRANCH AND SUBMITTED TO SERI MANAGEMENT.

PRESENTED THE WIND ENERGY SYSTEMS PROGRAM QUARTERLY REVIEW TO WSB/DOE IN WASHINGTON. THE MEETING WAS ATTENDED BY 18 PERSONS, INCLUDING VAS, MCCONNELL, SOUTH, AND LAVENDER FROM SERI. THE REMAINDER OF THE SERI WIND PROGRAM SUBTASK LEADERS PARTICIPATED VIA TELEPHONE HOOKUP.

ATTENDED THE TERRESTRIAL ENERGY SUBCOMMITTEE OF THE AIAA AND DISCUSSED THE PROGRAM PLANS FOR THE APRIL 1980 AIAA/SERI MEETING ON WIND ENERGY.

DISCUSSED WITH PRC STAFF (E. LUTHER) PLANNING STRATEGIES FOR WIND ACTIVITIES.

ARRANGED A PRESENTATION BY A. D. LITTLE STAFF ON ACTIVITIES RELATING TO WIND TECHNOLOGY AND ASSESSMENT STUDIES.

SENT TO DAVID BLACK, WESTINGHOUSE, SUMMARY OF PAPER ENTITLED, "ECONOMICS ASSOCIATED WITH WIND POWER SYSTEMS"

COMPLETED THE FY79 WIND SYSTEMS SUMMARY AND SUBMITTED TO DOE FOR INCLUSION IN THE FEDERAL WIND ENERGY PROGRAM FY79 SUMMARY.

MET FOR THREE DAYS AS MEMBER OF THE REVIEW PANEL FOR UNIVERSITY PROPOSALS TO RANK ORDER PROPOSALS FOR FUNDING BY DOE/SERI IN THE UNIVERSITY RESEARCH PROGRAM.

ATTENDED THE PLANNING MEETING AT PRC, McLEAN, VA., AND PROVIDED INPUT REGARDING FY81 AND BEYOND SERI EFFORTS.

MET AND DISCUSSED SERI WIND EFFORTS WITH THE FOLLOWING:

- o JEFF JORDAN GAO - FINANCIAL, ADMINISTRATIVE AFFAIRS
- o BRAD MEAD, INTERNATIONAL DIVISION OF GRUMMAN, CHAIRMAN, INTERNATIONAL TRADE COMMITTEE - WIND EFFORTS GENERAL
- o DR. BISHOP, NEW YORK STATE ENERGY RESEARCH AND DEVELOPMENT AUTHORITY - WIND EFFORTS GENERAL

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- o HERB WADE, DEPT. OF NATURAL RESOURCES, STATE OF MISSOURI - WIND EFFORTS GENERAL
- o DOE FINANCIAL REVIEW OF SERI WIND PROGRAM
- o J. PLUNKETT, DR. E. O'HAIR, THE MONTANA ENERGY AND MHD RESEARCH AND DEVELOPMENT INSTITUTE INC - DISCUSSED WIND PROGRAM.
- o DR. MARK WILLIAMS, SCIENCE AND TECHNOLOGY DEPT. BRITISH EMBASSY - DISCUSSED WIND PROGRAM.
- o SKIP SPENCELEY, STAFF DIRECTOR, SUB COMMITTEE OF ENERGY DEVELOPMENT AND APPLICATION, HOUSE COMMITTEE OF SCIENCE AND TECHNOLOGY - DISCUSSED DOE/SERI BUDGETS FOR WIND, CHANGES IN BUDGET.
- o AN ITALIAN DELEGATION WITH PROF. GIUSH, DR. SAULI, ING LUIGI, ING SERGIO, ING LUCIANO, ARCH SFORZU - TO DISCUSS WIND ISSUES.

SUBMITTED THE MODIFICATIONS WSB/DOE TO THE SOLAR OBJECTIVES.

SUBMITTED SMALL/MINORITY BUSINESS REPORT ON FY79, FY80 SUBCONTRACTS TO WSB/DOE.



PLANNED ACTIVITIES

CONTINUE REVIEW, PLANNING, AND REPORTING ACTIVITIES AS REQUIRED.

OUTPUT

QUARTERLY REVIEWS FOR PRESENTATION TO WSB/DOE

MONTHLY PROGRAM STATUS REPORTS

PROGRAM DEVELOPMENT PLAN FOR FY81

PROGRAM MANAGEMENT FOR WES PROGRAM

BUDGET SUMMARY

	1ST AND 2ND QUARTER	PLANNED 1ST AND 2ND QUARTER	
BUDGET	EXPENDITURES	EXPENDITURES	COMMITMENTS
225K	45.0K	52.7K	24.9K

SUBCONTRACTS

NONE

**Program Review and Planning (3531.10)**

Task or Subtask Activities		Fy 80											Fy 81					
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Planning/Administration (Task Management)		△			◆			◆	▽			◆		◆				
Program Development Plan				□	▽	■						□		■				
Arrange Consultant Agreements				△					▽									
Develop Institutional Plan		△							▽				▽					
Cumulative Accrued Costs \$ X1000	Planned	4.9	10.9	16.9	24.5	35.0	52.7	70.4	88.1	104.8	123.8	140	155.7					
	Actual	3.5	10.3	16.3	22.3	31.4	45.0											
	Variance	1.4	0.6	0.6	2.2	3.6	7.7											

- △ Begin Milestone
- Equipment Arrival
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- ▽ Milestone Complete
- Progress Report
- Final Report

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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 ASSESSMENT STUDIES BY SUBCONTRACTS.

CONDUCT A PROGRAMMATIC WORKSHOP.

REVIEW AND ASSESS UNSOLICITED PROPOSALS.

SUPPORT SPECIFIC R&D SOLICITED INNOVATIVE STUDIES.

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ACCOMPLISHMENTS

REVIEWED CURRENT R&D PROJECTS ON A CONTINUING BASIS.

