



# Probe on the Construction of Marine Environmental Safety Emergency Security Standard System in China

Shengwen Cao<sup>1,2</sup>, Wenhui Lu<sup>1,2</sup>, Fanchao Meng<sup>1,2</sup>, Xiaoyi Jiang<sup>1,2</sup>, Jin Liu<sup>1,2</sup>, and Lili Song<sup>1</sup>✉

<sup>1</sup> Technology Innovation Center of Marine Information, Tianjing, China  
lily.song\_ouc@163.com

<sup>2</sup> National Marine Data and Information Service, Tianjing, China

**Abstract.** In order to further improve the level of prevention and control of marine environmental security risks and emergency support in China, based on the current situation of marine environmental security in China and the progress of research on standardization of emergency support at home and abroad, and in combination with the actual business processes of marine environmental security incident emergency support disposal in advance, during and after the event, through material collection and extensive research, and drawing on the experience and guidelines of other industries in building standard systems, The overall framework and content of the marine environmental safety assurance standard system have been studied and formulated, and the requirements of six sub-standard systems, including basic general, management mechanism, data products, technical methods, system construction and application services, have been clarified. The results show that the marine environmental security standard system provides an important reference for the construction, operation and application of the marine environmental security platform, and effectively supports the emergency management of marine environmental security in China.

**Keywords:** marine environmental security · risk prevention and control · emergency support · overall framework · standard system

## 1 Introduction

As a big country with vast seas and oceans, China has long coastline and a large number of islands. In recent years, with the rapid socio-economic development of China's coastal areas, the acceleration of industrial and population aggregation to the coastal areas, coupled with the intensification of global climate change, the frequency and intensity of marine disasters have shown an upward trend, and the number of marine accidents and disasters has also increased year by year, resulting in a serious threat to China's marine environmental security. Marine environmental security is caused by marine natural disasters, accident disasters, social security and other factors, and poses a threat to marine environmental security, mainly including marine dynamic disasters, marine ecological

disasters, marine accident disasters, etc. [1], which are usually characterized by multiple types, wide distribution, high frequency, large destruction and rapid growth of losses caused by disasters.

The Third Plenary Session of the 18th CPC Central Committee stressed that “the government should strengthen the formulation and implementation of development strategies, plans, policies and standards” and “improve the public security system” [2]; As an important part of the public security system, marine environmental security has successively issued the Standard System for Marine Observation and Prediction and Disaster Prevention and Mitigation (HY/T 193–2015), the Standard System for Marine Safety Production Management (HY/T 0307–2021), the Standard System for Marine Big Data (HY/T 0332–2022), the Standard System for Marine Informatization (HY/T 0340–2022) and other relevant standard systems, and carried out the marine environmental protection standard system [3] The research on disaster risk prevention system [4], emergency management system [5] and other aspects has provided technical basis for China’s marine environmental security emergency support work, but it has not fully covered the prevent and post-event links such as information gathering, prediction and early warning, risk assessment, scenario deduction, emergency decision-making, emergency summary and so on in the actual business process of marine environmental security, In order to more effectively ensure the safety of China’s marine economy, society and people, it is necessary to build a complete marine environmental safety assurance standard system, and further improve China’s comprehensive emergency support capacity for marine environmental safety.

## **2 Current Situation and Deficiencies of China’s Marine Environmental Security**

In recent years, China has carried out timely and effective response and disposal of various marine environmental safety incidents, and has made considerable progress in marine observation and monitoring, prediction and prediction, risk assessment, intelligent decision-making and information system construction, which provides strong scientific and technological support for emergency response of marine environmental safety in China, but there are also many outstanding problems.

### **2.1 Marine Environment Observation and Monitoring**

China has established more than 200 multi-level marine environmental monitoring institutions covering the country, sea area, province, city and county, and has initially formed a three-dimensional monitoring system of the marine environment with multiple observation means such as radar, shore-based, buoy, ship, aircraft and satellite. The monitoring scope not only covers the waters under China’s jurisdiction, but also extends the international public waters closely related to China’s marine environmental rights and ecological security. However, large amounts of data are often scattered in different industries, departments and enterprises, which is very easy to cause information islands, leading to the failure of timely and unified collection, exchange, management, sharing and application of data in the emergency response process.

