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VIBRATIONS INDUCED BY THE FLOW OF MAGNET COOLING WATER

by

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1.0 BACKGROUND

In September, 1986, the Mechanics and Vibrations Section of the MCT Division performed a vibration survey of the Phase A beam line of the SDI Neutral Particle Beam Test Facility. As a part of the survey, vibration measurements were made both with and without the flow of magnet cooling water. Since the flow of magnet cooling water represents a potential vibration excitation mechanism for the APS, a review of the results from the Neutral Particle Beam Test Facility will provide insights relative to the significance of the mechanism.

2.0 MEASUREMENT RESULTS

The measurement positions are identified in Fig. 1. Among other positions, they include measurements made on the beam line components themselves, for example, position A_3, Horizontal, and on the 1-1/2 in. thick steel mounting platform, position B_3, Vertical. Results of measurement made with and without magnet cooling water flowing are presented in Figs. 2-9. Both acceleration response in the range ~ 1 to 1 kHz and displacement response in the range 10-500 Hz are given.

From measurements made on the beam tube (A_3, H), it can be observed that the total rms acceleration response increased by a factor of approximately 38 (1.93×10^{-4} g's to 7.39×10^{-3} g's, see Figs. 2 and 3), while the total rms displacement increased approximately 18 times (3.4 μ in. to 61 μ in., see Figs. 4 and 5). Total rms acceleration response of the 1-1/2 in. steel platform increased by a factor of 1.6 with the flow of cooling water while the rms displacement response was essentially unaffected, see Figs. 6-7 and 8-9, respectively.

3.0 DISCUSSION

It is important to note that the absolute values and response increase factors are specific to the Neutral Particle Beam Test Facility and should be used only to get a "feel" for the effect of coolant flow on vibration of the beam line components. In this regard, the results serve to demonstrate that coolant flow can have a measurable effect on vibration response and should be considered in the design of the APS magnets and magnet support system. To minimize coolant flow induced vibration, efforts should be made to reduce flow velocities, design to avoid flow separation, and minimize flow turbulence.

