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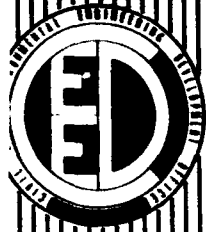
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CIVIL and ENVIRONMENTAL ENGINEERING

DEVELOPMENT OFFICE

FISCAL YEAR 1980

TECHNICAL OBJECTIVES DOCUMENT

12 21p.

PROGRAMS AND RESOURCES OFFICE

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FORM 102
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15 DECEMBER 1978

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CEEDO

**CIVIL AND ENVIRONMENTAL
ENGINEERING DEVELOPMENT OFFICE**
(AIR FORCE ENGINEERING AND SERVICES CENTER)

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER CEEDO-TR-78-52	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) CIVIL AND ENVIRONMENTAL ENGINEERING DEVELOPMENT OFFICE FY1980 TECHNICAL OBJECTIVES DOCUMENT		5. TYPE OF REPORT & PERIOD COVERED Technical Programs Objectives FY80
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s)		8. CONTRACT OR GRANT NUMBER(s) N/A
9. PERFORMING ORGANIZATION NAME AND ADDRESS Det 1 (CEEDO) AFESC/PRX Tyndall AFB FL 32403		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 62601F, 63723F, 64708F Planning Type Document
11. CONTROLLING OFFICE NAME AND ADDRESS Det 1 (CEEDO) AFESC/PRX Tyndall AFB FL 32403		12. REPORT DATE 15 November 1978
		13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Civil Engineering Energy Conservation Soils Environmental Quality Fire Protection Corrosion Pavements Shelters Structures		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This TOD describes the three Technical Planning Objectives developed to guide the conduct of research and development in passive defense techniques for the theater airbase, pavement studies, environmental pollution abatement and control, air mobility concepts, fire fighting equipment and resource/energy conservation. X		

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INTRODUCTION

The Air Force Technical Objective Document (TOD) program is an integral part of the process by which the Air Force plans and formulates a detailed technology program to support the development and acquisition of Air Force weapon systems. Each Air Force laboratory annually prepares a Research and Technology (R&T) Plan in response to available guidance based on USAF requirements, the identification of scientific and technological opportunities, and the needs of present and projected systems. These plans include proposed efforts to achieve desired capabilities, to resolve known technical problems, and to capitalize on new technical opportunities. The proposed efforts undergo a lengthy program formulation and review process. Generally, the criteria applied during the formulation and review are responsiveness to stated objectives and known requirements, scientific content and merit, program balance, developmental and life cycle costs, and consideration of payoff versus risk.

It is fully recognized that the development and accomplishment of the Air Force technical program is a product of the teamwork on the part of the Air Force laboratories and the industrial and academic research and development community. The TOD program is designed to provide to industry and the academic community, necessary information on the Air Force laboratories' planned technology programs. Each laboratory's TOD is extracted from its R&T Plan.

Specific objectives are:

- a. To provide planning information for independent research and development programs.
- b. To improve the quality of the unsolicited proposals and R&D procurements.
- c. To encourage face-to-face discussions between nongovernment scientists and engineers and their Air Force counterparts.

One or more TODs have been prepared by each Air Force laboratory that has responsibility for a portion of the Air Force Technical Programs. Classified TODs are available from the Defense Documentation Center (DDC) and unclassified TODs are available from the National Technical Information Service (NTIS).

HOW TO USE THIS DOCUMENT

Unsolicited proposals to conduct programs leading to the attainment of any of the objectives presented in this document may be submitted directly to an Air Force laboratory. However, before submitting a formal proposal, we encourage you to discuss your approach with the laboratory point of contact. After your discussion or correspondence with the laboratory personnel, you will be better prepared to write your proposal.

