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PLAN FOR SATELLITE GEODESY IN JAPAN

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INTRODUCTION

The National Space Development Agency of Japan (NASDA) is developing an experimental geodetic payload (EGP) which will be launched in August 1986 as a payload of the test flight of the H-I launch vehicle.

The purpose and mission of EGP are as follows :

(1) To adjust the geodetic network with high precision for the national land survey and map making;
(2) To determine the accurate geodetic positions of isolated islands which cannot be connected with the domestic network geometrically through conventional methods;
(3) To find the relationships between the Japanese geodetic system network and those of other parts of the world.

To accomplish the mission, operations will be carried out through the "geometrical satellite geodesy method" using EGP which reflects both laser and solar lights so that its range and direction can be observed from ground stations by laser trackers and optical instruments. So EGP has solar reflecting mirrors and laser retro-reflectors. But it has no radio equipment.

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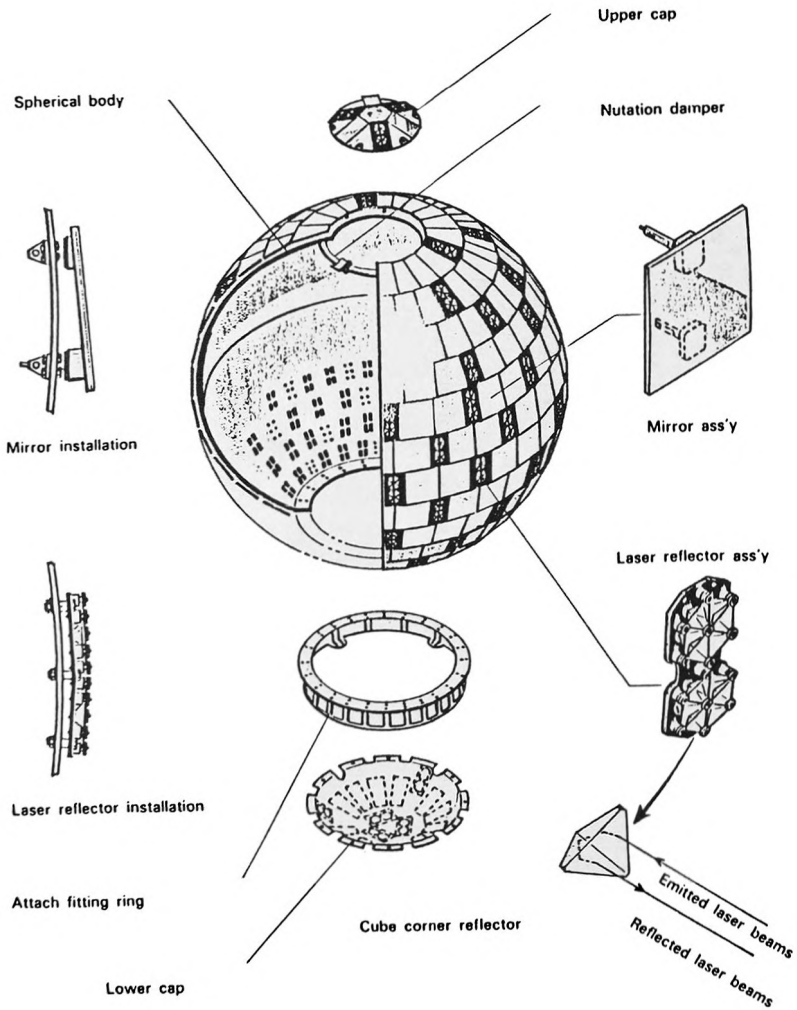
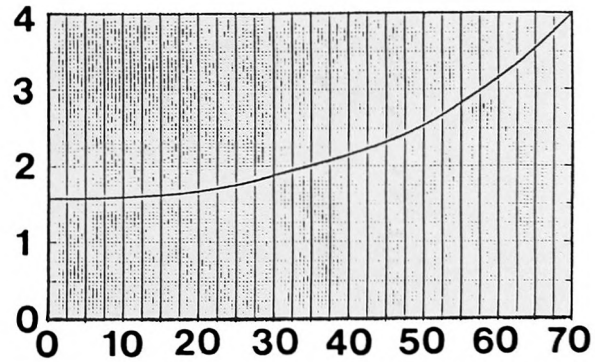
SYSTEM CONSTRUCTION



Solar Reflectance:	Specular reflectance	Rsp ≥ 0.85
	Mirror curvature	8.4 ~ 9.0 m
	Shining time	Approx. 5 msec
	Shining frequency	2 times or more/sec



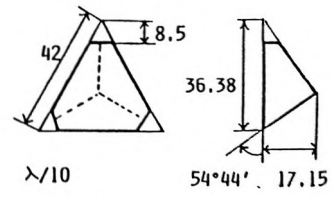
Laser Reflectance of Cube Corner Reflector:	Dimensions (Size in mm)	
	Flatness tolerance	λ/10
	Angle between faces	90° ± 2"
	Material	Fused silica

FIG. 1.

