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978-1-107-03011-4 - Too Hot to Touch: The Problem of High-Level Nuclear Waste
William M. Alley and Rosemarie Alley
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Too Hot to Touch

The Problem of High-Level Nuclear Waste

When the nuclear energy industry was launched in the 1950s, Robert Oppenheimer dismissed the waste problem as "unimportant." Over a half-century later, the waste issue is as prominent as reactor safety in the international controversies surrounding nuclear power. It is particularly topical in the US since the 2010 closure of the Yucca Mountain repository project. With no long-term plan in sight, high-level radioactive waste remains scattered across 121 sites in 39 states.

William and Rosemarie Alley provide an engaging and authoritative account of the controversies and possibilities surrounding disposal of nuclear waste in the US, with reference also to the difficulties and progress of other countries around the world. The book tells the full history from the early days after World War II up to the present time, with an insightful perspective drawn from William Alley's expertise in the field, including leading the US Geological Survey study of Yucca Mountain. Stories of key players bring to life the pioneering science, the political wrangling and media drama, and the not-in-my-backyard communities fighting to put the waste somewhere else.

Written in down-to-earth language, this is a fascinating book for public interest groups, affected communities, and anyone interested in finding out more about this issue. The timely and important subject also makes it a valuable resource for policymakers, political staff, environmentalists, and research scientists working in related fields.

WILLIAM AND ROSEMARIE ALLEY are a husband and wife team, writing for the general public on Earth Science issues confronting society. As a leading expert in the field of hydrogeology, Dr. William M. Alley has won numerous awards for his work, including the US Geological Survey (USGS) Shoemaker Award for Lifetime Achievement in Communication and the Meritorious Presidential Rank Award. Dr. Alley served as Chief of the Office of Groundwater for the USGS for almost two decades and oversaw the Yucca Mountain project from 2002 to 2010. Rosemarie Alley has a Master's Degree in special education. As a literacy specialist, she has taught young adults with language delays and conducted numerous reading workshops for teachers, administrators, and parents. Currently, Rosemarie is a writer, sculptor, potter, and gardener. The Alleys live in the foothills above San Diego, California.

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"Coming from a concerned environmentalist perspective, this is an outstanding, well-researched book, containing a wealth of information about the global issue of radioactive waste, and presented in a highly readable style."

– Professor Bill Lee FREng, *Co-director, Imperial College Centre for Nuclear Engineering*

"This is a fascinating and highly readable book from authors with deep knowledge and a wealth of sharp (and often amusing) insights into the ups and downs of the US radioactive waste management programme. It will appeal especially to geologists, nuclear scientists and technologists with a taste for the lessons of history, particularly those experiencing today the difficulties of implementing solutions to a complex technical problem that is also highly charged, politically and societally."

– Professor Neil Chapman, *MCM Switzerland and University of Sheffield, UK; radioactive waste-management consultant to international industrial, regulatory and governmental organisations.*

"An excellent source of information for both the experienced nuclear waste professional and other interested parties. The reader is taken from an Atomic Energy Commission (AEC) seminar on radioactive waste in 1949 to a final chapter on nuclear waste and our energy future.

A truly great ride that strikes a balance between the technical aspects and the extremely interesting history of our efforts to deal with the challenges of nuclear waste management."

– Professor James H. Clarke, *Civil and Environmental Engineering, and Earth and Environmental Sciences, Vanderbilt University.*

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WILLIAM M. ALLEY
AND
ROSEMARIE ALLEY

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This book is dedicated to all the scientists who have devoted their working lives to trying to solve the problem of high-level nuclear waste.

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Units

We use a combination of American and metric units, and show both where it is important for comprehension. Conversion factors are listed below for some commonly used units.

1 foot (ft) = 0.3048 meters (m)
1 inch (in) = 2.54 centimeters (cm)
1 mile (mi) = 1.609 kilometers (km)
1 square mile = 2.59 square kilometers
1 acre = 0.4047 hectares
1 gallon = 3.785 liters
1 pound = 0.45 kilograms (kg)
1 rem = 0.01 sieverts
1 metric ton = 1000 kilograms = 1.1 tons

