Jim Brian (00:14):

I'm Jim Brian from NASA Johnson Space Center and the Systems Capability Leadership Team Deputy. Happy to talk to you today about advanced Life Support and Human Performance, or ALSHP. We use lots of acronyms. How we're organized in a sample of some of our capabilities and where we need technology innovation. These three images on this slide shows some of our interest areas on the left is Nick Keg, performing maintenance on a ventilation fan inside the US laboratory in the middle is astronaut Kate Rubin sequencing DNA on the ISS for the first time using the min ion and on the right, ISS astronaut Steve Swanson harvesting a crop of red romaine lettuce in our veggie crop growth unit.

Jim Brian (01:01):

NASA space technology mission directorate has developed a strategic framework to help us communicate the four high level thrust areas: go, land, live, and explore. Not surprisingly, our capability primarily supports the live thrust is indicated by the dark and light green text here. We're interested in developing technologies that support humans on cislunar missions and longer duration Mars transit and surface missions without resupply. And without resupply is key, we mean, we need to eventually use local resources to provide air oxygen for crew health, as well as materials for the manufacturing of spare parts and using autonomous systems both when the crew are there and when they're not.

Jim Brian (01:44):

We have nine capability areas has indicated on this chart and they're divided broadly into two categories: environmental control and life support or ECLSS, which consists of life support, environmental monitoring, fire safety, and logistics. And then our crew health and performance our CHP category consists of Eva physiology, radiation, countermeasures, food, and nutrition and expiration medical. We use these icons throughout our pitch to indicate which capability a particular gap area falls into. And I'll talk a little bit about these on the next two pages.

Jim Brian (02:21):

The first page here was the ECLSS page and so I'll start at the bottom box, which represents the capability area. And this includes the icons from the previous page. The middle set of boxes define measures for the state of the art or SOA for a few of the capabilities, certainly not everything. And we call these key performance parameters or KPPs. The top set of boxes are the goals for our capabilities. And the difference between these are what we call a gap. And the KPPs and gaps are very important. I'll talk more about them later. I'll talk some of the specific needs for these capabilities near the end of the presentation. This next chart shows our crew health and performance capability areas, and they're organized similar to the ECLSS capability areas. I won't go through these in detail, I just want to point out EVA is not the design of the space suit, it's how the human interacts with the space suit and how the space suit influences what mission objectives or capabilities the crew can do.

Jim Brian (03:28):

Similarly, countermeasures is not just exercise there're countermeasures for sensory motor, which is like balance as well as psychological and then food, it's not only providing food, the food needs to maintain nutritional health, and we have to be able to monitor food intake and correct any nutritional deficiencies. So our crew are healthy maintaining high performance when they get to the surface to do EVAs in science and also, so they can come home to earth safely and take the reentry load and landing loads.

Jim Brian (04:05):

KPPs, overall, we have about 55 major gaps and then numerous sub gaps across the nine capability areas. And we're working over 250 KPP to try to define them better. Now we're very interested in using better technologies from small businesses to help close our gaps, however, communicating what we need and how a new technology helps solve that is difficult. We utilize mission trade studies and systems analysis, very heavily to inform our technology selection. So while qualitative descriptions might be helpful, they can't sufficiently convey the potential benefits. And that's where the use of KPP to describe the state of the art and your technology are really helpful to NASA. They say, we're trying to work more on our KPPs and here's some examples of how we measure or trying to measure how a technology performs. Generally, we're trying to normalize it and not give absolute value so that the mission changes in length or duration or number of crew members we can apply that information to different missions.

Jim Brian (05:19):

KPPs help you as a company make an assessment of how competitive is your technology compared to the state of the art. Make sure you explain the basis of your KPP, at least a little bit, to help us understand how you are valuing or how you're conveying the value of your technology. The next page here is examples of hardware. Of course, everyone likes to see pictures of hardware, and here's just a few that help define the state of the art or in the process of being developed to define the next state of the art. And these are incremental steps. We have technology developments in the area of life support, fire monitoring, logistics, trash, expiration health radiation, EVA physiology risk. Also plants are a large area of interest counter measures to make sure our crew remain healthy. This last page here is showing some of our goals for advanced life support and human performance.

Jim Brian (06:25):

We're trying to close loops, which we mean that we can reuse all the oxygen, reuse all the water and recycle that over and over again. We're also looking to reduce spares and consumables mass. And as I mentioned, maintaining Crew performance. I'll just hit a few of the make categories here. We certainly need help in identifying compounds in environmental monitoring, we're trying to identify or speciate specific compounds or microorganisms. We're trying to improve our removal of CO2, trying to use additive or institute manufacturing techniques. Trying to look at mass or trash mass reduction through jettison. As we can throw trash or jettison trash overboard on a transit mission, there's a relatively large fuel savings. Smaller vehicles and frequent EVAs will increase the oxygen concentration in environments. So we need soft goods, clothing, and other soft fabrics that meet the flammability requirements at these elevated levels.

Jim Brian (07:37):

As we vent gases overboard on particularly on Mars, but also on the lunar surface. How are we contaminating the outside where we may want to be doing science in the vicinity of the habitat or the space suit. And then always we're looking for better capability on our absorbance for air and water systems. We're looking to reduce the number of spares we need to take. We're looking for autonomous diagnostic so we can make more intelligent decisions rather than one or two parameters on when to change something. Looking to control microorganisms for long dormant periods on spacecraft. Lunar dust is going to be a prevalent problem in our capability area, as well as multiple capability areas. That's sort of across technology problem.

Jim Brian (08:24):

And also maintaining the crew health. How do we do diagnostics for the hundred and 20 conditions we need to treat for an expiration mission. Then there's how do we convey information to the astronauts on an Eva or even IVA so that they can make decisions real time in case we have losses of telemetry or the situation changes rapidly, where they're doing their science. Noise prevention typically takes heavy sound blocking materials while we're looking at low noise generation technologies, as well as absorbing technologies for primarily low frequencies. Exercise vibration. It can impact the solar panels, but it also takes a lot of mass oil power. So we're looking at novel solutions there. And finally, I already mentioned food is an area of interest to us in both crop production and nontraditional foods. So I hope this gives you an overview of what we're looking for in advanced life support and human performance. And we look forward to hearing from your technology solutions. Thank you very much.