ISSUED TWO LETTERS OF INTEREST FOR ASSESSMENT STUDIES OF WEIS CONCEPTS (RH-0-9173-1) (SMALL AND DISADVANTAGED BUSINESSES ONLY) AND TETHERED SYSTEMS (RH-0-9172-1). RECEIVED 21 RESPONSES TO THE LOI ON TETHERED SYSTEMS AND 27 RESPONSES TO THE LOI ON WEIS CONCEPTS.

PLANNED ACTIVITIES

INITIATE REVIEW OF ABSTRACTS FOR SECOND WEIS CONFERENCE.

REVIEW AND RANK PROPOSALS RECEIVED IN RESPONSE TO THE TWO LETTERS OF INTEREST FOR TETHERED AND WEIS ASSESSMENTS.

REVIEW UNSOLICITED PROPOSALS.

REVIEW THREE 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.

TABLE 1b. R&D SUBCONTRACTED PROJECTS, FY79 AND FY80

TITLE/SUBCONTRACTOR	TERMINATION DATE	FUNDING STATUS	
		FUNDING FY79	PROJECTED FUNDING FY80
INN. - W. VA. UNIV.	DECEMBER, 31, 1979	0	120,000
DAWT - GRUMMAN	FEBRUARY 15, 1980	89,293	120,000
TORNADO - GRUMMAN	AUGUST 30, 1979 (NER)*	N/A	200,000
EFD - MARKS	APRIL 30, 1980 (NER)*	64,007	N/A
EFD - U. DAYTON	MARCH 31, 1980 (NER)*	117,523	120,000
HUM. AIR - S. DAKOTA	MARCH 12, 1980 (NER)*	68,975	N/A
VORTEX - PINY	AUGUST 31, 1979	N/A	N/A
DYN. IND. - AEROV.	OCTOBER 15, 1980	121,835	N/A
OSCILL. VANE - UTRC	OCTOBER 15, 1980	119,900	
CYCLIC PITCH - WUTA	OCTOBER 15, 1980	106,318	N/A

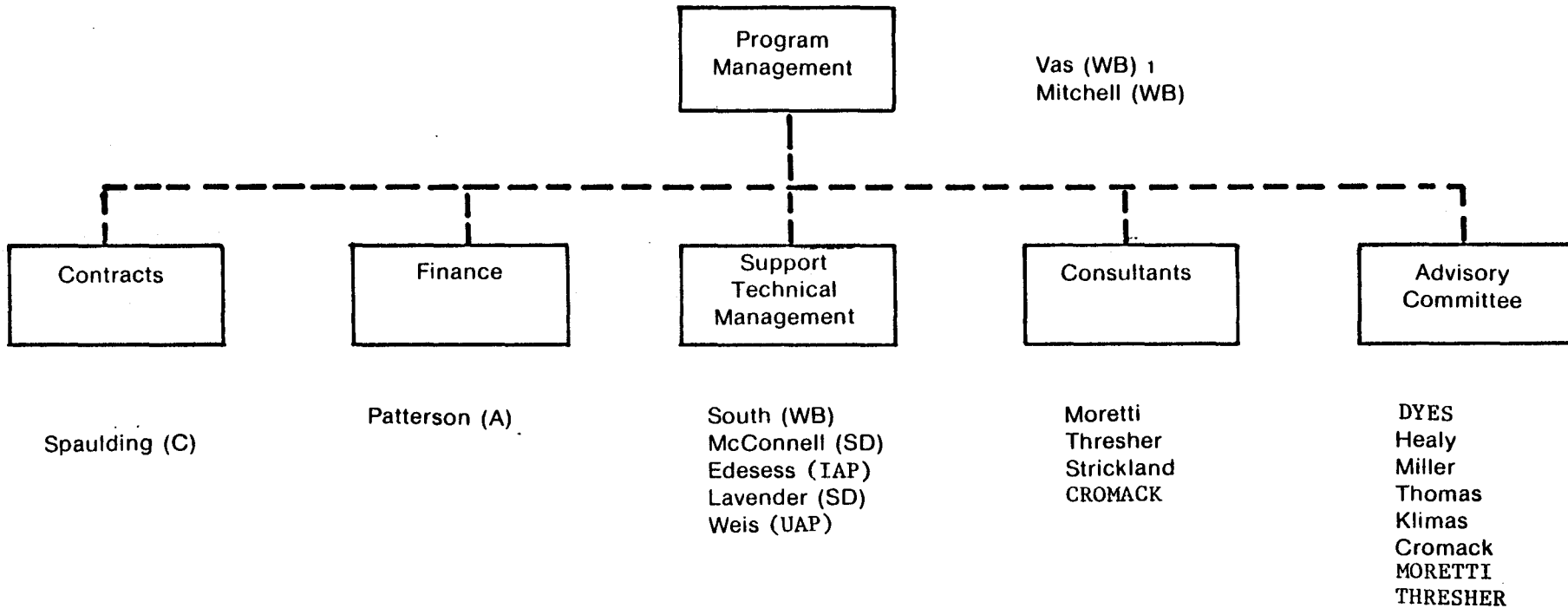
\*NER - NO-COST EXTENTION REQUESTED.

TABLE 17. PRINCIPAL SUBCONTRACTORS FOR FY80 R&D PROJECTS

PROJECT TITLE	SUBCONTRACTOR	PROJECT CODE	CONTRACT No.	PRINCIPAL INVESTIGATOR
INNOVATIVE WIND TURBINE	WEST VIRGINIA UNIVERSITY	WVU	EY-76-C-05-5135	E. WALTERS
DIFFUSER AUGMENTED WIND TURBINES (DAWT)	GRUMMAN AEROSPACE	G-D	XH-9-8073-1	FOREMAN
TORNADO-TYPE WIND ENERGY SYSTEMS PHASE II (TORNADO)	GRUMMAN AEROSPACE	G-T	EX-76-C-01-2555	T. YEN
TESTS AND DEVICES FOR WIND/ELECTRIC POWER CHARGED AEROSOL GENERATORS (EFD)	MARKS POLARIZED	MP	XH9-8123-1	M. MARKS
ELECTROFLUID DYNAMIC WIND GENERATOR PROGRAM (EFD)	UNIVERSITY OF DAYTON	UDE	XH-9-8074-1	E. MINARDI
ENERGY FROM HUMID AIR (HUMID AIR)	SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY	SD	DE-AC01-79ET23052	K. OLIVER
VORTEX AUGMENTORS FOR WIND ENERGY CONVERSION (VORTEX)	POLYTECHNIC INSTITUTE OF NEW YORK	PINY	E(49-18)2358	P. SFORZA
ADVANCED AND INNOVATIVE WIND ENERGY CONCEPT DEVELOPMENT-DYNAMIC INDUCER (DYNAMIC INDUCER)	AEROVIRONMENT	ADI	XH-9-8085-1	P. 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



