

## Design Code Calibration of Coastal Defences against Typhoon Attacks for Nuclear Power Plant

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### ABSTRACT

With the global warming and sea level rising, it is widely recognized the increasing tendency of typhoon occurrence frequency and intensity. The increasing typhoon disaster and severe consequences lead us to make a design code calibration of coastal defense against typhoon attacks on nuclear power plant. This paper discussed the reasonability of definitions about “probable maximum typhoon”, “probable maximum storm surge” in nuclear safety regulations of China and made some design code calibration by using our proposed Double Layer Nested Multi-objective Probability Model (DLNMPM).

**KEYWORDS:** Typhoon; Nuclear power plant; coastal engineering; Code calibration; Double layer nested multi-objective probability model.

### INTRODUCTION

In recent years some typhoon and hurricane disasters brought significant losses of life and properties to South Korea, China and USA, such as Typhoon Maemi in 2004, Typhoon Rananim and Hurricane Ivan in 2004, Hurricane Katrina and Rita in 2005, Typhoon Saomai and Bilis in 2006, Typhoon Sepat and Wipha in 2007, et al.

In China, three nuclear power plants have been built along coasts of Guangdong and Zhejiang provinces since 1980s. Some of them have operated. It is estimated in “2007 China Long Term Nuclear Power Plan” that, before 2020 about 450 billion RMB will be invested along 6 coastal provinces for increasing 23 million kilowatt nuclear electric energy.

With global warming and sea level rising, the frequency and intensity of typhoons and typhoon induced disasters have been increasing. All the coastal areas of nuclear power plants are menaced by typhoon disasters. So calibration of typhoon disaster prevention criteria is necessary for existed nuclear power stations and nuclear power plant on planning. In “China Nuclear Safety Regulations (HAF101, HAD101/09~11)”, some vague definitions should be discussed and endowed probability characteristics by using statistic analysis.

In this paper, one built nuclear power plant engineering along coast of South China Sea was taken as example for code calibration. Aiming at “China Nuclear Safety Regulations”, the uncertainties in regulations of Probable Maximum Typhoon (PMT), Standard Project Typhoon (SPT), Probable Maximum Storm Surge (PMSS), Design Basic Flood (DBF) and their induced differences of design criteria were calculated and analyzed (The PMT, SPT are corresponding to the definition of PMH and SPH, respectively). The theoretical foundation of this analysis process is our proposed “Double Layer Nested Multi-objective Probability Model” (DLNMPM). In the study, Global Uncertainty Analysis (GUA) and Global Sensitivity Analysis (GSA) should be involved in whole procedure for different combinations of typhoon characteristics with some return periods and their induced PMSS.

### DISCUSS ON “COASTAL NUCLEAR ENGINEERING SAFETY REGULATIONS OF CHINA HAD101/09~11”

#### **Discuss on four kinds of design criteria**

In this section, Design Basic Flood (DBF), Probable Maximum