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PROPOSAL FOR MODIFICATION OF ISS

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ABSTRACT

With the Space-Shuttle withdrawal in 2010, the International Space Station (ISS) enters unstable age for each country of program participator. For more than 15 years, Japan spent technical effort and the enormous budget to develop the Japanese Experiment Module (JEM:KIBO) and is very much concerned about an insufficient utilization of JEM. If the ISS program ends in barely several years, this kind of circumstance is not desirable for not only Japan but also other ISS participating countries.

By changing the constitution of ISS, utilization value of space infrastructure in low earth orbit can be maintained and furthermore life will be possible to extend. The reconstruction of ISS under the leadership of Japan is proposed to ISS community, America, Russia, Europe and Canada etc, in the framework of international cooperation or allotment work, by the smallest investment. Reconstruction means that several elements and modules are removed from the state at the time of ISS completion planned presently, and that the capability of the space station is reduced moderately with keeping the minimum function of manned activity.

Proposed reconfigured space station named "JSS(Joint Space Station)" is consist of JEM, other ISS elements , modules and new service module which is the modified HTV(H-II Transfer Vehicle) with solar paddles, attitude control system and environment supply. JEM is the principal module in the component of ISS on a maximum scale and capability, and the newest with time aged deterioration. Required electric power and fuel consumption of JSS decreases substantially and cost-effectiveness will be attained for the future extended operation. The large-sized truss and the solar paddles presently installed on ISS are removed.

1. Introduction

"Effective use of manned space facilities"

The operation of the space shuttle that provide capability to carry seven crews or less and supplies to International Space Station ISS is stopped in 2010. And, the planned completion date of spacecraft "Orion" of the United States that takes the place of the Space Shuttle is 2013, and beginning of mission is

scheduled in 2015. The Orion being launched by the Ares1 rocket is enabled to transport six crews to ISS. On the other hand, ISS is expected to be completion in 2010, and operation ends in 2016.

Therefore, in completed ISS, the most of manned Space Activity such as the space experiment, the engineering examination, or

general people's visiting, becomes possible within these six or seven years.

However, at least five years from 2010, the human transportation to ISS, becomes only the Russian Soyuz that carry maximum 3 crews. The restriction of the number of crew that can be transported to ISS is a serious problem for the participating countries. And it becomes an unstable matter of concern in the future Space Activity.

Moreover, after completing ISS, large amount of maintenance expense will be a source of distress to each country of participation. For instance, estimated share of expense to Japan during one year is 40 billion yen. Though ISS is completed, it is not preferable for each country of participation of not only for Japan, but also that the number of transportable crew is reduced, and enormous expense is urged on the other hand. It is extremely regrettable that the operation of ISS faces the ending in 2016, under such circumstances.

ISS is the only manned space infrastructure for each participating countries. When continuing operation of ISS becomes difficult, most of the participating countries lose the only manned space infrastructure. And, obtaining another opportunity like this will become difficult in the long future.

To use this valuable facilities as long as possible, and as effectively as possible, we participating countries should grope for the method of evading such a problem.

Then, we propose the re-composition of ISS as one of the methods of evading this problem.

2 Proposal 1

"Reducing scale of SS"

Completed ISS is a huge structure (108.5m×72m and about 450t in weight). It is uncertain why ISS became such large-scale.

However, it is certain that there is no necessity being large as present scale. (Fig.1)

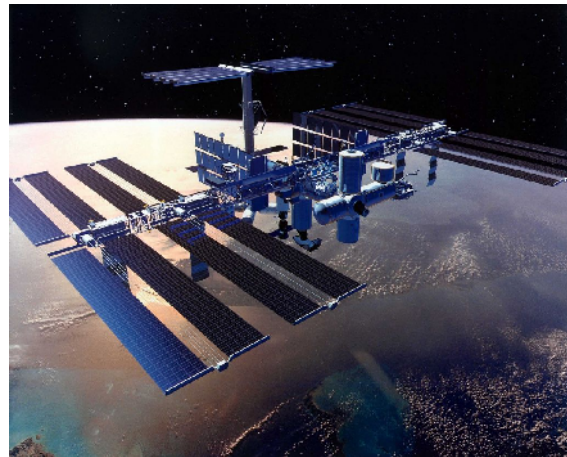


Fig.1 Image of International Space Station

Each country of participation should not leave those problems of the plan. To use over a long period of time, it is necessary to reduce the scale of ISS for decreasing the total maintenance expense greatly. Also, there is no necessity of residing continuously in the future, though now three astronauts stay. It should be a space infrastructure that can be used when it is necessary.

Because of long period of construction, old components and new components are coexisting in the ISS structure. There are modules and trusses that have already become superannuated in the part assembled at the early stage of construction, while "JEM(KIBO)" of Japan or "Columbus" of Europe are "new articles". From these ISS components, modules with long lifetime are selected by priority, and composed again as a small space infrastructure.

The main modules are "Soyuz (Soyuz)" of Russia, "Columbus (Columbus)" of Europe, "Node 1(unity)" and "Node 2(Harmony)" of United States, and "KIBO (JEM)" of Japan. The weight of the each component is as follows.(Fig.2)



Fig.2 Image of modified Space Station JSS

JEM	27.t
NODE 1 (3)	12.8t
NODE2	13.2t
QUEST	6.0t
Columbus	10.0t
Soyuz	7.1t
Total weight	71.8t

As an infrastructure under such a condition, the astronaut's stay cannot be maintained because of a service module. So, a new service module of the suitable scale for this small manned space facility is needed.

3 Proposal 2

"Addition of HTV/SM"

We propose the addition of "HTV/SM" as a service module of the small manned space facilities which described above. "HTV/SM" is a service module that remodels HTV of Japan.(Fig.3) HTV is developed for the purpose of the cargo shipment to ISS, and consisting of a pressurized career part, a non-

pressurized career part, an electric module, and the propulsion module.