### WEIS Program Management Chart



Office/Branch abbreviations are defined below:

- C - CONTRACTS
- A - ACCOUNTING
- SD - SYSTEMS DEVELOPMENT BRANCH
- WB - WIND ENERGY BRANCH
- UAP - UTILITY APPLICATIONS AND POLICY BRANCH
- IAP - INDUSTRY APPLICATIONS AND POLICY BRANCH



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.

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

ACCOMPLISHMENTS

THE DRAFT FINAL REPORTS FOR FY78 AND FY79 FUNDED SUBCONTRACT HAVE ALL BEEN SUBMITTED AND ARE IN REVIEW.

ASSESSMENT

ALL TASKS HAVE BEEN COMPLETED AND THE DRAFT FINAL REPORTS ARE TO BE REVIEWED DURING THE THIRD QUARTER OF FY80.

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## DIFFUSER AUGMENTED WIND TURBINE

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

### OBJECTIVE

DEVELOP AND REFINE THE ENGINEERING DESIGN OF THE DIFFUSER AUGMENTED WIND TURBINE (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

	<u>TASK NUMBERS</u>
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

ACCOMPLISHMENTS

ALL TASKS HAVE BEEN COMPLETED AND THE DRAFT FINAL REPORT IS TO BE SUBMITTED.

PLANNED ACTIVITIES

SUBMIT THE DRAFT FINAL REPORT TO SERI FOR REVIEW.

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ASSESSMENT

THE EFFORT HAS EXPERIENCED DELAYS IN SCHEDULING AND A NO-COST EXTENSION TO  
FEBRUARY 15, 1980 HAS BEEN APPROVED.

## 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 WIND ENERGY SYSTEM.

### 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 VANED TYPE MODEL.



TASKS

TASK NUMBERS

FLOW FIELD ANALYSIS OF VORTEX SYSTEMS	3.1
THREE-FT MODEL TESTS	3.2
SIX-FT SPIRAL MODEL DESIGN AND FABRICATION	3.3
TWO-AND-ONE-HALF-FT 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

ALL OF THE FY78 FUNDED TASKS HAVE BEEN COMPLETED AND THE DRAFT FINAL REPORT IS IN PREPARATION.

PLANNED ACTIVITIES

COMPLETE FINAL REPORT OF THE FY77 FUNDED EFFORT.

COMPLETE THE DRAFT FINAL REPORT FOR THE FY78 FUNDED EFFORT.

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ASSESSMENT

ALL TASKS HAVE BEEN COMPLETED AND PREPARATION OF THE DRAFT FINAL REPORT IS IN PROGRESS.

A NO-COST EXTENSION WILL BE REQUIRED TO COMPLETE THE FINAL REPORT OF THE FY78 FUNDED EFFORT.

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

ACCOMPLISHMENTS

CONTINUED THE TESTING OF ORIFICE DIAMETERS OF 20  $\mu$ , 30  $\mu$ , 76  $\mu$ , AND 100  $\mu$ .

THE TESTING OF THE GEOMETRY OF THESE ORIFICES HAS BEEN INITIATED.

PR-672  
MAY 21, 1980

TEST AND DEVICES FOR WIND/ELECTRIC POWER  
CHARGED AEROSOL GENERATOR

MARKS POLARIZED CORPORATION  
XH-9-8128-1  
(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.

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PLANNED ACTIVITIES

COMPLETE ALL TESTING TO MINIMIZE PRESSURE DROP.

CONTINUE TESTING PERFORMANCE UNDER VARIED ATMOSPHERIC CONDITIONS.

ASSESSMENT

THE FINAL REPORT FOR THE FY78 FUNDED EFFORT HAS BEEN SUBMITTED BY THE PRINCIPAL INVESTIGATOR. WORK WAS PERFORMED UNDER A DOE CONTRACT.

## ELECTROFLUID DYNAMIC WIND DRIVEN GENERATOR

UNIVERSITY OF DAYTON RESEARCH INSTITUTE  
XII-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 DROPLETS AND GENERATOR PERFORMANCE.

CONDUCT WIND TUNNEL STUDIES, DEVELOP CHARGED 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, 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

ACCOMPLISHMENTS

CONDUCTED FURTHER ANALYSES OF RELATIONSHIPS BETWEEN BUBBLE CHARACTERISTICS, FORMULATION ENERGY, AND ELECTRIC FIELD MAGNITUDES.

PLANNED ACTIVITIES

CONTINUE THEORETICAL STUDIES OF CURRENT PRODUCTION AND GENERATOR GEOMETRY.  
CONDUCT TESTS OF ECONOMIC CHARGE PRODUCTION AND GENERATOR GEOMETRIES.

ASSESSMENT

THE CURRENT EFFORTS HAVE EXPERIENCED DELAYS IN TESTING AND A NO-COST EXTENSION HAS BEEN REQUESTED TO AUGUST 31, 1980.



PR-672  
MAY 21, 1980

## ENERGY FROM HUMID AIR

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

### 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
DEVELOP COMPUTER MODELING OF THE FLOW	6.5
STUDY LOSSES	6.6
STUDY CONDENSATION & COOLING DYNAMICS	6.7
ESTABLISH SYSTEM PERFORMANCE	6.8
DEVELOP STRUCTURAL DESIGN	6.9
ESTABLISH ECONOMIC ESTIMATES	6.10

ACCOMPLISHMENTS

CONTINUED WORK ON THE COMPUTER SOLUTION FOR THE INNER REGION BY INTEGRATING FROM THE OUTSIDE TOWARD THE CENTER.

