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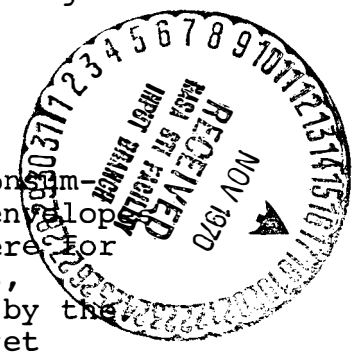
B70 10028

SUBJECT: Apollo 15 EVA Capability And Constraints Envelopes Case 320

DATE: October 13, 1970

FROM: P. Benjamin



MEMORANDUM FOR FILE

The EVA capabilities afforded by the PLSS consumables and assumed metabolic rates define operational envelopes for Apollo 15 traverses. These envelopes are shown here for EVA's 2 and 3. EVA 1 is time, rather than consumables, limited to 6 hours. The radius of operations defined by the rideback and walkback limits and PLSS consumables budget determines a constraint envelope which is also plotted for EVA's 2 and 3. The assumptions used for constructing these envelopes are in accord with those to be published by MSC in the Lunar Surface Mission Guidelines:

1. PLSS feedwater capacity is 9.8 lbs (10,065 BTU) with heat leaks of 0, 100, and 200 BTU/hr for EVA's 1, 2, and 3 respectively.

2. PLSS oxygen capacity is 1.3 lbs with leak rates of .01, .02, and .03 lbs/hr for EVA's 1, 2, and 3 respectively.

3. PLSS battery capacity provides a 7 hr capability for all EVA's.

4. The capacities above are defined after allowance for a 30 minute consumables reserve.

5. The metabolic rate for working, including overhead and science station activities, is 1050 BTU/hr.

6. The metabolic rate for riding the LRV is 700 BTU/hr.

7. The metabolic rate for planned walking traverses is 1200 BTU/hr at a speed of 3.3 km/hr.

8. A 20% pad is required for emergency walkback, making the metabolic rate 1440 BTU/hr at a speed of 3.3 km/hr for this activity.

9. The average LRV speed is 8 km/hr on nominal riding traverses and 10 km/hr in emergencies.

10. During B/SLSS operation the oxygen flow rate is 4 lbs/hr for 1.25 hrs. B/SLSS connection time is 5 min and 13 min are required for LM ingress, leaving .95 hrs for travel during emergency return to the LM.

11. Overhead consumes 1.5 hrs of EVA 2 and 1.75 hrs of EVA 3. About 1.5 hrs are available for a traverse on EVA 1.

The capability envelopes for riding traverses on EVA's 2 and 3 are shown in Figures 1 and 2. Points above or to the right of these lines exceed consumables capabilities. Consumables limit lines are plotted for combinations of working times and traverse lengths. Both EVA's are water limited for short traverses and battery limited for longer traverses. Working time is plotted in EVA time on the left scale and traverse station time (after overhead) on the right scale.

The capability envelopes for walking traverses on EVA's 2 and 3 are shown in Figures 3 and 4. Water is always the limiting consumable. For walking traverses the maximum radius of operations is 3.1 km, as defined by the .95 hrs of oxygen flow on the B/SLSS and the 3.3 km/hr walking rate. Any walking traverse which meets all other consumables constraints and does not exceed this return distance does not violate any walkback constraints.

Figures 5 and 6 show the return distance constraints for riding EVA's 2 and 3. During the early portion of the EVA the rideback constraint (PLSS failure) predominates and is defined by the .95 hr B/SLSS oxygen flow and the 10 km/hr emergency LRV speed. During the latter portion of the EVA the maximum return distance is limited by the walkback constraint (LRV failure) which is defined by the consumables remaining in the PLSS to support a walking return to the LM at 3.3 km/hr and 1440 BTU/hr. Since the consumables remaining for walkback are a function of the consumables used in working and riding during the EVA, a traverse consisting of 50% riding and 50% science station time is assumed for this calculation. A traverse which remains within this envelope meets the walkback and rideback constraints.

