March 2, 1993

Memo to: Primer Team
From: F. G. Lopata F. Lopata

Subject: Consistency of Manufactured Explosives

Particle size data analyses show the explosives manufactured on site are "consistent" with about an 8% excursion rate for lead styphnate. I have defined "consistent" to be that the sample median plus or minus one population standard deviation be inside the bracket of the population median plus or minus one population standard deviation.

Infrared data and differential scanning calorimetry show a chemically based ignition problem. It will take more detailed study to determine the root cause and to correct it. To correct the problem, I suggest that TNR purity or the magnesium styphnate purity receive the emphasis. This could be pursued while we continue with the next primer team objective.

Particle size analysis:

Out of 109 lead styphnate samples, two were statistically "fine," and seven were "coarse." Four of the "coarse" precipitations were consecutively manufactured. Both reaction rooms gave the same median value (108 microns, .00425 inch) with the same standard deviation of these medians (10 microns, .0004 inch). However, the averages of the geometric standard deviations were statistically different--the two rooms give different distributions of particle sizes.

Out of 15 TNR sample runs, one precipitation was statistically "coarse." (There were eight precipitation samples, but duplicate particle size analysis runs were made using different media.) TNR particle size has not been proven or disproven here to be significant in the styphnate process.

Out of 31 tetrazene sample runs on fourteen precipitations, laboratory techniques accounted for the two excursions. No inconsistency appears in the tetrazene particle size manufacture.

Infra-red spectra:

The manufactured materials are each chemically consistant from run to run, as shown by absorption peaks that occur at the same wave numbers every time. However, there are some differences from spectra taken from non-Remington manufactured materials. These have several peaks shifted from ours by more than ten wave numbers indicating some different molecular configuration or that the desired molecule is not attained 100% of the time. There hasn't been enough time to analyze fully the causes.

Differential scanning calorimetry:

Differential scanning calorimetry shows a 22.59 'C temperature spread in the onset of decomposition among the styphnate samples. This amounts to a spread of 4.85 standard deviations. Seventeen percent of the onset temperatures were between one and two standard deviations from the average, with 7.7% beyond those being more than two standard deviations from the average. Of all the styphnate samples measured, 15% fell below the MIL-SPEC of 270 C (518 F) minimum deflagration point. Fifty-one percent fell outside the range 275 - 280 C (527 -535 F) defined in one technical source (Meyer "Explosives," 4th ed.). I am concluding that an ignition problem exists with the product as currently produced.

TNR exhibits a twelve degree Celsius (21.6 F) spread in melting point onset and a twenty-five degree C (45 F) spread in onset of its first decomposition peak. With only eight samples analyzed, the statistics would not be reliable but these spreads are obviously excessive.

Tetrazene shows only a five degree spread among the samples in onset of decomposition. This is acceptable.