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Code for design of railway signaling

铁路信号设计规范

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Foreword

On the basis of TB 10007-2006 *Code for design of railway signaling*, this Code was hereby reviewed and revised through extensive solicitation, comprehensively summarizing the experience in China's railway signaling engineering construction, usage management and equipment maintenance in recent years, and fully absorbing relevant scientific research achievements.

This Code is divided into 19 chapters, including general provisions, terms and symbols, fixed lineside signal, track occupancy inspection device, turnout switching device, interlocking, blocking, train operation control, coding, train dispatching and commanding (TDC) & centralized traffic control (CTC), centralized signaling monitoring (CSM), hump signaling and marshalling station automation, crossing signaling, shunting train protection (STP), switch snow-melting device, electrical power unit (EPU), optical cables, operating environment, interface design, etc.

The main contents of preparation and revision in this Code are as follows:

1. MODIFY the scope of application in the chapter General provisions to "applicable to the design of standard-gauge railway signaling engineering".
2. ADD the chapter Terms and symbols to define the terms, codes and abbreviations used in this Code.
3. MODIFY the signal mechanism and lighting configuration, supplemented with signal marker, in the chapter Fixed lineside signal.
4. MODIFY the original chapter name Track inspection device to Track occupancy inspection device; DELETE the contents related to JZXC-480 AC continuous track circuit as well as 4-information, 8-information, 12-information, 18-information audio frequency shift modulated track circuits; DELETE the content of equipment parameters unrelated to engineering design; ADD the requirements for the length of track section; COMPLEMENT the contents with regard to ZPW-2000 series track circuit and asymmetrical high-voltage impulse track circuit; MODIFY the contents of track occupancy inspection device with axle counter.
5. MODIFY the original chapter name Switching device to Turnout switching device; DELETE the contents concerning the interlock switching device by electric locks; DELETE the construction installation content.
6. MODIFY the original chapter name Interlocking within stations to Interlocking; INCLUDE the relevant content of original TB 10071-2000 *Code for design of railway signaling interlocking within stations* into this chapter; DELETE the content of non-centralized interlocking, fly-shunting for shunting area on level tracks, etc.; COMPLEMENT the design requirements of computer based interlocking (CBI).

7. MODIFY the original chapter name Section blocking to Blocking; MODIFY the relevant contents of block design.
8. ADD the chapter Train operation control, defining the requirements for CTCS-2 and CTCS-3 level engineering design.
9. ADD the chapter Coding; INCLUDE the relevant content of original “cab signaling and automatic train protection (ATP)” into this chapter; COMPLEMENT the design requirements of CTCS-2 and CTCS-3 level coding.
10. MODIFY the original chapter name Transportation dispatching and commanding to Train dispatching and commanding (TDC) & centralized traffic control (CTC); INCLUDE the relevant content of *Interim Provisions on Design of Railway Train Dispatching and Commanding (TDC) & Centralized Traffic Control (CTC) System* (Construction Management Division, Ministry of Railways (2007) No. 205) issued by the former Ministry of Railways into this chapter.
11. The original section Monitoring and warning in the chapter Housing and others becomes a separate chapter, entitled Centralized signaling monitoring (CSM); COMPLEMENT the content of centralized signaling monitoring (CSM).
12. MODIFY the original chapter name Hump signaling to Hump signaling and marshalling station automation, with a specific reference to TB 10069 *Code for design of railway hump signaling and automation system for marshalling station*.
13. MODIFY the original chapter name Section crossing signaling to Crossing signaling; COMPLEMENT the design content of crossing signaling within stations.
14. ADD the chapter Shunting train protection (STP), defining the design content of the shunting train protection (STP) system.
15. ADD the chapter Switch snow-melting device, defining the design content of the switch snow-melting device.
16. The original content related to signaling electrical power unit in the chapter Power supply becomes a separate chapter, entitled Electrical power unit (EPU).
17. MODIFY the original chapter name Transmission line to Optical cables; COMPLEMENT the relevant contents.
18. INCLUDE the contents with regard to external power supply, signal production houses, interference protection, lightning protection and earthing in the original code into the chapter Operating environment.
19. ADD the chapter Interface design; COMPLEMENT the requirements for signal professional and other related professional interface design.
20. ADD the annex Naming rules for the signals, indicators and block section signal markers, defining the naming rules for various signals, indicators and block section signal markers.