The capability and constraint envelopes drawn here can be used for preliminary Apollo 15 traverse planning for both the nominal riding and backup walking missions. A detailed calculation of consumables budgets must be performed once definitive traverses have been designed.

2032-PB-meh

P. Benjamin

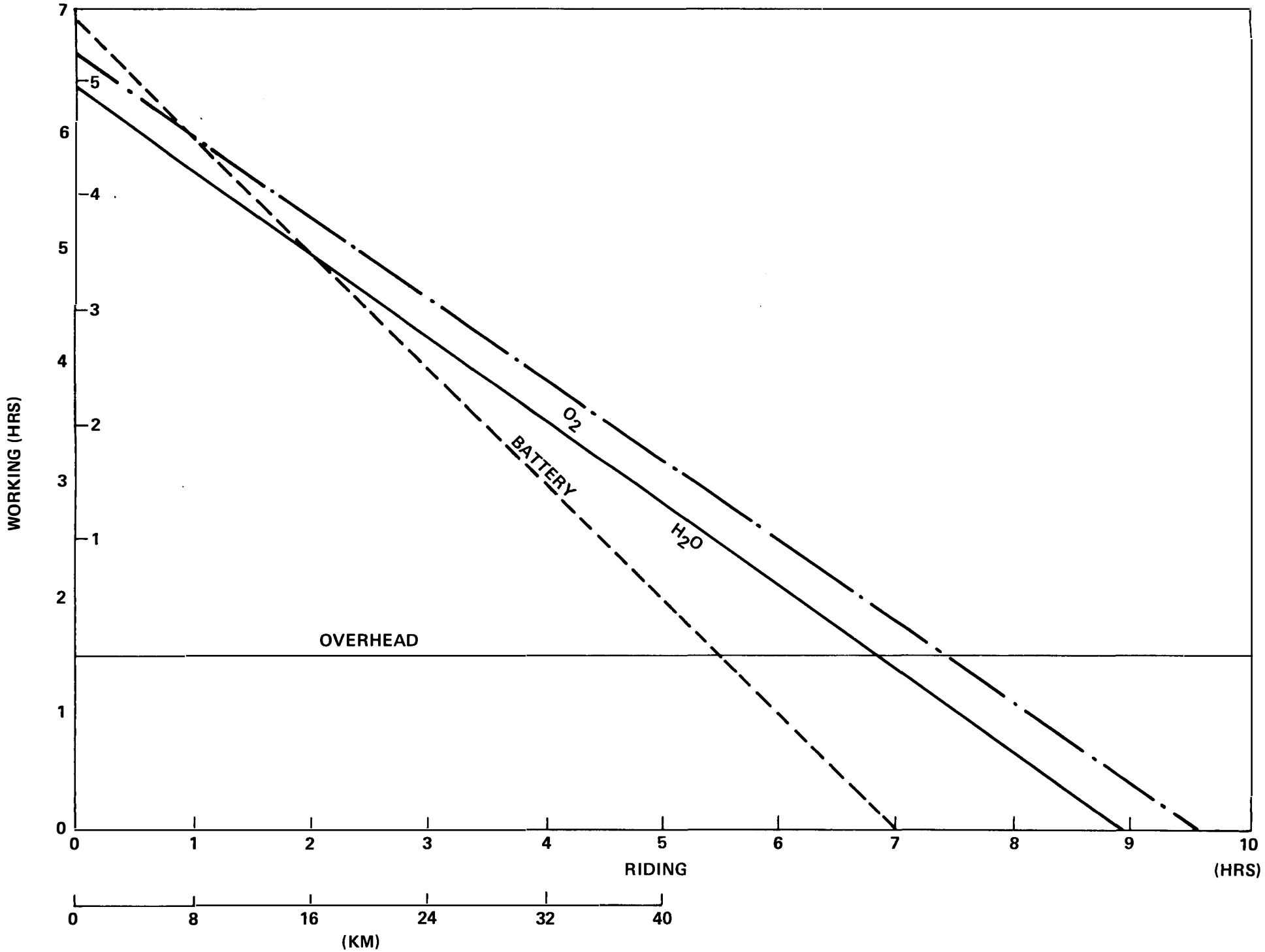


FIGURE 1 - EVA 2 RIDING CAPABILITY ENVELOPE

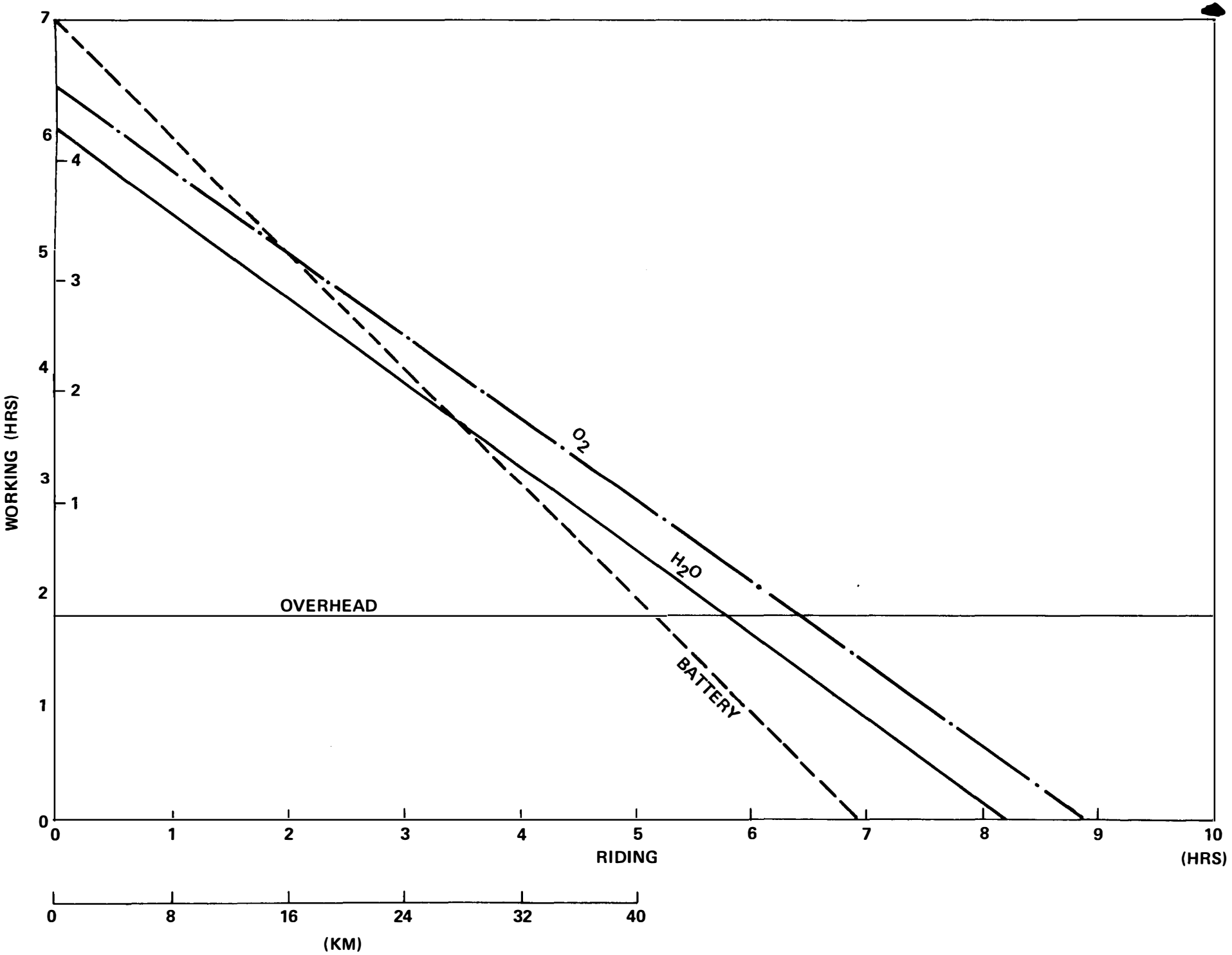


