***Exoskeletons for Humans***

**DARPA is Soliciting Innovative Research Proposals on Exoskeletons**

**Exoskeletons for Human Performance Augmentation**  
POC: Dr. Ephrahim Garcia - baa00-34@darpa.mil  
DARPA/DSO (EHPA), BAA00-34  
Fax: 703-696-3999

Source: DARPA  
http://www.darpa.mil/dso/solicitations/00/Baa00-34/cbd.htm

June 30, 2000

Due to the possibility of transcription errors, the official CBD announcement takes precedence over this transcription in any disagreement between the two. The transcription is provided for your convenience only.

PROGRAM OBJECTIVE AND DESCRIPTION

The Defense Advanced Research Projects Agency (DARPA) is soliciting innovative research proposals on Exoskeletons for Human Performance Augmentation (EHPA). The overall goal of this program is to develop devices and machines that will increase the speed, strength, and endurance of soldiers in combat environments. Projects will lead to self-powered, controllable, wearable exoskeletal devices and/or machines. The technological challenges that must be addressed are energy sources, power by generation, haptic interfaces, control algorithm development, as well as integration of actuation systems and all previously mentioned subsystems into a machine with an anthropomorphic architecture. Highly efficient actuators must be developed that can utilize a high density, man-wearable energy source in both a safe and quiet manner. The power provided to the EPHA system must support the exoskeleton for a duration of military significance, initially estimated to be 4-24 hours. Control approaches must be devised that enable direct and seamless interaction between human and machine. Finally, these devices and machines will be demonstrated in order to evaluate their utility to various military operations.

EHPA will enable new capabilities for ground forces. Inclusion of exoskeleton technology into land based operations will extend the mission payload and/or mission range of the soldier. Exoskeletons will also increase the lethality and survivability of ground troops for short range and special operations. The enhanced mobility and load carrying capability provided by the exoskeleton will allow soldiers to carry more ballistic protection and heavy weaponry. To meet the challenges set forth, DARPA is soliciting devices and machines that accomplish one or more of the following: 1) assist pack-loaded locomotion, 2) prolong locomotive endurance, 3) increase locomotive speed, 4) augment human strength, and 5) leap extraordinary heights and/or distances. These machines should be anthropomorphic and capable of bearing distributed loads, such as that generated by extensive armor protection, as well as typical pack loads. Other concepts for EHPA will also be considered in this solicitation.

Methods of transforming high-energy dense power sources to actuation power for these machines should be developed. Energy sources must be integrated with compact, man-wearable power generators and, possibly, new types of actuators that would allow long endurance missions. Concepts and designs that fail to address the full integration of energy sources, power converters and actuators into a complete exoskeleton system are generally not of interest. However, development of enabling technologies of extraordinary promise may be considered for support but are best melded into a larger effort of realizing a complete system.

WHITE PAPERS

All white paper submissions will be evaluated for responsiveness to the stated goals and objectives of this BAA. Those best meeting the criteria of this BAA will be asked to submit a full proposal. Proposers must submit an original and seven (7) copies of the white paper to DARPA/DSO, ATTN: BAA00-34, 3701 North Fairfax Drive, Arlington, VA 22203-1714 on or before 4:00 PM ET, April 21, 2000. White papers submitted by email or fax will be disregarded. White papers must meet the objective and format guidelines as described in the Proposer Information Pamphlet (PIP) in order to be considered. White papers are limited to seven (7) 1.5-spaced pages including cover sheet and should contain: 1) concepts for addressing the technical goals of EHPA; 2) program plan with technical milestones for developing components and critical subsystems; 3) integration approach and expected performance for an EHPA device or machine for DoD applications; 4) projected impact of developments on DoD applications; 5) proposed funding level for the effort; and 6) descriptions of experience and expertise of the performer(s) and sub-contractors. Appendices will be NOT considered in the evaluation of white papers. DARPA will acknowledge receipt of white papers within ten (10) business days and assign a control number that should be used in all further correspondence. Recommendations for full proposal submission will be made within approximately thirty (30) days of the submission deadline. All full proposals will be evaluated regardless of the disposition of the white paper.

FULL PROPOSALS

The proposed effort should be in two phases with an additional option at the end of the second phase, for a total not to exceed 60 months. The Phase I and Phase II periods will be conducted for up to 42 months and consist of an initial base effort that demonstrates proof-of-concept for key technologies, followed by an effort to complete the development of the individual projects. In addition to this 42-month period, a Phase II Option may be included that will proceed for an additional 18-month period to achieve end of program requirements as outlined in the PIP. The technical portion of the proposal is restricted to 40 pages (including figures). A suggested outline for full proposal follows:

1) an executive summary describing the concept(s), impetus, approach, and target application;

2) introduction with a statement of the perceived technical challenges and the concepts to be exploited to satisfy the requirements of the PIP;

(3) detailed technical discussion of the implementation of the proposed concept, technical risks, a set of metrics, and programmed milestones for evaluating progress;

(4) the overall management plan and a list of participating organizations, their relevant expertise, and tasks to be performed by each team member;

(5) a detailed Statement of Work with technical milestones and deliverables, including performance metrics and programmatic decision points;

(6) a summary cost and implementation schedule; and

(7) a plan for transitioning and commercializing the technology to industry and/or Government applications. References, resumes, or other supporting documentation may be included as appendices to the main body of the proposal, but will be included in the 40-page limit. A detailed cost and implementation schedule should also be included in a separate cost proposal. Further details are available in the PIP.

