Seeing the Light: The Case for Nuclear Power in the 21st Century

Nuclear power is not an option for the future, but an absolute necessity. Global threats of climate change and lethal air pollution, killing millions each year, make it clear that nuclear and renewable energy must work together as noncarbon sources of energy. Fortunately, a new era of growth in nuclear power is underway in developing nations, though not yet in the West. *Seeing the Light* is the first book to clarify these realities and discuss their implications for coming decades. Readers will learn how, why, and where the new nuclear era is happening, what new technologies are involved, and what this means for preventing the proliferation of weapons. This book is the best single work yet available for becoming fully informed about this key subject, for students, the general public, and anyone interested in the future of energy production, and thus, the future of humanity on planet Earth.

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Preface and Acknowledgments

This book is the product of a diplomat and a scientist. Thomas Graham Jr. is a senior US diplomat who, from 1970 to 1997, helped negotiate every international arms control and nonproliferation agreement put forth by the world. Scott L. Montgomery is a geoscientist who spent twenty-five years in the energy industry before becoming a university professor and author. Ambassador Graham has devoted his entire adult life to reducing the threat of nuclear war. It is because of this work that he sees nuclear power as a key means to reduce another global threat – that of climate change. Montgomery belonged to antinuclear organizations before being transmuted into an advocate by years of study and teaching, and by many discussions with nuclear professionals, health physicists, government officials, and, finally, by the implications of climate change.

Employing their backgrounds to hopefully good effect, the authors have sought to cover a wide array of subjects in this book that point up the troubled history, flaws, required re-evaluations, benefits, and necessity of nuclear power for the world. It is their firm belief that such coverage is required to make the reader a truly informed citizen in this domain. The task is significantly large but well within the bounds of possibility. It may even happen that nuclear professionals themselves will find novel and useful material in the pages that follow. We, the authors, would maintain that this is not entirely an accident.

A word about the text. While chapters have been written so that they can be read individually and not necessarily in order, the reader would do well to learn the basic material covered in Chapters 3 and 5 (on nuclear energy and radiation) at an early point. Much later discussion draws on the knowledge and terminology covered there.

Acknowledgments are important to any book, but they are especially necessary to a work where so much direct aid has been given.

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Finally, it is to Kyle, Cameron, Marilyn, and Clio that I am most indebted, as will always be the case. Their support, understanding, and patience live within these pages as much as anything of my own.

Abbreviations

AEC	Atomic Energy Commission (US)
AMD	Acid Mine Drainage
BEAR	Biological Effects of Atomic Radiation (report)
BWR	Boiling Water Reactor
CANDU	Canadian Deuterium Uranium Reactor
CF	Capacity Factor
CTBT	Comprehensive Test Ban Treaty
DOE	Department of Energy (US)
EIA	Energy Information Administration
EPA	Environmental Protection Agency (US)
FNR	Fast Neutron Reactor
FOE	Friends of the Earth
GCR	Gas-Cooled Reactor
Gen	Generation (nuclear reactors, e.g. Gen IV)
GHG	Greenhouse Gas
GW	Gigawatt (billion Watts)
HEU	High-Enriched Uranium
HGR	(HTGR) High-Temperature Gas-Cooled Reactor
HWR	Heavy Water Reactor
IAEA	International Atomic Energy Agency
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
ISL	In-Situ Leaching
kW	Kilowatt
kWh	Kilowatt-hour
LCOE	Levelized Cost of Electricity
LEU	Low-Enriched Uranium

LFTR	Liquid Fluoride Thorium Reactor
LNG	Liquefied Natural Gas
LNT	Linear No-Threshold
LSS	Life Span Study (Atomic Bomb Survivor Study)
LWR	Light Water Reactor
MOX	Mixed-Oxide Fuel (uranium and plutonium oxides)
MSR	Molten Salt Reactor
MW	Megawatt (million Watts)
MWh	Megawatt-hour
NAS	National Academy of Sciences (US)
NEI	Nuclear Energy Institute
NPT	Nuclear Non-Proliferation Treaty
NRC	Nuclear Regulatory Commission (US)
OECD	Organization for Economic Cooperation and Development
PWR	Pressurized Water Reactor
RBMK	Reaktor Bolshoy Moshchosty Kanalny (High-Power Channel Reactor)
SFR	Sodium-Cooled Fast Reactor
SMR	Small Modular Reactor
TMI	Three Mile Island
UNSCEAR	United Nations Scientific Commission on the Effects of Atomic Radiation
VVER	Vodo Vodyanoi Energetichesky Reaktor (Pressurized Water Power Reactor)
WHO	World Health Organization
WNA	World Nuclear Association