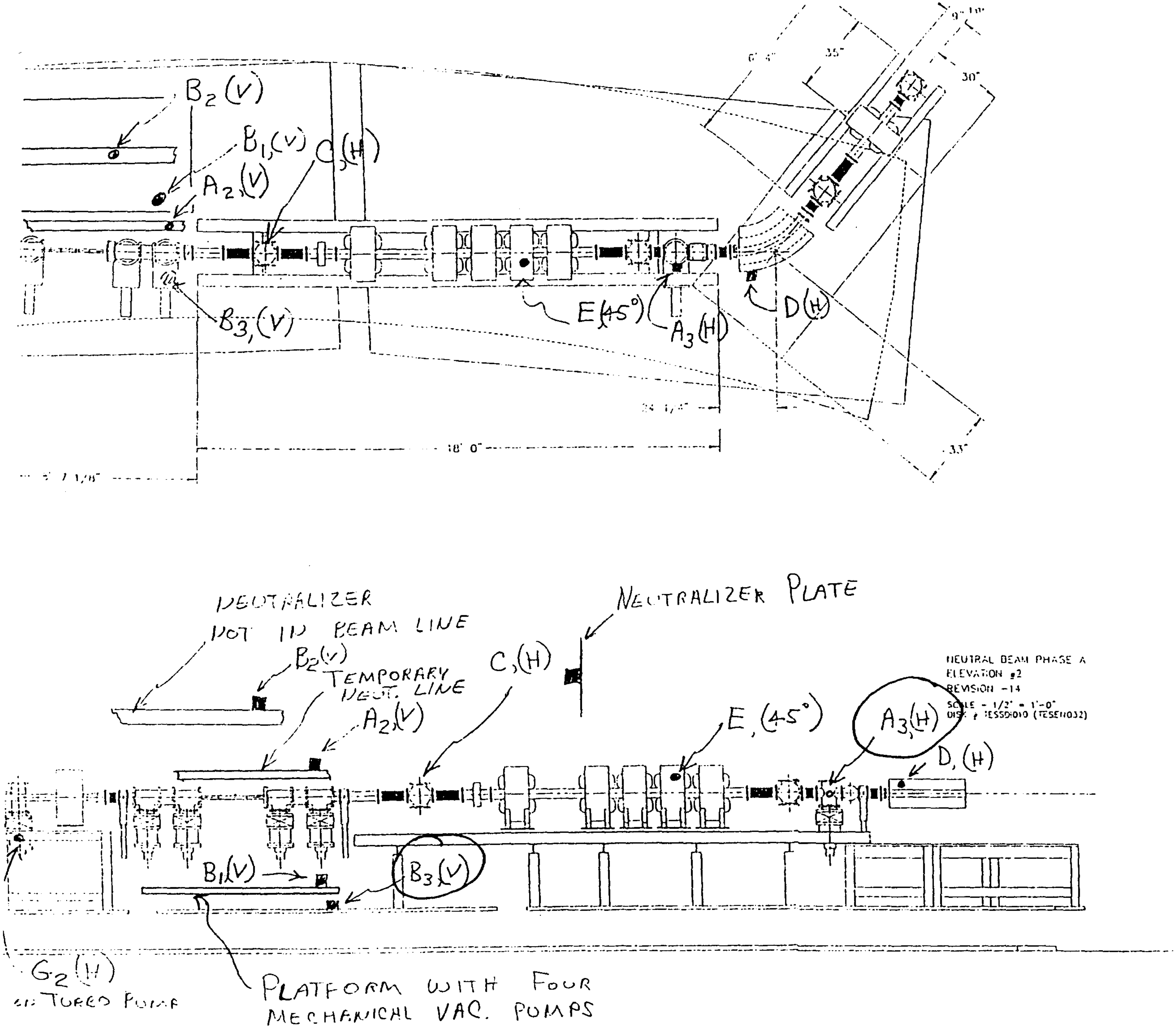

Fig. 1. Measurement Locations

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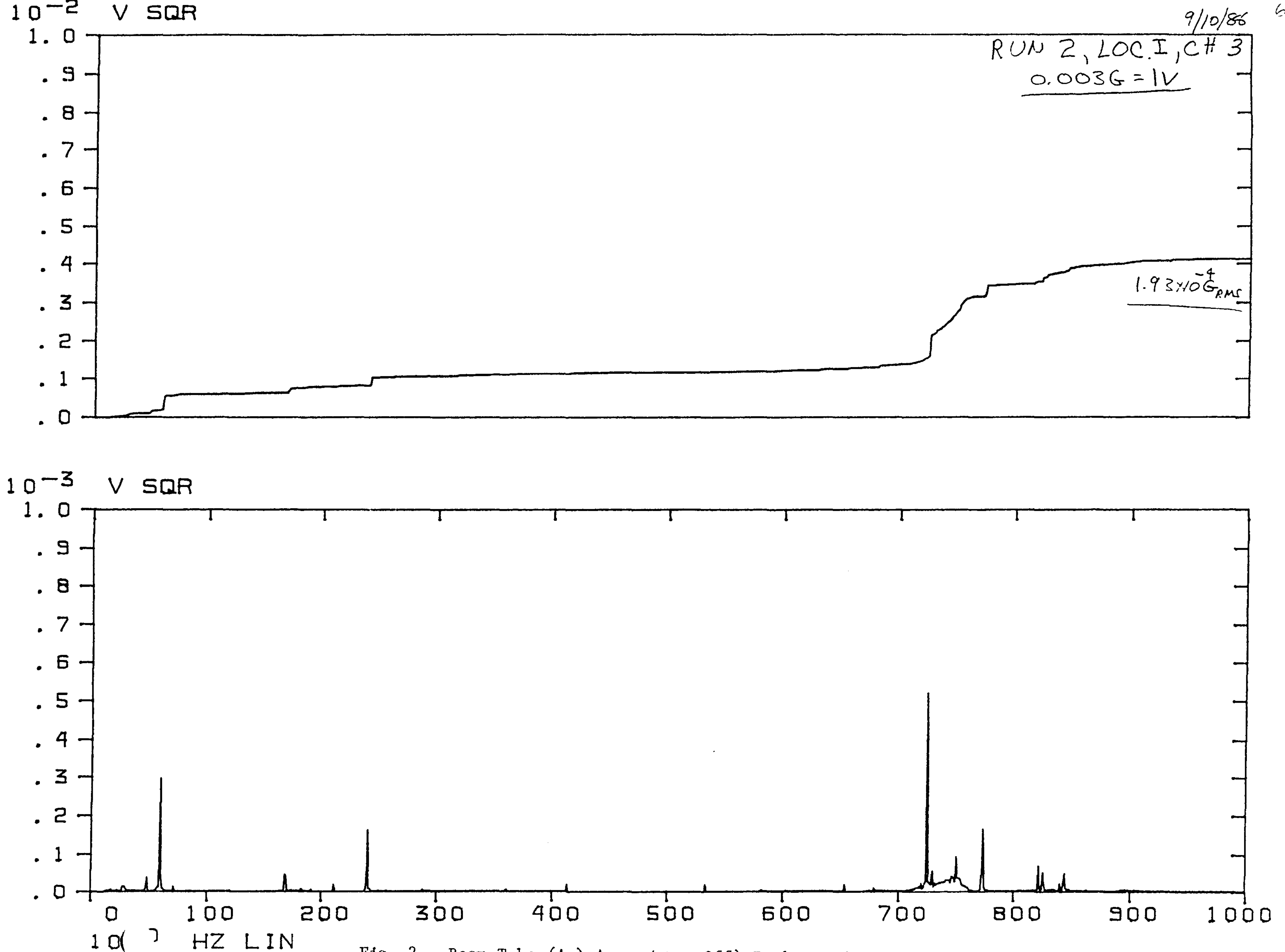

