Appendix 2: An Example of an Incoherent System

The standby parallel system depicted in Figure 1-1 in Chapter One often denotes the system that is more reliable than the active parallel system. Ideally, this system is coherent in a non-markov sense (*weakly incoherent*). This coherency feature comes from the fact that the *ideal* standby system with unit A active (switch positioned towards A) is always more reliable than the system with unit B active (switch positioned towards B), regardless of the individual failure probabilities associated to units A and B. Namely, when unit A is active, the system will fail only if "first unit A fails *and then* unit B fails", which is a subset of the event "unit B fails". It is assumed that unit B works at the time when unit A fails, i.e. unit B remains "as good as new" while in the standby mode. Figure
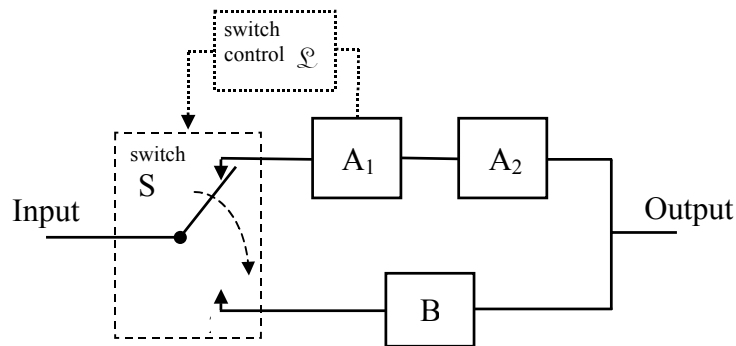

Figure A-1. Standby parallel system with an imperfect switch

A-1 depicts a more realistic standby parallel system in which the switch, S, will not activate every time when A fails. Switch S is controlled by the switch control, $\mathcal{L}$, that can detect only certain failures of A, and can also fail itself. Hence, A can be represented as a series system, in which A_1 denotes failure events detectable by $\mathcal{L}$, and A_2 denotes failure events not detectable by $\mathcal{L}$. A_2 also incorporates the on-demand failures of $\mathcal{L}$. The switch control is not an ordinary unit because it responds to the inner state of A rather than to the signal that comes from the outside. This system is *strongly incoherent* if the failure probability of B is larger than the failure probability of A_2, given that A_1 is relevant. Figure A-2 depicts an uniterruptible power supply (UPS). This system that can be either weakly ($\lambda_{A2} < \lambda_{B1} + \lambda_{B2}$) or strongly ($\lambda_{A2} > \lambda_{B1} + \lambda_{B2}$) incoherent in A_1, depending on the failure rates of the individual units.
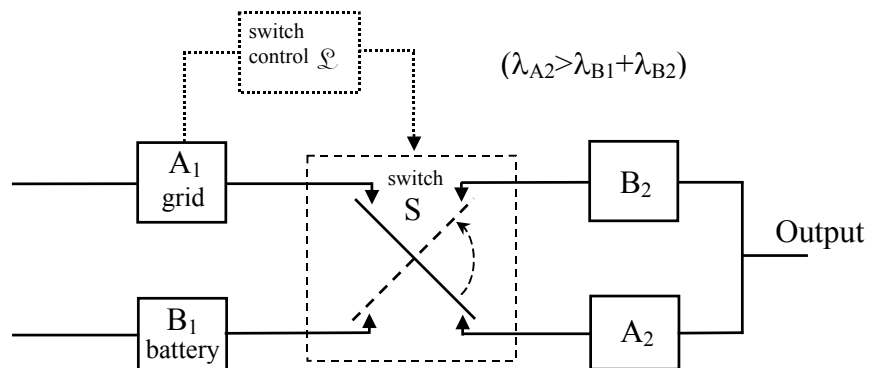

Figure A-2. Uninterruptible power supply as a strongly incoherent system