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Code for Design of Liquefied Natural Gas Port and Jetty

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3 Site Selection of Port and Jetty

3.0.1 The site selection of port and jetty shall conform to the urban planning and overall planning of harbor.

3.0.2 The site selection of port and jetty shall be determined through combining the site selection of LNG receiving terminal, user layout and outside-transportation mode, etc.

3.0.3 The LNG port and jetty shall maintain the necessary safety distance from densely populated areas, and the safety distance shall be determined by safety assessment.

3.0.4 The LNG port and jetty should not be placed on the upwind side of the normal wind direction in the sensitive areas.

3.0.5 The LNG port and jetty shall be selected in a location where the traffic is convenient and easy to evacuate.

3.0.6 The sea harbor LNG port and jetty should be selected on the waters that meet the requirements of LNG carrier does not take tidal navigation. If it is not satisfied, special arguments shall be made.

3.0.7 The sea harbor LNG port and jetty should not be selected at a port with a long access channel, and a high density of ships. When there is no other option, conduct the special assessment, propose effective measures to mitigate and eliminate its adverse effects.

3.0.8 When constructing the LNG port and jetty on an isolated island, the external traffic facilities such as safe entry and evacuation of personnel should be set up.

3.0.9 Without special argumentation, the LNG port and jetty are strictly prohibited from being selected in unfavorable areas such as complex geological structures and late active faults.

3.0.10 The site selection of the river harbor LNG port and jetty shall be linked to the construction and planning of the inland waterway, navigation buildings and buildings crossing river; and shall conform to the relevant provisions of current nationals standard *Navigation Standard of Inland Waterway* (GB 50139).

3.0.11 The site selection of river harbor LNG port and jetty shall analyze the riverbed evolution, considering the adverse effects of the existing and planning reservoirs, dams, bridges, etc. on the riverbed erosion and deposition; and considering the impact of the riverbed evolution on the navigation safety.

5 Graphic Design

5.1 General

5.1.1 The layout of the LNG port and jetty shall fully consider the influence of the natural factors such as wind, wave, flow, sediment back-siltation on the navigation, berthing/unberthing, loading/unloading operations of the ships.

5.1.2 Multiple LNG berths, LNG berth and LPG berth may be placed adjacent to each other. The LNG carrier and LPG carrier may share the berth. When using the offshore pier arrangement, the LNG berth and LPG berth may be separately arranged on both sides of the platform; but the berthing and unberthing operation time shall be staggered.

5.1.3 The layout of the LNG port and jetty should consider the possibility of expansion; and may consider the possibility of LNG carrier shipment, if required.

5.2 Waters on port and jetty

5.2.1 The stopping area of the sea harbor LNG carrier should be arranged in a straight line according to the direction of entering the harbor. When the arrangement is difficult, it may be arranged on a curve; however, the radius of curvature must not be less than 5 times of the design length of the ship. The stopping distance of the LNG carrier may take 4~5 times of the design length of the ship.

5.2.2 The turning basin of the sea harbor LNG carrier shall be located at a place convenient for the ship to enter and leave the harbor and berth/unberth the port and jetty. The diameter of the turning circle of the turning basin should be less than 2.5 times of the design length of the ship. When the arrangement is difficult and the flow rate is small, the diameter of the turning circle shall be less than 2 times of the design length of the ship. For the harbor greatly affected by the water flow, the turning basin may be arranged in an elliptical shape; the length along the direction of the water flow may be increased to no less than 3 times of the design length of the ship.

5.2.3 The mooring basin in the front of the river harbor LNG port and jetty shall not occupy the main channel. The width of the mooring basin in the front of the port and jetty of the river reach with gentle water flow may take 2 times of the design width of the ship; while it may take 2.5 times of the design width of the ship for the river reach with rapid water flow. When the port and jetty is closer to the main channel, the width of mooring basin in the front of the port and jetty shall be appropriately increased.

5.2.4 The turning basin of the river harbor LNG port and jetty should be located in a place convenient for the ship to enter and leave the harbor, and berth/unberth the port and jetty. The length of the turning basin in the direction of the water flow should be no less than 2.5 times of the design length of the ship. When the flow rate is more than 1.5m/s, the length of the turning basin may be increased appropriately. The width

5.4 Port and Jetty

5.4.1 The scale of the port and jetty shall be determined according to the design scale of the LNG carrier and calculation of natural conditions. The design ship type may be determined through analysis and argumentation, but also may select the equivalent levels of ships according to the current industry standard *Design Code of General Layout for Sea Ports* (JTS 165).

5.4.2 The front-end top elevation of the LNG port and jetty shall be determined according to the current industry standard *Design Code of General Layout for Sea Ports* (JTS 165) or *Code for Master Design of River Port Engineering* (JTJ 212).