As stated in the "AFSC Guide for Unsolicited Proposals" (copies of this informative guide on unsolicited proposals are available by writing to Air Force Systems Command/PPFR, Andrews Air Force Base, Washington DC 20334), elaborate brochures or presentations are definitely not desired. The "ABCs" of successful proposals are accuracy, brevity, and clarity. It is extremely important that your letter be prepared to encourage its reading, to facilitate its understanding, and to impart an appreciation of the ideas you desire to convey. Specifically, your letter should include the following:

1. Name and address of your organization.
2. Type of Organization (Profit, Nonprofit).
3. Concise title and abstract of the proposed research and the statement indicating that the submission is an unsolicited proposal.
4. An outline and discussion of the purpose of the research, the method of attack upon the problem, and the nature of the expected results.
5. Name and research experience of the principal investigator.
6. A suggestion as to the proposed starting and completion dates.
7. An outline of the proposed budget, including information on equipment, facility, and personnel requirements.
8. Names of any other Federal agencies receiving the proposal. (This is extremely important.)
9. Brief description of your facilities, particularly those which would be used in your proposed research effort.
10. Brief outline of your previous work and experience in the field.
11. If available, you should include a description brochure and a financial statement.

As you read through the pages that follow, you may see a field of endeavor where your organization can contribute to the achievement of a specific technical goal. If such is the case, you are invited to discuss the objective further with the scientist or engineer identified with that objective. Further, you may have completely new ideas not considered in this document which, if brought to the attention of the proper organization, can make a significant contribution to our military technology. We will always maintain an open mind in evaluating any new concepts which, when successfully pursued, would improve our future operational capability.

On behalf of the United States Air Force, you are invited to study the objectives listed in this document and to discuss them with the responsible Air Force personnel. Your ideas and proposals, whether in response to the TODs or not, are most welcome.

MISSION

On 15 November 1978 the Civil and Environmental Engineering Development Office (CEEDO) was inactivated as Detachment 1, ADTC (AFSC) and reactivated as Detachment 1, Air Force Engineering and Services Center (AFESC). While no longer part of the Air Force Systems Command, CEEDO (AFESC) will continue to be the lead agency for Research, Development, Test, and Evaluation in the area of civil and environmental quality engineering. In support of the Director of Science and Technology (HQ AFSC), CEEDO is the focal point for environmental quality technology, and facilities energy.

DIRECTOR'S ASSESSMENT

Mission needs of the Air Force dictate that the major technical emphasis of Civil Engineering Technology be upon the rapid runway repair (RRR) of bomb damaged runways. The quest for this technology not only directly supports the Air Force mission but also provides the significant technical opportunity to advance the static technology of present day geotechnical efforts. RRR constitutes a major investment of resources to achieve short and long range objectives and will dominate CEEDO's civil engineering technology efforts from the present to at least FY84. Emphasis on other technical areas of Environmental Quality, Facilities Energy, and Resource Conservation will remain at the present level.

The Environmental Quality program is expected to continue toward meeting the Air Force-stated objectives that its activities demonstrate leadership in conformance with the Environmental Policy Act, public laws, and their implementation among federal agencies. New alternate fuels, once identified, must be thoroughly analyzed regarding potential pollution problems which could inhibit Air Force operations if and when implemented. The strategies and technologies for required pollution abatement and/or control must accompany these analyses. The energy program will continue to investigate methods for reducing energy consumption and costs in the operation and maintenance areas through development of a total energy system concept. Geothermal, solar, wind, and the recovery/utilization of rejected energy will be initial efforts undertaken in this area. Subordinate to RRR, the mobility shelter program will continue toward the development of a DOD standard of construction. When the threat analysis indicates a requirement, development of methodologies for increased hardening or new passive defense techniques will be started. The geotechnical area will continue with pavement maintenance management technology.

In the area of environmental quality the Air Force must show that pollutants resulting from its current and planned operations comply with the environmental quality standards established by the federal, state, and local regulatory agencies. Adequate analytical techniques, and thus quantitative emission data, are often not available to demonstrate

compliance. Major thrusts in environmental quality will be the development and fabrication of sensitive and reliable instrumentation to collect appropriate emission data, the development and refinement of computer models with which to assess the environmental impact of Air Force operations, and the formulation of strategies and techniques for controlling the levels of emission. Environmental Quality is the only area in which CEEDO has programs in the three developmental phases: exploratory, advanced, and engineering.

