Memorandum

To: G. Ediss, R. Groves, N. Horner, A. R. Kerr, D. Koller, G. Lauria, S. -K. Pan

cc: J. Webber

From: J. Effland, K. Crady

Date: 26 February 2002

Rev: 27 February 2002 jee G. Ediss pointed out that the helium switches are in fact hydrogen switches.

Subject: Cool-downs of JT-1 Dewar Compared to JT-2

Introduction

Recent cool downs of the new JT-1 Dewar show that system may still lack sufficient cooling capacity. Temperature *vs.* time data are compared here of the JT-1 system against the existing JT-2 system. The JT-2 Dewar routinely reaches 3.8 K on its cold stage after 7 hours of cooling with a full thermal load. The JT-1 Dewar takes longer to achieve a warmer temperature without a full thermal load. It reaches 3.9 K in about 8 hours and 15 minutes and yet still lacks the thermal loading from the IF coaxial cables and LO waveguide.

This memo provides details of the cool downs for JT-1 and JT-2 and gives some steps planned to identify the problem.

Details

Figure 1 and Figure 2 show temperature *vs.* time for typical cool downs of the JT-2 Dewar. This Dewar contains the standard complement of components that thermally load the cold stages: bias, temperature sensor, and heater wires, IF coaxial cables, LO waveguide, and a 7.87-cm (3.1") window for the beam. The large temperature variation in the 20K-stage from 12K to about 18K has always been present on the JT-2 system, but probably indicates a subtle problem with the CTI refrigerator. Both figures show that the JT-2 system routinely reaches minimum temperatures in about 7 hours.

Crady and Horner replaced the wire and cleaned debris from the JT stage on JT-1 system. They then cooled the Dewar and used a resistor to determine the maximum thermal load where the cold stage temperature increases rapidly. This causes helium boil-off in the pot and depletes the He reserve. The original wire diameter was 0.152 mm (6.0 mils) and it could accept an 825-mW load. This was replaced by a 0.165-mm (6.5 mil) wire, which resulted in thermal runaway at about 700 mW. All the test data shown here (except for the initial cool-down data

shown in Figure 7) were obtained using the 0.165-mm (6.5 mil) wire. The remaining wire available is 0.178 mm (7.0 mil), but the system was never tested with a wire of that diameter.

Figure 3 is cool-down data for JT-1 when it contains only the cold plate and is lightly loaded by just heater wires, and temperature sensor wires passing from ambient to the 4-K stage through two stages of Koller heat sinks. Note that the IF plate sensor is intermittent during part of the cool down. This sensor is connected to the cold stage since the IF plate is missing for most of the JT-1 data.

Figure 4 is JT-1 data for a slightly higher thermal load consisting of the same number of sensor wires and heater wires, the 7.87-cm (3.1") window, and the cold IF plate and cold connector plate. The cold IF and cold connector plates are supported from the 50K radiation shield walls *via* G10 epoxy glass mounts which, as G. Ediss has pointed out, will introduce a small additional heat path between the 4K and 50K stations. The JT-2 Dewar configuration uses only one of these plates. The additional connector plate in JT-1 Dewar contains Koller's heat sinks and the Nanonics-to-MDM adapters. Cooling capacity measurements generated on 2002-02-26 indicate that the total capacity for this configuration has been reduced from 700 mW to approximately 650 mW. That is, the system experiences thermal run-away at 650 mW.

Dan Koller recommended confirming operation of the CTI-1020 system by cooling JT-1 with the JT refrigerator off and just using the CTI-1020 refrigerator to cool the Dewar. The temperature graph for this case, Figure 5, shows that the 20K stage reaches about 12K in 4 hours. This graph also shows that the hydrogen switches between the 20K and 4K stages are apparently working by providing a high thermal resistance between the stages, because the 4K stage never reaches the same temperature as the 20K stage. If the cold stage is isolated from the 20K stage, the cold stage would see the radiation shield which would provide thermal loading in addition to the temperature sensor wires.

