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Extraction and Utility of Reactor-Grade Plutonium for Weapons (U)

W. G. Sutcliffe and T. J. Trapp, Editors

April 27, 1995

5/21/97

5/14/97

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NUCLEAR WEAPON DATA Sigma 1,2,3

CRITICAL NUCLEAR WEAPON DESIGN INFORMATION.
DOD DIRECTIVE 5210.2 APPLIES.

Derivative Classifier: W. Michael Ploeger
Deputy Program Leader
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Preface

This report is based on briefings given to the National Academy of Sciences' Committee on International Security and Arms Control during its study of the management and disposition of excess weapons plutonium and is provided as a reference for its report. The briefings were given by experts from the Lawrence Livermore and Los Alamos National Laboratories. The agendas for the briefings at Livermore on January 25 and November 19, 1993, are contained in Appendix A. The briefing viewgraphs are contained in LLNL documents No. MAY-95-01 (SRD) and MAY-93-2 (SRD), except for two presentations from the November 19 briefings.

The editors thank the many authors and reviewers who contributed to this report:

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Overview

This report illustrates two facts:

1. Reactor-grade (RG) plutonium, such as that produced in commercial power reactors, can be used to construct a nuclear weapon with a yield of at least a kiloton.

2. RG plutonium can be separated from spent nuclear fuel with modest facilities and equipment.

The usual question is not whether RG Pu can be separated and made into a weapon, but how "difficult" or how "easy" it is to do so. That is, does it take a national effort on the part of some country, or could a terrorist group separate Pu and construct a bomb? This report addresses the "difficulty" issue by identifying the facilities, equipment, and materials needed to separate Pu and to fabricate simple designs into weapons, and by analyzing the performance of these designs.

The more important issue of technical expertise is not addressed. Because the skill required to build a nuclear weapon usually comes with experience, it is not a foregone conclusion that an untrained group with all the necessary facilities, equipment, and materials could produce a workable weapon before they could be stopped. Indeed, the problem is that an untrained group might be successful. Because the consequences are so grave, the risk is appreciable even if the probability is low. Of course, even an explosion of a device that failed to go critical, but dispersed Pu, could have grave consequences.

The availability of Pu must be considered in assessing this risk. So far, proliferating states have chosen to enrich uranium or manufacture Pu. However, a subnational or terrorist group would not likely have access to the necessary enrichment or production facilities and would not want to risk detection. For such a group, theft of highly enriched uranium (HEU) or Pu from the worldwide inventory would be more attractive. HEU and separated Pu, even in the form of oxide, offer the most attractive source. If these sources were well protected and thus not available, Pu from spent fuel could be an alternative source.

It is commonly believed that spent fuel is so radioactive (self-protecting) that it could not be stolen and processed by a terrorist group. Unfortunately, 10 to 15 years after reactor discharge, the radiation dose rate near spent fuel is greatly reduced. A subnational or terrorist group willing to incur substantial, but not lethal, radiation doses could obtain Pu by stealing and processing irradiated spent fuel.

Finally, it should be noted that throughout this document the primary focus has been on a terrorist threat, rather than the more traditional nonproliferation threat of a nation acquiring a nuclear weapons capability and stockpile. Although we have avoided going into specific scenarios, focusing on terrorism means that the requirements for yield, size, weight, reliability, shelf life (if any), etc., are vastly different. A terrorist group might only have to make a credible threat (that is, a threat that could not be ignored) and might have little to lose if the device did not give the optimum yield or even failed completely.