In the area of facilities energy, the major thrust will be development of a total energy system concept which will lead to energy self-sufficiency first for remote sites and ultimately for all installations. This concept envisions a multifaceted approach including development and integration of the following subsystems: energy recovery from currently wasted sources, a combination of alternate systems (solar, wind, geothermal, etc.) taking full advantage of a given site's potential, a reliable single point storage system, and a control system interfacing the new energy sources with the existing utility system accounting for all existing site/system characteristics and mission. CEEDO's efforts will be directed to development or adaptation, in the case of emerging technologies, alternate energy systems suitably scaled for AF remote site applications. This program was developed to make full use of existing and planned energy R&D by other federal agencies. Maximum emphasis is being placed on joint DOE/CEEDO funded projects in all areas of facilities energy R&D which are AF unique, particularly AF relevant or time critical.

In the shelter area, the major thrust is the development of a greatly improved family of tactical/mobility shelters. A recent study revealed that within the next decade the need for shelters will more than quadruple. The objective of near-term efforts must be toward development of materials and techniques to improve tactical shelters; long-term efforts must be aimed at development of a standardized family of shelters that can meet requirements throughout the Department of Defense.

The major thrust in aircraft operational surfaces will be the development of an improved rapid runway repair (RRR) capability. Included in RRR are the materials, techniques, and equipment for repair of spall damage and craters of all sizes. Efforts will be initiated toward development of concepts and techniques for an alternate aircraft launch surface capability. These are launch and recovery surfaces other than conventionally surfaced runways.

RELATIONSHIP OF PROGRAMS TO OTHER EFFORTS

The three technology planning objectives (TPOs) established by CEEDO are as follows: Environmental Quality (TPO-1), Facilities Energy and Resources Conservation (TPO-2), Civil Engineering Technology (TPO-3). Close coordination with R&D programs of Army and Navy laboratories is effected through the Joint Services Civil Engineering Research and

Development Coordinating Group (JSCERDCG) on a regular, formal basis. This prevents duplication of effort and makes for maximum utilization of laboratory expertise and capabilities. Air Force civil engineering requirements are further defined and identified through the Civil Engineering Research and Development Review Council.

TPO 1 - Environmental Quality: CEEDO is the laboratory focal point for all AFSC environmental quality efforts. This entails formal coordination with all AFSC laboratories as well as other DOD components. Informal coordination through regional meetings, seminars, and workshops provide interface with governmental agencies and the private sector.

TPO 2 - Facilities Energy and Resources Conservation: CEEDO and the Aeropropulsion Laboratory (APL) are the Air Force organizations responsible for conducting Research and Development in terrestrial energy systems. CEEDO is the AFSC lead laboratory for facility energy research. APL is the lead laboratory for mobile, unattended, and special power functional areas. These and the programs of the other services are coordinated through tri-service working groups, the facility energy sub-committee of the JSCERDCG and the Interagency Advanced Power group composed of Army, Navy, Air Force, NASA and DOE representatives. Attendance at regional meetings, workshops and seminars provides interface with other governmental agencies and the private sector.

TPO 3 - Civil Engineering Technology: Research and development in this area is a primary function of CEEDO and is conducted through contracts with the Army, Navy, and the private sector. Rapid Runway Repair research is closely coordinated with our foreign allies in NATO.

