DRAFT

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1 INTRODUCTION (U)

From JASON Performance Margins January 1999

(U) Maintaining an adequate primary yield to drive the secondary with confidence is a dominant technical requirement for modern thermonuclear devices. This requirement must be met throughout the full deployment cycle of each warhead up to its scheduled limited life component exchange (LLCE), making allowance for the 12.3 year radioactive half-life decay of tritium (T) in the boost gas transfer system.

(U) Today's stockpile reflects historical concerns to conserve T as a precious commodity in the design of warheads and their gas transfer systems. However we face very different circumstances in today's environment.

- no new nuclear device designs for deployment;
- no nuclear device yield testing;
- assumption of greatly increased weapon life;
- prospects for a smaller nuclear stockpile under negotiated limits;
- removal of constraints on T availability with the decision (January, 1999) to restart T production.

This prompts a reconsideration of the primary and its performance margins in our stockpile.

(U) During the 1995 JASON summer study on " Nuclear Testing",[1] we reviewed the issue of performance margins for primaries in the enduring stockpile. Based on material provided to us by the device laboratories we

[1] JASON 95-320.

systematically explored the relevant parameters and concluded that, for some of the warheads, the performance margins could and should be enhanced by one or more of several options involving the boost system. These system specific options include increased initial T loading, reduction of LLCE intervals, and use of improved gas transfer systems with the aim of improving the quality of the end-of-life boost gas fill. The analysis in Ref. 1 showed that optimization for a START I stockpile put a modest demand on additional T.

(U) The developments required to implement such improvements are not inhibited by the CTBT. They would be prudent steps to help maintain confidence in the nuclear stockpile by helping compensate for uncertainties in the minimum required yields of the primaries, based on the existing nuclear test data base, that may grow as the primaries age. The data assembled in our 1995 report suggested that many of the performance margin enhancements that were recommended as desirable were achievable without great expense.

(U) The JASONs reviewed this issue again in January 1999. Although some good technical work was presented to us in developing boost systems that would reduce the risk of degradation of performance margins with time, our overall finding is one of disappointment at the slow pace, low priority and limited scope of the lab/DOE efforts to provide enhanced primary performance margins.

(U) Our basic conclusion is that the US should act to preserve adequate performance margins promptly, rather than waiting for better potential technical solutions to emerge from the stockpile stewardship program. Since the 1995 study we have been offered no technical reasons – and foresee none emerging from future advances in understanding weapon physics – for delaying such enhancements.

(U) We emphasize the importance of enhancing the performance margin – i.e. the excess of the minimum expected primary yield under worst conditions, Y_{P1}, above the minimum primary yield required for certified secondary yield, Y_{P2}, for two specific reasons:

a) the primary must provide appropriate drive for the secondary or the warhead will fail to meet its military characteristics as designed

b) there are unavoidable uncertainties in determining the precise values of Y_{P1} and Y_{P2}, and confidence in their values may erode as weapons age and are refurbished without input from underground tests.

(U) The performance margins must be maintained at sufficiently high levels, under all operational conditions in the stockpile-to-target sequence, to cover these circumstances.

(U) **We therefore recommend that Defense Programs set as an explicit and high-priority program goal the increase of performance margins for selected weapons systems.** We also recommend caution in introducing potential changes that would introduce new risks or uncertainties, such as common mode failures associated with relying on single technologies (e.g. Acorn) for all, or most, of the gas transfer systems.

(U) The recent decision regarding tritium production, which should assure a known and reliable yearly amount of new tritium, will make it easier to develop the quantitative details regarding increase of margin through changes in gas systems and cycle times.

(U) Implementing enhancements of performance margins does not interfere with stockpile stewardship, and need not await the final completion of, for example, modern rebaselining of the weapons systems involved. Instead, enhancing performance margins is highly complementary to, and supportive of, the goals of stockpile stewardship, in that it helps compensate for any added uncertainties that might be associated with the ESP and SLEP. If margins are increased, it may be easier to achieve other goals of the stockpile stewardship program, for example by reducing the specs for purity or homogeneity of specific metal or high explosive parts. In fact the overall sensitivity of the warheads to small material changes in such components due to new remanufacturing techniques or to aging may be greatly reduced in the presence of increased margins. It would be of interest to expand current studies of these sensitivities for the present stockpile by also examining the case of a stockpile in which every weapons system has a substantial margin. The results could lead to important redirections of program efforts, provided that the necessary margin increases are put into place.

(U) In the following we review the present situation with regard to gas transfer systems for each individual warhead in the stockpile and recommend appropriate actions to address concerns where they are identified.