## **2.2 Marine Disaster Risk Assessment**

The Ministry of Natural Resources has completed the pilot work of marine disaster risk assessment and zoning at the national, provincial, municipal and county levels, and issued the technical specifications for disaster risk assessment and zoning of storm surge, tsunami, sea ice and sea level rise. In addition, China's first comprehensive risk survey of natural disasters has been carried out nationwide in 2021. Marine disasters are one of the types of natural disasters involved in this survey. However, China's marine environmental safety emergency response as a whole still lacks scientific decision-making basis and effective mechanism guarantee, and it is difficult to quickly and effectively achieve comprehensive research and judgment of safety incidents and crisis response, and the auxiliary decision-making ability is weak.

## **2.3 Construction of Marine Information System**

For many years, in response to the business needs of ocean observation monitoring, disaster prevention and mitigation, environmental safety assurance, etc., the company has established the ocean observation network management information system, the marine environmental protection comprehensive management system, the marine environmental safety assurance decision support system, the green tide emergency prediction system, etc., and has realized the business operation, and has played a good supporting role in their respective business fields. However, the degree of interconnection between the above systems is not high, and the business collaboration is insufficient; At the same time, it can only carry out analysis and evaluation for a single disaster, and its comprehensive decision-making support capacity is limited.

No matter from the perspective of nature, society or other aspects, it is easy to cause new crises if it is not handled properly; At the same time, how to effectively integrate multi-source data and effectively early warning, prevention, control and disposal of marine environmental security incidents by using the key technology of information emergency support is also a major problem to be solved. At present, China has initially established an emergency management mechanism led by the government system, and carried out the corresponding marine disaster emergency management work in all links of the marine disaster before, during and after the event [6]. However, after the institutional reform in 2018, China's marine environmental safety emergency management main force is still single, lacking a unified social coordination and command mechanism, facing complex emergencies, and cannot complete resource sharing, information integration in a short time Forecasting, early warning and emergency decision-making, etc., to form a unified force to deal with emergencies.

## **3 Relevant Situation of Domestic and Foreign Security Standards**

The world's marine powers have attached great importance to the construction and development of their own marine environmental safety emergency support system, gradually established a set of emergency plan management mechanism adapted to their national conditions, and continuously strengthened the independent research and development

of key technologies in emergency support, such as multi-source data fusion, forecasting, risk assessment, scenario deduction, collaborative response, system construction, and formed mature and effective technical standards, It has realized the effective prevention and comprehensive treatment of various marine environmental security incidents, and standardized and popularized the application through standardized means. The degree of standardization is also an important indicator to measure the level of response to marine environmental security of countries around the world.

### **3.1 Research Progress of Foreign Standards**

The United States has established a national emergency management system, which focuses on balancing the flexibility of emergency management, the diversity of emergencies and the standardization of procedures, and provides a reference template for emergency management standardization; As well as the establishment of a national marine safety emergency platform, integrating ocean observation, comprehensive research and judgment, crisis response and other functions. Canada has issued the Canadian National Standard for Emergency Plans (CAN/CSA Z731) and the Canadian National Standard for Hazard Management (CAN/CSA Q850), which are the basis for the preparation, revision and conformity assessment of relevant safety standards. Japan is a country with frequent natural disasters, especially earthquakes and tsunamis. Therefore, in terms of risk management, business continuity and other standards, Japan has highlighted the role of enterprises in emergency response, developed standards such as Business Continuity Plan Guide, Risk Management System Guide and Enterprise Crisis Management Manual, and established a national marine safety emergency system to achieve automatic access to meteorological observation data nationwide, It can quickly and accurately respond to various disasters, including earthquakes, and conduct disaster assessment, relief needs assessment, etc. The European Union has established a Mediterranean maritime security decision support system to achieve unified supervision of security incidents in the Mediterranean sea area; The United Kingdom, Spain and other countries have established a national marine environmental security technology system, which has the functions of marine risk analysis, marine emergency response and disposal, and ecological assessment.

### **3.2 Research Progress of Domestic Standards**

In recent years, with the promotion of the strategic position of the ocean in China, the Marine Environmental Protection Law of the People's Republic of China, the National Emergency Plan for Environmental Emergencies and the Administrative Measures for Standardization of Emergency Management have been issued to deal with emergencies, and on this basis, The national marine administrative department has also formulated the "Red Tide Disaster Emergency Plan", "Storm Tide, Tsunami, Sea Ice Disaster Emergency Plan" and "National Offshore Oil Exploration and Development Major Offshore Oil Spill Emergency Plan" and other normative documents, gradually established the system of emergency management, including laws, regulations, rules and normative documents, and strengthened the standardization of emergency management, It plays a fundamental role in improving China's comprehensive disaster prevention, mitigation