ORGANIZATION

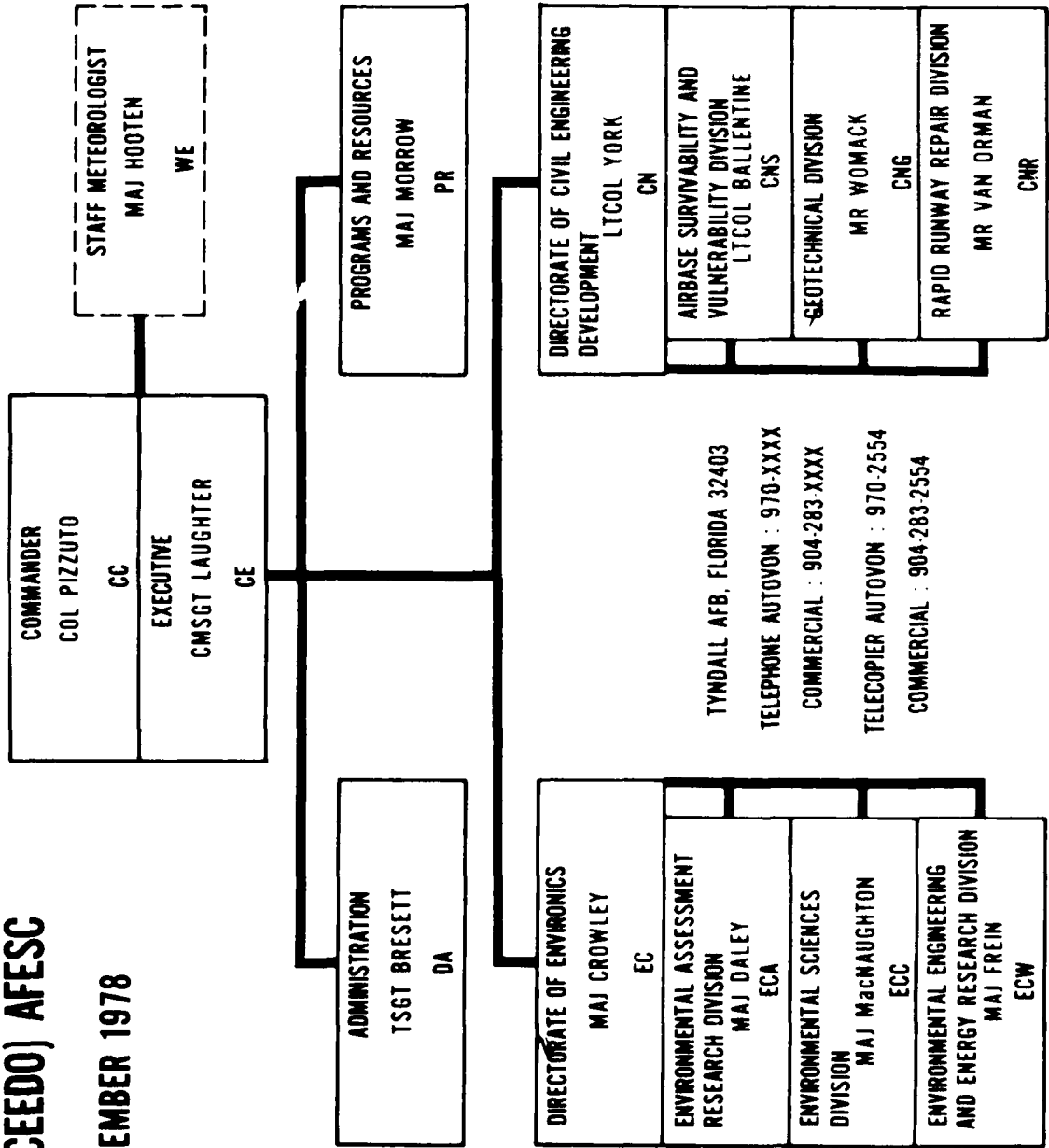
CEEDO is organized to reflect the major mission areas of civil engineering and environmental quality RDT&E.

FACILITIES

CEEDO currently fully occupies two base facilities and partially occupies two others. The Environics Laboratory is fully staffed and equipped and is used to conduct bench level and pilot-plant evaluations of methods to reduce and control pollution from Air Force unique activities, plus determinations of the fate and effects of Air Force unique pollutants. Other facilities such as weapon and pavement test section sites; corrosion and soils and pavements laboratories; and computation facilities are available for use.

DET 1 (CEEDO) AFESC

NOVEMBER 1978



TECHNOLOGY PROGRAMS

CEEDO technology programs encompass three fields: Environmental Quality, dealing with all areas and activities affecting or affected by air base development and operations; Facilities Energy and Resource Conservation, dealing with alternate energy resources for Air Force facilities, conservation of resources and recovery of materials and/or energy from refuse; Civil Engineering Technology, dealing with geotechnical engineering, rapid runway repair, protective construction, air mobility systems, facility corrosion and fire protection systems. Detailed descriptions of the TPOs follow.

