Bridging Knowledge Gaps in Space Systems

The Honorable Norman Augustine, Chairman
Review of U.S. Human Space Flight Plans Committee
Washington, DC

July 30, 2009

Mr. Chairman,

The National Academies, NSF, GAO and others agree today that "knowledge gaps" and shortcomings in science, technology, engineering and mathematics (STEM) subjects have undermined modern systems, especially, space systems. The shortcomings produced cost overruns, schedule slippages, problematic operations, expensive maintenance, short life and random failures. Bridging the knowledge gaps is vital to reinvigorate our space program, economy, education and world leadership. I have identified and resolved serious shortcomings in STEM subjects since the 1950s, and my Works will profoundly impact the space program. I urge the Committee to consider my works as they relate to its mission, and I am available to brief the Committee on these transformative works and to answer any question.

I am not advocating the use of reusable vs. expendable vehicles, liquid vs. solid propellants, manned vs. unmanned explorations, public vs. private approaches, or other alternatives. My input is directed at identifying, bridging and resolving knowledge gaps in STEM subjects, and it applies to all options. I have identified the following three relevant subjects for the Committee's consideration:

1. Start-up transient dynamic overshoot effect
See attached Report, The Problem with the Space Shuttle and the Space Program (1992, 2000, 2003)

My transient "dynamic overshoot" studies caused controversies since 1986. The Report I submit for the Committee's consideration on this subject is rather lengthy. To counter detractors, I found it necessary to discuss the ontological reality and epistemological foundation of the phenomenon, include overwhelming empirical evidence, straightforward mathematical analysis, sobering line of reasoning, and many relevant and, perhaps, irrelevant, opinions to shore up my case. It remains my opinion that the transient dynamic overshoot phenomenon has been the primary problem with the Space Shuttle and the Space Program.

- The start-up transient dynamic overshoot effect is a devastating effect that can exceed built-in safety margins, particularly, in lightweight space systems. It has undermined many systems, especially, the Space Shuttle. The "dynamic overshoot" was completely neglected in initial Shuttle design.
- I identified and corrected the dynamic overshoot effect in space hardware since 1969, and I included solutions in technical memos at Comsat Labs. Those works should have been forwarded through the chain-of-command to, at least, DOD, DOE and NASA.
- I detected the dynamic overshoot error in Space Shuttle design from the excellent reports of the Presidential Commission on the Challenger Accident in 1986. The mistake was widespread in the Shuttle. I informed NASA and DOD officers about it in closed doors meetings in 1986. I was asked, and I was prepared, then to join the effort to wipe out the mistake from the Space Shuttle and other space systems, but that did not happen.
- My transient dynamic overshoot studies went beyond the detection of a serious design mistake. The studies produced first-class inventions that are known to former NASA Administrators and other leaders in public, private and military sectors. For example, I used the "transient dynamic overshoot" studies to invent a method to double (ideally) the

thrust of motors and engines. I shared the invention with NASA, Space Command, the Air Force and major Contractors. You were very kind, Mr. Augustine, to refer that invention to an executive, who had two teams of experts evaluate it. I was embarrassed to receive a condescending evaluation from that executive, which was copied to you then. Experts from NASA and elsewhere were also initially dismissive. Ten years later, the Aldridge Presidential Commission listened to many experts from the country and the world. A distinguished member of your Committee, General Lester Lyles, singled out one Work for commendation during the Aldridge Hearings in 2004; that was the progress made by the Air Force to increase thrust beyond the magical 100 percent level using my pulsing thrust method. I mention this Item to highlight the importance of the dynamic transients studies and to caution against people who casually dismiss my works out of hand without full knowledge of the facts.

2. Wave modulations and higher-order modulations in Space Systems

See attached Letter to Physics Today on Rogue Waves (June 2009)

Problematic dynamics and mysterious stresses have haunted space systems since the beginning of the space program in the 1950s. For example, Pogo, fuel slosh, chugging and other problems caught all of us by surprise forty years ago and we spent considerable resources, energy and time to solve those problems. Related to this area, I bring to the attention of the Committee another Work that identifies dynamics and sources of stress, completely unrecognized before. This Work is the result of a lengthy research that led to the Patent, "Method for Producing Natural Motions" (Patent No. 6,826,449, Issue Date November 30, 2004, available on uspto.gov). I also urge the Committee to consider this Work.