LAUNCH SCHEDULE AND MAJOR SPECIFICATIONS OF EGP

Launch schedule	: August 1986
Launch site	: NASDA Tanegashima Space Center
Launch vehicle	: H-I Rocket (Test Flight No. 1)
Orbit	: Altitude approx. 1 500 km Inclination approx. 50 deg
Weight	: approx. 685 kg
Configuration	: Polyhedron inscribed in a sphere with the diameter of 2.15 m (See Figure 1)
Solar reflectors	: 318 pieces (See Figure 1)
Laser reflectors	: 120 sets (1 436 cube corner reflectors) (See Figure 1)
Attitude control	: Spin stabilization

OBSERVATION PLAN FOR EGP

The Geographical Survey Institute of the Ministry of Construction and the Hydrographic Department of the Maritime Safety Agency in the Ministry of Transport are each planning to observe the EGP.

(1) Geographical Survey Institute

The Geographical Survey Institute (GSI) is planning to observe the EGP for the following purposes :

1. Control of the geodetic network of Japan,
2. Positioning of the isolated islands in Japan,
3. Determination of the shift constants of the Tokyo datum to the worldwide geodetic system.

The GSI has been conducting primary precise geodetic network survey by trilateration almost all over Japan since 1973 in order to establish a precise geodetic network which contributes to detection of crustal movements and precursors of earthquakes, and revision of the geodetic coordinates of triangulation points for official use. Though the relative accuracy of the primary precise geodetic network is within 2 ppm, the position error of a point which is distant from the Tokyo datum point by about 1,000 km is estimated to amount to some meters. The long baselines which are obtained from EGP observations are expected to improve the accuracy of the precise geodetic network.

The isolated islands in Japan were positioned by the astronomical method. Therefore, the positions are considerably biased due to the deflections of the vertical. The coordinates of Tokyo datum point of longitude and latitude were also determined astronomically. Thus, the geodetic system of Japan is shifted by some hundred meters in the worldwide geodetic system. By EGP observations isolated

islands will be positioned correctly. EGP observations in collaboration with other nations are expected to contribute towards determination of the shift constants of the Tokyo datum.

Presently the GSI has a laser-ranging facility at the Kanozan Geodetic Observatory for EGP observations. In addition, a direction-observation facility, which is composed of timing equipment to detect flashes from the EGP and a camera on an equatorial mount, was installed at the Kanozan Geodetic Observatory in March 1985.

(2) Hydrographic Department, Maritime Safety Agency

The Hydrographic Department of Japan has carried out Satellite Laser Ranging (SLR) observation at the Simosato Hydrographic Observatory (SHO) since March 1982 and the total number of observations for Lageos, Starlette and Beacon-C amounted to 367,000 by the end of 1984. SLR observation was originated as one of the observations for standardization of geodetic positions in oceanic regions to constitute marine geodetic control. The observation of EGP is also to be made for the same purpose of standardization of geodetic positions.

Standardization in oceanic regions is effected through the following three stages :

1. SLR observation to Lageos is made at SHO to combine the Tokyo datum with a global reference geodetic coordinate system in cooperation with SLR stations worldwide. The geodetic position of SHO determined is to be the origin of the marine geodetic control.
2. SLR observation and photographing of EGP is made both at SHO and at the primary stations selected in ten representative islands of each group of islands around Japan to combine the geodetic positions of the primary stations with the origin of the marine geodetic control at Simosato. The field observation of this satellite will start in mid-1987.
3. Doppler observation of the US Navy Navigation Satellite is made at the primary stations and at the secondary stations selected in some main islands around the island of each primary station to combine the geodetic positions of the secondary stations with the primary stations by means of the translocation method using three or four Doppler receivers. Doppler observation has continued since 1980.

The distribution of the marine geodetic control is shown in Figure 2.

The observations of EGP are to be made within the framework of establishing the marine geodetic control around Japan.