5.4.3 The design water depth of the front-end of sea harbor LNG port and jetty shall be determined according to the safe stopping calculation of the full-load designed ship at the local theoretically lowest tide level. The design water depth of the front-end of the river harbor LNG port and jetty shall be determined through ensuring the safe stopping calculation of the full-load designed ship at the design low water level of the port and jetty.

5.4.4 Each rich depth in the calculation of the design water depth of the front-end of the port and jetty shall be selected according to the current industry standard *Design Code of General Layout for Sea Ports* (JTS 165) or *Code for Master Design of River Port Engineering* (JTJ 212).

5.4.5 The length of the port and jetty shall meet the requirements of the ship for safe berthing, unberthing and mooring operations; it is determined through simulation test, but should be no less than double design length of the ship. In the feasibility study phase, the 1.0~1.2 times of design length of the ship may be estimated.

5.4.6 Two dolphins should be provided for the pier LNG port and jetty; the center distance between the two dolphins may take 25%~45% design length of the ship. When the types of the stopping ships differ significantly, the auxiliary dolphin may be provided, or the working platform also be used as the dolphin.

5.4.7 The mooring facilities of the LNG port and jetty should be arranged symmetrically.

5.4.8 The operating platform should be set up on the working platform of the large and medium-sized LNG port and jetty. The layout and height of the operating platform shall be determined according to the manifold location of the designed ship type; and shall meet the safety operation requirements for the LNG carrier at the local maximum tidal range and wave variation range.

5.4.9 The large and small LNG port and jetty should be equipped with boarding ladders.

5.4.10 The LNG port and jetty should be arranged workboat berths, or use the existing workboat berths.

estimated as per the Formulas (5.5.2.-1) and (5.5.2-2), respectively.

5.5.5 When the water depth in front of the breakwater is large, and the waves are large; the inside of the vertical breakwater should not be suitable for serving as LNG berth also.

5.6 Access channel

5.6.1 When the LNG carrier navigates on the sea harbor access channel, the mobile safety zone shall be set; the specific scale of the zone shall be determined through the special argumentation. When the large-scale LNG carrier navigates on the sea harbor access channel, it shall be traffic-controlled and equipped with escort ships. When the medium and small-scale LNG carrier navigates on the sea harbor access channel, whether the traffic-control is required shall be determined through special argumentation.

5.6.2 The cargo tank of small inland river LNG carrier shall adopt Type-C independent cargo tank; the ship's side shall be designed with good anti-collision and shall conform to the relevant provisions of related current shipbuilding regulation of China Classification Society. When the small inland river LNG carrier navigates on the inland river access channel, under the normal navigation state, the sound and light warning shall be started. Under the fault state, the LNG carrier shall start the sound and light warning; and guarantee there are no other irrelated ships get close within the range of 300mm of front-and-rear, and 100m of left-and-right. Under the condition that the cargo tank is damaged and leaked, measures shall be taken within 1100m of around the LNG carrier to prevent the irrelated ships and personnel to enter.

5.6.3 The navigation width of the sea harbor LNG carrier access channel shall include track belt width, inter-ship richness width, and richness width between ship and the bottom line of the channel. The navigation width of the LNG carrier single-lane channel may be calculated as per the Formula (5.6.3-1). The navigation width of the channel where the LNG carrier meets other ships may be calculated as per the Formula (5.6.3-2). When the navigation channel is relatively long, the natural condition is relatively complicated, and the ship locating is more difficult, it may be widened properly; when the natural condition and navigation condition are favorable, it may be narrowed properly through argumentation.

$$W = A + 2c \tag{5.6.3-1}$$

$$W = c_1 + A_1 + b + A_2 + c_2 \tag{5.6.3-2}$$

$$A = n(L\sin\gamma + B) \tag{5.6.3-3}$$

Where:

W – channel navigation width (m);

A – track belt width (m);

adjacent to the main channel, the special access channel may not be provided. The access channel shall be provided for the main channel between dig-in basin and river or lake zone. When arranging the port and jetty in the fork channel of the river, the upstream and downstream fork channel of the port and jetty shall be designed according to the access channel.

5.6.6 The scale design of the access channel of river harbor LNG port and jetty shall conform to the relevant provisions of current national standard *Navigation Standard of Inland Waterway* (GB 50139). The reference surface for the calculation of the design water depth of the access channel shall take the designed lowest navigation level.

5.6.7 When the factors affecting the channel scale are complicated, the channel navigation width shall be verified by the ship operation simulation test; if necessary, the channel navigation width may be determined by combining the real ship observation.

