V. DATA HANDLING PROCEDURES

Each **First Class station** is equipped with an Eppley Precision Spectral Pyranometer (PSP) to measure global solar radiation, a tracker mounted Normal Incident Pyrheliometer (NIP) to measure direct normal beam solar radiation, and a temperature sensor. A Campbell Scientific CR-10 data acquisition system monitors the data, stores the data in memory and outputs the data to chart records. The chart records serve as backup in case of problems with retrieving the data from the CR-10. Data are stored in 5-minute intervals. The data are retrieved daily from the CR-10 via phone modem.

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Each Rotating Shadow band Pyranometer **(RSP) station** is equipped with Ascension Technology Inc. RSP. The RSP stations record the data using a CR-10 data logger and store data in 15-minute intervals. The data are downloaded via phone modem several times a week.

The **AgriMet stations** use LiCor pyranometers to measure global radiation and LiCor pyranometers with a LiCor type shadow band to measure diffuse radiation. The US Bureau of Reclamation (USBR) runs the AgriMet network. AgriMet stations store data in 15-minute intervals and send the data to the USBR computer once ever 4 hours via satellite. Every evening the USBR computer is called automatically and the data are downloaded to our computer.

People living or working at the sites maintain the instruments. They take care of cleaning the instruments, aligning the tracker, adjusting the shadow band, and sending the charts to the University of Oregon. In addition the site personnel keep a logbook on the maintenance at the site. A large portion of the credit for the high quality of our network data is due to the careful attention given by the onsite assistants. These activities are essential to collecting high quality data and we are fortunate to have excellent help at each of our sites. The names of site personnel are listed in the foreword on page i.

After the UO Solar Monitoring Lab receives the data, the data are stored as permanent records on hard disk and diskettes. At the same time the information is printed out and checked for errors that have been automatically flagged. After these errors have been corrected the data are formatted into monthly data blocks.

Next the chart records are digitized to fill any gaps in the records. Then the files are edited to eliminate erroneous data arising from such problems as misalignment of the pyrheliometer or snow or ice on the bulb of the pyranometer. By visually scanning the chart records and checking through the log records, problems are quickly spotted. These procedures are absolutely essential in order to obtain high quality data. Finalized versions of the data are printed out, and stored on diskettes and backup tape.

Data from the RSP and AgriMet stations do not include chart records. This makes errors harder to spot and we are testing the DQMS® software developed by Augustyn Company for NREL to identify problems in the data.

It is worthwhile to take a statistical look at the causes behind gaps in our historical data sets. On the average about 3% of the hourly global data were either bad or missing, while approximately 12% of the direct beam data were either bad or missing. About two thirds of the absent global data (2% of the total) were eliminated because there was ice or snow on the pyranometer. Eppley ventilators were in-

stalled in June 1995 on pyranometers at the first class stations. The ventilators have significantly reduced the loss of global data due to ice or snow on the pyranometers. About 1% of the overall global data was missing because of data logger problems. From 1995 to 1997 only one day of data has been lost due to data logger problems with the new Campbell Scientific CR-10 data loggers.

Nearly two thirds of the absent beam data (8%) were eliminated because the pyrheliometer was not aligned accurately with the sun. About one fourth of the alignment problems were caused by power outages that stopped the clock drive for the tracker. About 2% of the beam data were lost because the cord connected to the pyrheliometer (that is mounted on a tracker that rotates once every 24 hours) became twisted and broke. In January 1996, rotary connectors were installed at Burns and Hermiston and these rotary connectors eliminate the need to unwind the cord. Another 1% of the data was lost because moisture got into the pyrheliometer and altered the readings. Again, failure of the data logger caused about 1% of the direct beam data to be lost. The use of charts to backup the data enabled recovery of approximately 4% of the data that otherwise would have been loss due to data logger failure.

Almost no data are lost from RSP stations because no adjustment of the shadow band or tracker is required and photovoltaic panels power the systems. However at Bend, starting in September 1997 and continuing to April 1998, the 3/16 steel shadow band was bent. This caused the lost of most diffuse and beam data during this time period. In April, funds from PacifiCorp enabled the replacement of the RSP head unit.

Ventilators have significantly reduced the loss of global data due to ice or snow on the pyranometers