Figure 6 shows temperatures for a cool down of JT-1 when the cold stage is loaded to 0.25W by sending current through a resistor. Figure 7 are temperature vs. time data for the initial cool down of JT-1. That early cool down was with a lightly loaded system using the original JT stage. It is important to note that the temperature sensors are uncalibrated in this early data, and the JT compressor is in the “Start” position. When moved to the “Run” position a few hours after the time shown on this graph, the cold stage obtained an uncalibrated temperature of 3.7K.

Future Planned Tests

Given the large body of cool down data for both JT-1 and JT-2, the following tests are planned to further investigate the problem with JT-1. Each test will always use the Excel temperature-recording program:

1. Routinely record refrigerator pressures for JT-1 cool downs. (Only JT-2 has pressure sensors for automatic data acquisition.)
2. Cool down using both sets of refrigerator lines from JT-2.
3. Use JT-2’s hydrogen switches in JT-1. This involves a moderate dismantling of JT-2.

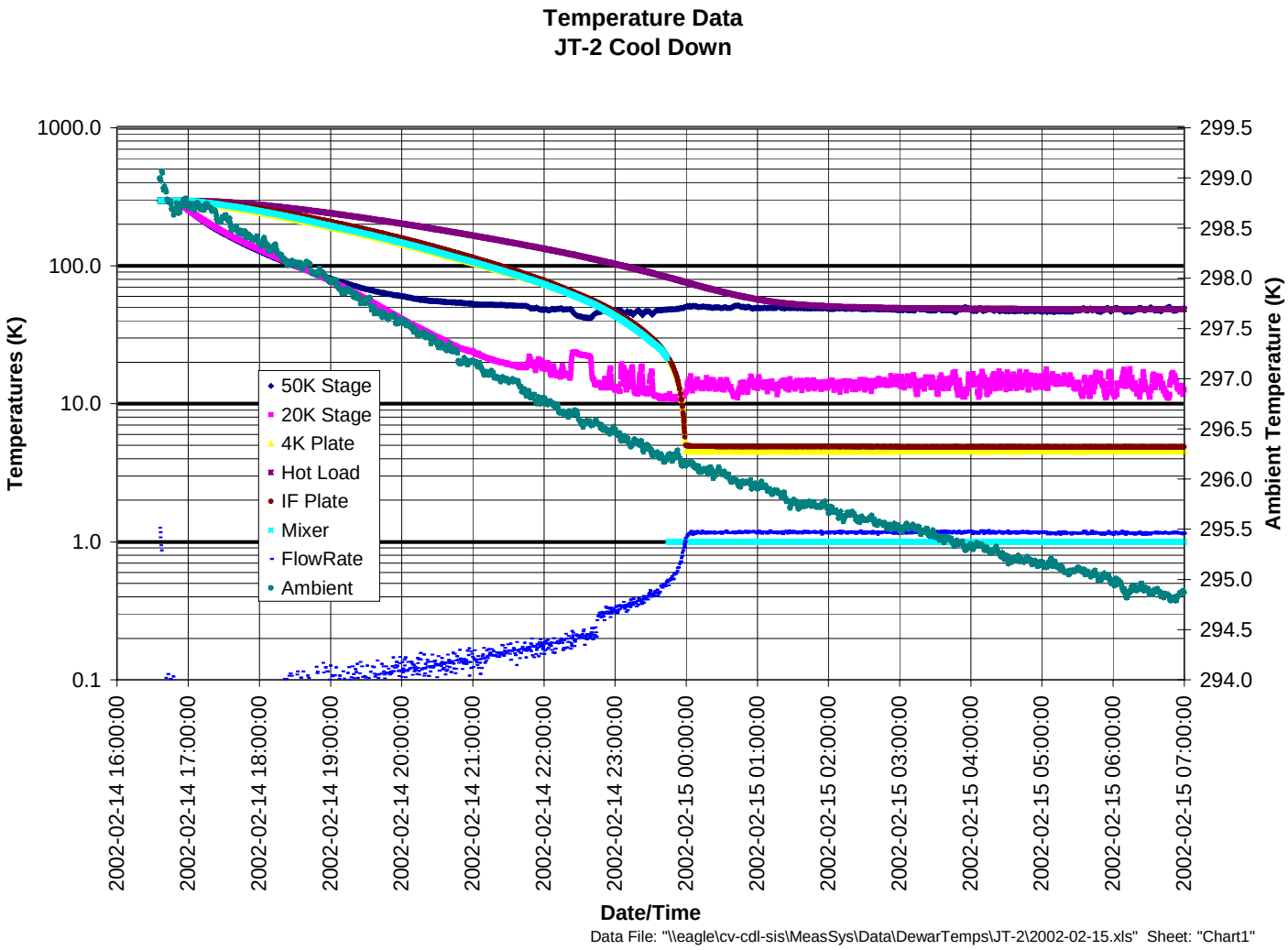

Figure 1: Typical JT-2 cool down

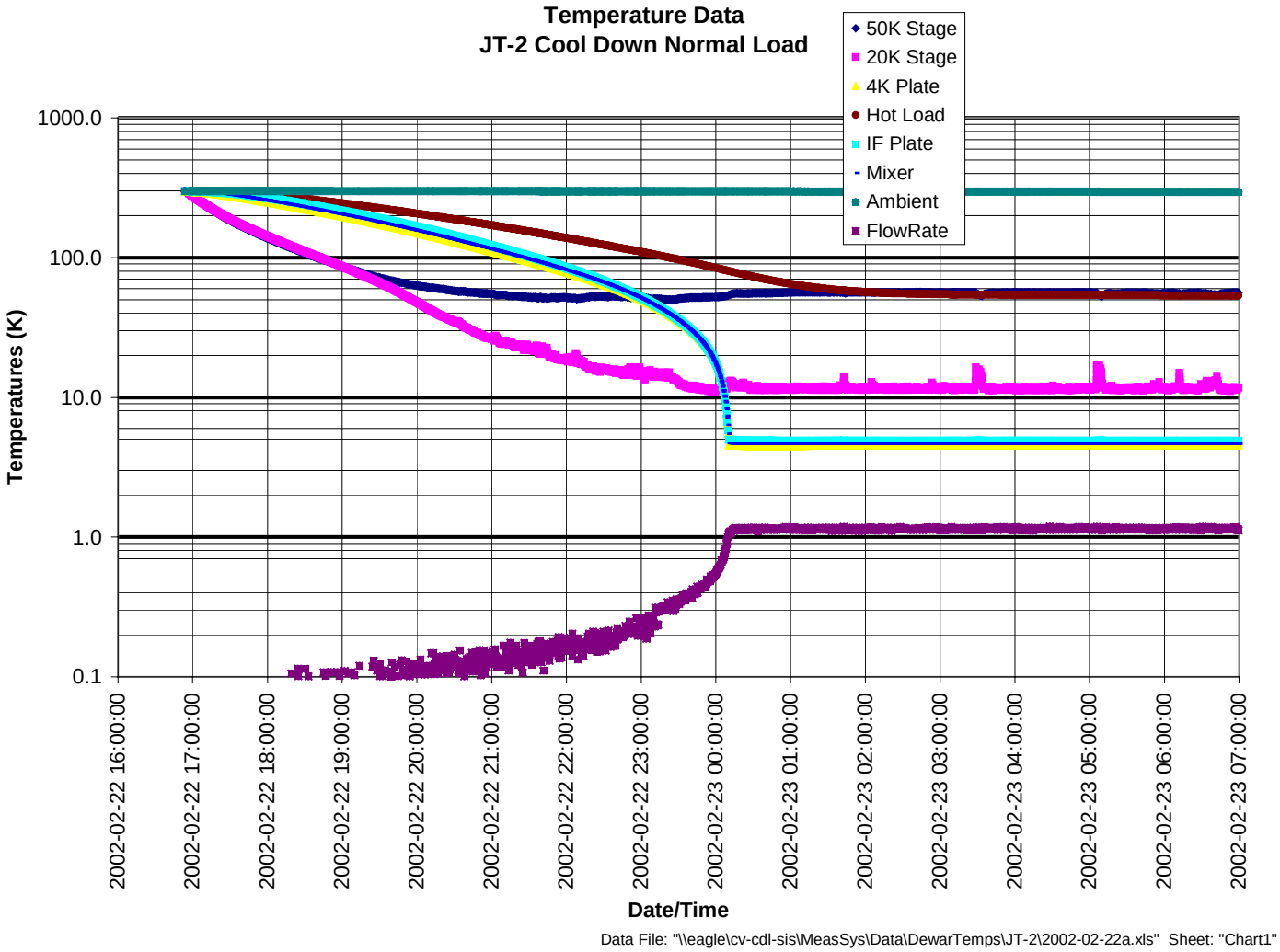

Figure 2: Another typical JT-2 cool down

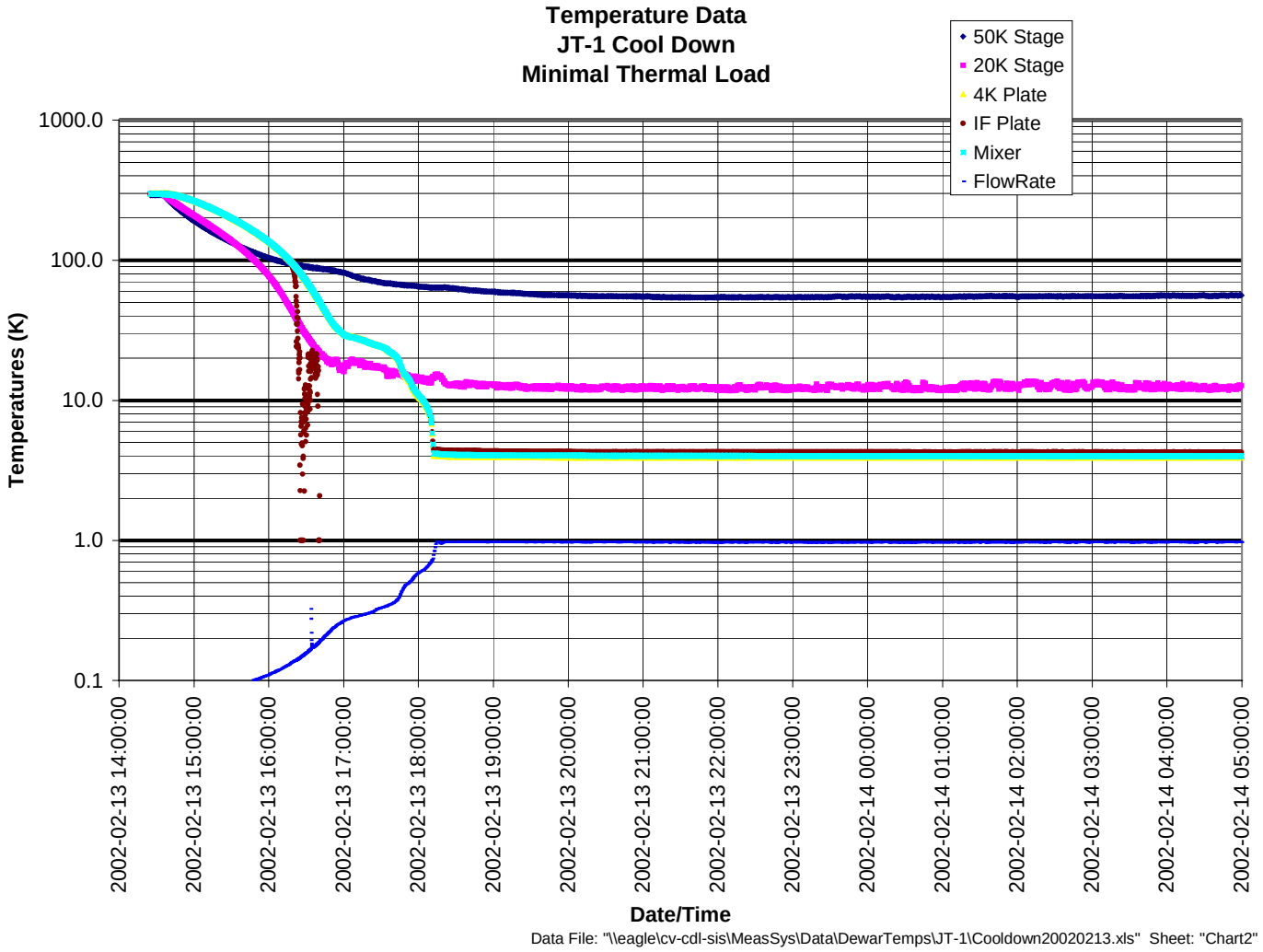

Figure 3: JT-1 with only cold plate loaded by heater wires, and temperature sensor wires.

