

## Therac-25 Radiation Overdoses June 1985-January 1987

The Therac-25 is a radiation therapy machine used in the mid-80s. It delivered two types of radiation beams - a low-power electron beam and a high-power x-ray. This provided the economic advantage of delivering two kinds of therapeutic radiation with one machine. From June 1985-January 1987, the Therac-25 delivered massive radiation overdoses to 6 people around the country. We can look at the causes of these overdoses in a root cause analysis performed as a Cause Map.

The radiation overdoses were caused by delivery of the high-powered electron beam without attenuation. In order for this to happen, the high-powered beam was delivered, and the attenuation was not present. As mentioned above, the machine was used for two types of radiation - the lower-powered beams did not require attenuation provided by the beam spreader, so it was possible to operate the machine without. The machine did register an error when the high-powered beam was turned on without attenuation. However, it was possible to operate the turn on the beam even with the error and the warning was overridden by the operators.

The Therac-25 had two different responses to errors - one was to pause the treatment - which allowed the operators to resume without any changes to settings - and another was to reset the machine settings. The error resulting in this case - having the high-power beam without attenuation - resulted only in a treatment pause, allowing the operator to resume treatment with an override, without changing any of the settings. Researchers talking to the operators found that the Therac-25 frequently resulted in errors and so operators were accustomed to overriding them. In this case, the error that resulted ("Malfunction 54") was ambiguous and not defined in any of the operating manuals. (This code was apparently only to be used for the manufacturing company, not healthcare users.)

### Cause Map Detail Level