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Abbreviations

AEC	Atomic Energy Commission
AFR	Away-from-reactor
AFSWP	Armed Forces Special Weapons Project
ANEC	American Nuclear Energy Council
BRC	Blue Ribbon Commission on America's Nuclear Future
DOE	US Department of Energy
EBR-I	Experimental Breeder Reactor-I
EEG	Environmental Evaluation Group
EIS	Environmental Impact Statement
EPA	US Environmental Protection Agency
EPRI	Electric Power Research Institute
ERDA	Energy Research and Development Administration
ESF	Exploratory Studies Facility
ET	Evapotranspiration
FEPs	Features, events, and processes
GAO	Government Accountability Office
GNEP	Global Nuclear Energy Partnership
INL	Idaho National Laboratory
IRG	Interagency Review Group
ISFSI	Independent spent fuel storage installation
LLRW	Low-level radioactive waste
MRS	Monitored retrievable storage
MOX	Mixed oxide
NAS	US National Academy of Sciences
NASA	National Aeronautics and Space Administration
NIMBY	Not in my backyard
NIMS	Not in my State
NRC	US Nuclear Regulatory Commission
NRTS	National Reactor Testing Station (now INL)

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NTS	Nevada Test Site (now named Nevada National Security Site)
NWPA	Nuclear Waste Policy Act
NWTRB	Nuclear Waste Technical Review Board
PUREX	Plutonium URanium EXtraction reprocessing
R&D	Research and development
RCRA	Resource Conservation and Recovery Act
RMEI	Reasonably maximally exposed individual
SLAC	Stanford Linear Accelerator Center
TSPA	Total system performance assessment
TVA	Tennessee Valley Authority
UNLV	University of Nevada-Las Vegas
USGS	US Geological Survey
UZ	Unsaturated zone
WIPP	Waste Isolation Pilot Plant

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Introduction

On Labor Day in 1954, President Eisenhower appeared on television to announce the start of construction of the Nation's first nuclear power plant. The plant was to be built in the small town of Shippingport, Pennsylvania on the Ohio River, about 25 miles (40 km) west of Pittsburgh. The site was not far from Titusville, Pennsylvania, the birthplace of the petroleum industry, and was almost on top of one of the world's greatest coal fields. The Pittsburgh utility had come onboard the demonstration project for one basic reason – pollution control. Pittsburgh, once the "Smoky City," had instituted strict air pollution requirements, and the local citizens were resisting plans for a coal-fired power plant. [1]

President Eisenhower, vacationing in Denver, Colorado, made good use of the new television medium to dramatize the event. The President held up a large neutron-generating "magic wand" for the viewers to behold. As he waved the atomic-age magic wand over a neutron counter, an electronic signal traveled 1,200 miles (1,900 km) from Denver to Shippingport. The signal activated an unmanned, remote-controlled bulldozer which began to break ground for the new plant. It was an impressive feat. The local crowd rose to their feet and applauded. Two weeks later, Lewis L. Strauss, Chairman of the Atomic Energy Commission, delivered his oft-cited speech that "Our children will enjoy in their homes electrical energy too cheap to meter." [2–3]

Signed into law a few months earlier, the Atomic Energy Act of 1954 opened the way for peaceful uses of the atom. For the first time, civilians were allowed to join the elite nuclear club by building and operating privately owned nuclear power plants. Soon thereafter, the Atomic Energy Commission announced its Power Demonstration Reactor Program. The program offered free nuclear fuel for up to seven years, money for research and development and, in some cases, a large part of the capital needed to build nuclear plants. One member of Congress

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characterized it as an attempt to "force-feed atomic development" with tax dollars. [4]

In the euphoria of abundant and cheap energy just around the corner, the question of what to do with the radioactive waste from nuclear power plants rarely came up. Nor were there many concerns about the high-level nuclear waste that had been accumulating at Hanford and other atomic weapons plants since the start of the Manhattan Project. For many years, the problem of nuclear waste would go unrecognized or be considered trivial. Predictions that the problem would almost solve itself would prove miserably wrong.

By the late 1960s, a general optimism prevailed that there would be a permanent site for high-level nuclear waste by 1980. Time and again, the date would be revised. In 1982, the Nuclear Waste Policy Act mandated that the federal government begin accepting high-level wastes for burial in a geologic repository by January 31, 1998. The government was so sure of itself that it signed binding agreements with the utilities to accept responsibility for the waste by this date. A few years later, the Office of Technology Assessment for the US Congress suggested that the 1998 goal was unrealistic, but expressed "considerable confidence" that a repository would be operating by 2008 and a second by 2012, "even if significant delays are encountered." Newly revised predictions of the date for an operational repository continue to be pushed further and further into the future, as the dates of previous predictions recede into the past. [5]

Meanwhile, high-level radioactive waste from electricity generation and weapons production remains scattered among 121 sites in 39 States. As of 2012, the United States had accumulated almost 70,000 tons of spent fuel from nuclear reactors. In addition, about 20,000 giant canisters of defense-related high-level radioactive waste will need a final resting place. [6]

More than a half-century has passed since Eisenhower waved his magic wand. The Shippingport plant has come and gone. It shut down in 1982, after 25 years of successful operation. By any measure, it is well past the time to tackle the waste problem. No magic wand will make it go away.

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