Book review

Chernobyl – History of a Tragedy

S. Plokhly, Allen Lane/Penguin, London, UK, 2018, ISBN 978-0-241-34902-1, £20.00, 387pp.

This book, by a Ukrainian historian now domiciled in the United States, is the first full treatment of the Chernobyl disaster. While it has been reviewed a number of times in the national press, and indeed was the 2018 winner of The Baillie Gifford Prize (formerly The Samuel Johnson Prize) for Non-Fiction, this particular review looks at it from an engineering perspective. The author makes clear, however, that the many technical failures that led to the disaster, and therefore such a perspective, cannot be considered in isolation from the Soviet political system and the flaws within its military/industrial command economy.

The book contains a preface; a prologue; 21 chapters which cover the whole story of the Chernobyl power plant; and an epilogue. It covers the plant's political and economic background right through to the New Safe Confinement Project over the damaged reactor in 2018. As may be expected from its title, not all chapters are of technical interest to the civil engineer.

The first two chapters describe the desire of the Soviet regime and the young, energetic President Gorbachev to 'go nuclear'; a history of the Chernobyl area in Ukraine; a short biography of the director of the Chernobyl Nuclear Power Plant; a description of the initial site surveys; and the organisation and construction of both the plant and its nearby purpose-built city of Prypiat.

Chapter 3 details the quality and programme issues associated with ongoing construction work at the site, and highlights the Soviet system's main tool for addressing shortcomings, that is to direct a barrage of reprimands at any officials deemed responsible. The RBMK (*reaktor bolshoy moshchnosti kanalny*, high-power channel) reactor, with an output twice that of those favoured by the West, and with cheaper build and operational costs, is also described in some detail.

The lead-up to a turbine test on operational unit 4, the test itself and the subsequent explosion, are vividly described in Chapters 4 and 5. A problem in the RBMK reactor design was exposed in 1975 when a major accident at the Leningrad power plant was narrowly averted. When the control rods were not fully inserted into the graphite core, an effect of positive reactivity, or a spike in the fission reaction, could occur. Unfortunately, this information was withheld from personnel at other plants.

For a number of reasons, the ill-fated turbine test proceeded even though power output at 200 MWt was dangerously low, and an emergency shutdown was activated. The 'positive void effect' design problem caused the power output to rise rapidly above 30 000 MWt, the fuel rods disintegrated, and there was an enormous increase in steam pressure. The resulting explosion destroyed the reactor casing, throwing the 200 t upper biological shield through the roof and tearing off coolant lines. The shield landed back down on the casing but left an opening through which radiation escaped into the atmosphere. Without cooling water, the thermal power of the core increased even more, and a second explosion destroyed the containment building and threw highly radioactive graphite blocks all over the site. The time was 01:24, 26 April 1986.

Chapters 6 to 16 describe not only the immediate and heroic response to the disaster, the evacuation of nearby citizens and the massive clean-up operation, but also the initial denial of the Soviet regime and its tendency to withhold information and to avoid responsibility. By 5 May, radiation levels had subsided, but no-one knew exactly why. Further semi-permanent works were implemented to ensure that the reactor could not burn its way down to the water table, and to ensure that radiation into the atmosphere was contained.

The last five chapters of the book document the political fallout from the disaster, culminating in Ukraine's independence, the break-up of the Soviet Union and the availability of European funds for the New Safe Confinement Project. Energy sector engineers will note that the newly independent Ukraine's preference for a nuclear-free power base proved unfeasible, and so new nuclear plants have now been built to replace Chernobyl.

The book's epilogue suggests that, with many countries still putting military and economic objectives before safety, environmental and health concerns, a similar disaster of biblical proportions cannot be ruled out. The author advocates close international co-operation on all nuclear projects, to counteract nationalist and isolationist tendencies.

Civil engineers should not be put off by the historical nature of this book. It contains enough reasonably presented technical detail to satisfy most professional practitioners, and importantly, places that detail into the broader geopolitical context. It is guaranteed to be of compelling interest to all readers.

Phillip G. Thurlow