EXPLANATION AND REQUIREMENTS FOR UNIVERSAL TIME

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This subject strongly depends on feedback and is one of extreme importance for the Observatory, which asks for your patience, all of you who are not directly concerned with the subject, the last Time Service Announcement, Series 14, on plans for an improved system of universal clock time dissemination. A copy of this information is available if you have not received one. The changes, very briefly, have a high probability in excess of 95 percent to change the system of dissemination of UT. Presently this is being done by the "offset" clock time system, UTC. In the future it will operate without offset on the standard frequency.

As you recall, standard frequency in the so-called Systeme Internationale (S.I.), is defined by the length of one second expressed in so many cycles of the cesium frequency. The Observatory does not at this time correct its clocks or operate its clocks at this rate, but instead operates at a slightly different rate called "offset." Under that system, it has been able, with very few adjustments, to stay within 100 msecs of UT. The list, which has been shown before, indicates that a very large number of users require that kind of precision, and that has been the reason for the system of UTC as it has been operated until now.

The yearly frequency adjustment has not always been sufficient to retain the rate within the tolerance, and the Observatory has had to make additional 100-msec adjustments. However, they were very infrequent.

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That system was an excellent one; in fact, it was the perfect one 15 years, 10 years, or 5 years ago. But approximately 1,000 atomic frequency standards are now owned and operated by the U. S. government or by contractors; and many, many oscillators are working continuously in the field. The Observatory has been lucky during the last four years not to be forced to make any such frequency adjustments. However, that luck cannot be depended upon to prevail, and in the future such adjustments may be required every year or every second year. It has become quite evident that the great increase, or expected increase, in time-frequency technology users will force upon us a revision of these methods. Once you agree that the frequency offset is a bad thing and that it is very hard to change frequencies, for instance, of a TRANSIT satellite, of a TIMATION satellite, or of a listening station in Antarctica; and once you agree that one cannot continue to make frequency adjustments, then you must provide UTI by way of information in the form of a time code which will give you the small differences (which may become as large as .6 or .7 seconds) directly on the time signal. The code, which the Observatory intends to use on the Naval time signals (which are presently emitted on about 35 frequencies every couple of hours) will be in this form, which will indicate the digit in question by emphasizing or marking the respective second tick.

There are two questions with which as many potential users as possible should certainly be acquainted. If you have any opinions on them, let the Observatory staff hear them. The two questions are these: (1) Is there any need to have that correction immediately available at the moment of use, (with the time signal) with a precision exceeding 100 msecs; say 10 msecs? Some users have indicated that there may be such a requirement. If there is such a requirement, the Observatory wants to know about it. (2) Would the proposed time code be acceptable, and do you envision any difficulties? There is one which came to light after the announcement

was published, that it would be impossible to mark the zero digit. That point can be modified to the extent that if the correction is going to be zero, the mark will be second 30 or - 0, instead of + 0. UT is defined as a correction to be applied to UTC in order to give UT1 directly an additional change since the users are not interested in UT2. It is an artificial concept which is excellent for the timekeeping and timemeasuring people, but not for the user. The user needs UT1, and the correction, therefore, will refer directly to UT1. At any rate, if you plot that correction, you will have adjustments of exactly 1 second. When the adjustment begins to exceed $-\frac{1}{2}$ second, then it will jump to $+\frac{1}{2}$ second. The correction will go slowly from + to -, and a step will be made about every year or so. That adjustment, therefore, will be exceedingly simple for all precision clocks. All that is necessary is to press the button at the right moment and you have dropped one second. It is the dropping of the second which will, in all likelihood, be a necessary adjustment--not the introduction of an additional second. However, the system makes provisions for both, because the performance of the earth's rotation cannot be predicted far enough into the future. So, that is the way the difference will go, and the advantage will definitely be that it is a better compromise which necessarily has to be selected. It is a compromise weighted more in favor of electronic timekeeping, of applications in physics and technology, and less in favor of the users of astronomical time.

The Observatory must move to that system because of almost insurmountable difficulties which otherwise would have occurred. However, as stated in the proposal, it will really have minimum impact on the users. It is only an adjustment which you will have to make on your clock, showing minutes and hours and days of the week, but not on your electronic systems for LORAN-C, for instance, nothing needs to be adjusted. All the Observatory will do is issue new times of coincidence tables (TOC) to become effective at the moment a step is going to be made, which will be known three or

for months in advance, and you will just remove the old table, throw it away, and use the new one. You need not make any adjustment except on your wall clock, The adjustment also will not disturb OMEGA. None of these systems needs to be adjusted. All that has to be done is to receive a new reference table to give you the fundamental epoch of the system. The same could be true, of course, for a collision avoidance system. Simply do not start on seconds 3,6,9 and so on, if your basic period is 3 seconds, but instead start on 1,4,7 and so on.

Everybody should now be aware of these plans and there does not seem to be any major difficulty from the correspondence which has been received in response to this announcement. A feeling of relief is evident from some people who said, "that is very fine; we didn't like the offset frequency and that is a step in the right direction."