SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Upper Stages, Space Transfer, Entry and Landing Systems (3)

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# CONCEPT STUDY ON ADDING RETURN CAPABILITY TO HTV

**Abstract**

The H-II Transfer Vehicle (HTV) is the Japanese unmanned spacecraft that delivers supply cargo to the International Space Station (ISS) and it is launched by the H-IIB rocket from the Tanegashima Space Center. The maiden flight "HTV1" mission was completed successfully in November 2nd, 2009 with destructive re-entry to the south Pacific as planned. With the completion of HTV development, Japanese human space technology has moved another step closer to realize manned spacecraft. Next step is recognized as to acquire capability for return in moderate environment with guided re-entry. Therefore, studies on re-entry spacecraft or a return capsule have been conducted in Japan, since 2004. To take advantage of HTV success, such vehicle studied in Japan is focused on adding return capability to the HTV or HTV Return system (HTV-R). Two configuration of HTV-R are currently under study. One configuration places the return capsule in the Unpressurized Logistics Carrier of HTV. This is call Option 1. Another configuration is a full replacement of the Pressurized Logistics Carrier of HTV to a return capsule. It is called Option 2. We consider Option 2 has more advantages compared to Option 1, in terms of, a) better demonstration capability of manned spacecraft technologies, and b) maintaining HTV unique feature of delivering unpressurized cargo to ISS. A study on Option 2 was conducted to define its configuration. The return capsule's shape is a truncated cone with blunt base, similar to the Apollo Command Module. The semi apex angle of the cone is about 20 degrees. This configuration was selected considering several design factors, such as sufficient volume for payload delivery and equipment, moderate lift to drag ratio characteristics for lifting or guided entry, aerodynamic stability, limiting the maximum aeroheating for thermal protection, launch vehicle interface, etc. The capsule is covered with thermal protection system, such as ablative materials, to resist from heat of reentry. It also has docking system at the truncated face, similar to HTV, to mate with the ISS. Furthermore, adapter section placed between the return capsule and the unpressurized carrier, to pass the capsule load smoothly on to the Unpressurized Logistics Carrier. Solar panels are also placed on the adapter section to obtain sufficient power. The 1st flight of HTV-R is now planned around mid 2010s. To support mission schedule, detailed configuration

is now under consideration. This paper describes the results of the concept study of HTV-R, especially on Option2.