9. CDS FAILURE IMPACTS

"Stationary bicycles fall over" - ageless wisdom, in words of Arthur Zajonc

The CDS experiment and the SOHO spacecraft contain many areas of potential failure; because of the nature of the mission, the machines involved are necessarily complex. Thus we must consider the impact of the failure of particular features on the scientific capabilities of CDS and possible reactions to those failures. It is very difficult to specify a dividing line one side of which we are obtaining useful observations, the other we are not, but in the context of this section it is useful to think in terms of satisfying, at the very least, the desire to fly an EUV spectrometer with the capability to view at least a handful of useful emission lines. Let us consider several possible scenarios:

9.1 Loss of CDS Systems

(i) Loss of one or more detectors - Each detector offers the observation of several tens of lines. Thus, the loss of all but one detector still offers room for good science and satisfies our basic need, though the temperature range may become somewhat limited. Table 9.1 shows the rough temperature range of each band, in first order, and indicates that all bands offer over a decade in temperature range. With the addition of second order lines it is clear that there would be little justification in turning CDS off even if we are restricted to one band.

Table 9.1 CDS Band Temperature Ranges

155-224Å	GI	2×10^5 to 3.2×10^6K
261-346Å	GI	5×10^4 to 3.2×10^6K
396-495Å	GI	8×10^4 to 4×10^6K
662-786Å	GI	2×10^4 to 2.5×10^6K
310-380Å	NI	1×10^5 to 2.5×10^6K
517-633Å	NI	2×10^4 to 6.3×10^6K

Loss of the NIS removes our capability of operating in a viewfinder mode, where the NIS finds targets for the GIS to home in on. This would result in less efficient use of the GIS system for some Studies but is no reason to abort the CDS operation.

(ii) Loss of slit change mechanism - Given that we are presented with the ability to use only one slit, there is clearly room for much scientific investigation though the nature of the CDS goals would change. For example, given only a wide-slit capability we may not obtain useful dynamic observations yet we would be able to concentrate on studies of structure and evolution. Loss of the slit change mechanism would also result in an inability to raster in the N-S direction (unrolled spacecraft). This would restrict GIS to 1-D images. If we were left with one of the long slits (2x240 or 4x240), NIS would be unaffected and could still record 2-D images. If we were left with one of the pinhole slits (2x2 or 4x4), then NIS would only produce 1-D images. Clearly, this option would be very restricting but useful science can be obtained without question.

(iii) Loss of CDS pointing control - Such a loss would result in observation within a fixed 4 x 4 arc minute field on the Sun, without ability to re-point. Observations of the network, spicules, jets, bright points etc. within this 4x4 arcminute area would not be affected, though for active regions and sunspots we would have to wait for their passage through our field. It is more likely that only one of the two components of the pointing mechanism would fail, allowing diagonal motion and some capability for target selection. However, loss or degradation of this system, assuming we are able to view the Sun's disc(!) would have relatively little impact on the final scientific returns of CDS.

(iv) Loss of the scan mirror mechanism - This would result in 1-D images in the N-S direction in both grazing and normal incidence, which would be restricting but still useful.

Full loss of the raster capability would result from loss of control of the scan mirror *and* the slit change mechanism. In the event that both mechanisms are lost we may produce instantaneous images by virtue of the available slits in the normal incidence mode and use the rotation of the Sun to construct images in the east-west direction. In all of these cases we have to remember that CDS is a spectrometer observing the quiet Sun. Thus, at the most basic level loss of pointing (as long as we are viewing a piece of the Sun) is not critical.

(v) Degradation of Signal - This could be due to loss of detector sensitivity or degradation of reflecting surfaces. As a guide we must use our basic goal of an EUV spectrometer viewing a reasonable number of lines. We may assess the effect of a degraded signal by studying the tables and the quiet Sun intensities. A degradation of a factor of 10 will still provide a handful of lines both in normal and grazing incidence. Such a loss would be devastating to the CDS science but would not be fatal. On the other hand a loss of 10-20% is within the error of the predicted intensities and should be considered as undesirable but acceptable.

(vi) Failure of Door Mechanism - This could be fatal - at least for one of the CDS spectrometers, if its door remains shut. However, as long as one spectrometer is operational, the CDS operation should continue.

9.2 Lifetime Monitoring

All mechanisms (scan mirror, slit selection/scan, pointing system, doors) have limited lifetimes. Lifetime tests have been performed but a mechanism could fail at any time. A scheme to monitor the cumulative useage of the mechanisms is to be installed. In addition, the scientific planning is to be performed in a way which minimizes the use of mechanisms (e.g. by bunching together a set of observations on one target).

9.3 Influence of Other Instruments

Although the chances are remote, it is possible for there to be adverse influences from other instruments. For example, jitter problems generated by SUMER and UVCS, or even electromagnetic contamination during particular activities of some instruments. Whatever these problems are, if they are associated with particular operations, and are short-lived, we must negotiate for time-lining of operations. In the long term, this should not influence the scientific return of CDS.

9.4 Loss of Other Instruments

The greatest value of SOHO is the fact that it contains a co-ordinated package for observing the Sun's atmosphere. In particular, the CDS and SUMER instruments are intimately linked and complementary. Whereas the loss of other instruments would, at worst, mean that some targets must be selected on the basis of ground based data, the loss of SUMER would be a major blow to the CDS operation. The extension to lower temperatures, and the provision of high resolution line profiles would be lost.

There is no question that CDS would continue operations but the operations scenarios may be very different without the close collaborative work with SUMER.