Fig. 2. Beam Tube (A_3) Acc .Vater Off) Background

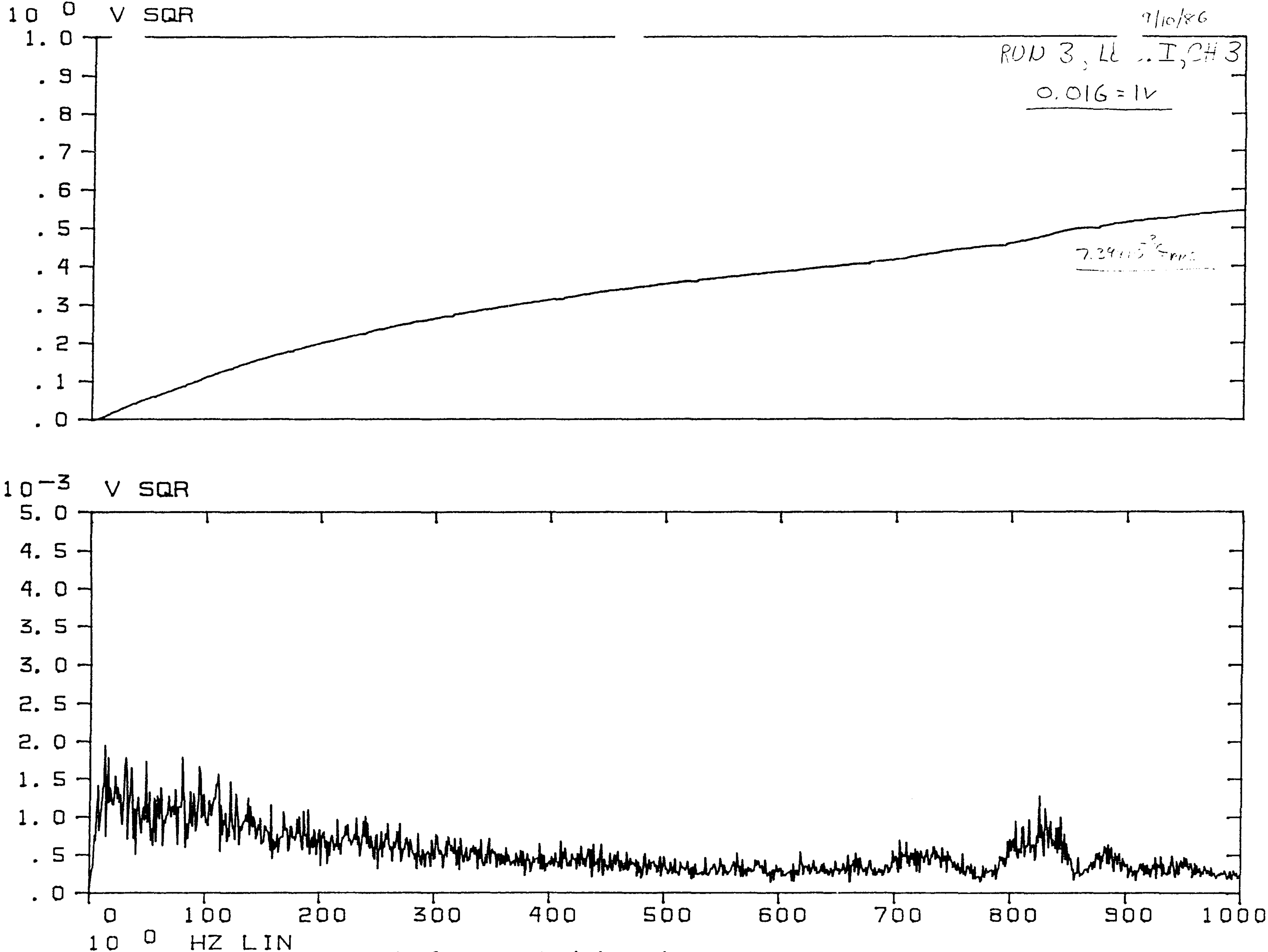

Fig. 3. Beam Tube (A_3) Acc (Water Flow)