5.7 Anchor station

5.7.1 The sea harbor LNG port and jetty shall be provided with emergency anchor station. The emergency anchor station may be shared with the oil and gas chemical transporting ships; and the safe clear distance from the anchor station of the non-hazardous substance ships shall be no less than 1000m. The arrangement and scale of the anchorage shall conform to the relevant provisions of current industry standard *Design Code of General Layout for Sea Ports* (JTS 165).

5.7.2 The river harbor LNG port and jetty shall be provided with emergency anchor station. The emergency anchor station may be shared with the oil and gas chemical transporting ships; the arrangement and scale of the anchorage shall conform to the relevant provisions of current industry standard *Code for Master Design of River Port Engineering* (JTJ 212); and the safe clear distance from the anchor station of the non-hazardous substance ships shall be no less than 1100m.

5.8 Ships operating in the harbor

5.8.1 When the sea harbor LNG carrier berths and unberths, it shall be provided with the full-rotation tugboats to assist the operations. The total towing force of the tugboat shall be determined according to the relevant provisions of the current industry standard *Design Code of General Layout for Sea Ports* (JTS 165).

5.8.2 The configuration of the tugboat in the sea harbor LNG port and jetty shall conform to the following provisions.

5.8.2.1 When 80000m^3 and above LNG carrier berths, 3~5 tugboats may be configured to assist the operation; when unberthing, 2~3 tugboats may be configured to assist the operation. The minimum power of the single ship shall be no less than 3000kW.

7 Hydraulic Structure

7.1 Structure safety level, fortification against the earthquake, and deformation

7.1.1 The structure safety level of LNG port and jetty shall take Level-I.

7.1.2 The structure safety level of revetment directly sheltering tank area shall take Level-I; while the structure safety level of the remaining revetment shall take Level-II.

7.1.3 The ground motion parameters used for the fortification against the earthquake of the LNG port and jetty, and the revetment in storage tank area shall be determined according to the special earthquake safety evaluation results; and shall be no less than the value determined by the existing map of the ground motion parameters.

7.1.4 The earthquake-proof of the LNG port and jetty, revetment in storage tank area, and the like hydraulic structures shall be checked according to the following two working conditions.

7.1.4.1 Operation reference earthquake working condition shall take the 10% more earthquake impact levels over 50 years as the design earthquake. Check the ultimate state of the bearing capacity. The structural importance factor shall take Level-I hydraulic structure. When it is required to control the structural deformation, conduct the special argumentation on the structural deformation.

7.1.4.2 Safe shutdown earthquake working condition shall take 2% more earthquake impact levels over 50 years as the design earthquake. Check the ultimate state of the bearing capacity. The structural importance factory may take 1.0.

7.1.5 The standard on fortification against earthquake of breakwaters and revetments non-direct sheltering tank area shall conform to the relevant provisions of *Code for Seismic Design of Water Transport Engineering* (JTS 146).

7.1.6 The deformation of the structures such as trestle, working platform of laying the process pipeline shall meet the requirements for the use and safety of the pipeline.

7.2 The value of the applied force calculation parameter

7.2.1 The basic wind pressure should be calculated at an open flat ground near the harbor, about 10m from the ground, and once-in-a-century wind speed. The wind speed for the structure design of the ultimate state of bearing capacity, and the limit state of normal use should take the average maximum wind speed in 10min. The designed wind speed in the ultimate state of bearing capacity of the structures such as pipe deck above the trestle and the working platform shall take the average maximum wind speed within 3s.

8 Land Formation and Foundation Treatment of the Receiving Terminal

8.1 Land formation

8.1.1 The site elevation for the land formation of the receiving terminal shall be determined by the comprehensive factors such as use requirements for receiving terminal, and requirements for earthwork balance, terrain around the site, flood and moisture control; and shall consider the connection with the long-term planning.

8.1.2 The plan for land formation shall be determined according to the following factors such as site use requirements, natural conditions, safety requirements of receiving terminal, material sources, construction conditions, etc.; combined with the site foundation treatment plan; and through the economic and technical argumentation.

8.1.3 The land formation shall do well in temporary drainage, meeting the requirements for discharge of underground and surface water. When conditions permit, it may be set through combining the permanent drainage facilities of the receiving terminals.

8.2 Foundation treatment

8.2.1 When the land formation of the receiving terminal is finished, if the foundation conditions do not meet the requirements for the constructions of the upper buildings and structures, the foundation treatment shall be carried out.

8.2.2 The foundation treatment plan of the receiving terminal shall be determined through the comprehensive analysis and combining the following conditions such as local natural conditions, material sources, use requirements, construction periods, engineering experience and technical levels, etc. When using the newly-deposited soft soil and newly-dredged soil, or the soft soil required by the filling as the foundation of the buildings and structures on the site, the site pre-treatment should be carried.