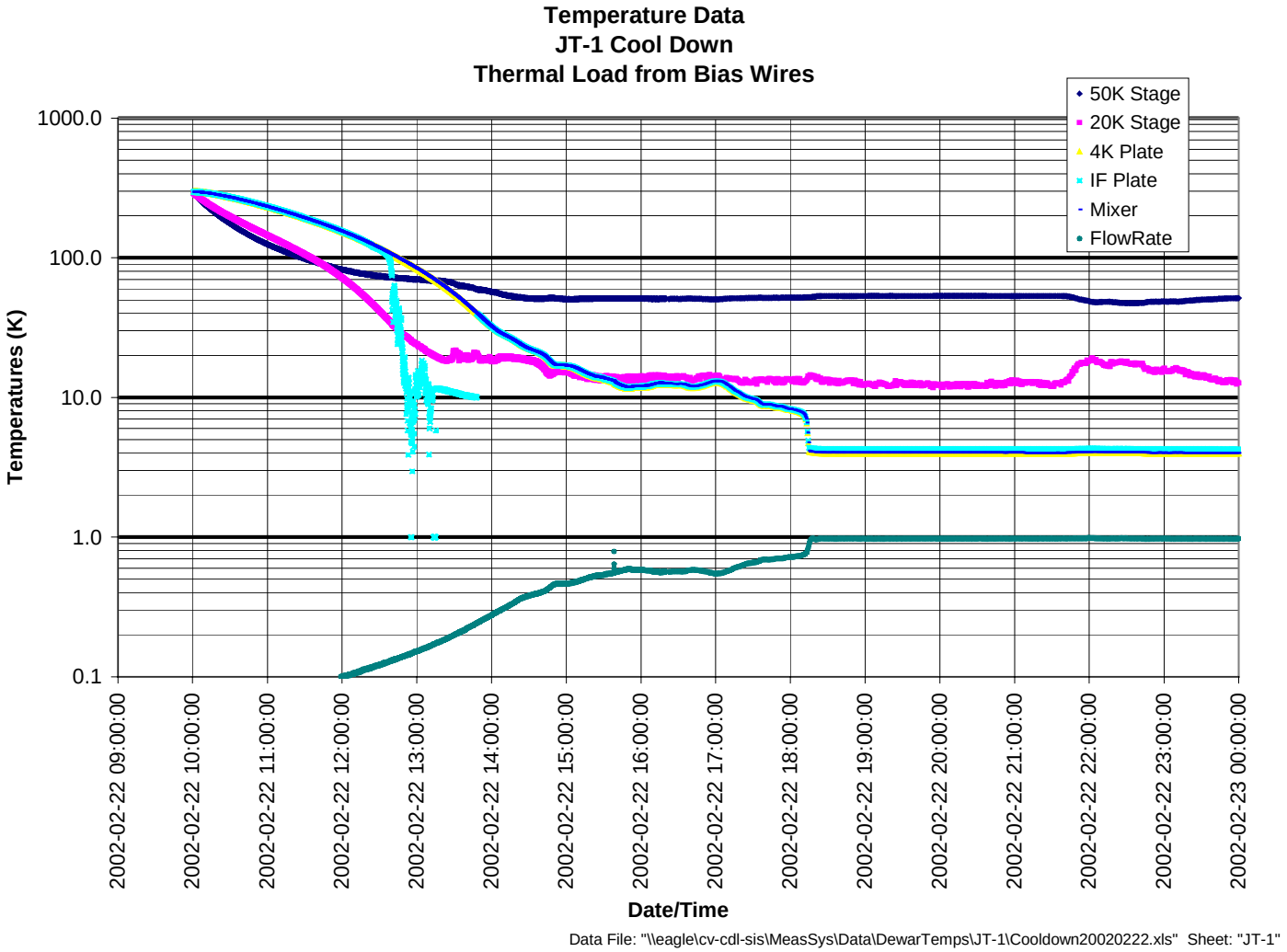

Figure 4: JT-1 Cool down with thermal load from bias wires and both IF plate and connector plate

