SAFETY MANAGEMENT OF EXPO 2010 SHANGHAI CHINA

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ABSTRACT

The construction of Expo 2010 Shanghai China Program is a big challenge for China, which comprises more than 200 pavilions and facilities projects in the 5. 28- square-kilometer Expo site. During the compressed construction period, how to establish an effective safety management system for all the projects in the park is one of the core issues. This paper analyses the main safety challenges, and provides a systematic resolution for it, which includes management objective, organization, and management approaches. The conclusion in the end could provide a reference to scholars and practitioners.

Keywords: Safety management, Major hazards controlling system, Site inspection, Humanism

1 INTRODUCTION

As the first registered World Exposition in a developing country, the construction scale of Expo 2010 Shanghai China (hereinafter referred to as 'Expo 2010') is the biggest in the Expo history (Expo History, 2006). The Expo Site covers a total area of 5.28 km^2, including the enclosed area and outside areas of supporting facilities, which is double the size of the Montreal Expo site. It spans both sides of the Huangpu River, with 3.93 km^2 in Pudong (the site on east side of Huangpu River) and 1.35 km^2 in Puxi (the site on west side of Huangpu River). The enclosed area measures 3.28 km^2, which is made up of 5 section areas—section A, section B, section C, section D and section E (Master Plan of Expo 2010, 2009). The planned floor area of the 2010 Expo site totals about 2 million m^2 and the total investment is about 3 billion US dollars. The site construction for Expo 2010 started in 2007 and shall be completed by in the end of 2009, and the event will officially begin on the 1st of May in 2010. Its master plan is shown in Figure 1.

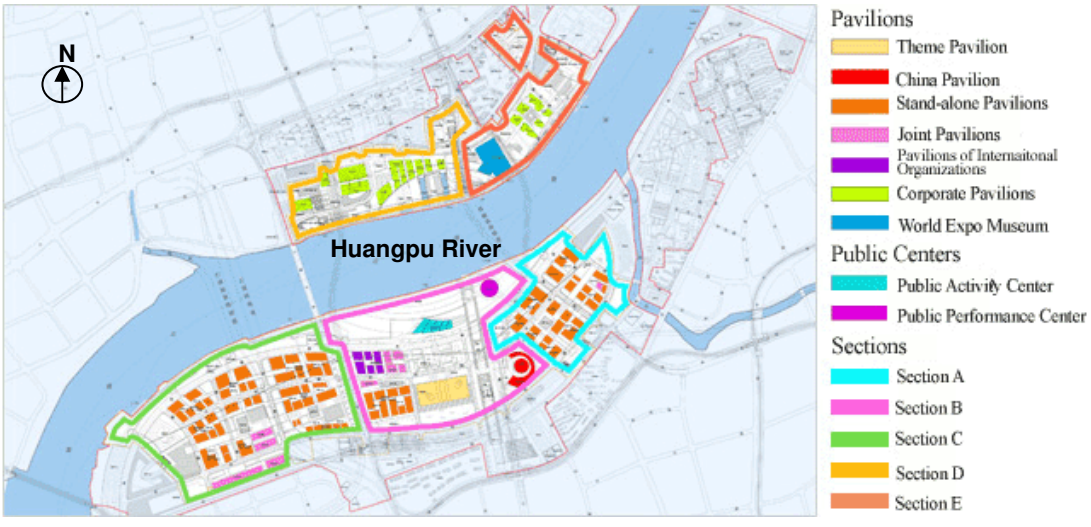

Figure 1. Master Plan of the EXPO site

As more than 200 pavilions and facilities projects shall be completed in three years, safety issues should be the first consideration in construction. This paper analyses its safety challenges and characteristics for Expo 2010, and makes recommendations for further research on resolution and implementation of stated issues.

