Advanced extravehicular activity (EVA) systems are necessary for the successful support of future human space missions. Complex missions require innovative approaches for maximizing human productivity and for providing the capability to perform useful work tasks. Requirements include reduction of system hardware weight and volume; increased hardware reliability, durability, and operating lifetime (before resupply, recharge and maintenance, or replacement is necessary); reduced hardware and software costs; increased human comfort; and less-restrictive work performance capability in the space environment, in hazardous ground-level contaminated atmospheres, or in extreme ambient thermal environments. All proposed Phase I research must lead to specific Phase-II experimental development that could be integrated into a functional EVA system. Additional design information on advanced EVA systems can be found in the EVA Technology Roadmap of the EVA Project Plan. Areas in which innovations are solicited include the following:

Environmental Protection

- Radiation protection technologies that protect the suited crewmember from radiation particles;
- Puncture protection technologies that provide self-sealing capabilities when a puncture occurs and minimizes punctures and cuts from sharp objects;
- Dust and abrasion protection materials to exclude dust and withstand abrasion; and
- Thermal insulation suitable for use in vacuum and low ambient pressure.

EVA Mobility

- Space suit low profile bearings that maximizes rotation which is necessary for partial gravity mobility requirements and is also lightweight and low cost.

Life Support System
- Long-life and high-capacity chemical oxygen storage systems for an emergency supply of oxygen for breathing;
- Low-venting or non-venting regenerable individual life support subsystem(s) concepts for crewmember cooling, heat rejection, and removal of expired water vapor and CO₂;
- Fuel cell technology that can provide power to a space suit and other EVA support systems;
- Convection and freezable radiators that will be low cost and weight for thermal control;
- Innovative garments that provide direct thermal control to crewmember;
- High reliability pumps and fans that will provide flow for a space suit but can be stacked to give greater flow for a vehicle;
- CO₂ and humidity control devices that, while minimizing expendables, function in a CO₂ environment; and
- Variable conductance flexible suit garment that can function as a radiator for high metabolic loads and as an insulator for low metabolic loads.

**Sensors, Communications, and Cameras**

- Space suit mounted displays for use both inside and outside the space suit—outside mounted displays will be compatible with space;
- CO₂, bio-med, and core temperature sensors with reduced size, lightweight, increased reliability, and packaging flexibility;
- Visual camera that provides excellent environment awareness for crewmembers and the public and are integratable into a spacesuit that is lightweight and low power;
- Minimass spectrometer that detects N₂, CO₂, NH₄, O₂, and hydrazine partial pressures; and
- Radio and laser communications that provides good communications among the crew and the base that is lightweight and low power.

**Integration**

- Robotics interfaces that permit autonomous robot control by voice control via EVA;
- Minimum gas loss airlock providing quick exit and entry and can accommodate an incapacitated crewmember; and
- Work tools that assist the EVA crewmember during operations in zero-gravity and at worksites; specifically, devices that provide temporary attachments, which rigidly restrain equipment to other equipment and the EVA crewmember, and that contain provisions for tethering and storage of loose articles such as tool sockets and extensions.