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, AND A NO-COST EXTENSION HAS BEEN REQUESTED TO JUNE 30, 1980.

## VORTEX AUGMENTORS FOR WIND ENERGY CONVERSION

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

### 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, CONTROL, AND SAFETY ASPECTS OF THE VAC SYSTEM UNDER OPERATING CONDITIONS.

DEVELOP PERFORMANCE CHARACTERISTICS OF THE PROTOTYPE VAC SYSTEM.

TASKS

TASK NUMBERS

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

ACCOMPLISHMENTS

ALL TASK EFFORTS HAVE BEEN COMPLETED AND THE DRAFT FINAL REPORT IS IN PREPARATION.

PLANNED ACTIVITIES

COMPLETE AND SUBMIT THE DRAFT FINAL REPORT FOR REVIEW.

ASSESSMENT

THE DRAFT FINAL REPORT HAS NOT BEEN SUBMITTED.

## DYNAMIC INDUCER

AEROVIRONMENT, INC.  
XH-9-8085-1  
(PETER B. S. LISSAMAN, P.I.)

### OBJECTIVE

DETERMINE THE PERFORMANCE AND COST EFFECTIVENESS OF TIP VANE POWER AUGMENTATION ON A FIELD-OPERATED 4-M DIAMETER WIND TURBINE.

### APPROACH

DETERMINE THE OPTIMAL TIP VANE GEOMETRY WITH WIND TUNNEL TESTING OF A MODEL WITHOUT POWER BLADES.

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

CONDUCT FIELD TESTS OF THE FIELD SCALE DYNAMIC INDUCER.

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

TASKS

TASK NUMBERS

ANALYSIS OF DYNAMIC INDUCER	15.1
WIND TUNNEL TEST	15.2
FIELD TEST	15.3

ACCOMPLISHMENTS

COMPLETED ANALYSIS OF THE DYNAMIC INDUCER SYSTEM THAT INDICATES THAT A TIP VANE SYSTEM DESIGNED FOR THE KEDCO WIND TURBINE CAN ACHIEVE A COEFFICIENT OF POWER ABOVE THE BETZ LIMIT.

COMPLETED DESIGN OF THE WIND TUNNEL MODEL.

INITIATED BIDS FOR THE CONSTRUCTION OF A 1/3 SCALE MODEL OF THE KEDCO WITH TWO SETS OF REMOVABLE TIP VANES.

PLANNED ACTIVITIES

SCHEDULE TIME FOR WIND TUNNEL TESTING.

FABRICATE WIND TUNNEL MODEL.

CONTINUE COMPUTER ANALYSIS.

ASSESSMENT

THE CURRENT EFFORTS ARE ON SCHEDULE. A COST EXTENSION HAS BEEN REQUESTED TO COVER INCREASED G AND A RATES.



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MAY 21, 1980

## OSCILLATING VANE CONCEPT

UNITED TECHNOLOGIES RESEARCH CENTER  
XH-9-8085-2  
(R. L. BIELAWA, P.I.)

### 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.

TASKS

TASK NUMBERS

WIND TUNNEL MODEL DESIGN AND TESTING	16.1
ANALYSIS OF SYSTEM	16.2
PROTOTYPE DESIGN	16.3

ACCOMPLISHMENTS

COMPLETED FABRICATION AND ASSEMBLY OF THE WIND TUNNEL MODEL AND THE THREE INTERCHANGEABLE VANES (3.5-5.0, -AND 6.5-IN CHORDS).

COMPLETED AND CHECKED OUT THE DEVELOPMENT OF PERFORMANCE PREDICTION CODES AND UPGRADED THE FLUTTER ANALYSIS.

PLANNED ACTIVITIES

INITIATED TESTING OF THE WIND TUNNEL MODEL.

ASSESSMENT

THE CURRENT EFFORTS ARE ON SCHEDULE.

THE YAWING OF WIND TURBINES WITH BLADE CYCLIC PITCH

WASHINGTON UNIVERSITY TECHNOLOGY ASSOC., INC.  
XH-9-8085-3  
(DR. K. H. HOHENEMSER, P.I.)

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-0A SIZED MACHINE USING BLADE CYCLIC PITCH.

VERIFY THE ANALYTICAL RESULTS WITH FREE ATMOSPHERIC TESTING OF BLADE CYCLIC PITCH USED ON A SPECIFIC HAWT.

TASKS

	<u>TASK NUMBERS</u>
WIND TUNNEL MODEL DESIGN AND TESTING	17.1
ATMOSPHERIC TEST EQUIPMENT	17.2
ATMOSPHERIC TESTING	17.3

ACCOMPLISHMENTS

COMPLETED STATIC DEFLECTION AND DYNAMIC TESTING OF AW-10B BLADES.

COMPLETED THE AEROELASTIC STABILITY ANALYSIS OF THE SYSTEM.

CONTINUED CONSTRUCTION OF THE TEST SITE FOUNDATION.

COMPLETED FABRICATION AND ASSEMBLY OF ATMOSPHERIC WIND TURBINE.

PLANNED ACTIVITIES

COMPLETE A CHECK OUT OF THE ATMOSPHERIC TEST EQUIPMENT.

INITIATE ATMOSPHERIC TESTING.

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ASSESSMENT

THE CURRENT EFFORT IS ON SCHEDULE. CONTRACT COST MODIFICATION HAS BEEN REQUESTED FOR INCREASED INSTRUMENTATION OF THE FIELD TEST MODEL FOR HIGH STRESS AREAS.