Pointing observations of EGP by using the mount of the SLR system in SHO will be commenced just after the launch. Depending on the accuracy of the created orbital elements, SLR observation might become possible in the early stage. Supporting observation by using a satellite camera will also be made at the Bisei Hydrographic Observatory near Okayama. The pointing information and SLR data will be transferred to the Tsukuba Space Center of the National Space Development Agency or to the Hydrographic Department by telex and new orbital elements will be created continuously.

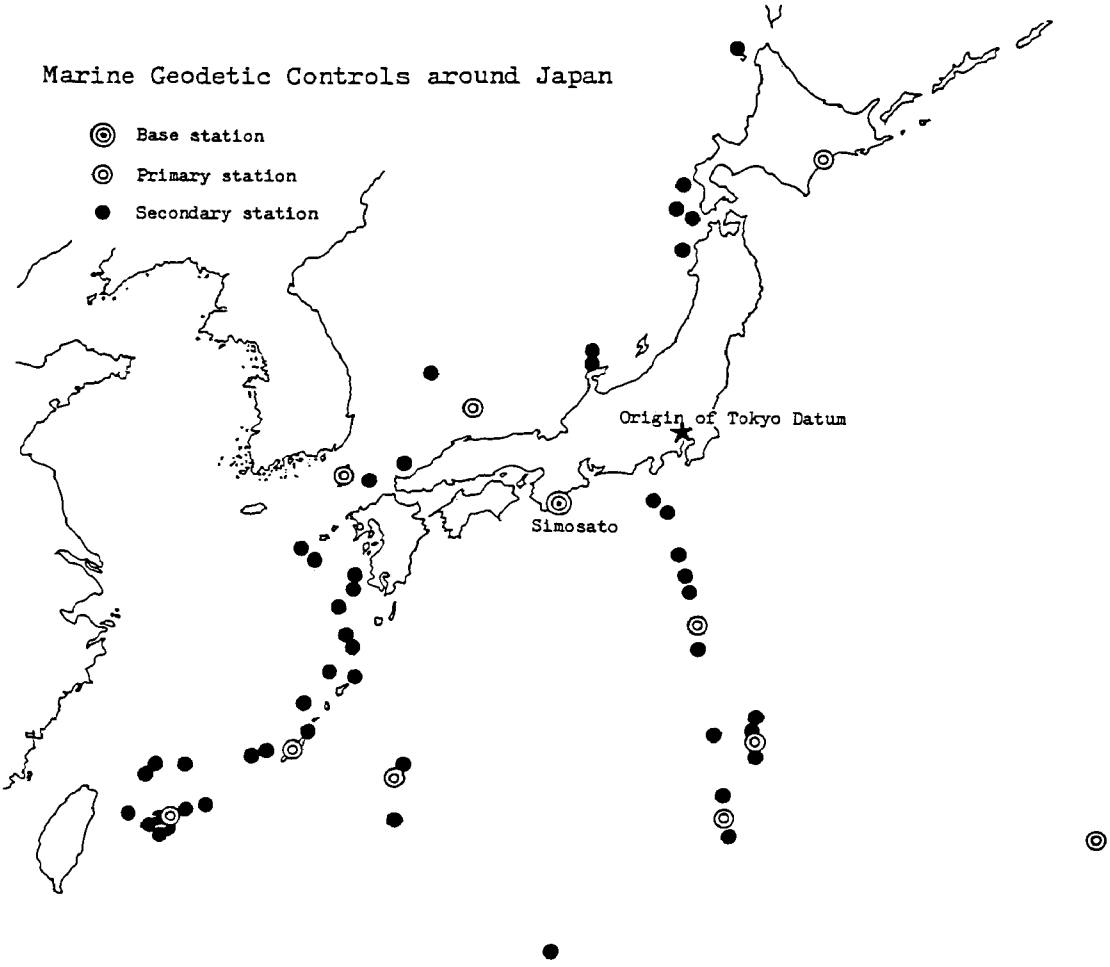


FIG. 2. — Distribution of the marine geodetic control around Japan constructed by the Maritime Safety Agency.

Field observations at the primary stations will be made for at least five years after mid-1987. The observations are made by using an SLR system and a satellite camera on an equatorial mount both at a primary station and the fixed station, Simosato. The flashing time of EGP for photographing is simultaneously measured with SLR observation by using a photomultiplier tube mounted on the tracking mount of the SLR system, not by satellite camera on the equatorial mount. The manufacturing of a mobile SLR system for field observation started in mid-1985.

In addition to the main work above, efforts to detect plate motions and crustal movements will be made in the SLR observation project and the observation will contribute to estimating earth rotation and geophysical parameters.