2 SAFETY CHALLENGES FOR EXPO 2010 PROGRAM CONSTRUCTION

2.1 Program Characteristics

i. Lots of investors. Expo 2010 Program comprises more than 200 projects, including pavilions, parks, docks, supporting service facilities and municipal facilities, which are invested by numerous companies and organizations such as Expoland company (a stated company), Expogroup company (another stated company), municipal facilities departments of Shanghai government, foreign governments and enterprises.

ii. Mega construction scale. According to the plan, the investment for pavilions, parks, docks, supporting service facilities and municipal facilities in the Expo site may achieve 30 billion US dollars, and such investment excludes the constructions of new-built tunnel and metro.

iii. Lots of projects constructing in parallel. Since 2007, dozens of projects have been constructed in parallel; and in the October of 2008, there were nearly 200 projects being constructed in parallel at the Expo site.

iv. Compressed Construction Period. According to the construction schedule, the majority of pavilions and supporting service facilities have started since 2007; and they shall be finished in the end of 2009, which excludes pavilions of foreign governments and enterprises. Completing 2-million-m^2 –floor-area construction in three years is a big challenge for contractors.

2.2 Safety Management Objectives

Comparing with other project management objectives, the safety management objective is certainly clear i.e. zero death or injury during construction, and this requires tremendous effort from the site staff to achieve the goal. The client (owner) of Expo 2010 also requires that no fatal accident shall occur during the construction. In China, contractors (employer) usually employ workers (employee) from rural areas and provide accommodation. Migrant workers' living safety, health and welfare should also be of concern, which have positive impact on construction safety according to the research of LIU *et al* (2006). Consequently, the safety management context is more than construction site safety. Safety management of Expo 2010 program comprises of two main issues as shown in Figure 2.

Main Issue	Detailed Content
Construction Site Safety	1. Safety of scaffold system 2. Safety of formwork engineering of cast-in-place concrete 3. Safety of working at height 4. Temporary protection for special places (elevator shaft, holes or exits and son on) 5. Personal protection for workers 6. Safety of construction Machines 7. Temporary electricity use 8. Safety of Flood controlling (including typhoon, rainstorm, tidewater and flood) 9. Safety management system and files
Migrant Workers' Living safety, Health & Welfare	1. Food safety 2. Epidemic prevention facilities and management (including toilets, bathrooms, sewage facilities and so on) 3. Safety of fire controlling 4. Medical Rescue

Figure 2. Safety Management Content of Expo 2010

3 SAFETY MANAGEMENT ORGANIZATION

In Expo 2010, the investment and construction management of pavilions and supporting facilities in the Expo site are implemented by various organizations. Stated companies such as Expoland offer funds for the program investment; and the construction management works for the major projects at the Expo site are implemented by an organization, Shanghai World Expo Construction Headquarter Committee, which is led by Shanghai executive vice-mayor and comprises of all the directors of related construction department of Shanghai Municipality. Its routine work is executed by its standing body —Shanghai World Expo Construction Headquarter Office (SWECHO). SWECHO has established a unified management and coordination system to manage all the construction projects on site.

During the construction, SWECHO plays a major role in operating nine functional divisions and ten Project or Program Management Teams (PMTs). Every functional division is responsible for one function management task; and one is Safety and Quality Management Division (SQMD) which is responsible for safety management of all the projects in the Expo site. Every PMT takes on client duty of managing site construction of projects in various sections of the Expo site; and site safety management is one of their main tasks. SQMD and PMTs are comprised of the full safety management organization of the client as shown in Figure 3.