SUBTASK BUDGET SUMMARY

BUDGET FOR FY80		PLANNED 1ST	
990K		AND 2ND	
TRANSFER FROM FY79	1ST AND 2ND	QUARTER	
447K	QUARTER	EXPENDITURES	
TOTAL BUDGET	EXPENDITURES		COMMITMENTS
1437K	340.7K	355.2K	196.5K

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 MAY 21, 1980

TABLE 18. SUBCONTRACTS

CONTRACTOR	WORK TITLE	PLANNED					ACTUAL		
		AMOUNT \$K	PR. COMPL. DATE	START DATE	END DATE	AMOUNT TO BE COSTED DURING FY80	AMOUNT \$K	START DATE	AMOUNT TO BE COSTED \$K
<u>3535.35 WEIS</u>									
WEST VIRGINIA UNIV.	INNOVATIVE WECS	120	1/30	4/80	4/81	60			
GRUMMAN	DAWI	120	2/80	5/80	1/81	95			
DAYTON UNIV.	EFD STUDIES	120	3/80	6/80	6/81	85			
GRUMMAN	TORNADO	200	2/80	5/80	5/81	75			
TBD (COMPETITIVE)	ASSESSMENT OF SPECIFIC WEIS	191	2/80	9/80	8/81	15			

WEIS (3533.35)

Task or Subtask Activities	Fy 80												Fy 81					
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Subtask Management	△	◆		◆			◆	▽										
WEIS Conference				△				▽			◆		□					
Project Management	△			◆		◆		▽	◆									
Award Renewal Contracts		△				▽				▽								
Award Solicited Contracts			△								△							
Cumulative Accrued Costs \$ X1000	Planned	63.0	124.8	186.2	242.5	299.8	355.2	402.4	440.3	479.1	543.8	618.9	728.3					
	Actual	50.2	109.5	181.2	237.5	288.8	340.8											
	Variance	12.8	15.3	5.0	5.0	11.0	14.4											

- △ Begin Milestone
- ▽ Milestone Complete
- Equipment Arrival
- Progress Report
- Draft Final Report
- Final Report
- ◆ Workshop or Special Meeting



PR-672  
MAY 21, 1980

ENGINEERING ANALYSIS AND COST ESTIMATING OF INNOVATIVE WECS

PETER SOUTH

### OBJECTIVES

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

PROVIDE AERODYNAMIC AND ENGINEERING ANALYSES OF IWECS TO ASCERTAIN THEIR PERFORMANCE, STRUCTURAL, AND MATERIAL CHARACTERISTICS.

### ACCOMPLISHMENTS

PREPARED RFP TO DEVELOP SAMICS PROGRAM FOR PRODUCTION COSTING OF WECS.

BEGAN WRITING MANUAL DESCRIBING ESSENTIAL CHARACTERISTICS OF IWECS AND THEIR SUBSYSTEMS.

ISSUED CONTRACT TO A CONSULTANT (ROBERT ALLEN) TO ANALYZE THE PRODUCTION COSTS OF A MADARAS WIND SYSTEM.

### PLANNED ACTIVITIES

CONTINUE AERODYNAMIC ANALYSES OF DAWT AND TORNADO WHILE INITIATING OTHER ANALYSES (E.G., CIRCULATION CONTROLLED VAWT).

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MAY 21, 1980

DEVELOP SAMICS METHOD FOR PRODUCTION COSTING.

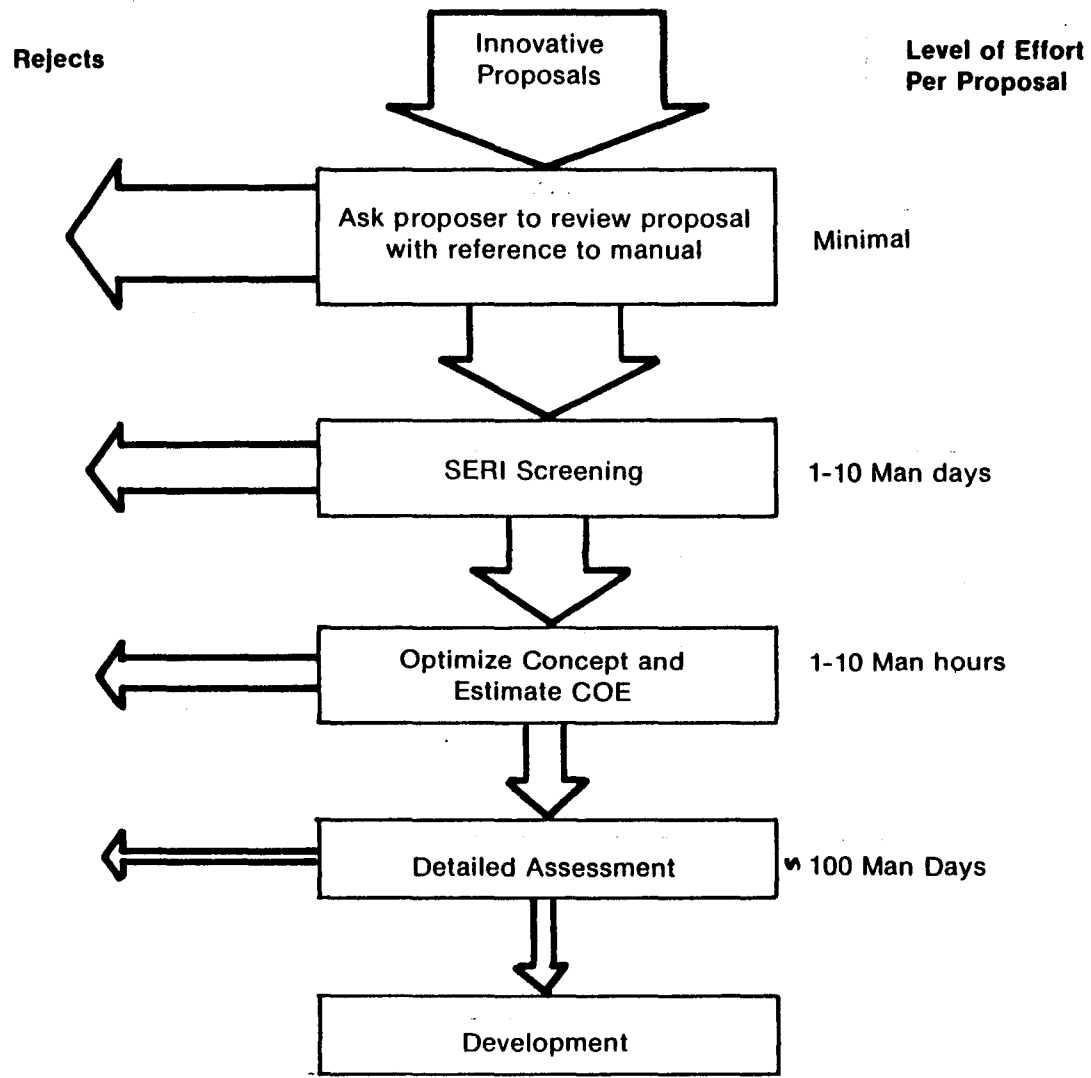
WRITE, ACQUIRE REVIEW FOR, AND SEND RFP'S FOR IWECS DEVELOPMENT COSTING.  
CONTINUE WORK ON REPORT DESCRIBING FUNDAMENTAL AERODYNAMIC CHARACTERISTICS OF  
GENERIC IWECS.