8.2.3 The residual settlement and uneven settlement of land site of receiving terminal, as well as the standard value of foundation bearing capacity after treatment shall meet the use requirements for the buildings and structures in different areas of the receiving terminal.

assisting in the fire rescue for the mooring designed ship type.

9.2.3 The dry powder fire extinguishing system equipped with in the LNG port and jetty shall conform to the following provisions.

9.2.3.1 The dry powder fire extinguishing system on each berth shall include 2 powder fire monitors, and 2 powder fire branches.

9.2.3.2 The range of the powder fire monitor shall cover the range of the loading and unloading area of the working platform of the port and jetty. The rated range of the powder fire branch shall be no less than 1.1 times of the actually required range.

9.2.3.3 The continuous supply time of the dry powder shall be no less than 60s.

9.2.3.4 The reserve of the dry powder shall conform to the relevant provisions of current national standards *Code of Design for Powder Extinguishing Systems* (GB 50347), and *Code for Design for Fixed Fire Monitor Extinguishing Systems* (GB 50338).

9.2.4 The fire water monitor equipped with in the LNG port and jetty shall conform to the following provisions.

9.2.4.1 No less than 2 sets of fixed remote-controlled fire water monitors shall be configured.

9.2.4.2 The range of the fire water monitor shall at least cover the range of loading and unloading area of the working platform of the port and jetty, as well as the loading and unloading pipe manifold area of the designed ship type. The rated range of the fire water monitor shall be no less than 1.1 times of the actually required range.

9.2.4.3 The fire water monitor on the port and jetty may assist in the fire-fighting ship or ship for fire-fighting and towing to meet the requirements of covering the whole ship range and the water amount of the mooring designed ship type; the proportion of the water amount for the fire monitoring on port and jetty shall be no less than 50%.

9.2.4.4 The fire tanks (cabins) and adjacent tanks (cabins) of the burning ship require water spray cooling; the supply strength should be no less than 4L/(min•m^2); the cooling area shall take 50% sum between surface area above the maximum storage tank (cabin) deck of the designed ship type and surface area above the adjacent storage tank (cabin) deck.

9.2.4.5 The working time of the fire water monitor shall be no less than 6h.

9.2.4.6 The fire water monitor shall adopt the DC water spray dual-purpose nozzle.

9.2.4.7 The fire water monitor shall have the ire control and wireless control functions.

9.2.5 The drencher system shall be provided at the front of the operation platform,

9.2.8.5 The automatic fire alarm system shall be provided for the control room and power distribution room of the port and jetty; meanwhile, the gas fire extinguishing system shall be provided.

9.2.9 The water consumption of the port and jetty for fire-fighting shall be the sum of the maximum water consumption for water fire monitor, drencher, water spray equipment, and mobile fire-fighting device working together.

9.2.10 The external fire-fighting performance of the fire-fighting ships or ships for fire-fighting and towing shall satisfy the following standards.

9.2.10.1 The fire-fighting ships or ships for fire-fighting and towing provided for the sea harbor LNG port and jetty shall meet the requirements of Level-I fire-fighting ship specified in *Rules for Classification of Sea-Going Steel Ships* issued by China Classification Society.

9.2.10.2 The fire-fighting ships or ships for fire-fighting and towing provided for the river harbor LNG port and jetty shall conform to the provisions of *Code for Construction of Steel Inland River Ships* issued by China Classification Society.

9.2.10.3 The performance of fire-fighting ships or ships for fire-fighting and towing provided for the river harbor LNG port and jetty shall conform to the provisions of *Supplement Requirements for Inland River Fire-Fighting Ships* issued by China Classification Society. The performance of fire-fighting ships or ships for fire-fighting and towing provided for the LNG port and jetty for the ships with berthing capacity of 8000m^3 and below shall meet the requirements of Level-I fire-fighting ship; while the performance of fire-fighting ships or ships for fire-fighting and towing provided for the LNG port and jetty for the ships with berthing capacity of 8000m^3 above shall meet the requirements of Level-II fire-fighting ship.

9.3 Communication and navigation facilities

9.3.1 The LNG port and jetty shall be provided with ship-bank dedicated wired communication system.

9.3.2 The LNG port and jetty shall, according to the safety emergency communication requirements of hazardous goods berth, be provided with VHF explosion-proof radiotelephone for marine accidents, safety, and traffic management. The communication equipment in the hazardous area of explosion shall be intrinsically safe.

9.3.3 The LNG port and jetty should be provided with an emergency broadcast intercom system with functions such as alarm, broadcast and intercom.

9.3.4 The LNG port and jetty shall be provided with a complete navigation facilities and aids. The LNG port and jetty located in the complicated navigable environment may be equipped with pilot facilities with electronic marine chart and

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