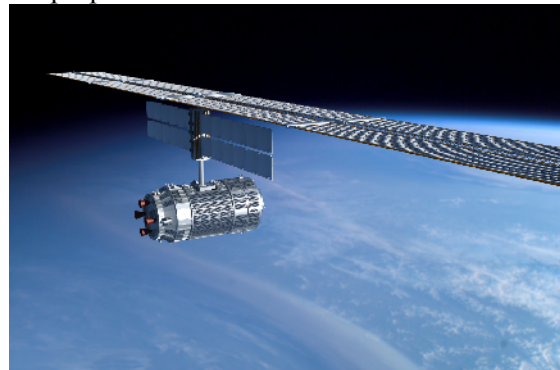


Fig.3 Image of HTV/SM

The necessary electric power in small space facilities is about 27 kW. This is about 3.6 times of the electric power generated with the solar paddle (7.5kW SAW: Solar Array Wing) of the Japanese engineering test satellite (ETS-8). Then, a necessary electric power is supplied to small manned space facilities by enlarging the electric power system for the ETS-8, and installed it in the non-pressurized part of HTV.

Other utility features are similarly built in the pressurized part and non-pressurized part of HTV.

Estimated weight of HTV/SM becomes about 16.5t or less. Therefore, the all up weight of small manned space facilities is provisionally calculated to be 95.1t, which is 1/5 from 1/4 of ISS. And it seems that the capacity of the pressurized chamber becomes about 1/4 of ISS by 290m³. The amount of a necessary electric power is assumable from this with 27kw. However, it is expected that the amount of a necessary electric power lower in addition. As previously stated, of Space Activity in ISS after 2010, the possibility of decreasing is high because of the withdrawal of the space shuttle. Therefore, it is appropriate to set the amount of a necessary electric power as 27kw.

Considering such a background, the operation cost of the manned space facilities when miniaturizing it according to the re-composition is expected to become 1/4 of ISS when completed.

The production of 7 vehicles is scheduled as HTV that is the original-type of HTV/SM now. After the Space Shuttle ends operation in 2010, space activity in ISS is expected to decrease from present. Therefore, the amount of the payload decreases, and the operation frequency of HTV will be expected to be smaller than first plan. Then, 1 of the 7 HTVs that scheduled production is remodeled to the Service Module providing the utility function. As for this method, the feasibility is extremely high, and economical.

We call this small manned space facility by the re-composition "JSS (Joint Space Station)".

4 Proposal 3

"Change in the operation form"

The purpose to make ISS smaller-scale is not only a reduction of the operation expense. For an efficient and long-term use of JSS, we propose to change the form of operation. For instance, in JSS, two experiment modules or more are not needed. Remodeling either of

JEM or Columbus to the habitation module should be examined as one of the possibilities. The astronaut's residing is also not necessary. Astronauts in each country of participation stay according to their space activity. However, the astronaut's residing is not necessary.

JSS is a permanent base on the orbit where the astronaut can stay as the need arises.

Moreover, the experiments for the engineering examination or Space Activity executed in the engineering test satellite are concentrated on the outboard palette etc. as much as possible. The large-scale exposure part of "JEM" is a great feature that no other modules have. (Fig.4) The space industry strongly requests the chance of the environmental test and the proof examination of the commercial-off-the-shelf component.

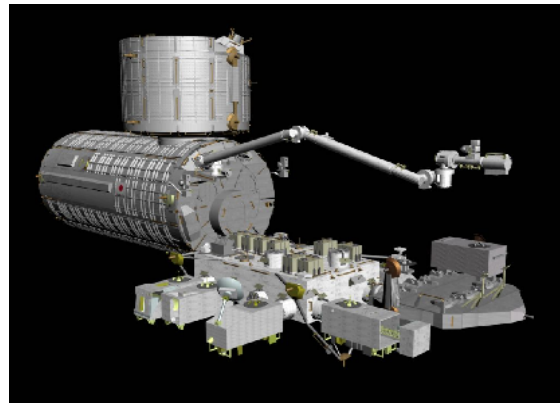


Fig.4 The palette and JEM

Such an examination can be done low-cost over a long period of time.

It is also possible to advance the examination of the robotics technology, the research and development of the space suit, the experiment on the life-support system, and the transmission examination of SSPS (Space Solar Power Systems).

Proceeding a large amount of examinations efficiently becomes a great contribution for the space industry.

In addition, we propose the plan to build HTV/C(HTV-Capsule) by a partial remodeling HTV with the capsule technology.

5 Conclusion:

“Development into the future”

Present Space Activity has been occupied with the small number of space development advanced countries. In the near future, it is almost a certainty that countries not developing satellite and rocket are likely to be interested in space activity. Hereafter, accepting the use of JSS(Joint Space Station) by such countries promote the development of Space Activity in the world. However, when ISS is miniaturized to JSS, and it opens it to a lot of countries, various Issues will be caused. In the relation of each country of participation, it is not only a problem of a technological field in space, and it is expected to phlegm to actualize a political, racial, religious various problems. If those problems become serious matter, the opinion adjustment between attending countries becomes extremely difficult. Therefore, it is preferable that the adjustment post between each participation countries is a country with flexibility in politically, the race, and the religion. In present ISS attending countries, Japan's standpoint is politically, racially, religiously neutral.

Considering such a background, the leader of work to make up the space infrastructure opened by JSS(Joint Space Station) is Japan. It is a suitable position for performing of Japan.

We propose to start based on Japan's positively advancing the adjustment of the JSS plan in 2015, and to achieve it by 2020.

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