# OFFSHORE SPACE CENTER (Offshore Launch Site)

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An Offshore Space Center (OSC) from which space vehicles could be launched into and returned from orbit, is a logical concept for development of the high level of space activity expected in the not too distant future. The OSC provides substantial benefits as a support base and launch site for such a pattern of use. Any activity which requires the development of a heavy launch lift vehicle (HLLV) will benefit by operation from an OSC. Cost, operational, and political advantages make the OSC an attractive concept.

Operating from near the equator provides a twenty percent increase in payload in an ecliptic plan orbit. The offshore site, in international waters, will function as a central location, easily reached by earthbound transportation from worldwide sources of materials which must be launched into space. The remote location in international waters isolates the launch operations (e.g. noise) from population centers and from some other major potential environmental objections. Such an OSC site provides independence from foreign control. Acceptable sites exist, affording a mild climate with excellent weather and orbital windows for each orbit around the earth.

OSC concepts considered include a moored floating (semisubmersible) design, a stationary design supported by fixed piles, and a combination of these two. The facility supports: a 15,000 foot long, 300 foot wide runway, designed to accommodate a two-staged winged launch vehicle, with a one million pound payload capacity to low earth orbit; an industrial area for HLLV maintenance; an airport terminal, control and operation center, and observation tower; liquid hydrogen and liquid oxygen production and storage, and fuel storage platforms; a power generation station; docks with an unloading area; two separate launch sites; and living accommodations for 10,000 people.

Potential sites such as the Paramount Seamount at 3°N, 91°W (in the Pacific Ocean off the north coast of South America) afford an acceptable water depth of less than 600 feet. Wave heights are below four (4) feet for eighty percent (80%) of the time. Hurricanes do not occur this near the equator, which leads to an anticipated severe design wave of only twelve (12) feet. A tolerably small current of one-half to one knot further enhances the favorable expected design conditions for such a site.

Cost estimates for the supporting structure (not the above deck facilities) have been developed for both the moored semisubmersible design and the pile supported stationary design based on an assumed installation in a 600 foot water depth. The total installed cost estimate is $3.0 billion for the moored semisubmersible OSC and $3.9 billion for the stationary pile supported concept based on projections from structures installed in the Gulf of Mexico where design conditions are much more severe (e.g. 80 foot design waves). Thus, these estimates are viewed as upper bounds which should decrease somewhat with the benign weather conditions of the more desirable equatorial sites. The 15,000 foot long runway is the primary cost driver in the designs, and the suitability of a floating (semisubmersible) support for the runway is questionable. Less deviation from a truly level and straight runway will result from a pile founded stationary structure. An OSC can progress from conceptual design to completion in approximately six years.

Boeing studies have shown that upgrading the Kennedy Space Center in Florida for HLLV operation will require $2 to $3 billion. Assuming a cost of $60 billion for a five (5) gigawatt Solar Power Satellite (SPS) with a twenty percent (20%) transportation cost, the OSC can be shown to pay for itself with the construction of a relatively few SPS's. With ion engine cargo transportation from an orbit inclined 30 degrees, approximately five percent (5%) of the total transportation costs or $600 million could be saved per five (5) GW SPS by an equatorial launch. The cost of the development of the ion engine drive would also be eliminated. With chemical engine cargo transportation the improvement in costs is even more apparent. Approximately twenty percent (20%) of the total transportation costs or $2.4 billion could be saved per five (5) GW SPS by an equatorial launch.

An OSC is the logical, cost effective choice for supporting HLLV launches when an HLLV operation is justified. Site selection studies, collection of environmental and soil data to permit design and trade-off studies between different OSC layouts, operations concepts, and specific component designs should proceed to prove the cost effectiveness of the OSC concept.