SUBTASK PROGRESS HAS SLIPPED DUE TO PRIORITY OF NOISE SUBTASK AND LACK OF  
PERSONNEL.

OUTPUT

REPORTS DESCRIBING COSTING TECHNIQUES SUITABLE FOR IWECS TO EVALUATE POTENTIAL  
AND COST EFFECTIVENESS, DEVELOPMENT COSTS, AND PRODUCTION COSTS.

REPORTS ON AERODYNAMIC CHARACTERISTICS OF IWECS.



## DEVELOPMENT COSTS METHODOLOGY

### APPROACH

ESTABLISH COST DATA BASE FOR FIRST UNIT COSTS.

FIND COST ESTIMATING RELATIONSHIPS OR ALGORITHMS IN THE DATA BASE.

### PRODUCTION COSTING

#### APPROACH

THE IWECs WILL BE CONSIDERED A COMBINATION OF A LIMITED VARIETY OF SUBSYSTEMS. THE ESSENTIAL CHARACTERISTICS OF THESE SUBSYSTEMS WILL BE STUDIED AND CATALOGUED. THE CLASSES OF SUBSYSTEMS LIKELY TO BE COST-EFFECTIVE WILL BE DETERMINED FROM THIS STUDY, ALLOWING THE ASSESSMENT OF THE POTENTIAL OF MOST INNOVATIVE PROPOSALS TO BE MADE.

THE INNOVATIVE PROPOSAL WILL BE PROCESSED IN A SERIES OF STEPS, EACH STEP REQUIRING ROUGHLY AN ORDER OF MAGNITUDE MORE EFFORT THAN THE PRECEDING ONE. AT EACH LEVEL THE PROPOSALS PROVEN NOT TO BE COST-EFFECTIVE WILL BE DISCARDED.

THE FIRST STEP WILL BE TO SEND THE INNOVATOR A MANUAL THAT DESCRIBES THE COST EFFECTIVENESS OF VARIOUS TYPES OF SUBSYSTEM AND REQUEST THAT HE ILLUSTRATE WHERE HIS DEVICE IS MORE COST EFFECTIVE THAN OTHERS.

IN THE SECOND STEP, A SIMILAR EVALUATION WILL TAKE PLACE WITHIN SERI.

THIRDLY, THE PROPOSED CONFIGURATION WILL BE OPTIMIZED USING GENERAL PERFORMANCE AND COST CRITERIA. THE OPTIMIZED CONFIGURATIONS WILL BE COSTED USING DATA PRODUCED BY THE SAMICS PROGRAM AND COE DETERMINED.

A DETAILED ANALYSIS THAT WILL BE REQUIRED FOR ALL THE PROPOSALS THAT CANNOT BE SHOWN TO BE NONCOST-EFFECTIVE.

FINALLY, THE PROPOSALS WILL GO THROUGH A DEVELOPMENT AND PROOF-OF-CONCEPT PHASE.

BUDGET SUMMARY

BUDGET	1ST QUARTER AND 2ND EXPENDITURES	PLANNED 1ST AND 2ND QUARTER EXPENDITURES	COMMITMENTS
362K	41.2K	46.4K	0

TABLE 20. SURCONTRACTS

CONTRACTOR	WORK TITLE	PLANNED					ACTUAL		
		AMOUNT \$K	PR. COMPL. DATE	START DATE	END DATE	AMOUNT TO BE COSTED DURING FY80	AMOUNT \$K	START DATE	AMOUNT TO BE COSTED \$K
<u>3533.40 ENGINEERING ANALYSIS AND COST ESTIMATING OF IWECS</u>									
TBD (COMPETITIVE)	DEVELOPMENT COSTING METHODOLOGY	25	1/80	6/80	10/80	25			
TBD (COMPETITIVE)	PRE-PRODUCTION COSTING METHOD- OLOGY	183	2/80	9/80	3/81	30			

**Cost Estimating and Engineering Analysis of Weis (3533.40)**

Task or Subtask Activities		Fy 80											Fy 81					
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Development Cost Methodology		△							▽									
Engineering Evaluation (innovative manual)				△			▽					□						
Production Cost Methodology					△			▽									□	
Subtask Management		△	◆		◆		◆		◆		◆		◆		◆			
Cumulative Accrued Costs \$ X1000	Planned	5.2	7.5	14.1	23.8	33.5	46.4	60.1	85.4	112.6	137.9	166.9	210.4					
	Actual	6.0	10.0	15.8	25.2	28.6	41.2											
	Variance	(0.8)	(2.5)	(1.7)	(1.4)	4.9	5.2											

- △ Begin Milestone
- ▽ Milestone Complete
- Equipment Arrival
- Progress Report
- Draft Final Report
- Final Report
- ◆ Workshop or Special Meeting



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MAY 21, 1980

TECHNICAL INFORMATION DISSEMINATION

PATRICIA WEIS

OBJECTIVE

ENHANCE MARKET DEVELOPMENT FOR WECS BY CONVERTING THE TECHNICAL RESULTS OF THE FEDERAL R&D PROGRAM INTO TOOLS FOR WIDER AUDIENCES, ESPECIALLY DEVELOPERS, INFLUENCERS, AND USERS.