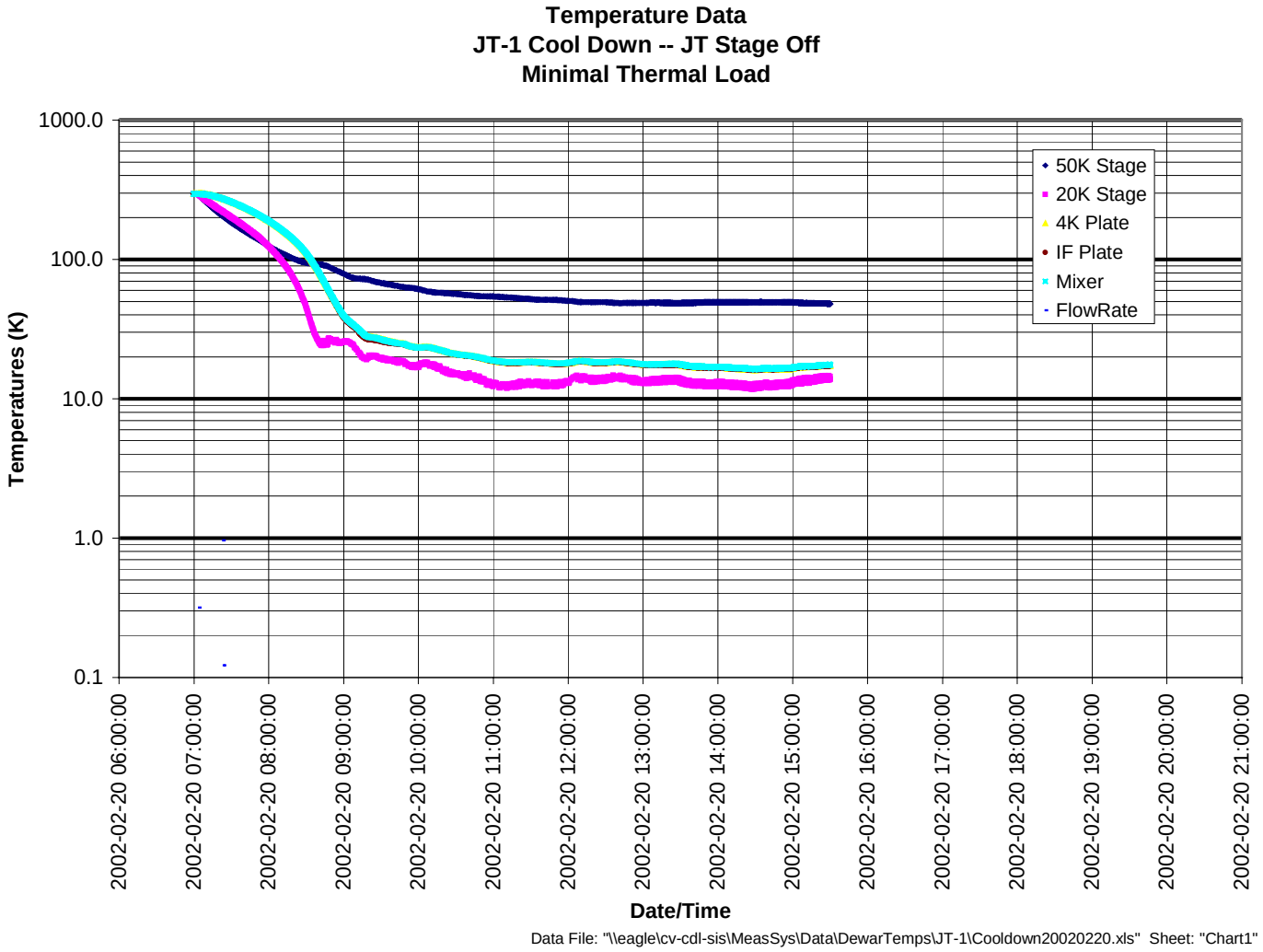

Figure 5: Cool down of JT-1 system with same thermal load is