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DRAFT

PART IV, SECTION M

ATTACHMENT B

STATEMENT OF WORK
(Cluster RFP)

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Outline

INTRODUCTION

TASK 1.0 MX-RES DATA BASE REVIEWS

Subtask 1.1 - Assessment of Initial MX-RES Data Base

Subtask 1.2 - Review of Data Base Updates

TASK 2.0 PRELIMINARY DESIGN AND ANALYSIS - PHASE IA

Subtask 2.1 - Systems Analysis and Selection

Subtask 2.2 - Preliminary Point Design

Subtask 2.3 - Availability Analyses

Subtask 2.4 - Performance Analyses

Subtask 2.5 - RES Cost Estimates and Economic Analyses

Subtask 2.6 - Adaptability of Preliminary Point Design

Subtask 2.7 - Design Variations

TASK 3.0 PREPARATION OF RES SYSTEM SPECIFICATION

TASK 4.0 DETAILED DESIGN AND ANALYSIS - PHASE IB

Subtask 4.1 - Detailed Design

Subtask 4.2 - Availability Analyses

Subtask 4.3 - Performance Analyses

Subtask 4.4 - Cost Estimate and Economic Analysis

Subtask 4.5 - Adaptability of Detailed Point Design

Subtask 4.6 - Design Variations

TASK 5.0 SYSTEM IMPLEMENTATION PLANNING

Subtask 5.1 - Operations Planning

Subtask 5.2 - Environment and Safety Analyses

Subtask 5.3 - System Acquisition Planning

Subtask 5.4 - Risk Management

TASK 6.0 COMMERCIALIZATION ANALYSES

TASK 7.0 PHASE II PROPOSAL--PROTOTYPE SYSTEM DESIGN, FABRICATION,
AND TEST

INTRODUCTION

This Statement of Work (SOW) describes the tasks to develop preliminary and detailed point designs of Renewable Energy System(s) (RES) capable of powering MX cluster grouping. The "Point Design" of the proposed RES must be designed to meet the power and power availability requirements at the site and with the resources specified in the MX-RES Data Base. The MX-RES Data Base, which will be provided at contract award, will contain information on (1) MX system description and power requirements, (2) renewable energy resource availability, and (3) MX site characteristics. The proposed RES may include one or more RES technologies, storage and/or backup power subsystems (including utility grid interconnect), and any transmission network(s) necessary to meet the stated requirements. For the purposes of this SOW, RES technologies include solar thermal, photovoltaic, and wind systems.

In the development of the Point Design the contractor shall also consider adaptability to power requirements, site characteristics, and renewable energy resources of cluster groups throughout the MX Designated Deployment Area (DDA). The variability of regional design requirements and conditions is separately characterized in the MX-RES Data Base to support studies of Point Design adaptability and design variations.

The determination of RES application to the commercial sector is an integral part of this program. In this regard, marketability and producibility will be assessed. The purpose of this effort is to promote the acceleration of commercial RES applications in support of national goals for energy independence. Additionally, RES technologies are expected to reduce or eliminate MX dependence on conventional energy sources.

Activities covered in this SOW include a preliminary design (Phase Ia) and a detailed design (Phase Ib). Phase II of the MX-RES Project, which covers prototype design, fabrication, and testing, is not included in this SOW. Each of the sequential design phases provides progressively more detailed design information about the system in terms of cost and performance characteristics, as well as subsystem and component definition. In particular, the following levels of system specification will be required at the end of each of the design phases:

<u>Phase</u>	<u>Phase Title</u>	<u>Level of Definition</u>	<u>Desired Tolerance in System Cost and Performance Estimates</u>
0	Proposal	System	Proposed
Ia	Preliminary Design	Subsystem	15%
Ib	Detailed Design	Component	10%
II	Prototype Design, Fabrication, and Testing	Component	5%

1.0 TASK 1.0 MX-RES DATA BASE REVIEWS

1.1 Subtask 1.1 - Assessment of Initial MX-RES Data Base

The contractor shall review the MX-RES Data Base and shall report Data Base deficiencies, if any, to the MX-RES Project Office. Also, based on this review, the contractor shall report all design assumptions to be made as a result of Data Base deficiencies in order to proceed with the design effort. An MX-RES Data Base Review and Design Assumptions Report shall be submitted in accordance with the Deliverables list. Should the contractor wish to take any exceptions to the information presented in the Data Base, these exceptions (and recommended changes) shall also be identified in the submittal. The MX-RES Project Office will notify the contractor of approval or disapproval of these exceptions, or instructions to modify, within 30 days of receipt of the submittal.