The total amount of funding available for this BAA is approximately $50M; it is anticipated that there will be multiple awards. The most important part of the full proposal will be the technical concepts proposed for the successful production of a human performance enhancing exoskeleton machine or device. The goal of the program is the development and demonstration of novel, self-powered exoskeleton machines that can be implemented to augment the performance and extend the mission capability of the ground combatant. The end products of this solicitation will be deliverable hardware demonstrating the approach achieved toward meeting the goals and objectives listed in the PIP. Proposals that are considered less than satisfactory in terms of Scientific and Technical Merit will not be evaluated further. Proposers must submit an original and nine (9) copies of the full proposal to DARPA/DSO, 3701 North Fairfax Drive, Arlington, VA 22203-1714 (Attn.: BAA00-34) on or before 4:00 PM, ET, June 30, 2000. Proposals must meet the objective and format guidelines as described in the PIP to be considered.

Proposal identified for funding may result in a contract, grant cooperative agreement, or other transaction, depending upon the nature of the work proposed, the required degree of interaction between parties, and other factors. If warranted, portions of resulting awards may be segregated into pre-priced options.

TEAMING ARRANGEMENTS

Teaming is encouraged to ensure that advances in technology can be rapidly integrated into useable military devices. To assist the teaming process an interactive web site has been established at URL: www.sainc.com/DARPA/EHPA. Individual researchers and organizations with specific, relevant expertise and/or capabilities may provide non-proprietary descriptions of their capabilities and interests. The web site will remain active from the date of issuance of this BAA until proposals are due. More information on teaming can be found in the PIP.

PROPOSAL EVALUATION

Proposals will be evaluated according to the following criteria in decreasing order of importance: (1) scientific and technological merit of the proposed program; (2) impact of the successful development on defense systems; (3) ability of the proposer(s) to achieve goals and execute project management plan (4) cost realism. All proposals will be reviewed by Government officials only. Input on technical aspects of the proposals may be solicited by DARPA from non-Government consultants and/or experts who are bound by appropriate non-disclosure requirements. Non-Government technical consultants will not have access to proposals that are labeled by the offerors as "GOVERNMENT ONLY." Restrictive notices notwithstanding, proposals may be handled, for administrative purposes only, by a support contractor. This contractor is bound by appropriate non-disclosure requirements. The Government reserves the right to select for award all, some, or none of the proposals received. Cost sharing is encouraged, but not required. All responsible sources capable of satisfying the Government's needs may submit a proposal that shall be considered by DARPA.

GENERAL INFORMATION

Proposers must obtain the pamphlet entitled "BAA00-34, Exoskeleton for Human Performance Enhancement (EHPA) Proposer Information Pamphlet (PIP)," which provides detailed information on program objectives, areas of interest, the submission, evaluation, and funding processes, proposal formats, and other program information. This pamphlet may be requested from the World Wide Web (WWW), fax, electronic mail (e-mail), or mail requests through the administrative contact information given below. This announcement and the PIP may be retrieved via the WWW at URL: /dso/ in the solicitation area.

Proposals not meeting the format described in the pamphlet may not be reviewed. All administrative correspondence and questions on this solicitation, including requests for information on how to submit a proposal to this BAA, should be directed to DARPA/DSO, BAA00-34, fax: (703) 696-3999, electronic mail (e-mail): BAA00-34@darpa.mil, or mail: DARPA/DSO, ATTN: BAA00-34, 3701 North Fairfax Drive, Arlington, VA 22203-1714 (e-mail or fax is preferred). DARPA intends to use electronic mail and fax for correspondence regarding BAA00-34. Proposals submitted by fax or e-mail will be disregarded. DARPA encourages use of the WWW for retrieving the PIP and any other related information that may subsequently be provided. This notice, in conjunction with the BAA00-34 PIP, constitutes the total BAA. No additional information is available, nor will a formal RFP or other solicitation regarding this announcement be issued. Requests for the same will be disregarded. Minority Institutions and Historically Black Colleges and Universities are encouraged to submit proposals and join others in submitting proposals. However, due to the technical nature of the hardware demonstration, no portion of this BAA will be set aside specifically for these entities.