and relief and emergency rescue capabilities, and protecting the safety of people's lives and property. At the same time, due to the continuous progress of information technology, marine science and technology have also made considerable progress, and the work foundation in ocean view monitoring, disaster prevention and mitigation, environmental security and other aspects has been gradually consolidated, and the awareness of standardization and participation of all parties have been significantly improved, The marine industry has successively customized and released more than 40 technical standards, such as Green Tide Forecast and Alarm Release (HY/T 217–2017), Marine Disaster Emergency Response Initiation Level (HY/T 0293–2020), Marine Disaster Prevention and Mitigation Terminology (GB/T 39632–2020), and Technical Guide-lines for Storm Surge Disaster Response Analysis and Assessment (T/PSC 14–2022), for China's marine environmental security incident response Information system construction, operation and application services provide technical support.

Although China has gradually strengthened its attention to the safety of the marine environment, and the relevant management systems and technical standards have also played an important role in China's marine environmental security work, narrowing the gap with international maritime powers, the foundation of China's marine environmental security system is still weak, and the rules and regulations such as cross-regional and cross-sectoral emergency linkage coordination, data resource integration and sharing mechanism need to be improved, The standard coverage and quality of key technologies such as risk identification and assessment of marine environmental safety incidents, construction and deduction of marine disaster scenarios, emergency intelligent decision-making, risk prediction and early warning information release are not complete and need to be improved. It is urgent to build a comprehensive marine environmental safety protection standard system.

## **4 Construction of Standard System**

### **4.1 Construction Principles**

Combined with the characteristics of marine environmental safety emergency support work, guided by the needs of various business links of emergency support, such as before, during and after the event, and in accordance with the principles of practicality, scientificity and systematicness, the construction of the standard system is comprehensively and deeply promoted, and a comprehensive, complete, coordinated and supporting marine environmental safety assurance standard and specification system is gradually formed.

### **4.2 Overall Framework**

According to the principle of standard construction, the overall framework of marine environmental security standard system has been developed from the aspects of technical methods and management mechanisms such as information aggregation, fusion analysis, observation and early warning, risk assessment, system construction, application services, etc. (see Fig. 1). According to the nature of the standard, it is subdivided into

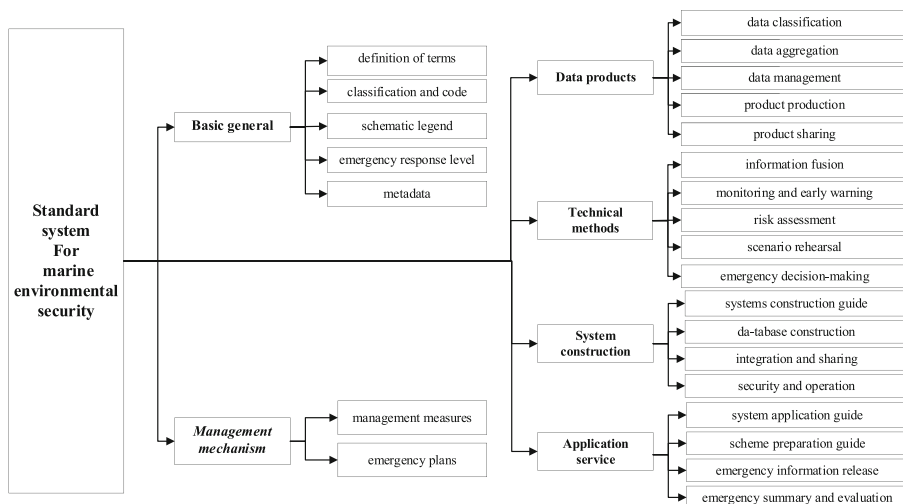


Fig. 1. Overall framework of marine environment security standard system

six sub-standard systems, including basic universal, data products, technical methods, system construction, application services and management mechanism. Among them, the basic universal and management mechanism sub-standard system is mainly used to guide and run through the construction and expansion of the subsequent entire marine environmental safety protection standard system; The sub-standard system of data products, technical methods, system construction and application services is a professional category of marine environmental security emergency support, which mainly regulates the actual marine environmental security emergency support business.

### 4.3 System Composition

The composition of this standard system fully combs and absorbs the existing research results such as national standards, industry standards, local standards, group standards and management policies related to emergency security of marine environment, and plans the follow-up key technical standards according to the actual needs of emergency security business and the development trend of key technologies, effectively improving the scientific and systematic nature of the standard system, It provides technical support for China’s marine environmental safety emergency management.

