Soft Start Procedure
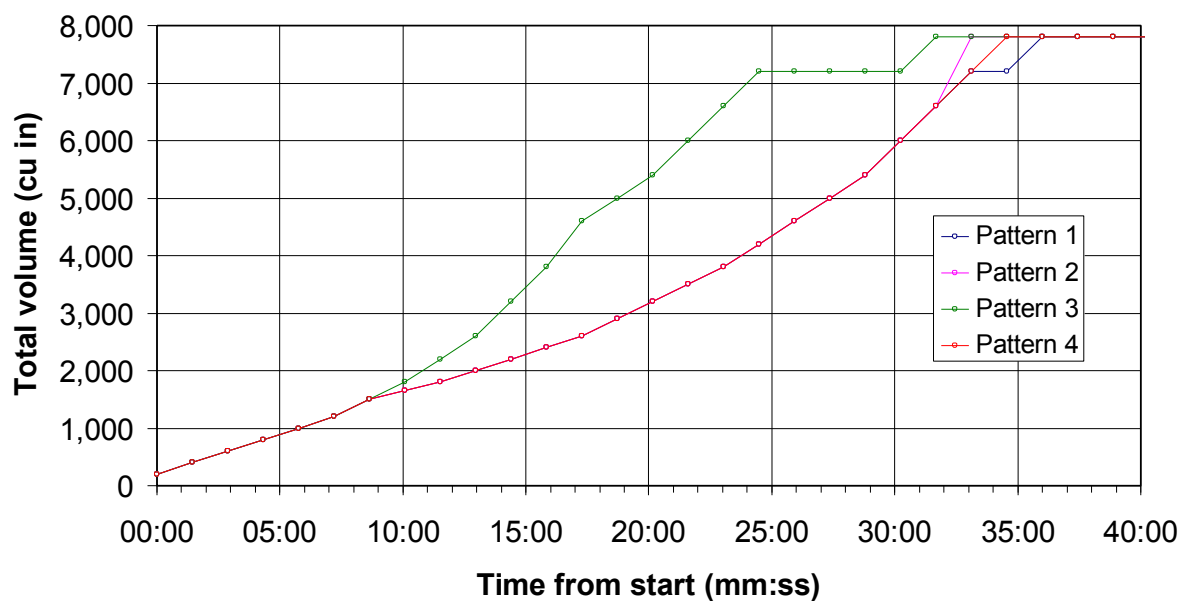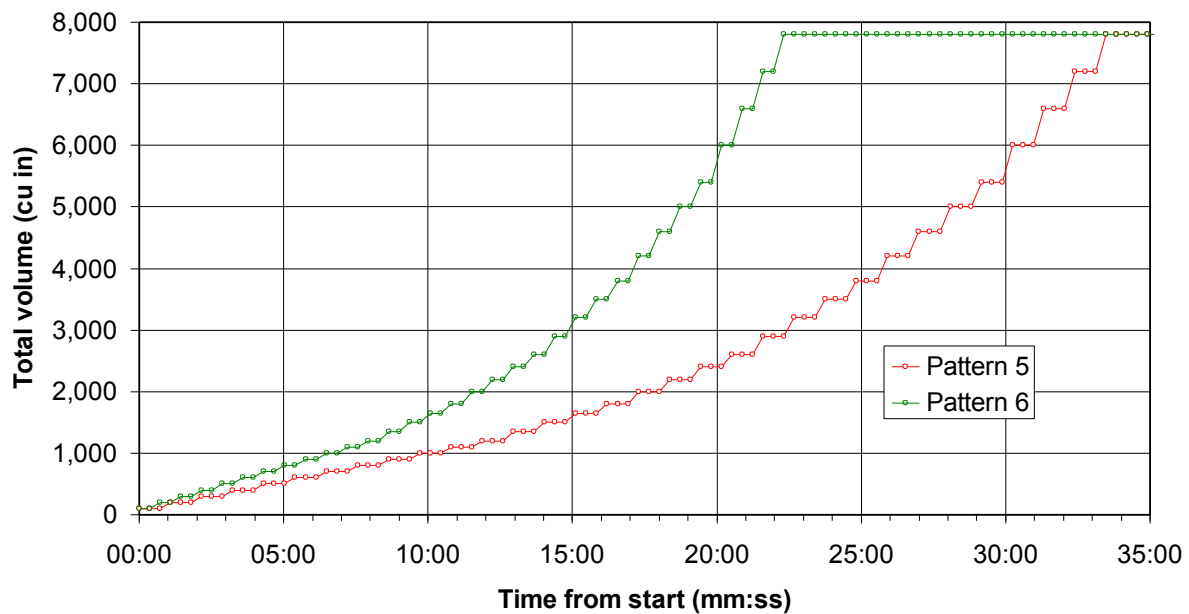
Soft starts on the project involved an increase in the number of guns fired to achieve a steady ramp-up (rather than using an increase in pressure). Guns were fired at the same shotpoint interval (SPI) (i.e. distance) as for the following line (rather than firing at set times). This had the disadvantage that the duration of the soft start procedure was dependent on vessel speed - if the vessel was moving slowly then the soft start could take longer than the minimum 30 minutes required, and if moving quickly there was a risk that the soft start would be completed in under the 30 minutes. To address this issue, six slightly different soft start procedures (called "patterns") were used during the project. Patterns one to four were used during Leg Two when a shotpoint interval of 200 m was used (Figure A1).

Figure A1. Soft start patterns one, two, three and four for 200 m SPI, plotted using a vessel speed of 4.5 knots. Each pattern was used once.

Patterns five and six were used during Legs Two and Three when the SPI was 50 m (Figure A2). Pattern five was used for all but one of the 50 m SPI lines, when pattern six was used. In this case the vessel was travelling as slowly as possible to avoid overshooting the re-start of the line following a cetacean shutdown. When plotted at 4.5 knots, pattern six does not meet the required duration of 30 minutes, but the minimum 30-minute soft start duration was achieved as the vessel was travelling less than 3.3 knots on average.

Figure A2. Soft-start patterns five and six for a 50 m SPI, plotted assuming a vessel speed of 4.5 knots.

As there were no spare guns in the arrays there was no issue of exceeding the permitted maximum output for the survey during the soft start (i.e. when all guns were fired this was the maximum *and* operational volume).

Gun tests

During all gun tests guns were tested individually and guns were fired from the minimum to maximum volume within each sub-array (at the suggestion of the PAM operator) i.e. so as to effectively ramp-up from smallest to largest gun for each sub-array. Usually guns were fired once (though occasionally more than once to verify results). The sequence was: #8 (100 in³), #2 (100 in³), #1 (100 in³), #7 (150 in³), #3 (200 in³), #4 (300 in³), #6 (400 in³), #5(600 in³).