Especially, the increase in efficiency in satellite operation is called for these days and QZSS is no exception. In order to satisfy this demand, various studies were carried out in QZSS. In particular, the points studied preponderantly are the promotion of system automation, and a non-automating portion. That is, it is clarification of the work territory by operators. This does not affect only an operation design but is related also to a satellite and a ground system design. As described in section III, the operation design was started after system design completion previously in many cases. However, in QZSS, the above issue was able to be solved by synchronizing two designing.

The system of the QZSS is designed so that satellite Housekeeping and positioning mission operation can apply independently and respectively. But in attitude and orbit maneuver, bus equipments, navigation payloads and the ground system need to be cooperated and operated. In respect of these cooperation operations, by identifying in the initial process of an operation design, the design was performed so that each operating assignment and timing could be performed appropriately.

B. Operation diagram

As stated above, in QZSS, the operation design was started in the early stage of the system design. These operation design results were visualized using the activity diagrams. And system designers and operation designers would share the same information, and it prevented both doing the disagreement of recognition. There was a goal which especially promotes automation operation of not only the satellite but the ground system in QZSS. Therefore, utilization of the activity diagrams was much effective in discernment of the automated and non-automated operation. Also, the check of the operation procedure by an activity diagram is effective at the time of anomalous operations of satellite system. Satellites, these days, has a advanced 'Fault Detection Isolation and Reconfiguration(FDIR)' function, and it came to have the automation function and the autonomous function in which this performs separation of a failure component, and a change in a redundant component by itself. With these functions, a satellite system has come to have an automatic and an autonomous functions and the lead to an operator seems to be light. However, an operator may need to carry out recovery procedures if needed. As a result, the necessity of grasping the configuration of the satellite remains in operators regardless of the advancement of satellites. So, it leads to an activity helping an operator's understanding the satellite configuration. Figure 6 shows an example of operational flow diagrams of QZSS.

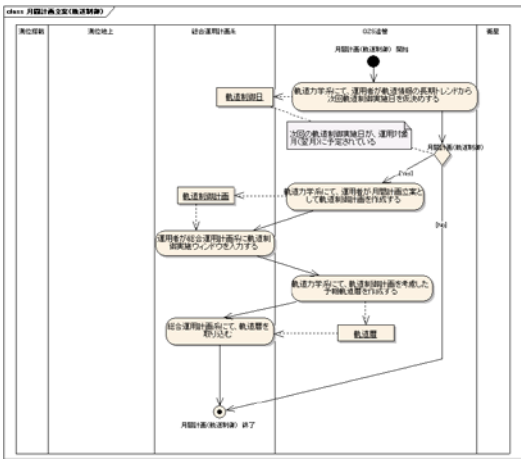

Figure 6 Example of Operational Flow in UML Format

VI. Conclusion

The first satellite of the QZSS, "MICHIBIKI," was launched on September 11, 2010. The result of the initial on-orbit checkout showed that the satellite performance satisfies all the required specifications. Technology and application demonstrations have started from the middle of December 2010.

The ground system of QZSS was able to make the idea to operation between system designers and operation designers shared by starting an operation design in the early stage of a system design. We think that the activity which made both wheels the system design and operation design especially by V-model structure led to making a system gentle to QZSS operators by making an output called an activity diagram feed back to a system design. By taking in the same process also in future satellite operation system development, we hope that it leads to construction of the high-efficient ground system.

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