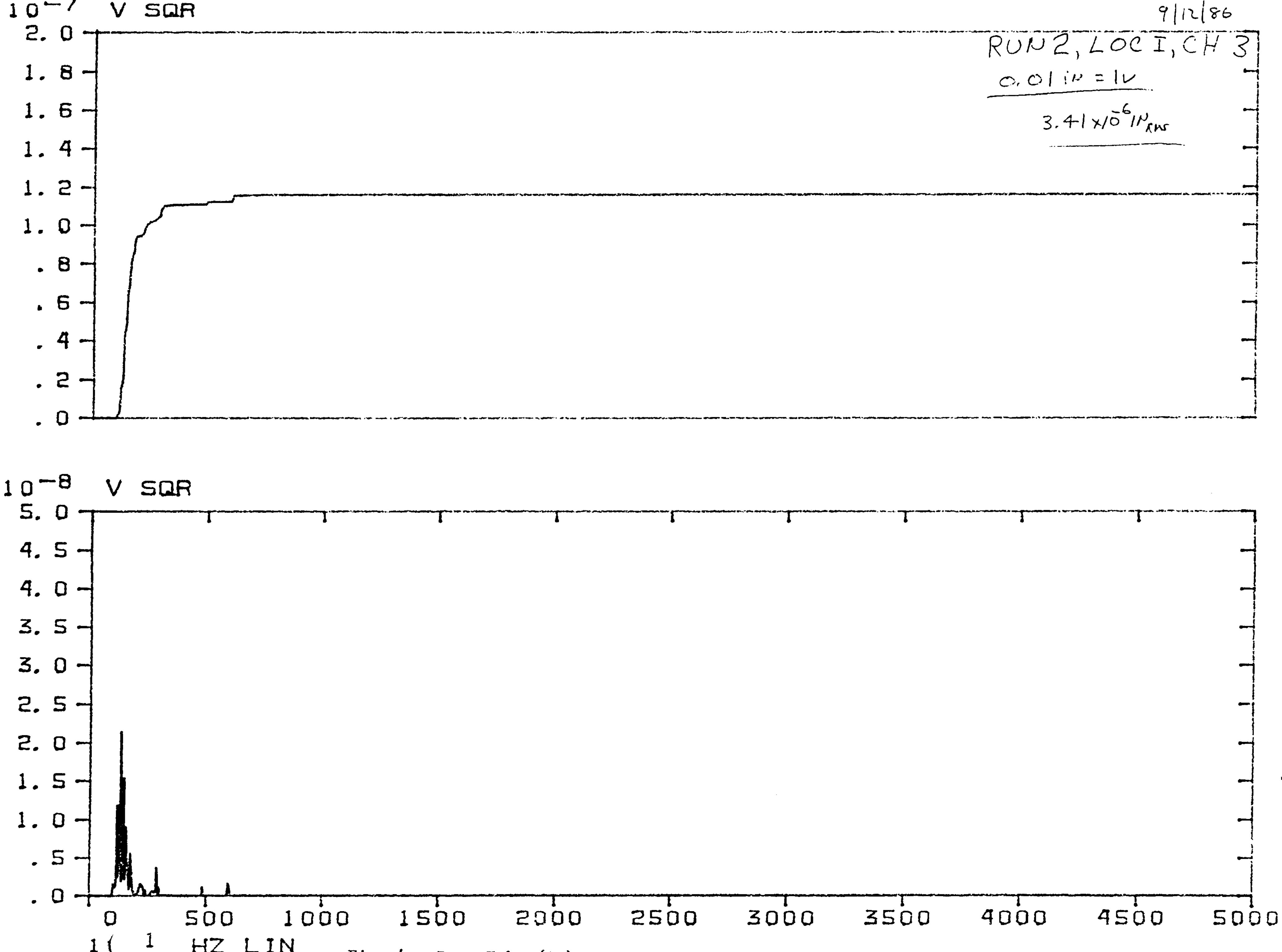

Fig. 4. Beam Tube (A_3) Dis, Water Off) Background