#### 4.3.1 Basic General

It mainly includes the definition of terms, classification and code, schematic legend, emergency response level, metadata and other standard contents related to natural disasters. It provides basic and guiding standard specifications for the operational work of marine environmental safety emergency support, and is the basis for the implementation of other standards. It runs through the whole process of standardization of marine environmental safety emergency support, and has stability, continuity and guidance for a long period of time.

The term definition standardizes the expression of basic terms related to marine disasters such as storm surge, tsunami, red tide, etc., so as to eliminate the ambiguity in concept understanding; Classification and coding standardize the unified classification and coding rules of marine dynamic disasters, marine ecological disasters, marine accident disasters, maritime rights and interests disputes and other events; The schematic legend standardizes the plotting of schematic, legend, symbol and other elements related to marine environmental safety events, and provides standardized representation for system visualization, product mapping, etc.; The emergency response level regulates the starting level of emergency response to marine disasters such as storm surge, sea wave, sea ice and tsunami, providing a reference for the rapid delimitation of emergency event level; Metadata standardizes the basic information description of marine environmental security data resources and provides support for information release, information sharing and database construction.

#### **4.3.2 Management Mechanism**

It mainly includes emergency plans and management measures, which define the responsibilities and obligations of each functional body, ensure the construction, application and operational operation of the marine environmental safety emergency support-related systems, and is the basis for the coordinated operation of all business systems and components, which is conducive to the overall unified management of the security system, the interconnection between businesses, and the safe and stable operation.

The emergency plan refers to the disaster emergency plans for storm surge, sea wave, tsunami, sea ice, oil and other disasters issued by the state, ministries, commissions and local authorities, and defines the responsibilities, obligations and cooperative operation mechanism of all relevant departments and personnel in emergency response at all levels; The management measures regulate the data update and maintenance, risk assessment implementation, emergency consultation, emergency guarantee and business operation management of the business system to ensure business operation.

#### **4.3.3 Data Products**

It mainly includes data classification, data aggregation, data management, product production, product sharing and other standard contents related to marine environmental safety emergency response. It standardizes the key nodes of the whole life cycle of marine environmental safety data resources from aggregation, management, production to sharing, and provides data support for the prediction, analysis, research and application of marine environmental safety event risks.

Data classification standardizes the specific classification and unified coding rules of marine environmental safety data resources, facilitating the warehousing management of data resources; Data aggregation standardizes the timely and effective collection of marine environmental security data from different fields and different types of sources according to a unified access method; Data management standardizes the structure design of marine environmental security database, which is convenient for efficient storage and management of massive and multi-source data; The product production has standardized the production of different types of data products, such as storm tide, sea ice, green tide,

etc., to improve the quality of data application; Product sharing standardizes the online interface mode of data product sharing service, facilitates the call of other business systems, and provides emergency business collaboration capability.

#### **4.3.4 Technical Methods**

It mainly includes information fusion, monitoring and early warning, risk assessment, scenario rehearsal, emergency decision-making and other standard contents. It aims at the early multi-source data rapid fusion, monitoring and early warning in the process of marine environmental security emergency, the risk assessment and scenario rehearsal in the middle of the event, and the emergency decision-making/disposal after the impact of the event reaches a certain degree, and other key technologies to support the whole process analysis of the event emergency technical process.

Information fusion standardizes data resources such as observation, monitoring, forecasting and basic geography accessed by different systems, and adopts big data technology to achieve rapid and effective data fusion; Monitoring and early warning standardizes the marine environment monitoring technology and early warning analysis capability of marine hydrology, meteorology, ecology and other disciplines; Risk assessment standardizes the business and technical process of risk assessment of various marine disasters such as storm surge, oil spill, tsunami, sea ice, etc.; Scenario deduction regulates the construction of the marine environmental security multievent coupling scenario database and the dynamic deduction of the business technical process; The emergency decision-making standardized the business and technical process of crisis situation and trend analysis of various marine disasters such as storm surge, oil spill, tsunami, sea ice, etc.

#### **4.3.5 System Construction**

It mainly includes the construction guide of marine environmental security emergency related systems, database construction, integration and sharing, security and operation and maintenance, and other standard contents. The goal is to realize the interconnection, information sharing, risk analysis, and business coordination between various business application systems of marine environmental security emergency, and to adopt common Java Web application development, common information exchange standards, open service integration, and scalable deployment of cloud platform. The technologies such as front and rear end separation and integration of 2D and 3D GIS ensure support for multi-level, multi-agent, multi-application and multi-scenario requirements.