FIGURE 2 - EVA 3 RIDING CAPABILITY ENVELOPE

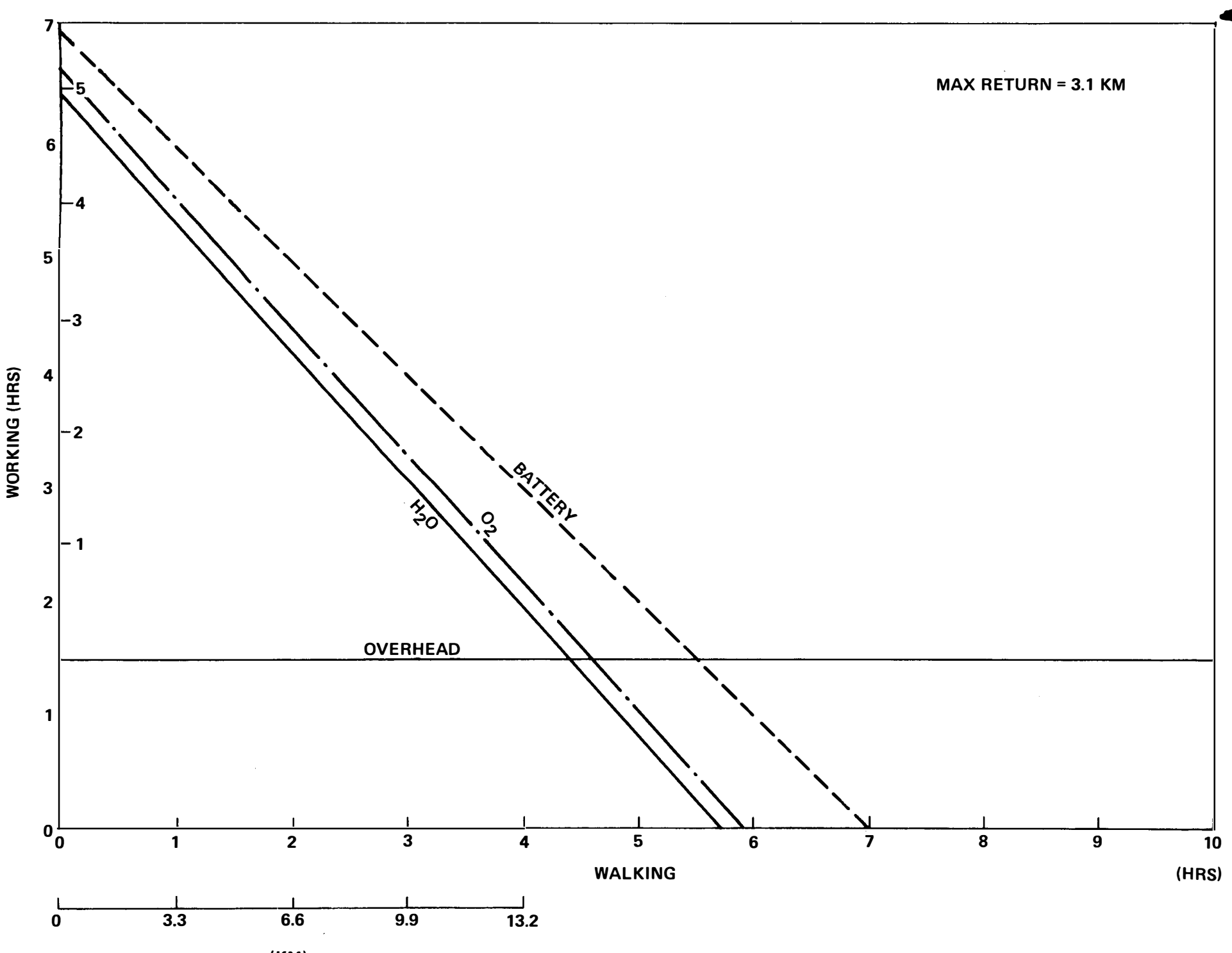


FIGURE 3 - EVA 2 WALKING CAPABILITY ENVELOPE