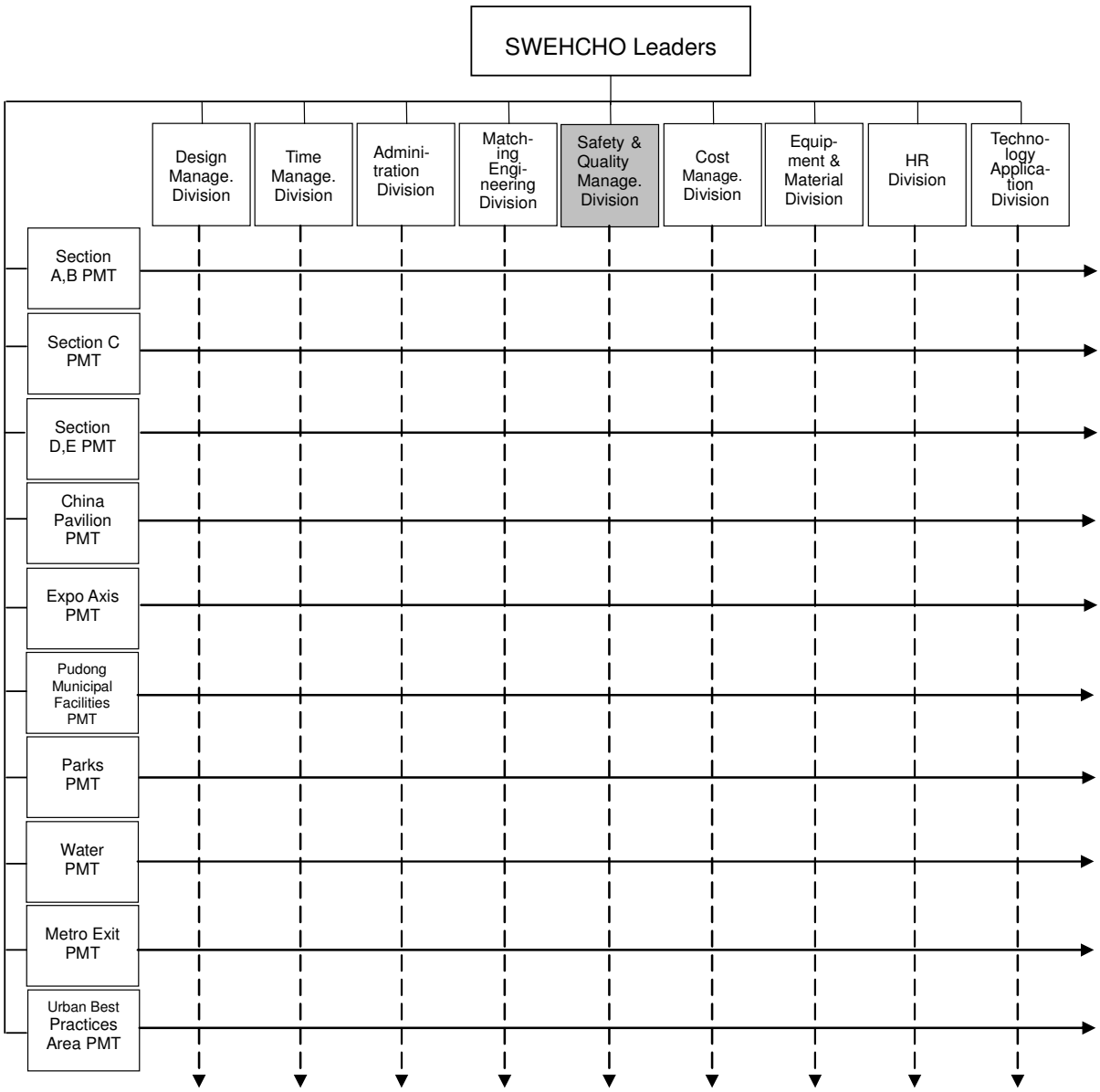

Figure 3. SWEHCHO Organization Structure

For the projects managed by SWECHO, safety management levels are divided into four levels as shown in Figure 4.

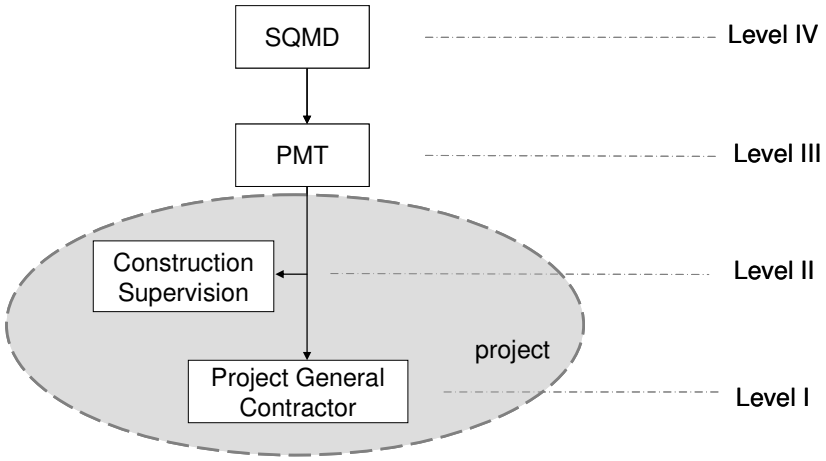

Figure 4. Safety Management Levels of Expo 2010

Level IV: As the safety functional division, SQMD has developed policies, standards, regulations, and processes of safety management; and established safety management systems and kept them operating effectively. Besides, SQMD takes other responsibilities as follow.

i. Promoting project construction safety management at the construction site, and making on-site safety inspections regularly.

ii. Assisting other divisions' work, and coordinating construction safety conflicts.

iii. Providing assistance in dealing with accidents.

