PRELIMINARY REPORT OF SES SIMULATI[illegible]

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From 4 September through 20 September 1973, a series of motion tests were conducted on human subjects at Marshall Space Flight Center (MSFC). The effort was administered by the Surface Effect Ship Project Office (SESPO) PM-17 using personnel from Systems Technology Incorporated (STI) to conduct the tests, medical personnel from the Naval Aerospace Medical Research [illegible]ratory (NAMRL) Detachment, New Orleans, Louisiana, to provide medical support and interp[illegible]tion of medical responses to the motion, National Aeronautics and Space Administration ([illegible]) personnel and Link Company on-site contract personnel to operate the motion simulat[illegible] certain support computer control equipment, and data collection and analysis eq[illegible]ment Oceanics Inc., via STI supplied motion data which were abstracted from measurements by Bell Aerospace Corporation of the SES 100B missions 191 and 194, and the model of the motion of the proposed SES 2000T. The basic data records and the model of the 2000T were not available at the test site and have not been reviewed for this report.

The simulator is a Link six-degree of freedom motion simulator (Figure 1). The limits and specification of the system are discussed in the report. The simulator was computer controlled for the tests and control was exercised by the test conducter at the simulator control room. Medical supervision was exercised by a medical officer at the control room before, during and after each run. A total of 78 tests using human subjects were conducted. They are numbered serially in the medical officer's chronology. Four crewmen, HELM, NAV, TECH, and WATCH, were used in each test with a few exceptions. The test duration was a nominal 5 minutes (4 - 10 minutes) for familiarization, and ½ hour and 4 hour runs for data. There were 40 five-minute runs, 36 one-half hour runs, and 2 four-hour runs for a total of about 117 manhours of experience.

Twelve volunteer candidates were solicited from crew members of the 100A and 100B ships, and one volunteer was a civil service employee. Of this group four naval personnel were found to have conditions considered medically disqualifying for the tests. This is a substantial rejection rate considering that the volunteers were solicited from presumably able bodied naval personnel. This is consistent with the prior experience of NAMRL in attempting to qualify volunteers for human experimentation. Of the nine acceptable volunteers, only one was found free of medical defects. The remaining eight had various medical defects which were considered incidental and were not a source of excess risk to the subjects during the tests.

The simulator is strictly limited in stroke and velocity. At certain commanded accelerations and frequencies considerable distortion of the desired vibration was introduced by this limitation and other steps in the processing of the analogue voltage commanded to the valves controlling the motion base. A demonstration of this effect is shown by comparison of AXZW (commanded acceleration) (Figure 2) and DDZ (measured acceleration) (Figure 3), from a run of 2000T, 60 kts., -45 degrees sea heading, sea state 4, without heave alleviation. The magnitude of the acceleration at 7 HZ was completely unintended. Therefore, the fidelity of each run must be considered before attributing subjective comments and task performance to any part of the predicted vibration profile of a 2000T SES. It should be noted that the 1970 ISO lines indicated in Figures 2 and 3 are modified and extended below 1.5 HZ.

Encl. (1)

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The details and the scoring of these tests is being reported by STI. In addition, there were pre-day and post-day medical examinations, and pre, during and post-run observations by the medical officer and volunteers recorded in narrative form in a chronological log. There were also self rater (Figure 4) and observer rater forms (Figure 5) filled out at the end of each data run. The preliminary results of these various sources of information are as follows.

1. The observer rater form uniformly gave negative results. That is, there was no evidence of significant pallor, sweating, unsteadiness, anxiety of facial expression, or slow recovery from simulator to room environment, noted by the medical officer raters. These observations, if present, are often associated with motion sickness.