TECHNOLOGY PLANNING OBJECTIVE

TPO 1: ENVIRONMENTAL QUALITY

GENERAL OBJECTIVE AND INVESTMENT STRATEGY:

The objective of this technology is to provide Air Force managers with a process for making rational choices among alternative futures to insure continued uninterrupted mission operation IAW federal environmental quality laws, conservation of resources, and the development of facilities and services required to support Air Force activities. It addresses the unified social, economic, and physical development of Air Force communities and their environs, including their relationships with states, regional, and national objectives, and incorporates the scope of "comprehensive planning." It includes all areas/activities affecting or affected by air base development and operations.

Without a long-range and an associated integrated environmental RDT&E program, the military services will be forced into a long series of reactions to crisis situations which could stop or detract from their basic mission of national defense and result in inefficiency of performance. For environmental considerations to be evaluated realistically and promptly so as not to impede the overall decision making process, research and development in environmental quality is critical and operational requirements cannot be met without it.

SPECIFIC GOALS AND TECHNICAL APPROACHES:

The principal goal is to provide technology that will overcome the effects of physical, chemical, and biological pollutants that adversely affect human health or welfare, unfavorably alter ecological balances important to human life, adversely affect animal or plant life, cause damage to and deterioration of man-made materials or property, or degrade the utility of the environment for aesthetic and recreational purposes.

The technical approach is to investigate, understand, and model the basic phenomena underlying the pollution generation, transport, and control process. This includes identifying the source and character of

significant emissions; evaluating pollutant life cycle interactions; defining environmental transport and chemical mechanisms; developing control, detection, monitoring, disposal, recovery, recycle, and abatement technology, assessing environmental impact of Air Force decisions; and, finally, addressing environmental assessment and impact evaluation techniques using a systematic interdisciplinary approach for decision making.

Three major thrust areas have been established under which technology will be developed. Each thrust area has major supporting tasks.

A. ENVIRONMENTAL CHEMISTRY AND MONITORING OF AIR FORCE POLLUTANTS
(TASK 20)

Ambient Pollutant Measurement Systems

Source Emission Measurement Systems

Chemical and Physical Pollutant Transport Mechanisms

B. POLLUTION CONTROL TECHNOLOGY (TASK 70)

Compliance and Conservation Driven

Air and Water Pollution Control

C. ENVIRONMENTAL ASSESSMENT TECHNOLOGY (TASK 90)

Environmental Quality Assessment Methodologies

Environmental Data Baselines

Natural Resources Management

Comprehensive Environmental Planning

The general criteria to be followed in carrying out the R&D efforts are as follows: (1) Develop the technology and hardware necessary to assess, control and/or abate the pollution emanating from operations, facilities, or equipment unique to the Air Force; thus meeting applicable environmental standards in situations where operations or equipment may be adversely restricted or impacted because of lack of commercial solution; (2) Develop data pertinent to Air Force operations to serve as the basis for standards or criteria where none exist, or modify existing standards or criteria that appear to be based upon inadequate data; (3) Develop R&D programs to make present pollution abatement technology more timely and cost-effective; (4) Engage in R&D efforts necessary to evaluate and extend the technology base in a specific pollution-abatement area where Air Force has unique expertise or has equipment that is not available in the civilian community. Criteria 1 and 2 are most important, and in all

cases the Air Force will participate in joint R&D efforts with organizations engaged in mutually beneficial environmental projects.

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TECHNOLOGY PLANNING OBJECTIVE

TPO 2: FACILITIES ENERGY AND RESOURCE CONSERVATION

GENERAL OBJECTIVE AND INVESTMENT STRATEGY:

Research, development, and investment in this technology area provide the technology base and hardware development for application of alternate energy resources to Air Force facilities, conservation of valuable Air Force resources and development of technically feasible, cost-effective, military-applicable design criteria and specifications for technologies to recover materials and/or energy from refuse in accordance with Congressional Legislation and directives, Executive Orders, Environmental Protection Agency mandatory "Guidelines" and DOD directives.