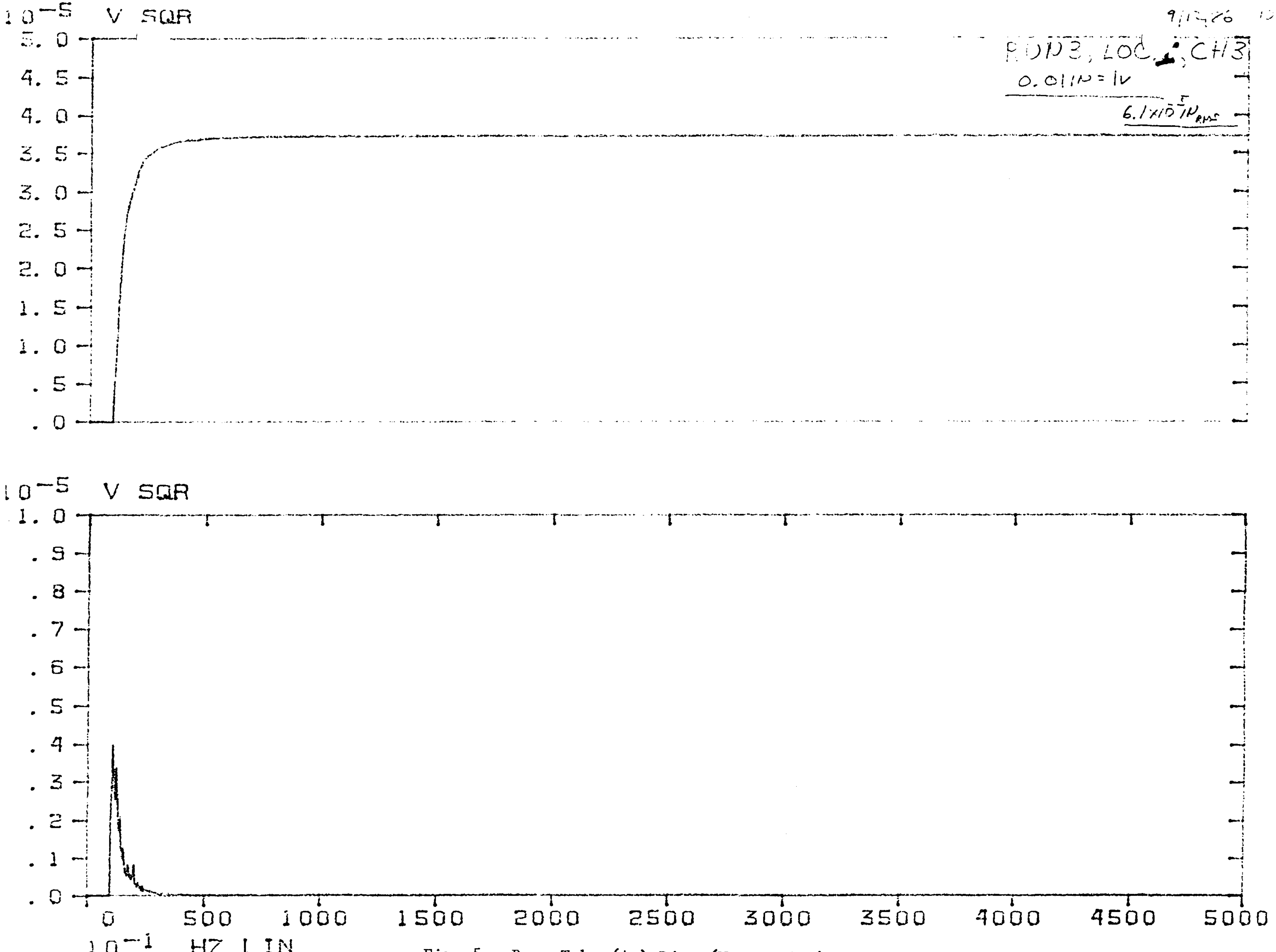

Fig. 5. Beam Tube (A_3) Disp (Water Flow)

