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Statement of W. M. Shepherd before the House Committee on Science, Space, and Technology

Chairman, Beyer, ranking member Babin, and members of the Committee: I have recently joined the International Space Station Advisory Committee that advises NASA and the multinational partners in the ISS Program. Thank you for this opportunity to present thoughts on the Space Station and related space activities.

Even before the U.S. had a national space program, engineers and scientists envisioned an orbiting station above the Earth that would be a steppingstone for the exploration of the Moon and other planets. NASA Space Shuttles and crews, using robots and spacewalks, built the large ISS vehicle, in the weightless vacuum of space, traveling 17,000 miles an hour. A capability we cannot match today.

Crews aboard ISS live, explore, and do research, in a place that's not part of the Earth anymore. ISS is our foothold in the cosmos. In 21st years of continuous operations ISS has hosted 65 expeditions and hundreds of astronaut and cosmonaut researchers who have performed thousands of hours of scientific research. In complexity and scale, ISS is my generation's "Apollo Program".

There were many difficulties in the design and construction of this station. Forming a workable international partnership was not easy. Combining each partner countries' different "technical culture" was a challenge. Many aerospace critics in the U.S. opposed putting Russian elements in ISS's "critical path"; others said it could not be done. History has shown all of them wrong. ISS would not be flying today without our partners' unique capabilities and especially those that are Russian. And ISS has performed beyond its designed capabilities; many systems and components are operating acceptably at twice their design life. ISS has had no major failures or accidents.

One could ask what benefits the Russians brought to the partnership? Working with them, I have seen unique spacecraft and spacecraft system designs, excellent crew equipment and space suits, well developed life support systems; excellent metal working and fabrication; simple but effective thermal control systems, solar arrays and controls, good crew-to-computer integration. Russian engineers taught us a most valuable technique--mixing the complex alongside the simple in their system architectures--creating exceptionally robust capabilities. Today NASA calls this "dissimilar redundancy". Our thinking here on how we design and build things has changed—this will be a critical characteristic of our future space missions.

The numerous ISS "change of command" events have always been highlights. New station "commanders" from Russia, Canada, Europe, and Japan are supported by the many different ground control teams who keep operations safe and productive. Thirty years ago, an American commander in charge of billions of rubles of Russian state property--or a Russian Cosmonaut in charge of a huge US spacecraft--would have been unthinkable. But it is the reality today.

Since last fall, ISS has experienced moderate internal air leakage to space. Leaks have been traced to the interior of the transfer tunnel at the rear of the Russian Service Module. Leak sources are small surface cracks in the tunnel's aluminum hull. The crew has sealed leak sites, and the leakage rates have reduced. Engineers and technicians in Russia and the U.S. work together to understand and resolve this issue; but the root cause of the cracking, their failure modes, and impacts on ISS safety and future operations have not been adequately

determined. Top level NASA and Roscosmos management attention is needed now to focus the technical teams, to provide necessary resources, and to drive this issue to closure.

Technical and operational integration was a major effort in the ISS Program. This remains a significant challenge for future space programs. Expeditions to the Moon will require crews to operate systems designed and built by many different companies, contractors, suppliers, and countries, all with distinct characteristics, controls, displays, computer and verbal languages, symbols, and other requirements. Small groups of astronauts on the Moon may have to "make do" as the Apollo 13 crew did to fit their "square" CO2 absorbers into "round" receptacles. This was graphic illustration of what "bad" integration looks like. NASA's historical role, integrating and verifying hardware and software has been diluted as we rely more heavily on work done by commercial space companies. Considering what we have learned building ISS, this is a big step backwards.

There is debate on the technologies that will be needed for Mars expeditions. A Mars exploration will draw on the best skills and resources from many nations. Crew and cargo vehicles going to Mars will be very large. They will be too big to be lifted into space on a single launch, even with large boosters. They will be assembled in low Earth orbit, with robotic operations and human spacewalks. Vehicle designs will be robust, reliable, durable. Crews and their spacecraft will perform extended, independent operations. Space Station is the blueprint to do this.

If you ask what a Mars Program will look like--these questions are behind us.