Development of renewable and/or alternate energy sources is essential to reduce dependence on limited fossil-based fuels. Continued reliance on petroleum, particularly from foreign sources, will result in increased susceptibility to energy shortages, ultimately challenging the Air Force's ability to fulfill its mission requirements. In addition, costs for petroleum products continue to rise rapidly making it increasingly expensive to operate Air Force facilities. Similarly, in the area of materials used in day-to-day operations, costs continue to rise making it necessary to seek technologies for recovery/reuse of resources. The ultimate goal of this technology area is more effective mission support at reduced operation and maintenance costs through energy self-sufficiency and maximum recovery/reuse of valuable resources consistent with national environmental and energy policy.

SPECIFIC GOALS AND TECHNICAL APPROACHES:

The principal goal of the facilities energy area is to provide technology that will lead to developing suitable alternate energy systems first for remote sites and ultimately to total energy self-sufficiency for all Air Force installations. In the Resources Conservation area, the principal goal is to develop technology which will allow maximum recovery/reuse of valuable resources and materials with major emphasis on material and energy recovery from refuse in the short term.

The general criteria to be followed in carrying out the R&D efforts in this area are as follows: (1) determine the quality-quantity-distribution of Air Force Energy Resources; (2) identify existing energy requirements; (3) adapt emerging technologies or develop the technology to provide systems to match alternate energy resources with requirements; (4) determine feasibility and conceptual systems for materials recovery/reuse. Concentrated and coordinated efforts are underway and will continue in the areas of energy conservation, alternate energy sources, and advanced energy technology. Conservation techniques will continue to be identified and evaluated during FY79 and 80 with demonstration of new methods during FY80 through 82.

Government and industry developed energy conservation measures will be monitored and, where applicable, adapted for Air Force use on a continuing basis. In the area of alternate energy sources, work beginning in FY79 will continue through FY80 into development of technically feasible systems to recover energy from refuse with major emphasis on co-firing Refuse Derived Fuel (RDF) with coal and oil. These systems will be demonstrated during FY81-83 to develop applicable design criteria and specifications for major construction/ retrofit projects. Development of a tactical scale vertical axis wind turbine will be completed in FY80. Feasibility studies and systems development for use of Air Force wood resources and biofuels as alternate fuels will continue through FY81. Beginning in FY79 and continuing through FY81 studies to determine the feasibility and develop systems for utilization of geothermal resources will be conducted. These systems will be demonstrated starting in FY80 and continuing through FY81. Beginning in FY80 and continuing through FY82, alternate energy systems will be developed into a total energy system (TES) package to meet the requirements of remote sites. Adaptation of the total energy system concept to base applications will be undertaken in FY81 and FY82. Demonstration of the TES concept and component integration will be accomplished in FY82-FY84. Development of Advanced Energy Storage Systems as well as new energy management systems will be undertaken in FY82-83.

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TECHNOLOGY PLANNING OBJECTIVE

TPO 3: CIVIL ENGINEERING TECHNOLOGY

GENERAL OBJECTIVE AND INVESTMENT STRATEGY:

Civil Engineering Technology addresses a broad family of technical disciplines of which geotechnical engineering, rapid runway repair, protective construction, air mobility systems, facility corrosion, and

aircraft fire fighting equipment form finite subsets. Broad goals are to provide both fixed and transient facilities to support Air Force mission readiness worldwide.

Allocated geotechnical engineering resources seek to provide criteria for the design, repair and rehabilitation of horizontal structures and the foundation element of vertical structures. Virtually every Air Force facility and weapons systems is supported upon, departs from and/or returns to, terra firma; therefore it is essential that geotechnical concepts and capabilities are adequate to solve increasingly complex problems unique to advanced mission planning. Investments provide for immediate adaptation of existing facilities to new weapons systems and maintenance management to assure proper and timely preventive measures. Extended return provides new design and evaluation criteria to permit increased flexibility in mission planning.