Level III: PMTs have implemented SQMD's policies, regulations and processes; and managed general contractors and construction supervisors to meet the safety standards and requirements.

Level II: According to Chinese construction law, when the government-investment project achieves a specific construction scale, a national certified construction supervision company will be employed as the third party to ensure the implementation of all related state construction safety standards and regulations, which shall employ at least one full-time supervision engineer to control site safety.

Level I: In China, the government has developed very detailed construction standards and regulations; and construction safety regulations and standards are the majority. In relevant standards and regulations, it outlines detailed requirements on management team configuration and staff qualification, controlling process, controlling the requirement of safety management of the general contractors. The general contractor shall conduct the compulsory regulation and standards, which constructs the basic level of safety management system.

Besides, for other projects invested by foreign governments and enterprises, SQMD does not manage them directly, but monitors the implementation of safety management, and offers necessary support, such as making monthly site inspection to ensure the requirements are met in the construction.

4 SAFETY MANAGEMENT APPROACHES

4.1 Making Safety Management Polices, Standards and Regulations

As the top safety management level, SQMD has the responsibility of making safety polices, standards, and regulations, which with the following three type's documents are mainly concerned.

i. Safety clauses in contracts of general contracting and construction supervision. It includes safety management objectives; personal qualification requirements; safety management procedures and so on.

ii. Site safety assessment standard. In order to encourage site construction of general contractors, SWECHO has set up a prize fund for general contractors and established a construction assessment standard, which is called "Civilized Construction Assessment Standard (CCAS)". All the general contractors who pass the CCAS could receive extra payment as the prize. CCAS is developed and implemented by SQMD, whose assessment concerns construction quality; construction safety; and migrant workers' living safety, health and welfare. CCAS makes detail assessment standards on major hazard controlling, such as scaffolding system, form work engineering of cast-in-place concrete, work at heights, temporary protection for special places (elevator shaft, holes or exits and so on), construction machines, temporary electricity use and so on.

iii. Safety regulation of various engineering construction and seasonal construction. Nearly every season, SQMD may issue various safety management documents on presenting systematic safety dangers or notice for the next construction phase, such as safety management regulation in Typhoon weather; and fire controlling regulation in fitting-out engineering and so on.

4.2 Making Regular /Irregular Site Inspection

Among the site inspections of construction supervision, SQMD's site inspections can be divided into two types as follow.

i. Regular site Inspections: SQMD may judge whether there is any systematic safety danger in program construction site safety and take adequate measures. If necessary, SQMD may issue warning documents on the systematic safety danger and take correspondent controlling measures.

ii. Irregular site Inspections: If there is new safety management document issued, SQMD may carry out site inspection randomly to ensure its implementation.

By carrying out regular/irregular inspection, SQMD can get feedback from safety standards and requirements issued and ensure their effectiveness and efficiency on improving safety management.

4.3 Assist Establishing Major Hazards Controlling System

For major construction hazards, SQMD has established full-process controlling procedures as follows.

i. Before commencement of construction: For the major construction hazards, the contractor should provide the construction plan and safety management plan to SQMD for a feasibility check. Only the plans that pass the check, related engineering construction procedures can start.

ii. At the beginning of construction: The contractor should employ enough full-time safety engineers and a establish safety work responsibility system; and SQMD may arrange a site inspection to certify its effectiveness.

iii. During the construction process: In order to ensure general contractor's performance in accordance with the management plan and requirements, related PMT may arrange site inspections once a week; and SQMD may conduct random site inspections once a month. If there is any danger found during the site inspection, SQMD or PMT may inform the contractor directly and require the contractor to correct in time.

SQMD has made a record of safety engineers and safety supervisors of all the projects in the Expo site, which constitutes the basic safety management network of Expo 2010. In order to enhance their ability continuously, SQMD may hold meetings for them to release information and communicate.