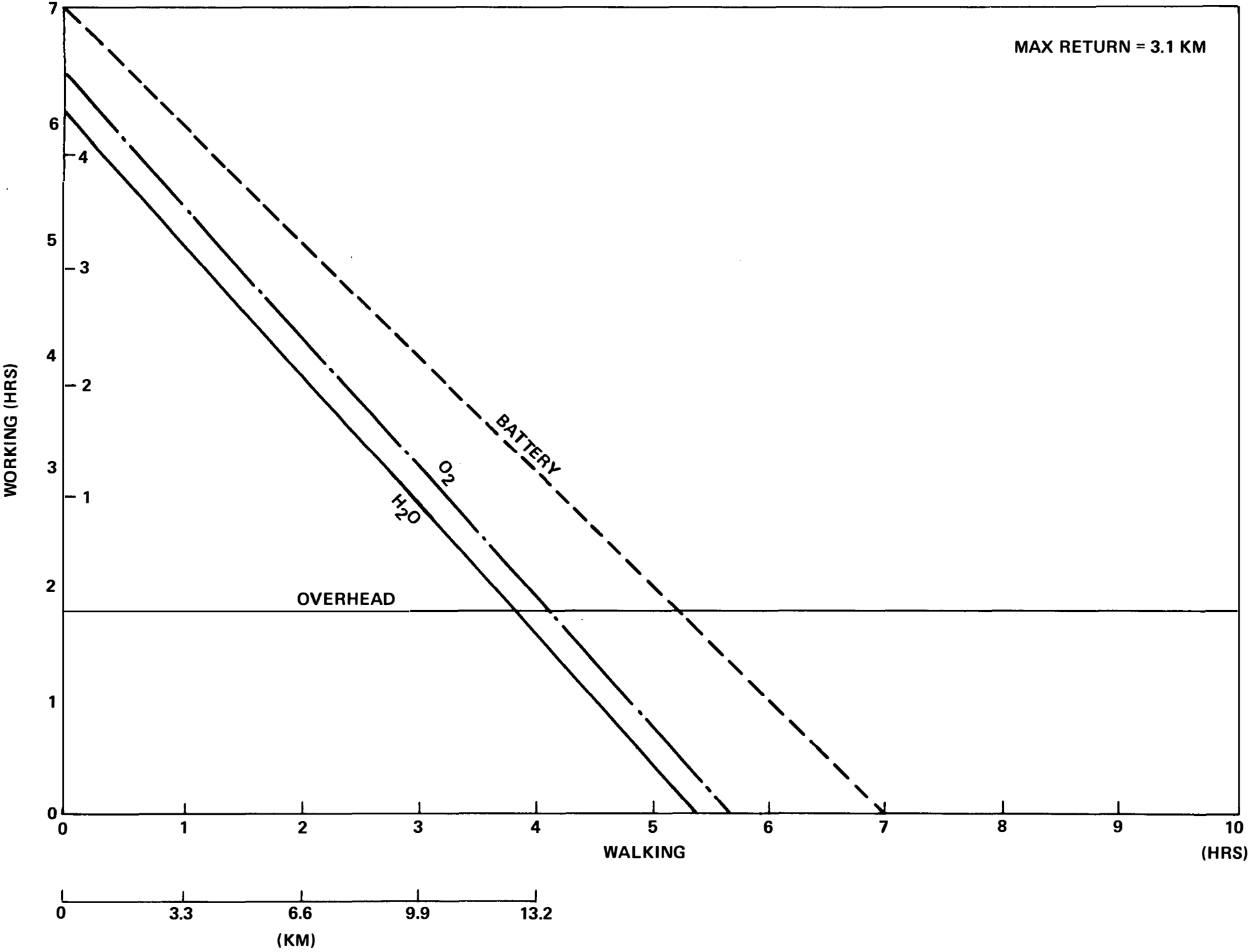


FIGURE 4 - EVA 3 WALKING CAPABILITY ENVELOPE

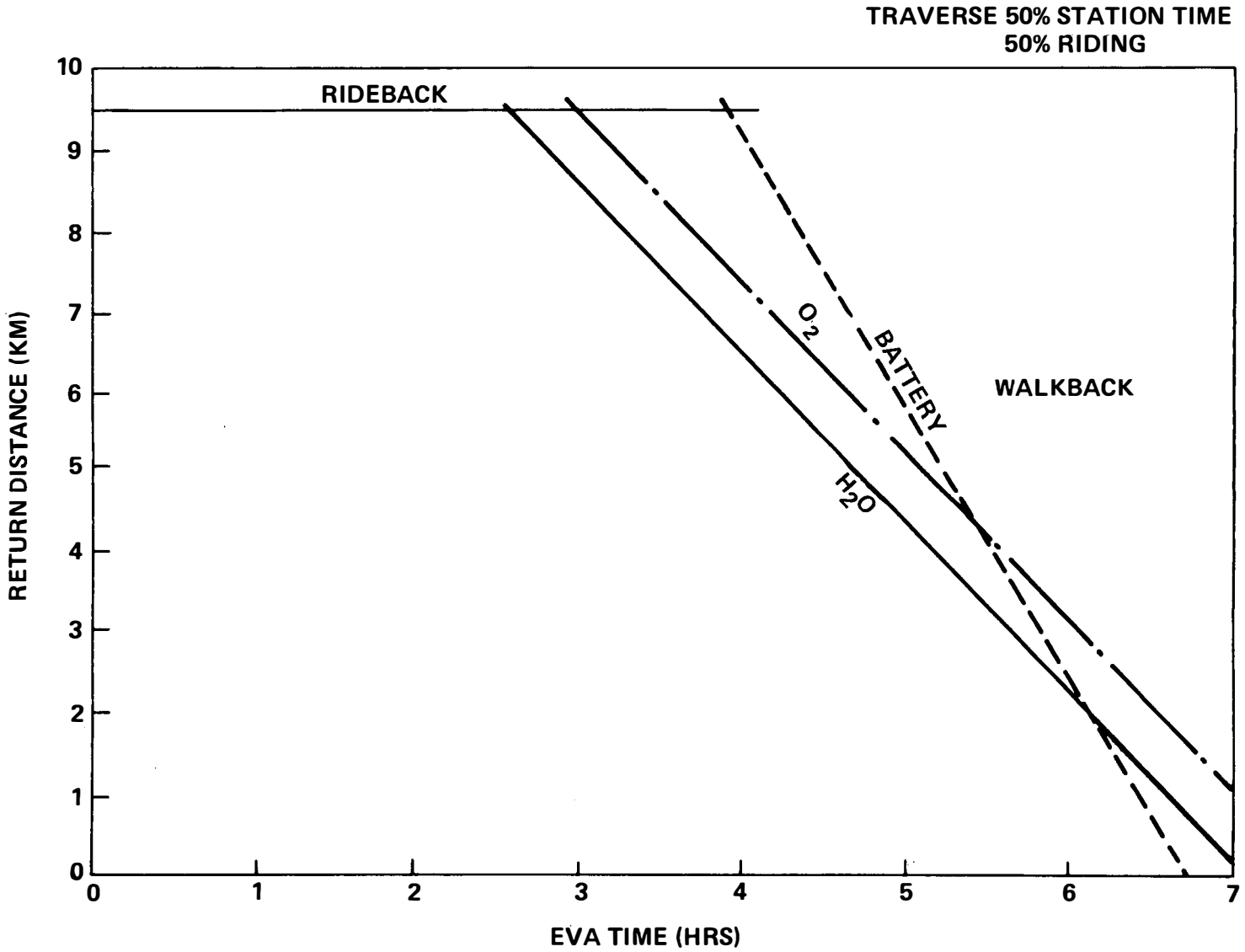


FIGURE 5 - EVA 2 CONSTRAINTS ENVELOPE