2. There were significant complaints regarding one or more of the ten fact[illegible] the self-rating forms within considerable variation depending on run or subject. These [illegible]s are undergoing analysis with regard to run number, subject and subject position. However, in no case was a subject compelled to abort a run or unable to complete his assigned tasks because of the feelings. In general, the extent of these unfavorable reactions as a group was less than the unfavorable reactions of aviation candidates to the Brief Vestibular Disorientation Test, NAMRL, Pensacola, Florida. Presuming no inherent differences in the groups, this implies that the motions of the test simulation are less severe than the Brief Vestibular Disorientation Test, with regard to disorientation.

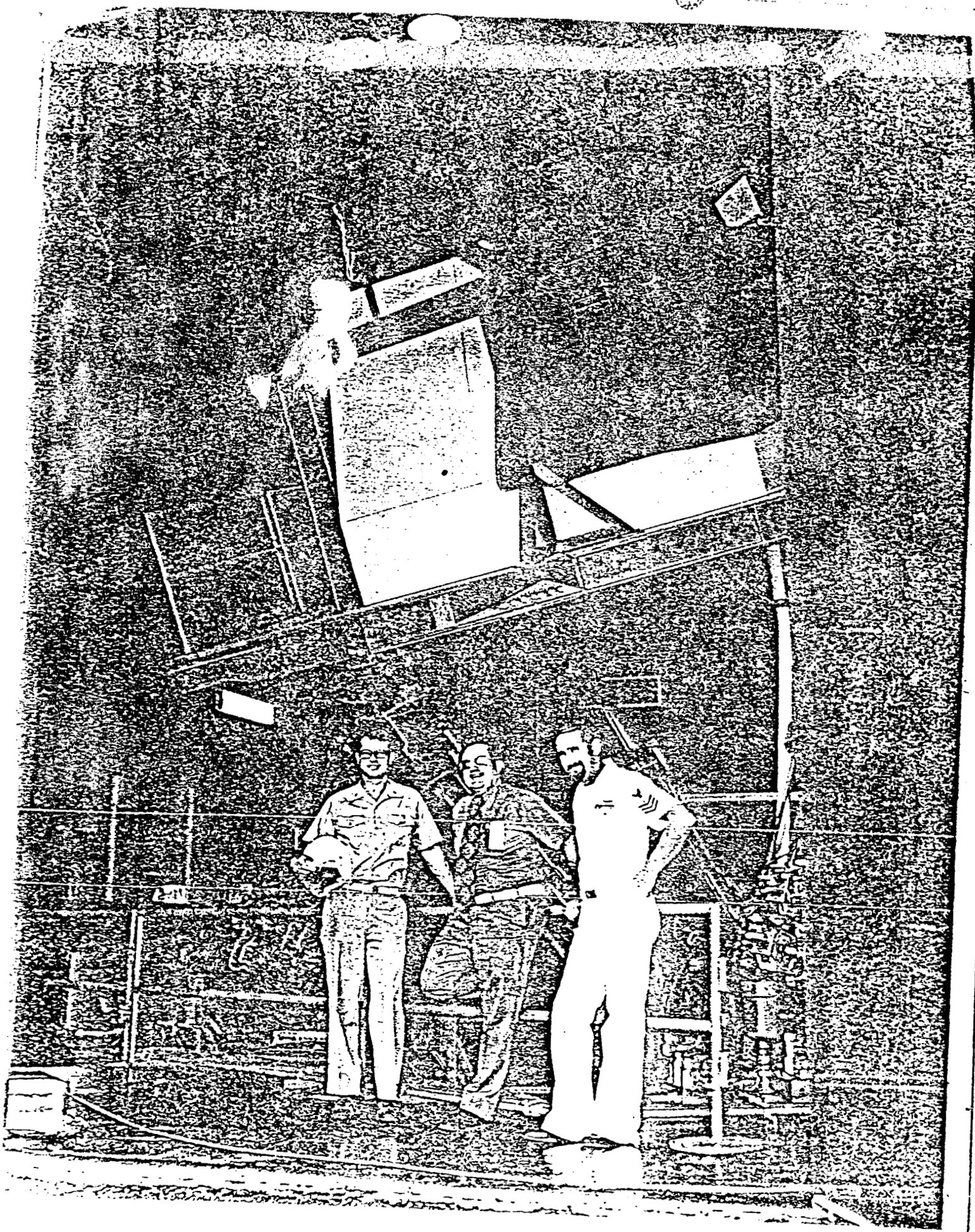
The most severe case of abdominal or stomach awareness symptoms occurred during human run 73, September 19, 1973, 1912 hours, on subject 021. He felt that he would have vomited had the run continued much longer. However, the pre-day exam disclosed symptoms of heart-burn. Pre-run he had further symptoms occurring after lunch. The primary basis of these symptoms was considered to be a mild gastroenteritis not associated with the tests.