shown in Figure 3

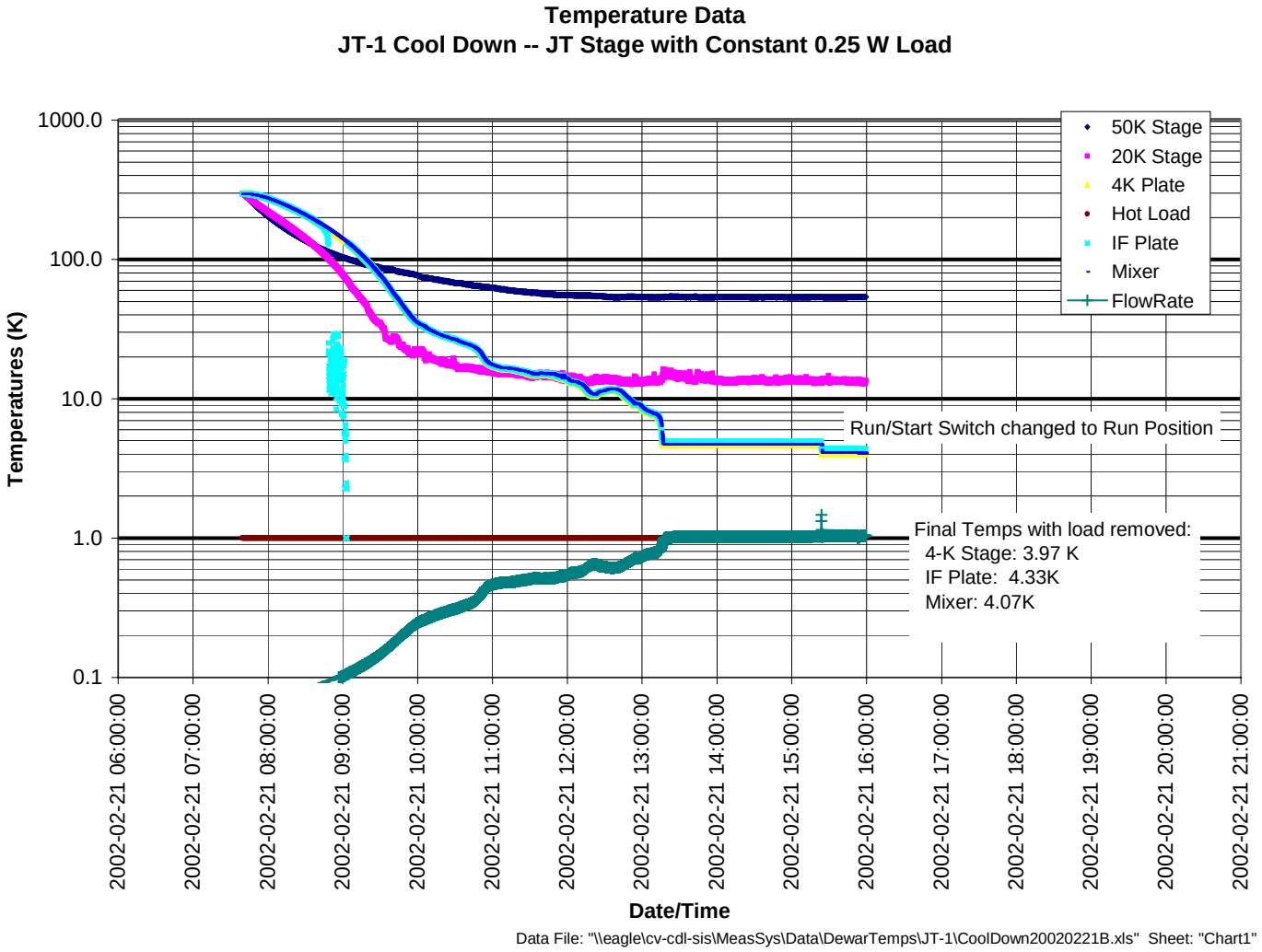

Figure 6: JT-1 cool down with 0.25W load