1.2 Subtask 1.2 - Review of Data Base Updates

Updated MX-RES Data Base information will be provided to the contractor at 3-month intervals after contract award. Within 10 days of receiving new Data Base information, the contractor's Project Manager shall provide a written statement to the MX-RES Project Office as to whether and how the use of these new data could have a significant impact on design, cost, or schedule.

2.0 TASK 2.0 PRELIMINARY DESIGN AND ANALYSIS - PHASE IA

The contractor shall develop a preliminary design in sufficient detail to permit an evaluation of technical feasibility, and an assessment of the performance and economics of the proposed concept. This task shall include all engineering studies, evaluations, and analyses necessary for (1) the selection and sizing of all subsystems (energy collection, conversion, control, storage, backup, etc.); (2) the preliminary description of the resulting Point Design, and (3) an assessment of the adaptability of the Point Design to other sites or conditions.

The contractor shall identify and justify all critical analytical assumptions and sources for all data and describe the procedures, models, or calculations used to support this task. Innovative approaches to system design, fabrication, operation, integration and/or adaptability to power requirements, environmental considerations, or resource availability shall be addressed. In the event that the contractor's proposed RES incorporates two or more kinds and/or sizes of energy collection or storage subsystems, the contractor shall provide appropriate information for each such module.

The contractor shall present a Preliminary Design Progress Briefing to the MX-RES Project Office that provides the status of subsystem definition activities, an assessment of the system's capabilities to meet the requirements of the MX-RES Data Base, and a detailed outline of the Preliminary Design Report. A copy of the briefing charts, bound with facing page annotation discussing chart contents and key points shall also be provided in accordance with the Deliverables list.

The contractor shall submit to the MX-RES Project Office for review a Draft Preliminary Design Report documenting all work accomplished under Task 2.0 and

providing an interim report of work accomplished under Task 5.0, System Implementation Planning, and Task 6.0, Commercialization Analyses. Within 30 days, the Project Office will provide comments for incorporation into a final Preliminary Design Report. Both the draft and final reports shall be delivered in accordance with the Deliverables list.

2.1 Subtask 2.1 - Systems Analysis and Selection

Using the design assumptions of Task 1.0 and the MX-RES Data Base, the contractor shall perform parametric studies to refine the proposed system concept and to select a preferred configuration. Consideration shall be given to the adaptability requirements discussed in Subtask 2.6, and to the extent of dependence on nonrenewable sources of electrical power.

The contractor shall define tradeoff parameters, identify system constraints, develop system selection criteria, and conduct the necessary system/subsystem tradeoffs. These studies shall provide justification for subsystem sizing and selection, and the proportion of power to be provided from each backup source.

The contractor shall define and justify all operating modes required for the power system to perform its intended operational functions, including: (1) startup and shutdown; (2) normal, intermittent, and emergency operation; and (3) storage and/or use of backup subsystems.

2.2 Subtask 2.2 - Preliminary Point Design

Based on the results of Subtask 2.1, the contractor shall design and describe the subsystems composing the preliminary Point Design of the RES. The Point Design shall be specifically tailored to the site, power requirements, and resource availabilities specified in the MX-RES Data Base and shall be consistent with the contractor's activities in Tasks 5.0 and 6.0. Subsystem descriptions shall include, as a minimum, relevant drawings and diagrams (including operational signal flows), equipment lists and specifications, and site layouts. Interfaces and functional relationships between the RES and the MX system and among the individual RES subsystems (including backup power sources) shall be described. Functional requirements for subsystem components shall be identified. System and subsystem requirements for various operating modes and the transition between modes shall be defined. The Contractor shall define instrumentation, control, communications and display requirements associated with procedures and data requirements for plant operation. Design features related to environmental, health and safety, operations and maintenance, and load growth considerations shall be described.

2.3 Subtask 2.3 - Availability Analyses

The contractor shall conduct analyses to demonstrate how the RES concept developed in Subtasks 2.1 and 2.2 will meet the availability goals specified in the MX-RES Data Base. These analyses shall be detailed in accordance with instructions to be supplied by the MX-RES Project Office. These analyses shall identify unavailability fractions attributable to subsystem mean-time-between-failures, associated mean-times-to-repair, scheduled maintenance, scheduled

component or subsystem wearout-avoidance replacements, unavailability of backup power systems, etc. The contractor shall estimate the operational lifetimes of each subsystem. The contractor shall also perform an initial failure modes and effects analysis in order to highlight areas requiring reliability design emphasis and to develop estimates of required repair times. Subsystem failures attributable to unexpectedly large or abrupt fluctuations in demand or resources shall be considered in these analyses. Based on these analyses, the contractor shall state the derived reliability and maintainability design goals for each subsystem. A discussion of factors which could significantly influence the attainment of goals for the various parameters involved in availability estimates shall be provided.