4.4 Cooperating with Safety Departments of the Government

In China, the government pays much attention to work safety issues; and concerning construction safety issues, it also has more than ten government departments supervising various safety aspects of the construction industry. Every year government departments may arrange site inspections regularly. As a key government-invested construction program, the safety issues of Expo 2010 program have also been concerned with relevant departments of Shanghai governments. In order to strengthen the cooperation between relevant departments and SWECHO, SQMD on half of SWECHO has established a Safety Management Joint Meeting System (SMJMS) and developed cooperative supervision on safety management of Expo 2010. The government departments joining the SMJMS are shown in Figure 5.

Figure 5. Government departments joining the SMJMS

Through SMJMS, SQMD has established a multi-to-single effective communication system with related government departments; and they take joint actions as follow:

i. Arranging joint site inspections regularly, inspecting site construction safety, flood controlling safety, fire controlling safety and food safety.

ii. Organizing safety training regularly, which should focus on personal protection for workers, work safety, and emergency dealing and so on.

iii. Promoting irregular safety events, which should highlight personal protection for workers, work safety, food safety, A/H1V1 Flu prevention and so on.

In the past two years, SMJMS has worked very efficiently, which improves the traditional relationship between government departments and the client; and improves the work efficiency greatly.

4.5 Establishing Flood Controlling Emergency Management System

Shanghai is located at lower reaches of the Yangtze River, the longest river in China, on the west bank of the East China Sea and in the middle of China's coastline, so every summer natural disasters, such as typhoon, flood, tide, and rainstorm may affect industrial production and people's lives, and normal construction is also affected by these disasters as well. In China, controlling summer disasters is referred to as "flood controlling".

For Huangpu River and Bailianjing River across from the Expo site, flood controlling is also a main safety management work for SQMD in summer. According to Chinese construction practice, every year SWECHO takes up the necessary measures as follows:

i. Creates an emergency management plan; and establishes an emergency management organization (EMO).

ii. Checks on flood controlling facilities before the flood controlling period (from 1st May to 1st Oct.) to ensure the facilities such as the flood controlling gate, drainage facilities and others can meet the requirements.

iii. Establishes emergency rescue teams and necessary rescue materials and equipment.

iv. Establishes an emergency management plan dealing with accidents in rainstorms or flood.

v. Arranges night shifts during the flood controlling period at every construction site; and if there is any emergency, shall report to EMO timely.

vi. Establishes a four-class-alarm typhoon and rainstorm response system, and according to the alarm class released by the government, takes the corresponding action.

5 APPLICATION OF "HUMANISM CONCEPT" IN SAFETY MANAGEMENT

Among government-invested projects, SWECHO regards Expo 2010 as a model program which has impacted on the development of Chinese construction. In the construction management practice, establishment of necessary management systems has included the application of the humanism concept as a basic principal, which embodies in three aspects as follow:

i. Since the beginning of Expo 2010, migrant workers' living safety issues have been considered by the client, which is a major part of safety management content.

ii. By strengthening cooperation with related government departments, the client has made a lot of safety promotions and training to improve migrant workers' safety sense and skills, which are concerned with personal protection for workers, work safety, emergency dealing, food safety, and traffic safety.

iii. "Total safety Culture" (Fang 2001) has been practiced in the Expo 2010 program. In its safety management framework and levels, nearly all the stakeholders are concerned except the designers, which seldom take part in construction safety management according to Chinese practice; and all construction plans are usually made by contractors.

6 CONCLUSIONS

China is a developing country with mega construction project investment every year, and most construction workers are not industrial workers but migrant workers from rural areas who are in lack of professional sense and skill, so the general construction safety situation in China is very serious. For Expo 2010, the mega scale and compressed construction period makes safety even more challenging.

Hence in the program, the client has made lots of explorations in strengthening safety management, including establishing SQMD and PMTs, making standards and regulations, carrying

out site inspections and so on. According to the report (MOHURD 2008), the Shanghai construction death toll is 61 persons in 2007 and the death ratio is 0.41 person every million construction area. Therefore, so far no fatal accidents have happened in Expo 2010 and the death ratio is lower than the local average level.

According to Huang and Hinze's research (2006), efforts of large projects' clients have paid off by the lower injuries on their projects; and the client's safety management practice of Shanghai Expo has proved it in some extent. The client of large projects or programs could play a more active and important role in safety management; and Expo 2010 may be a government-invested model program for building a more safe and health construction industry in China.

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