3. The medical observations were extensive and they are summarized for the final report. In general, the most common symptoms were headache, backache, occasional stomach awareness, and musculo-skeletal stiffness. All of these symptoms were mild and of the type commonly associated with many different types of transport vehicles. They could not be specifically related to any given test. However, the symptom of backache could presage a problem of excess rate of such a symptom with SES type vessels.

4. The desired lower frequency (0.1 to 1 HZ) amplitudes, which were attenuated, and the undesired high frequency (7 HZ), which was introduced into the simulator, (as illustrated in Figures 2 and 3) must be carefully considered when reviewing any task performance, medical observation, or crew comments pertaining to the runs. The responses could be related to the higher frequency amplitudes, and to the unrealistic jolting on certain runs which have nothing to do with the predicted 2000T response. Furthermore, the lower frequency amplitudes on some of the runs could not be simulated by the device, particularly the heave (Z) acceleration. This underestimates the severity of the predicted 2000T motion response.

5. The inertially triggered shoulder restraints are hazardous for vibration simulation and would be of no value for restraint against vibration. The alternating motion is sufficiently slow such that the restraints do not lock. This was demonstrated in run 77. Subject 024 at the TECH station, which is starboard facing, hit his head against a cabinet at about 1148 hours due to jolting of the cab. No physical findings or residual complaints were found.

A detailed chronology of the runs, a list of each medical symptom, comparison of the desired [illegible] MSFC and analysis of the self-rated responses will be submitted with the final report. Further extension of the summary findings will then be possible.