ACCOMPLISHMENTS

FILM "WIND: AN ENERGY ALTERNATIVE" - 12 MINUTES

- o APPROVED FOR SALE BY NATIONAL AUDIO VISUAL CENTER, \$76.50 STOCK #A02709
- o 60 COPIES ORDERED FOR TIC FILM LIBRARY
- o RSEC's, LABS, DOE, AND SERI ALSO GET COPIES.

VIDEOTAPE "WIND ENERGY THEATER" - 46 MINUTES

- o 20 COPIES DISTRIBUTED AND LOANED
- o ENCOURAGE BORROWERS TO COPY

DRAFT CAPITAL FORMATION FOR SWECS MANUFACTURERS - AWEA

- o BEING REVIEWED BY RSEC'S, ATTENDEES, SERI, DOE, AND OTHERS
- o INITIAL REVIEWS VERY POSITIVE, EXPECT FEW CHANGES.

DRAFTS BEING REVIEWED AND FINALIZED FOR PRINTING IN MAY--RDD CONSULTANTS. THE  
DOE LARGE WIND TURBINE DEVELOPMENT PROGRAM.

- o TECHNICAL HISTORY AND OVERVIEW
- o 50 PAGES TYPESET WITH 60 ILLUSTRATIONS

THE DOE LARGE WIND TURBINE PROGRAM

- o EXECUTIVE SUMMARY OF #1
- o 8 PAGES TYPESET

THE MOD 2 WIND TURBINE PROJECT

- o TECHNICAL OVERVIEW
- o 25 PAGES TYPESET, 20 ILLUSTRATIONS

WINDPOWER-MOD 2

- o PAMPHLET FOR DEDICATIONS ETC.

PRELIMINARY DRAFT - PLANNING GUIDE FOR COMMUNITY APPLICATIONS OF WECS - RSSG

- o FIRST DRAFT VERY ROUGH
- o CONTRACT FUNDS EXPENDED
- o SERI STAFF INPUT AND REVISIONS BEING MADE
- o NEGOTIATIONS WITH CONTRACTOR IN PROGRESS

PLANNED ACTIVITIES

PUBLISH AND DISTRIBUTE CAPITAL FORMATION FOR SWECS MANUFACTURERS

- o PRINT IN MAY
- o DISTRIBUTE TO AWEA GENERATED LIST OF MANUFACTURERS AND DISTRIBUTORS
- o COPIES TO RSECS

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PUBLISH AND DISTRIBUTE MATERIALS ON LARGE WIND TURBINES.  
COMPLETE DRAFT OF PLANNING GUIDE FOR EXTERNAL REVIEW.

UPDATE AND REPRINT WIND ENERGY INFORMATION DIRECTORY.

- o 10,000 DISTRIBUTED
- o GOOD READER RESPONSE

PRELIMINARY DRAFT OF SITING COURSE FOR SWECS

- o BEING DRAFTED NOW AT SERI
- o WILL INCLUDE INPUT FROM CONSULTANTS ON PRACTICAL ASPECTS OF SITING AND INSTALLATION.

UPDATE AND DISPLAY OF LARGE EXHIBITS ON WIND ENERGY

- o SUBCONTRACT TO ROCKWELL EXHIBITS GROUP
- o JOINT PROJECT WITH ROCKY FLATS WIND GROUP

PRELIMINARY DRAFT OF A/V MATERIALS KIT FOR REVIEW

- o BEING DRAFTED NOW AT SERI

OUTPUT

SITING COURSE FOR SMALL WECS - SLIDE SHOW

PLANNING GUIDE FOR COMMUNITY APPLICATIONS OF WECS - HANDBOOK

CAPITAL FORMATION FOR SWECS MANUFACTURERS - A GUIDE TO METHODS AND SOURCES

THE DOE LARGE WIND TURBINE DEVELOPMENT PROGRAM - TECHNICAL BRIEF

THE DOE LARGE WIND TURBINE PROGRAM - TECHNICAL SUMMARY

THE MOD 2 DEVELOPMENT PROJECT - TECHNICAL BRIEF

WINDPOWER - MOD 2 - PAMPHLET

WIND: AN ENERGY ALTERNATIVE - 16 MM MOVIE

WIND ENERGY THEATER - VIDEOTAPE

AIV MATERIALS KIT - SLIDE SHOW

EXHIBITS

BUDGET SUMMARY

FY80 BUDGET			
250K			
CARRY OVER FY79 BUDGET			
123K			
TOTAL BUDGET			
373K			
	1ST AND 2ND QUARTER	PLANNED 1ST AND	
	EXPENDITURES	2ND QUARTER	
	117.6K	EXPENDITURES	COMMITMENTS
		128.9K	13.8K

TABLE 20. SUBCONTRACTS

CONTRACTOR	WORK TITLE	PLANNED					ACTUAL		
		AMOUNT \$K	PR-COMPL-DATE	START DATE	END DATE	AMOUNT TO BE COSTED DURING FY80	AMOUNT #K	START DATE	AMOUNT TO BE COSTED \$K
AWEA	CAPITAL FORMATION	20	--	9/79	4/80	20	20	9/79	20
RSSG	COMMUNITY GUIDE	25	--	10/79	2/80	25	28	10/79	28
ROCKWELL INTERNATIONAL	EXHIBITS ON WIND	50	--	5/80	11/80	55			



Technical Information Dissemination (6722.16)