2.4 Subtask 2.4 - Performance Analyses

The contractor shall develop engineering estimates of system and subsystem performance characteristics for the preliminary Point Design developed in Subtask 2.2. The contractor shall demonstrate the capability of the Point Design to meet the power requirements of the MX-RES Data Base for the renewable energy resources specified therein. The flow of power from each energy source (including all backups) to net power output throughout the day shall be indicated for each generating unit and for the entire system for several key days. These key days shall be determined by the pattern of power output fluctuations throughout the year by the various generating units and shall include but not be limited to the days of maximum, minimum and average resource availability. The power flow shall be illustrated for typical and extreme loads on each of these days. All subsystem efficiencies and losses (thermal, mechanical or electrical) shall be given, along with the routing of power among collection, conversion, and storage subsystems, for each operating mode. A similar analysis of annual energy production from each subsystem shall be performed to determine average annual efficiencies and losses. System conversion efficiencies and capacity factors shall be supplied for all power levels to which the design is applicable. The sensitivity of overall performance of the Point Design to the assumed values of subsystem performance parameters shall be determined. Any significant impacts on system performance of environmental, health and safety, operations, and maintenance considerations, or load growth potential shall be described.

2.5 Subtask 2.5 - RES Cost Estimates and Economic Analyses

The contractor shall estimate costs and perform economic analyses of the Point Design of Subtask 2.2 based on performance estimates of Subtask 2.4. The estimates of capital and operations/maintenance costs of the RES shall be categorized at the subsystem level and detailed in accordance with instructions to be supplied by the MX-RES Project Office. Costs shall be expressed in constant FY 1980 dollars.

The contractor shall develop life-cycle cost estimates for the Point Design. These estimates shall encompass all costs commencing with Phase II through 30 years of operations, assume no Government-furnished equipment or installations, and include all support costs necessary to deliver power to the prescribed interface with the load. Sensitivity of system cost to cumulative production, production rate, and length of construction/production period shall be determined. In addition, the

contractor shall determine the sensitivity of overall system costs to variations in both the connected load and resource availability from the values specified in the MX-RES Data Base and to variation in the estimated subsystem capacities, performance parameters, and operational lifetimes. Costs related to environmental, health and safety considerations shall be identified.

The contractor shall assess the incremental costs associated with the provision for and the actual implementation of the load growth potential (in accordance with the MX-RES Data Base) inherent in the Point Design and shall describe the resulting implications for design, performance, operation, and siting.

2.6 Subtask 2.6 - Adaptability of Preliminary Point Design

The contractor shall conduct studies to illustrate the adaptability of the Point Design for the representative cluster group to other valleys. The distribution of the number of clusters for various valleys in the DDA will be given in the MX-RES Data Base.

Adaptability may be achieved through modularity and/or scalability, as appropriate to either distributed or centralized systems. If the contractor uses combinations of complete system modules to achieve power level flexibility, the design, performance, and costs associated with each module shall be described in Subtasks 2.2, 2.4, and 2.5, respectively. Methods of accomplishing module-to-module integration required for different power levels and/or resource availabilities and the resulting performance and cost implications shall be discussed in this subtask. If the contractor's approach involves a system in which specific subsystems are scaled up or down to achieve the required flexibility, the contractor shall illustrate means of adapting the Point Design to the power levels and resource variabilities of the other valleys.

Limits on the range of adaptability of the contractor's system due to factors such as concept characteristics, energy resources, cost, or producibility, shall be identified. These studies shall identify associated changes in required support facilities. Block diagrams shall be provided to illustrate representative configuration arrangements, and layouts shall be provided to illustrate significant differences from the Point Design for the representative cluster group. The contractor shall provide performance and cost estimates for the other sites in a form compatible with that provided for the Point Design in Subtasks 2.4 and 2.5.

