APPENDIX I

INVESTIGATION MODELS AND ANALYSES

Linear sequencing is the arrangement of the time line sequence in which events occurred, starting with the first employment of Liston and Roach by the BLM. It establishes experiences (commonalties, variations and differences) between both cases. It defines and analyzes the use of safety gates (management procedures and practices in use to control adverse outcomes and accidents). It identifies the conditions and events that occurred on the day of the accident. The purpose of linear sequencing is to identify what events, conditions, and standard practices must occur to ensure a safe outcome for the employees, and to identify any deviation from the accepted practice. This process requires detailed analysis of documentation to identify any deficiencies in management controls or adherence to established management controls. The linear sequence follows that the employee using equipment follows procedures to process a job task or materials within an environment.

On the third day of the investigation following initial data collection, initial development of the linear sequencing chart began to identify missing gaps in the evidence collected by the team. The Team then formulated and executed a plan to obtain the missing information.

On the fourth day of the accident investigation, the Team began the initial development of the fault tree analysis due to the extremely complex and detailed system and processes involved. This was particularly important due to the comprehensive safety systems (personnel selection, training, equipment, materials, and procedures) in place to prevent parachute malfunctions by the BLM smokejumpers.

The fault tree analysis utilizes the deductive method of logic (i.e., moves from the general to the specific). Since Liston's accident clearly resulted from more than one initiating factor (failure of the main parachute deployment, and failure of the emergency reserve parachute to successfully deploy) and the circumstances of Roach's parachute malfunction, a systematic process was necessary to analyze each potential causal factor. As the Team identified specific events, which may have contributed to the accident, the Team had to identify whether supporting evidence upholds or contradicts various possibilities in the likely series of events. By placing each possible contributing factor in its respective location on the fault tree, the Investigation Team can accurately identify where any breakdowns in the system, task, process or work operation occurred, or did not occur as the case may be.

Although the fault tree analysis implies that it is a tool primarily for analyzing faults in the system or process, it is important to note that fault tree analysis also was used by the Team to evaluate the actions necessary to result in desired events or a successful outcome.

The use of fault tree analysis is a very organized, meticulous, and versatile type of analysis. It is organized because it evaluates each event with consideration for that event's specific purpose,

function, or place within a system or process. It is meticulous because it attempts to describe the relationship of any and all events that may have acted upon a system that resulted in the accident. This method is versatile in its ability to evaluate hypothetical events, which the accident investigators may introduce into the fault tree to determine potential effects on the resulting event.

On the seventh day of the investigation, the Interagency Representative, Jerry Williams, developed a comprehensive fault tree analysis, which the Investigation Team utilized for evaluating each event separately or in combination with other events on the tree. With the identification of more than one contributing events (or possibilities), each interacting or possibly interacting event is placed into a set. Essentially, the set isolates specific events in the system and allows for a qualitative examination of the relationship between the set and, as a whole, on its effect of the resulting event.

The Team then assigned a probability value to each event, and then through analysis of these events, yielded quantitative results which describe the most likely scenario of events to the least likely scenario.