The aim of research and development in the rapid runway repair area is to increase the capability to launch Air Force aircraft following an attack on the conventional pavement systems at forward area bases. This area includes not only the development of improved repair systems for repair of the pavements, but also the development of damage assessment systems, pavement roughness criteria, alternate launch surfaces, and techniques for operation in a hostile (chemical/biological warfare) environment.

Research in protective construction provides the technology base for hardened aerospace structures to resist the effects of chemical, biological, tactical nuclear and conventional weapons and for reducing air base vulnerability through improved passive defense measures and increased protection.

Research on air mobility systems is aimed at improving the tactical or mobile shelters which the Air Force uses to support all contingency operations. These shelters now house most forward-area electronic systems as well as provide temporary working and living space to support rapid deployments of weapons systems and personnel.

Facility corrosion losses continue to be a significant cost in the annual operations and maintenance budget, and research in this area is aimed at reducing these unnecessary costs and the mission disruptions that accompany the replacement of corroded utilities and facilities.

SPECIFIC GOALS AND TECHNICAL APPROACH:

Specific geotechnical goals are the structural evaluation of foundation system in terms of gross loading and expected magnitude of stresses and deformations, fatigue characterization and functional performance relations. Nondestructive testing methods and hardware systems are being developed to meet these goals. Within the framework of this development, laboratory and field investigations are being

conducted to establish parameter sensitivity and boundary conditions for use in analytical and modeling studies. In FY78 criteria will be published for establishing airfield pavement condition index (PCI). The PCI will be incorporated into AFR 93-5 and will establish a baseline for establishing pavement maintenance and repair priorities. An air transportable system for the nondestructive evaluation of airfield pavement structural capacity will be field tested in FY79 and deployed to the field in FY80 for validation with airfield pavement performance. Development of improved maintenance materials and methods will extend into the FY80 time frame with some materials and methods transitioning to advanced development for field validation and long-term performance studies. FY81 will produce the prototype model of the data base and reporting system for airfield pavement maintenance management. This system will produce the strategies for optimum maintenance and assess the consequences if not accomplished at the scheduled time. FY83 will initiate interface actions to establish a complete structural evaluation, life cycle cost and maintenance management system permitting worldwide assessment of Air Force horizontal facilities needs and the relationship of these needs to mission planning and overall Air Force resources management. Built-in feedback loops will address fine tuning of the total system in late FY83 and on into FY84. FY84 will terminate all efforts with an implemented system for assessing all foundation support problems associated with transit loadings and a management system functional at all levels within the Air Force for allocating resources for preventive maintenance, repair and rehabilitation of horizontal structures.

The broad area of airbase survivability/vulnerability is inclusive of protective construction, air mobility systems, air base vulnerability, facility corrosion, and fire protection. Protective construction seeks to improve the configuration and hardness of air base facilities to survive current and projected effects from high explosives, chemical, biological, and tactical nuclear weapons. The approach to be taken is to analyze, study, and test enemy weapons and their effects against air base target elements and develop means to defeat them. Utilizing the results of threat and vulnerability studies, the most vulnerable target elements will be upgraded first. Aircraft shelter development and weapons effects testing to prove survivability against the NATO threat was completed in FY76 and R&D emphasis shifted to studies and testing of weapon effects and protective construction for other threats. This emphasis will continue through FY79. Weapon effects studies and testing against command/control/communications (C³) facilities will be accomplished through FY79. USAFE will upgrade specific key support facilities using protective construction modifications developed and tested during FY78-82. Upgrade analysis for aircraft shelters will continue through FY80 to defeat selected munitions. Foreign technology assessments will be performed on a continuing basis to identify cost and performance effective materials and construction techniques applicable to Air Force facilities.

Air mobility systems will develop new technology and materials for use in, and in support of, air-transportable systems. The primary

objectives are to standardize shelters, reduce life cycle costs, and improve transportability and utility of the shelters. Beginning in FY81 this program will be directed by the Joint Committee on Tactical Shelters (JOCOTAS) and funded through the Department of the Army. USAF tactical shelter RDT&E requirements will be forwarded by CEEDO for inclusion in the DOD program. CEEDO will continue to perform R&D functions as directed and funded by JOCOTAS. The planned CEEDO program has been coordinated with JOCOTAS and no major changes are anticipated.