2.7 Subtask 2.7 - Design Variations

Definitive estimates of actual MX power requirements and site-specific renewable energy resources will not be available until or after the end of Phase I. Therefore, the contractor, using the techniques developed to support Subtask 2.1, shall perform analyses to indicate changes in the preferred RES configuration (as determined in Subtask 2.1) which would result from variations in each of the following: (1) power and power availability requirements; (2) the availability of renewable energy resources; and (3) availability and cost of alternative sources of backup power. The range of variations to be analyzed is specified in the MX-RES Data Base. Design, performance, and cost implications of changes in the preferred RES configuration shall be identified.

Geothermal and large-scale wind energy sources are being considered for incorporation as part of an integrated MX-RES system. If these sources are included, then a portion of their generated energy may be made available, either continuously, during nighttime or daytime only, or at random times. The Contractor shall indicate how his preferred RES design, as developed in Subtask 2.1, would be changed if this external RES energy were to be available. The Contractor shall also define associated cost and operational impacts. The amounts of such energy which might be available will be specified in the MX-RES Data Base.

Results of these analyses shall be presented at the same level as those used in establishing the preferred configuration for the Point Design in Subtask 2.1.

3.0 TASK 3.0 PREPARATION OF RES SYSTEM SPECIFICATION

The contractor shall prepare system criteria and specifications for the RES design, based on the preliminary design work of Task 2.0. The design specifications shall follow MIL-STD-490A format. In accordance with the Deliverables list, the contractor shall submit a Preliminary Design Specification. Within 30 days the MX-RES Project Office will provide comments.

The contractor shall update the Preliminary Design Specification throughout the detailed design activities of Task 4.0. He shall inform the MX-RES Project Office of any planned specification changes as part of normal progress reporting and shall submit a Detailed Design Specification, in accordance with the Deliverables list.

4.0 TASK 4.0 DETAILED DESIGN AND ANALYSIS - PHASE IB

The contractor shall develop a detailed design, consistent with the Preliminary Design Specification of Task 3.0, in sufficient detail to permit an evaluation of the technical feasibility and an assessment of the performance and economics of the proposed concept. The contractor shall present a Detailed Design Progress Briefing to the MX-RES Project Office on the status of Task 4.0 activities. Copies of the briefing, bound with facing page annotations discussing the chart material and key points, shall be provided. The contractor shall submit to the MX-RES Project Office a Detailed Design Report documenting all work accomplished under Task 4.0, including a final report of work accomplished under Task 5.0, System Implementation Planning, in accordance with the Deliverables list.

4.1 Subtask 4.1 - Detailed Design

The contractor shall update the Preliminary Design of Task 2.2 to the detailed component design level. The contractor shall provide interface and engineering drawings, diagrams, site layouts, electrical layouts, operations signal flows, and equipment lists to the component level of detail. These drawings shall identify and explain the procedures necessary to complete site preparation and installation work, and shall highlight any special equipment, expertise, or other requirements for system production and/or construction. The contractor shall identify and characterize the signatures (acoustic and electromagnetic) of the RES in its various operating modes.

4.2 Subtask 4.2 - Availability Analyses

The contractor shall conduct an analysis, based on the detailed design developed in Subtask 4.1, to demonstrate how the design achieves the reliability and maintainability goals defined in Subtask 2.3, and the power availability requirements delineated in the MX-RES Data Base. A discussion of the degree of uncertainty and the possible range for the various parameters involved in availability estimates shall be provided.

The contractor shall also identify the environmental regimes (i.e., combinations of wind, dust, humidity, precipitation, earthquake, sandstorm, and other conditions) in which the RES is designed to operate and to survive; the impact of excursions from these regimes on system reliability; and any potential degradations of performance due to long-term exposure to the environment.

4.3 Subtask 4.3 - Performance Analyses

The contractor shall update and modify the performance analysis in Subtask 2.4 to reflect the design specification of Task 3.0 and the detailed design data of Subtask 4.1.

4.4 Subtask 4.4 - Cost Estimate and Economic Analysis

The contractor shall update and modify the analyses performed in Subtask 2.5 to reflect the design specification of Task 3.0 and the detailed design data of Subtask 4.1.

4.5 Subtask 4.5 - Adaptability of Detailed Point Design

The contractor shall update and refine the adaptability concepts developed in Subtask 2.6 to reflect the design specification of Task 3.0 and the detailed design data of Subtask 4.1.

4.6 Subtask 4.6 - Design Variations

The contractor shall update and refine the design variations analyses developed in Subtask 2.7 to reflect the design specification of Task 3.0 and the detailed design data of Subtask 4.1.