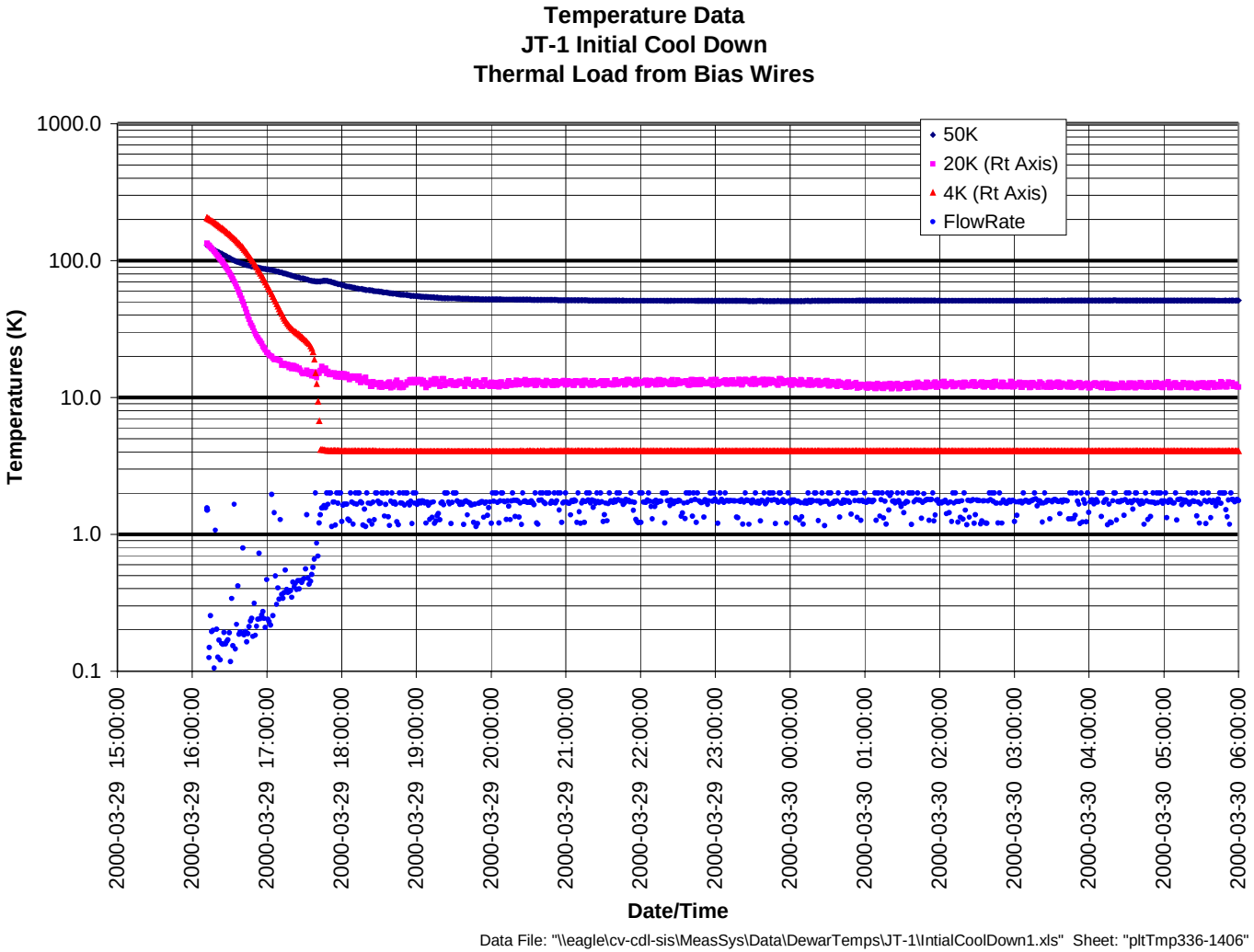

Figure 7: Initial cool down of JT-1 with a light thermal load