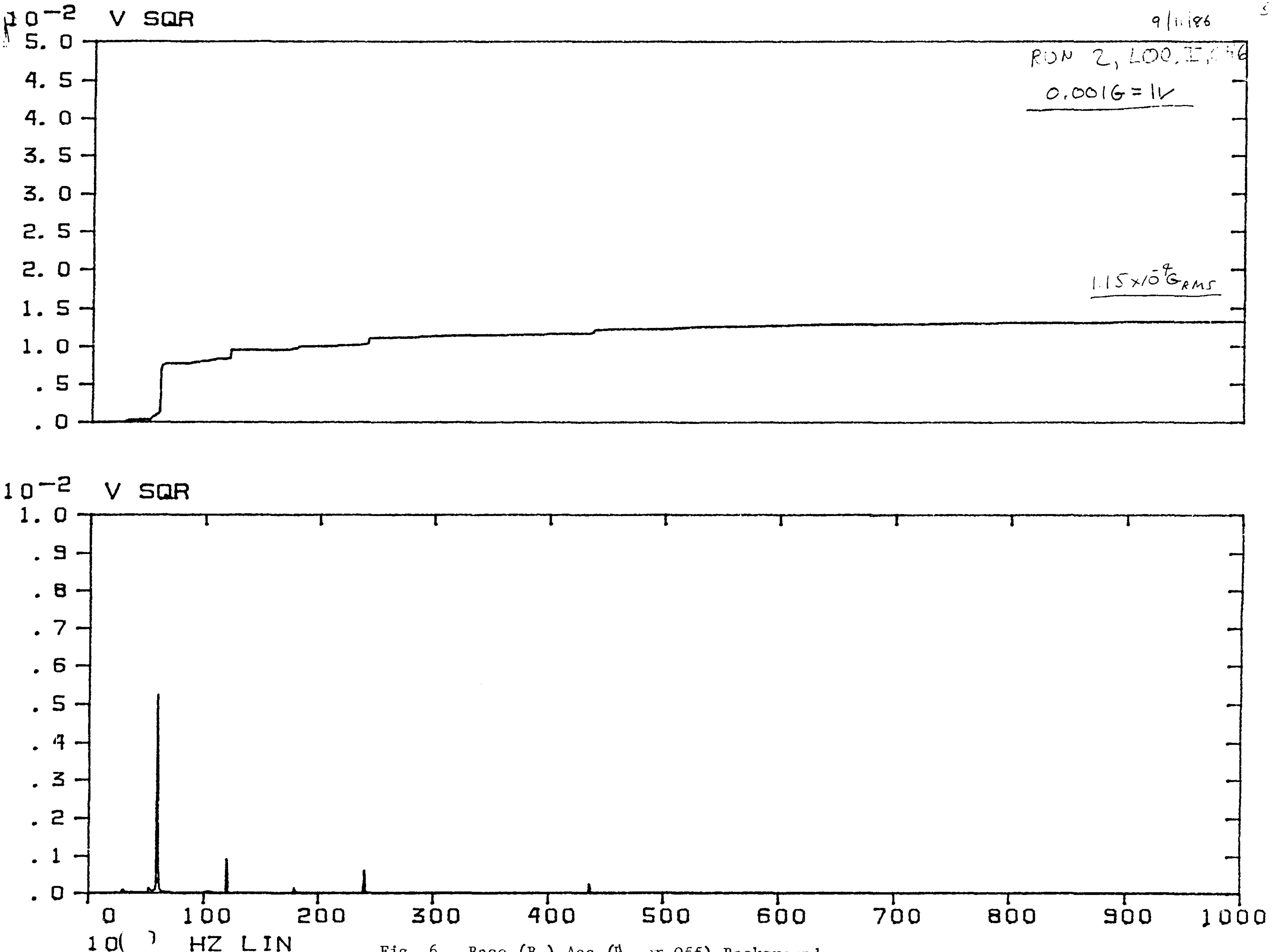

Fig. 6. Base (B_3) Acc (W er Off) Background

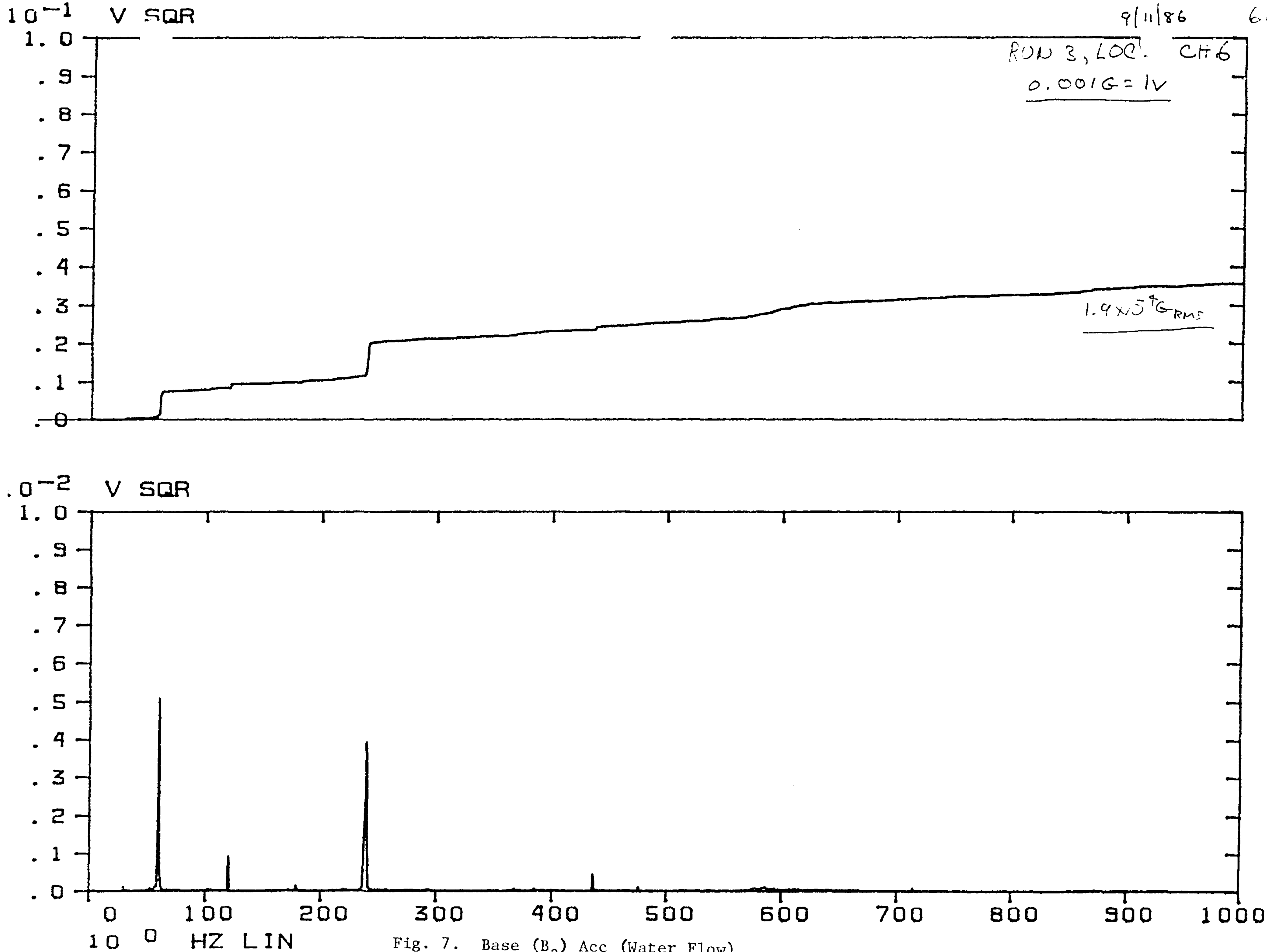

Fig. 7. Base (B_3) Acc (Water Flow)