The construction guide specifies the construction mode and interconnection design of the relevant marine environmental safety emergency system of the country, province, city, county and sea area; The database construction standardized the storage and management of structured and unstructured marine environmental safety data; Integration and sharing standardizes the unified identity authentication and sharing interface of the system, facilitating the integration between systems and the sharing of business data; Safety and operation and maintenance regulate the daily operation and maintenance of the system, system change and safety management.



### 4.3.6 Application Service

It mainly includes system application guide, scheme preparation guide, emergency information release, emergency summary and evaluation and other standard contents, indicating the application direction for the construction of marine environmental safety-related information system and better carrying out market-oriented services.

The system application guide specifies the functions, application principles, application scenarios, application processes and scenario applications of various marine environmental safety emergency prevention and control systems; The plan preparation guide specifies the technical methods and requirements for the preparation of risk prevention and control plans for various marine environmental emergency events such as storm surge and green tide; The emergency information release standard standardizes the work processes of the collection, review, release product production, early warning release approval management, and accurate early warning release of various marine environmental emergency events, to ensure the timeliness, accuracy and coverage of the early warning information release of marine environmental security events; The summary standard of emergency evaluation is to comprehensively evaluate the whole emergency process of pre-event, in-process and post-event, store, query, count and analyze the evaluation results, and optimize the contents of relevant plans.

## 5 Application of Standard System

During the 13th Five-Year Plan period, China set up a special project of “marine environmental security”, in which the construction of the technical system of marine environmental security platform is one of the key tasks. The construction objective is to take the marine environmental safety management process (prevention and preparation, monitoring and early warning, emergency response and rescue, recovery and reconstruction) as the main line, and provide technical support services combining software and hardware for the normalized daily marine environmental safety management and the unconventional marine environmental safety events (storm surge, Enteromorpha, oil spill and other major marine disasters and emergency environmental events) response.

The research of this standard system is fully combined with the key technologies of the construction of the marine environmental security platform to standardize the construction and operation of the platform, while relying on the platform to optimize and improve the standard system. In practical application, a large number of mature technologies, models and methods have been accumulated mainly for the key links such as the overall technical requirements of marine environmental safety emergency response, data collection and fusion analysis, comprehensive risk assessment and prediction and early warning, scenario deduction and crisis response, integration and application. The construction team has formulated six management mechanisms including the Platform Operation Management Measures, the Platform Risk Assessment Implementation Measures, and seven industry standards including the Specification for Classification and Coding of Marine Environment Comprehensive Database (HY/T 0328–2022), the Technical Guidelines for Marine Disaster Risk Assessment and Zoning Part 5: Sea Level Rise (HY/T 0273.5–2021) in strict accordance with the working mode of national standards, And 9 group standards and specifications, including the Classification and

Coding of Marine Environmental Safety Events (T/PSC3–2022), the Technical Guidelines for Green Tide Disaster Risk Early Warning (T/PSC9–2022), are all included in the marine environmental safety assurance standard system, covering six major parts of the standard system, which can effectively guide the platform to collect and integrate multi-source data, integrate disaster prediction, risk assessment, emergency decision-making and other auxiliary models, and share application services Management mechanism operation, etc. It has also carried out a pilot operation in the Ministry of Natural Resources, the Ministry of Emergency Management and other ministries and commissions, and the relevant disaster prevention and mitigation departments of coastal provinces and cities, which effectively supported China's marine disaster prevention and mitigation work.

## 6 Conclusion

Based on the current situation of China's marine environmental security and the research progress of the marine emergency security standard system at home and abroad, the framework of the marine environmental security standard system has been constructed, including six subsystems of basic general, management mechanism, data products, technical methods, system construction and application services, to provide technical support for China's marine environmental security emergency security work.

The marine environmental safety assurance standard system not only effectively guides the construction and operation of the marine environmental safety assurance platform, but also enriches and perfects the existing emergency standard system, and makes the platform break through the cross-level, cross-regional, and multi-application platform construction technology, forming the operational ability to respond to the marine environmental safety events, and filling the gap of the national security platform in the sea area.

Marine environmental security emergency response is a long-term basic work, which is related to national interests and people's welfare. We should continue to pay attention to the key technologies of marine environmental security emergency response at the international frontier, and study the emergency management system of marine power in depth. Guided by the current situation and development needs of China's marine environmental security emergency response capacity, we should further optimize and improve the multi-source data collection, risk analysis and assessment, emergency assistance decision-making Key technologies such as emergency capability evaluation, comprehensive command and dispatching capability, and multi-sector collaborative emergency mechanism have continuously improved China's marine environmental safety risk prevention and control and emergency management level.

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