5.0 TASK 5.0 SYSTEM IMPLEMENTATION PLANNING

The contractor's activities specified under this Task shall be closely coordinated with those specified under Tasks 2.0 and 4.0. Interim results of this Task shall be reported in the Preliminary Design Report and final results in the Detailed Design Report. The contractor shall assess the implementation feasibility of the proposed Point Designs with respect to environmental impact, health and safety, developmental risk, and maintenance considerations.

5.1 Subtask 5.1 - Operations Planning

The contractor shall develop an operating plan for the Point Designs that establishes procedures for the operation (including security operations) and maintenance of the system, including operational test requirements. The contractor shall address the support facilities, equipment, supplies, services, personnel, and training programs required for operations and maintenance of the system.

5.2 Subtask 5.2 - Environment and Safety Analyses

The contractor shall identify and assess potential environmental impacts and health and safety risks associated with the installation, operation, and maintenance of the RES. The contractor shall assess anticipated impacts of the system on all aspects of the environment and impacts of the environment on the design, fabrication, operation, and performance of the proposed system. Health and safety assessments shall address the impacts of the system on the health and safety of: (1) personnel for production, installation, operations and maintenance; (2) the population served by the RES; and (3) site intruders. Special procedures required to comply with OSHA, state, and local standards shall be identified.

5.3 Subtask 5.3 - System Acquisition Planning

The contractor shall develop a plan, including schedule information, covering all items commencing with Phase II activities and culminating in the operational availability of the system as a part of the MX missile system. This plan shall reflect all necessary design, development, prototype testing, qualification testing, acceptance testing, fabrication, installation, checkout, and training activities. This plan shall also address facilities, equipments, materials and software (if any) necessary to achieve the production levels required for MX power system implementation.

5.4 Subtask 5.4 - Risk Management

The contractor shall identify areas of possible performance, cost, or schedule risk covering all activities commencing with Phase II and culminating in the operational availability of the system as a part of the MX missile system. The contractor shall discuss the causative factors of these risks, and shall develop plans for minimizing these risks.

6.0 TASK 6.0 COMMERCIALIZATION ANALYSES

The contractor shall identify and characterize the various commercial markets in which the RES design might be applied. Appropriate design, operations and maintenance procedures, and safety and environmental differences between commercial versions of the design and that for the MX-RES application shall be identified. Various factors which could influence the extent and timing of market penetration shall be identified, and the nature of their influence described. Discussions on the aforementioned items should be included in the Preliminary Design Progress Briefing described in Task 2.0.

The contractor shall also analyze and develop estimates of the costs of commercial versions, including the influences of such factors as the quantity and scheduling of

systems procured for MX-RES application, the production rate of systems for the commercial marketplace, possible financial incentive alternatives, and ownership arrangements.

The contractor shall develop an assessment of the market potential of a commercial version of the proposed RES that addresses the nature and size of potential markets, the extent and timing of market penetration, and potential barriers to market penetration. The contractor shall also outline a plan for commercializing the proposed system that addresses capital formation and development of the necessary market infrastructure.

The contractor shall report progress on all items of this task as a part of the Detailed Design Progress Briefing described in Task 4.0. All activities under this task shall be reported in the Commercialization Analyses Report in accordance with the Deliverables list.

7.0 TASK 7.0 PHASE II PROPOSAL--PROTOTYPE SYSTEM DESIGN, FAB-
RICATION, AND TEST

The contractor shall prepare and submit a proposal for Phase II design, fabrication and test (in whole or in part) of a prototype system and/or subsystems. Further specifics pertaining to the format, content, and evaluation of the proposal shall be provided approximately 60 days before required proposal submission date. At that time, the contractor will be informed as to what items of already transmitted updated MX-RES Data Base information will be operative for purposes of Phase II proposal preparation. The Phase II Proposal shall be delivered in accordance with the Deliverables list.

DELIVERABLES

<u>Task</u>	<u>Deliverables</u>	<u>Date*</u>
1.0	MX-RES Data Base Review and Design Assumptions Report	30 Days
2.0	Preliminary Design Progress Briefing (Including Annotated Hard Copies)	4 Months
2.0	Draft Preliminary Design Report	7 Months
2.0,3.0	Preliminary Design Report (Including Preliminary Design Specification)	9 Months
3.0	Detailed Design Specification	13 Months
4.0	Detailed Design Progress Briefing (Including Annotated Hard Copies)	10 Months
4.0	Detailed Design Report	14 Months
6.0	Commercialization Analyses Report	7 Months
	Interim Report (Preliminary Design)	14 Months
	Final Report	
7.0	Phase II Proposal	11 Months

* After contract award