Air base vulnerability studies will continue to maintain cognizance of air base vulnerability to enemy threats and assess the requirements for protective construction to counter the threats. Threat assessment of air base vulnerability will be a continuing effort with periodic in-depth study. Air base vulnerability and passive defense studies will be accomplished indepth during FY81.

The corrosion research program will be phased out in 1980 unless new research requirements are identified. Only two efforts remain to be completed. An effort to provide several much needed refinements to cathodic protection methodology will be completed in July 1979. The final corrosion effort, one which will provide an improved protective coatings system (15-year life), will be completed in Feb 1980.

During FY80-FY84, efforts will continue toward improving firefighting agents, agent systems, training equipment and vehicles. In FY80 efforts will continue with P-4 air-transportability. In addition equipment development will be undertaken to increase fire suppression capability within existing manning levels. Also, development of mixtures of firefighting agents which increase effectiveness will be started. Starting in FY81 an air-mobile, multi-purpose compact vehicle for use at auxiliary air fields, as a rescue vehicle and as an initial attack firefighting vehicle, will be designed, fabricated, and tested. During FY82, state-of-the-art advances will be investigated toward retrofitting and testing the AS32P-4 aircraft crash fire suppression vehicle.

The rapid runway repair program is currently the largest effort underway in the civil engineering research area, encompassing extensive work in both the 6.3 and 6.4 program. The overall aim of the program is to increase the capability of Air Force aircraft to operate from forward-area bases following an attack on the conventional pavements at those bases. Toward that objective, the R&D program is structured into four major areas of investigation: bomb damage repair, surface roughness, alternate launch and recovery surfaces, and post attack environment.

The R&D program is structured in such a way that the results can be applied in the field as improvements in capability are developed. The bomb damage repair program will develop, through laboratory and field tests, improved methods for repairing war damage to conventional pavements. The research area entitled alternate launch and recovery surfaces will identify and develop low-cost surfaces which can provide alternate

platforms from which the first waves of retaliatory aircraft can be launched while the conventional pavements are being repaired. The extensive investigations into surface roughness (through computer simulations and large-scale field tests of aircraft transversing AM-2 mat repairs) are necessary in order to quantify the level of roughness which is acceptable in a repair system. Work in the post attack environment area is essential to a complete program because of needed improvements in repair strip identification and in operations in a chemical/biological warfare environment.

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SUMMARY

TECHNOLOGY PLANNING OBJECTIVES AND PROJECT LISTINGS

The CEEDO technology areas and technology planning objectives are synonymous.

<u>PROGRAM ELEMENT</u>	<u>PROJECT</u>	<u>TITLE</u>	<u>TPO</u>
62601F	1900	Environmental Quality Technology	1
63723F	2103	Environmental Quality/ Facilities Energy Technology	1&2
	2104	Civil Engineering Technology	3
64708F	2054	Aerospace Facilities Engineering Development	ALL
	2505	Aircraft Crash Fire/Rescue	3

OPPORTUNITIES

This section identifies several areas of technology, related to the CEEDO R&D efforts, which appear especially appropriate for the Independent Research and Development (IR&D) Program. The respective TPO focal points can provide additional information.

TPO-1 ENVIRONMENTAL QUALITY

Advanced environmental monitoring techniques
Toxic substance control/treatment techniques

TPO-2 FACILITIES ENERGY AND RESOURCE CONSERVATION

Solar energy application to light industrial complexes

TPO-3 CIVIL ENGINEERING TECHNOLOGY

Rapid clearance of unexploded ordnance from bomb-damaged runway.

Methods for selecting optimum repair strip of damaged runway.

Innovative techniques for rapid repair of damaged runways/
taxiways.

Development of materials and methods for protecting communications facilities (particularly antennae) from blast and shrapnel. Method/ material must not interfere with normal transmission and receipt of signals.