Task or Subtask Activities	Fy 80												Fy 81					
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Siting Course				△				▽			□	■						
Large Wind Turbines			△				□	■	▽									
Community Guide	△			□				▽	□			■						
AV Materials Kit			△					▽	□			■						
Handbook on Capital						□		■	▽									
Film Version of Multimedia	△			■			▽											
DOE-ACTS			△	□	■	▽				●	●	●	●	●				
Exhibits & Educational Materials						△		▽	■									
Update & Reprint Directory								▽										
Cumulative Accrued Costs \$ X1000	Planned	27.4	54.4	80.5	116.5	133.7	154.5	194.1	231.1	264.5	318.7	331.8	349.2					
	Actual			93			117.6											
	Variance			(12.5)			36.9											

- △ Begin Milestone
- Equipment Arrival
- Draft Final Report
- ◆ Workshop or Special Meeting
- ▽ Milestone Complete
- Progress Report
- Final Report

PR-672  
MAY 21, 1980

SMALL WIND TURBINE PRODUCTION EVALUATION  
AND COST ANALYSIS

CARL NORDQUEST

OBJECTIVE

THE OBJECTIVE OF THIS TASK IS TO DEVELOP TECHNICAL AND COST EVALUATIONS OF SMALL WIND ENERGY CONVERSION SYSTEMS (WIND TURBINES OF LESS THAN 100 KW RATING) TO IDENTIFY THE BENEFITS OF AUTOMATION FOR REDUCING PRICES AND TO UNDERSTANDING THE TECHNICAL REQUIREMENTS FOR LOW-COST HIGH VOLUME PRODUCTION. THIS TASK HAS A FURTHER OBJECTIVE OF PROVIDING AN ANALYTICAL FOUNDATION FOR THE EVALUATION OF FUTURE WIND TURBINE DESIGNS.

APPROACH

THE SCOPE OF WORK IS DIVIDED INTO THREE PRINCIPAL TASKS. THE FIRST TASK IS A PRODUCTION REDESIGN OF THE WIND TURBINE. THE SECOND TASK IS A PRODUCTION ANALYSIS AND THE THIRD TASK IS A COST ANALYSIS OF THE WIND TURBINE. A CONTRACT WILL BE GIVEN TO A FIRM WITH PROVEN MASS PRODUCTION AND AUTOMATION EXPERIENCES TO PERFORM THE TASKS. OVER 100 FIRMS RESPONDED TO THE CBD. HOWEVER ONLY SIX RESPONDED TO THE RFP SINCE THE SELECTION CRITERIA SPECIFIED THAT THE BIDDER HAVE EXTENSIVE ACTUAL AUTOMATION EXPERIENCE.

THE PRODUCTION REDESIGN AND PRODUCTION ANALYSIS ARE DONE CONCURRENTLY UTILIZING THE ENTIRE TASK GROUP. EVERY PART AND ASSEMBLY MUST BE ANALYZED FOR AUTOMATION POTENTIAL.

ACCOMPLISHMENTS

- o RFP (RH-0-9049) ISSUED FEBRUARY 5, 1980.
- o THE PROPOSAL EVALUATION BOARD HAS REACHED A CONCLUSION IN SELECTING THE SUBCONTRACTOR. A CONTRACT WILL BE AWARDED BY JULY 1.
- o SMALL WIND TURBINE SELECTED FOR ANALYSIS.
- o PREPARED A LIST OF QUESTIONS FOR THE FINAL NEGOTIATIONS WHICH SHOULD TAKE PLACE THE FIRST PART OF JULY 1980.

PLANNED ACTIVITIES

- o INITIATE CONTRACT WITH SELECTED MANUFACTURER.
- o PROVIDE WIND TURBINE TO CONTRACTOR FOR ANALYSIS/DESIGN.

OUTPUT

- o EVALUATION OF PRODUCTION SUITABILITY OF SELECTED 8-10 kW WIND TURBINE AND DESIGN MODIFICATION WHERE APPROPRIATE TO MAKE IT ADAPTABLE TO PRODUCTION BY AUTOMATED METHODS.
- o DETAILED COST ESTIMATES ON NONRECURRING AND RECURRING COST ELEMENTS FOR THREE PRODUCTION SENARIOS. THE WORK INCLUDES FACTORY PLANS, ASSEMBLY FLOW SHEETS, MATERIAL PROCUREMENT PLAN, CAPITAL EQUIPMENT/FACILITIES

LIST, PLANT LAYOUT, WORK STATION DESCRIPTIONS AND MANPOWER/MATERIAL FOR EACH STATION.

- O IN-DEPTH COST AND SENSITIVITY ANALYSIS ON UNIT HARDWARE COSTS CONSIDERING CHARGES IN PRODUCTION QUANTITY/RATE; TOOLING CONCEPTS; ADDITIONAL AUTOMATION; TOLERANCES AND RELIABILITY.
- O A REPORT ON ALL OF THE ABOVE SHOULD BE READY FOR PRINTING SIX MONTHS AFTER THE CONTRACT DATE.
- O PLANT FACILITIES, SWECS COST AND TOOLING REQUIRED WILL BE FURNISHED FOR THREE PRODUCTION LEVELS: 100,000/YR, 750,000/YR, AND 2,000,000/YR.

BUDGET SUMMARY

	1ST AND 2ND QUARTER EXPENDITURES	PLANNED 1ST AND 2ND QUARTER EXPENDITURES	
	LABOR: \$41K	\$51K	
	MATERIAL: 1K	22K	
	OTHER DIRECT: —	25K	
FY90 BUDGET			COMMITMENTS
\$279K			0
(NOT WIND FUNDS)	\$42K*	\$98K	

\*ACTUALS LESS THAN PLANNED BECASUE WIND TURBINE NOT PROCURED AND SUBCONTRACT NOT LET.

PR-672  
MAY 21, 1980

SUBCONTRACT SUMMARY

	<u>NUMBER</u>	<u>(\$ x K) AMOUNT</u>
PLANNED SUBCONTRACTS	1	130
PURCHASE REQUESTS APPROVED	1	130
SUBCONTRACTS AWARDED/\$ COMMITTED	0	0



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