- A synopsis of the Invention is given in my attached Letter to the Editor of Physics Today on Rogue Waves (June 2009). Note in particular how wave trains (caused by vibration) traveling within a body (e.g., the Orbiter, External Tank, and Boosters on the Shuttle or other launch vehicles) can modulate to produce forces orthogonal to the direction of the applied pulses. In aerospace and other engineering areas, the exciting forces are usually discarded on the basis of Newton's Third Law of Motion – because the forces are equal and opposite in direction, the forces are discarded, with drastic consequences.
- Higher-order modulations produce other, hitherto unknown, rhythmic effects that depend on variations in exciting frequencies, a condition that happens at lift-off, MECO, SECO and other flight regimes. All future space hardware must take these effects into account at the design stage, and not wait to identify the effects from failures during test or operation.
- Please note that I demonstrated crude models of the above Invention to senior DDR&E officials in mid-1980s, and I built, delivered and successfully tested ten motion models (black boxes) for DARPA in 1998.
- I had tested the above effects on hundreds of materials, and discovered that the effects are very pronounced in "foam" materials! "Foam shedding" in the Shuttle became critical after the Columbia tragedy. I therefore contacted NASA and the Investigation Teams and offered to demonstrate the above effects; but my offers were rejected out of hand then. And foam shedding continued.

3. New Transformative STEM Discoveries

See Attached Message to the National Science Foundation (May 2009)

These discoveries will transform knowledge in physics, engineering, mathematics and other subjects in dramatic and unprecedented ways. The background and extent of this Item are described in the attached

message to the distinguished Director of NSF, Dr. Arden Bement, May 2009. The following issues are relevant to space systems and our space program.

- The new discoveries give specific methods to identify hitherto unknown fundamental frequencies of oscillation that could account for unexpected resonance conditions that could easily ruin a launch vehicle, spacecraft, aircraft, bridge and other structures. Please note that my responsibilities 40 years ago included the mathematical calculation of the fundamental frequencies of all components and subsystems on satellites, correlation with computer derived numbers and, where possible, verification of results in lab tests. The fundamental frequencies mentioned above are distinctly different from the frequencies normally calculated in standard and advanced dynamics.
- Physicists noted problems in the important Law of Conservation of Energy (LOCOE) a century ago. Those problems were sidestepped at the time, and physics and engineering proceeded without satisfactory solution throughout the 20th century. Here, I identify specific problems with LOCOE and provide cogent solutions, which are vital to the design of all future space hardware and systems.
- The problems with the Action-Reaction Law discussed in the above Item I recur here. The new discoveries give correct forms for the Action-Reaction conditions. These are also essential for the design of future space systems.

The above three subjects are vital to the next steps we take in the space program. The subjects apply to all alternatives chosen for manned and unmanned systems. Getting people and payloads to Low Earth Orbit safely, reliably, economically, and frequently must be a priority. These were distinct goals for the Space Shuttle in 1972. The shuttle failed to achieve these goals, as soberly described in my report, “The Problem with the Space Shuttle and the Space Program.”

President Barak Obama has shown wisdom to ask for independent review by your Committee, rather than rush into declarations of trips to the Moon, Mars and other destinations. The President asks for “human space flight” that is “safe, innovative, affordable, and sustainable.” Bridging serious knowledge gaps and solving serious shortcomings in STEM subjects will contribute greatly to these goals. Mr. Chairman: My Works are essential to eliminate, or greatly reduce, the vicious and expensive cycle of design, build, test, identify weak points, redesign, rebuild, retest, etc. of the past. I hope my input is useful, and I will be honored to answer any questions from the Committee.

Respectfully,

Ali F. AbuTaha
9381 Hersch Farm Lane
Manassas, VA 20112
Tel-Fax: 571-292-2508
aabutaha@aol.com