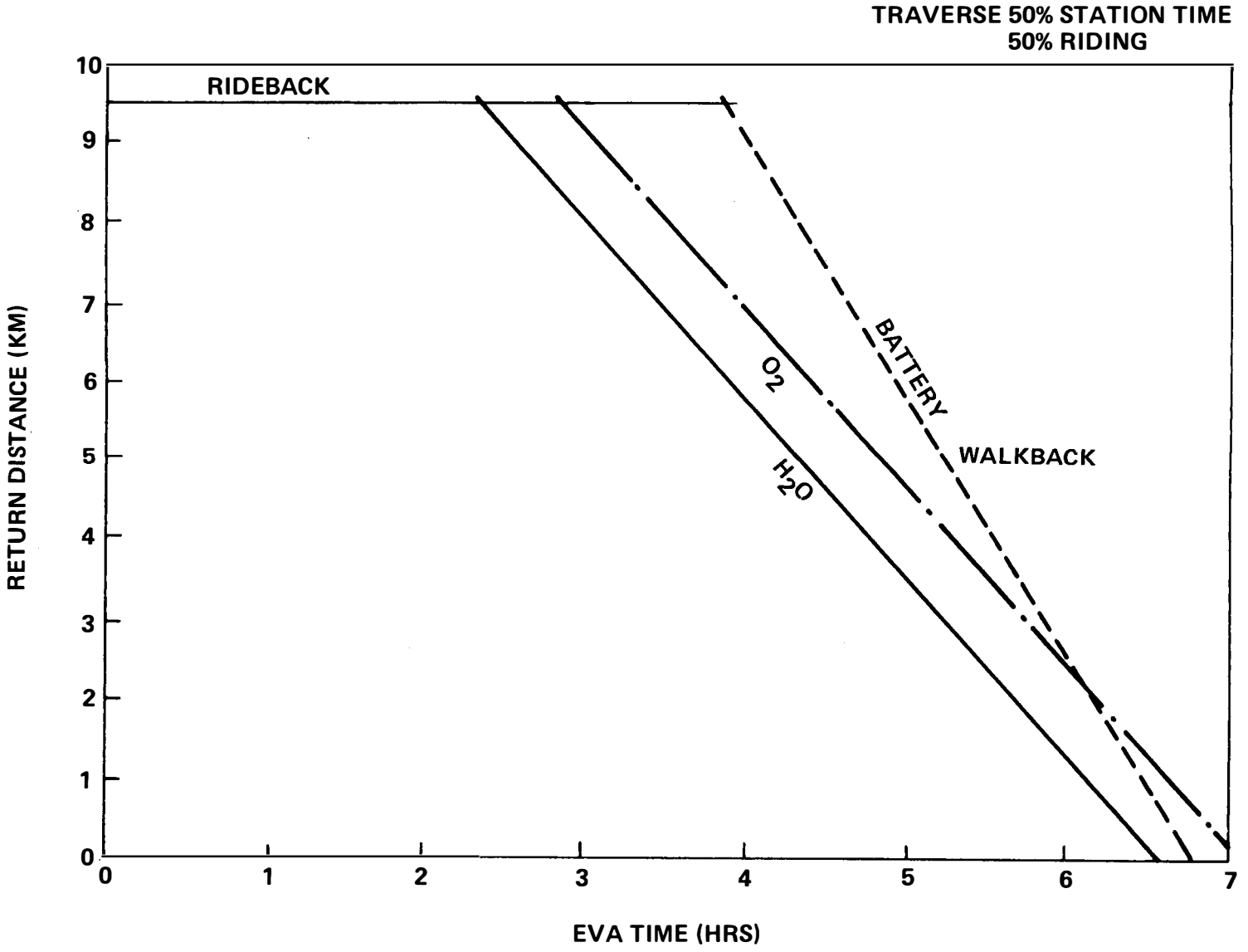


FIGURE 6 - EVA 3 CONSTRAINTS ENVELOPE

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