

Retire The Shuttle on Orbit *by Richard Godwin & Dennis Wingo*

If I didn't know better I'd swear that NASA took many leaves out of Ray Kroc's book when they built the monolithic government agency that they have become. For those of you unfamiliar, Kroc was the entrepreneurial genius who took a couple of hamburger restaurants in California and turned them into the largest restaurant chain on this planet, McDonald's.

One of the most radical changes that McDonald's perfected and which NASA seems to have adopted with a vengeance is the throw away culture; use disposables and throw everything away after a single use.

Now don't get me wrong, I realize that if you send a spacecraft to the outer solar system, it's a pretty far reach to be able to bring the craft back to earth and reuse it. This is the main reason that the Space Transportation System or Space Shuttle was developed in the hope that reusing a craft multiple times would reduce operating or average costs of a space launch system. The problem is that even though the shuttle is an awesome vehicle and highly capable, it was designed by Congressional fiat and had to be all things to all men. As a result we see an awesome machine reduced to forced obsolescence due to it being a compromised and inherently dangerous design.

As a result we have decided to go back to the future and design a new vehicle that we hope works pretty well and safely, namely Orion or Project Constellation (Apollo on steroids). I would think that if the first consideration is as it should be, crew safety, then Orion should be much safer than Shuttle. Hopefully we will also kill fewer astronauts flying this new system. (But I for one am going to miss those amazing Shuttle launches.)

As a result we now intend to retire the Shuttle STS system by 2010 (if you believe that one I have a bridge to sell you) so that it can be replaced by the new safer system. We will all be able to gaze longingly on Endeavour, Atlantis and Discovery in museums throughout the country shortly afterwards. Here is where I have a problem.

We are unlikely to see the incredible on orbit capabilities of Shuttle again for at least a generation and probably longer. Forget about watching astronauts being able to grapple satellites like Hubble, drag them into the cargo bay, fix 'em up and send 'em out again, those days will be long gone. I know, I hear you saying, "But you said it was a flawed system" and indeed it is. However the problems that have mostly arisen for Shuttle have always been at launch, even the demise of Columbia was caused by a launch failure. However once she gets on orbit, she is a fine machine and basically as safe as any space vehicle ever built with amazing capabilities that could be enhanced with a few "minor" modifications.

What I propose is that NASA considers retiring the shuttle fleet (or even just one of the orbiters) on orbit where it can still be a very useful asset. When I've mentioned this in passing to NASA engineers and managers I hear the following comments, "It was never designed to stay for prolonged missions on orbit." Or "it doesn't have the power capabilities for prolonged missions," or "it would quickly run out of OMS and RCS fuel and would be a dead duck," and the final kicker which is typical for NASA, "Better to design a completely new system dedicated to the task in hand." Is it just me or are these guys on orbit already? Dreaming of new systems that will never be funded or even considered!

If we want to utilize an asset (the Shuttle) that already exists but that was created for a different purpose we are going to have to retask it as cost effectively as possible, something that is very common in the world outside of government agencies, where capital is still limited. If we want to retire Shuttle on orbit there are a few things that need to be done to it in order for it to be more than space junk.

Firstly there is the issue of fuel for the OMS and RCS systems; these will run down very quickly. So we would need to be able to develop an alternative means of attitude control and orbital station keeping. Currently both systems on Shuttle are hypergolic, meaning that they operate without the necessity of cryogenic storage, but the fuels involved are highly toxic and corrosive. We might need to consider other fuels that do not require cryogenics or corrosive elements. An alternative to the existing RCS and OMS system would be to do the reboost with an ion propulsion system. Hall effect thrusters are particularly suited to this task and for very little mass could keep the orbiter in orbit. The shuttle could be placed in a gravity gradient mode (vertical with respect to the earth) which would minimize any RCS fuel needs. You could simply dump the existing RCS system and use a modular RCS system based upon gaseous hydrogen and oxygen derived from electrolysis of water brought up as a resource. The combination of the above would dramatically reduce the consumables needed to keep the orbiter in orbit. It's also possible that a non toxic, non cryogenic system could be adopted such as pressurized O2 and Methane. We don't have to limit our thinking here, even ignition systems can be non electric.

Secondly there is the issue of long term energy onboard the Shuttle. Currently energy is provided by the onboard fuel cells but at this point these only work for a maximum of a few weeks. We'd need a longer term solution and solar power would probably be the best bet. Placing a retractable solar power system within the back of the cargo bay would provide long term energy just like on ISS. A similar system to this was designed as far back as 1977 by the University of Michigan and the Shuttle currently has the capability to use external power as has been recently implemented for extended stays at the space station. A large solar array would provide all the power needed for normal operations and would be able to power the Hall Thrusters for reboost and the electrolysis for the RCS gasses.

There are other issues, like various consumables, that would have to be addressed in order to make the vehicle space worthy for extended duration, but none of them are show stoppers, especially if the shuttle were to be placed in close proximity to ISS.

So the question is, if we were prepared to make this leap of faith and retask one or more of the orbiters, what would we get out of it?

We'd retain and enhance the on orbit capabilities of the most awesome spaceship ever built.

Per se:

- 1) If parked near to ISS it would be safe haven for several astronauts for weeks at a time in the event of an emergency.
- 2) The retention of its own Canadarm would allow it to assist in any construction projects on or near to ISS.
- 3) It could provide reboost for ISS if docked temporarily.
- 4) It could substantially increase the lab area of the whole Shuttle-ISS system, especially if it retained something like a Spacehab module in the cargo bay.
- 5) If it did not have a module in the cargo bay it could instead be utilized as a hangar bay for all sorts of on-orbit assembly work.
- 6) If the orbiter were parked "ahead" of the station, it could provide some shielding from orbital debris by sweeping the orbit (another use for those shuttle tiles)
- 7) It could be used for what it was originally designed for, which is repair and inspection of satellites within a close enough orbital regime to its parking orbit.
- 8) It's the ideas that haven't been thought of that could come to fruition given the capabilities described above.

I know what I am suggesting is heresy as far as NASA is concerned and all sorts of qualified people will tell me why it is impossible. But I would ask just one thing of those critics: Please! Just take off your NASA hat for a moment, shut down your unlimited funding wish list and just for a moment think how this idea might just work if we had the gumption to attempt it. This might be the kind of thinking we need before we start considering the next great "throw away", the ISS itself.

If we are incapable of doing this then I suggest we ask the Russians if they would trade one Shuttle for a bunch of Soyuz rides and see if they can't achieve the impossible.

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