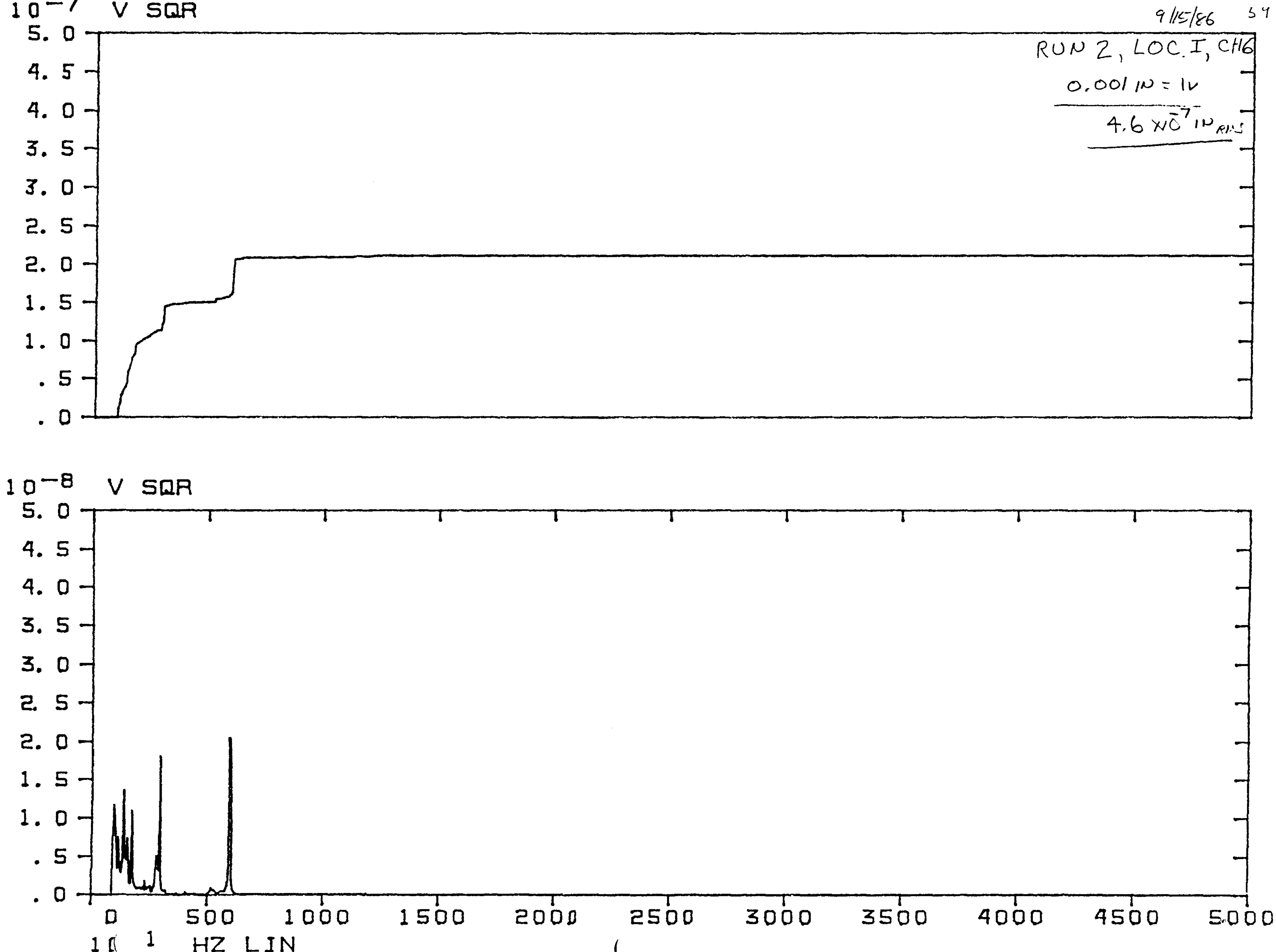

Fig. 8. Base (B_3) Disp (..ter Off) Background