Starboard View

Figure 1

used for 1/2hr runs 3&10

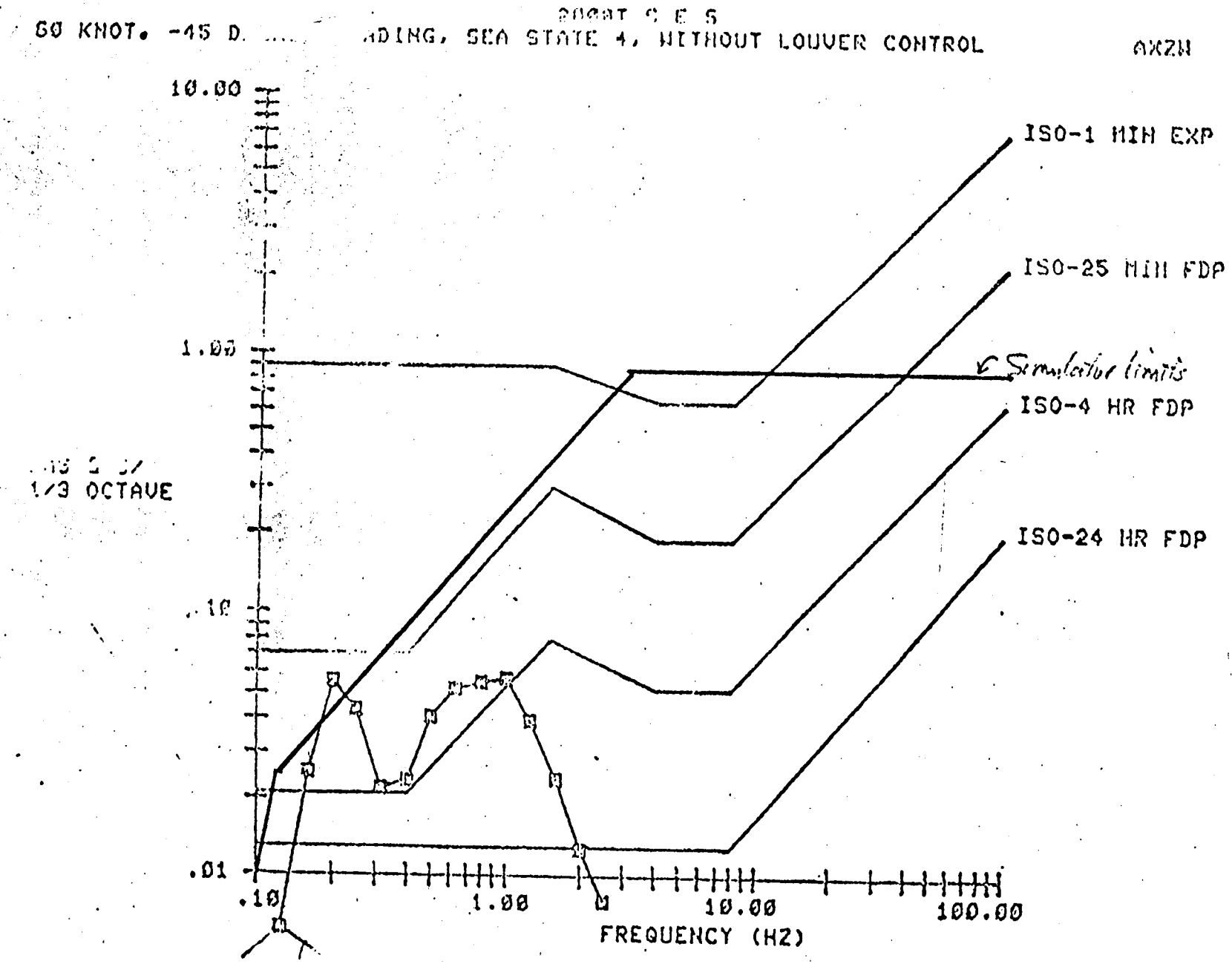


Figure 2

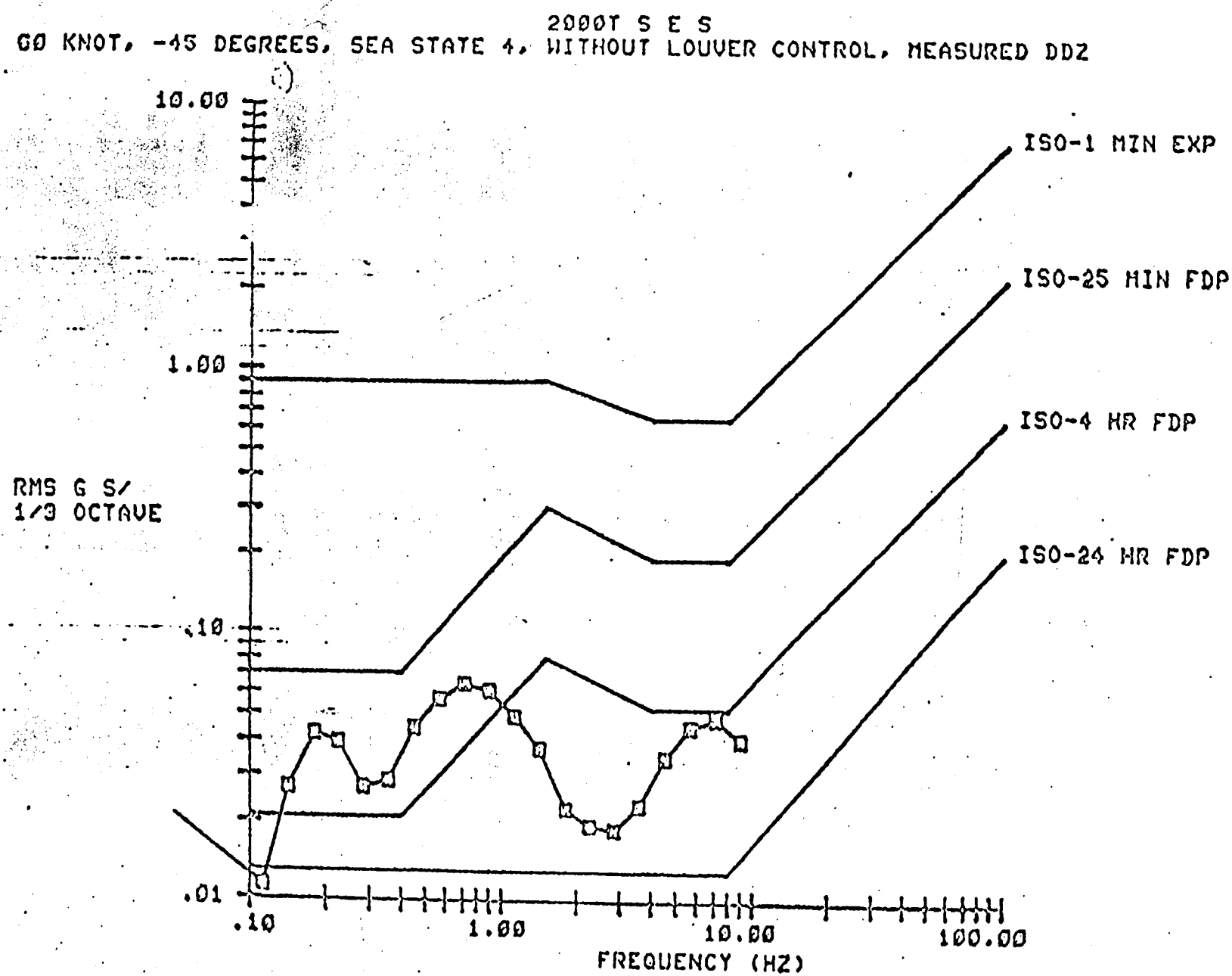

2000T S E S
00 KNOT, -45 DEGREES, SEA STATE 4, WITHOUT LOUVER CONTROL, MEASURED DDZ
10.00
1.00
.10
.01
RMS G S/
1/3 OCTAVE
ISO-1 MIN EXP
ISO-25 MIN FDP
ISO-4 HR FDP
ISO-24 HR FDP
.10
1.00
10.00
100.00
FREQUENCY (HZ)

Figure 3

DATE _____

Rate the following items on the appropriate point according to how this ride affected you:

1. Like _____ _____ _____ _____ _____ _____ Dislike

2. No stomach effects _____ _____ _____ _____ _____ Strong effects

3. No dizziness _____ _____ _____ _____ _____ Strong dizziness

4. No sickness feelings _____ _____ _____ _____ Strong feelings

5. Steady _____ _____ _____ _____ _____ Very unsteady

6. Hot _____ _____ _____ _____ No change _____ _____ _____ Cold

7. Dry _____ _____ _____ _____ _____ _____ Wet

8. Readiness for physical test _____ _____ _____ Non-readiness

9. Readiness for aptitude test _____ _____ _____ Non-readiness

10. Not worried _____ _____ _____ _____ _____ Worried

Form by: ROSALIE K. AMBLER and FRED E. GUEDRY, JR.

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AMBLER, R. K., and F. E. GUEDRY, JR. *Reliability and validity of the brief vestibular disorientation test compared under 10-rpm 15-rpm conditions.* Aerospace Med. 42(2):188-189. 1971.

Figure 4

Rater's Name _____ Date _____

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Name										
Pre-test Anxiety										
Disorientation										
Pallor										
Sweating										
Facial Expression										
Unsteadiness										
Slow recovery										
Over-all										
TOTAL										
Remarks										