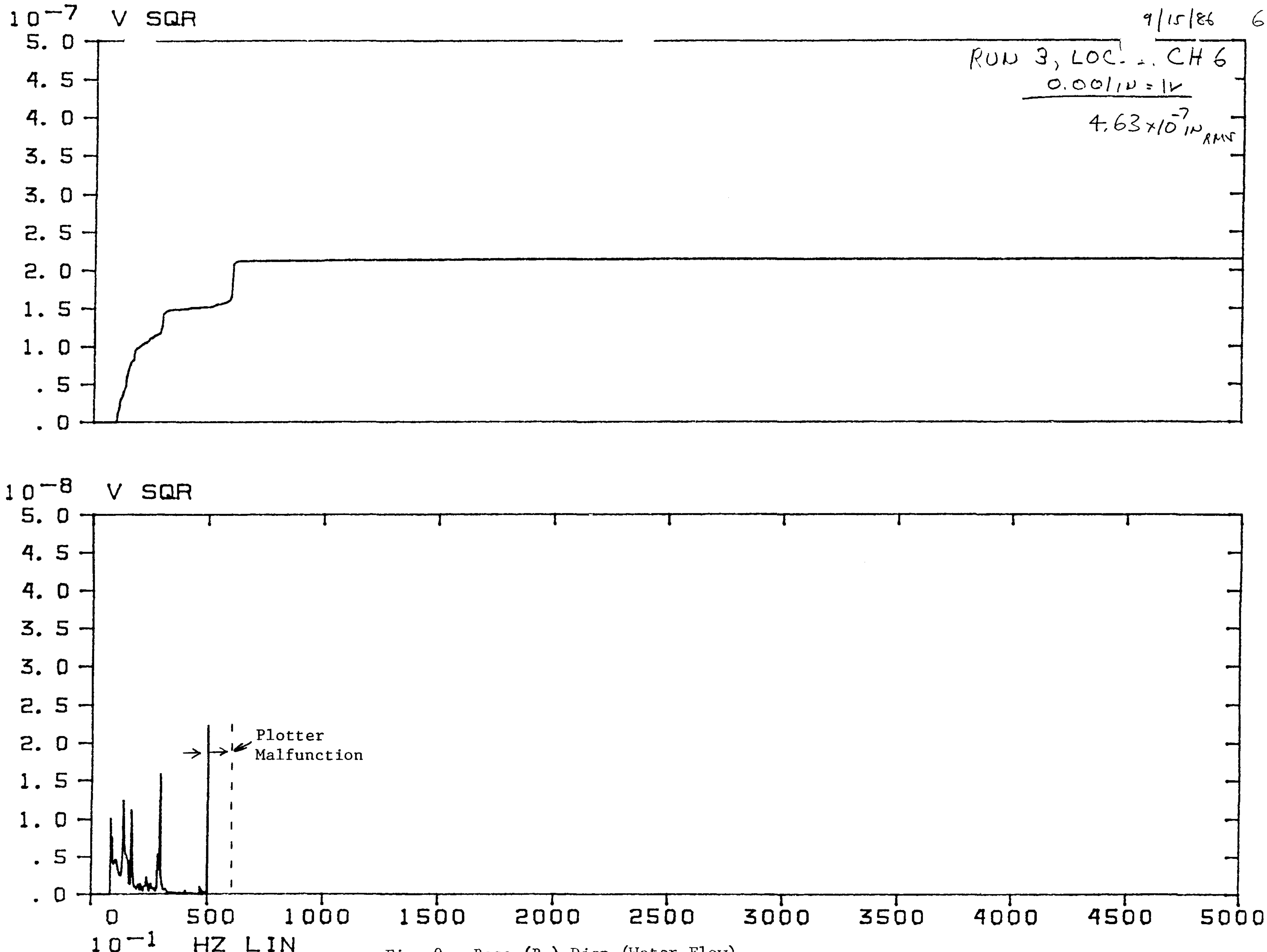

Fig. 9. Base (B_3) Disp (Water Flow)