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1 General provisions

1.0.1 This Code is formulated with a view of unifying the railway signaling engineering design criteria.

1.0.2 This Code is applicable to the design of standard-gauge railway signaling engineering.

1.0.3 The railway signaling engineering design shall meet the requirements of major railway technical policies.

1.0.4 The railway signaling engineering design shall meet the requirements of main-line design speed, train operation character, cross-line train operation and other transport organization schemes.

1.0.5 The railway signaling engineering design shall meet the requirements of railway transport demand, network planning and economic development level; and it shall be in line with the principle of safe application, advanced maturity and economic rationality.

1.0.6 In case of adopting new technologies, new processes, new materials and new equipment, the railway signaling engineering design shall meet the relevant requirements of the railway engineering construction management.

1.0.7 The railway signaling system and circuit design involving the traffic safety must comply with the “fail-safe” principle of railway signaling.

1.0.8 The engineering design of railway signaling system shall meet the requirements of GB/T 21562 *Railway applications - Specification and demonstration of reliability, availability, maintainability and safety (RAMS)* as well as traffic command and control, and equipment maintenance.

1.0.9 The location and mode of railway signaling equipment shall not intrude into the railway construction clearance. The elevation variation of additional track surface shall also be taken into consideration.

1.0.10 The railway signaling engineering design shall meet the requirements of the laws and regulations with regard to energy saving, land saving, water saving, material saving, environmental protection, etc.

1.0.11 The railway signaling reconstruction engineering design shall make reasonable use of existing equipment and apparatus in line with the conditions of use.

1.0.12 The graphic symbols and codes used in the railway signaling engineering design shall not only comply with this Code, but also meet the

2 Terms and symbols

2.1 Terms

2.1.1 Route through turnout by straight track

Train route or block section through no turnout or through turnout by straight track.

2.1.2 Route through turnout by lateral track

Train route or block section through turnout by at least one set of lateral track.

2.1.3 The first signal

The signal that arrives first, when a train or train consist encounters two consecutive signals that indicate its operation in the process of operation.

2.1.4 The second signal

The signal that arrives later, when a train or train consist encounters two consecutive signals that indicate its operation in the process of operation.

2.1.5 Block section signal marker

The signal marker of the automatic block section that uses onboard signaling as the train running token, which is set at the boundary point of the interval block section for indicating the boundary point of the block section.

2.1.6 Level crossing signal

A signal that is set at the level crossing facing the road, indicating whether the road vehicle and pedestrians can pass.

2.1.7 Track section unit

A basic track unit that is equipped with track occupancy inspection.

2.1.8 Track section

A track unit that is equipped with track occupancy inspection and is used as the logical processing object of the interlocking, blocking and other signaling systems. A track section may consist of one or more track section units.

2.1.9 Insulated overlapped section

3 Fixed lineside signal

3.1 General requirements

3.1.1 A color-light signal shall be used as the ground signal.

3.1.2 The high or dwarf mechanism type of the signal shall be set in accordance with the following requirements:

- 1 The routes that use ground signaling as the train running token
 - 1) should adopt the high signals;
 - 2) as for the route signal for departure, starting signal on the receiving-departure track where trains do not run through, shunting signal in the switch section, and signals in the bridge and tunnel sections, the dwarf signals should apply.
- 2 The routes that use onboard signaling as the train running token should adopt the dwarf signals.

3.1.3 The location of the signal shall meet the following requirements:

- 1 in compliance with the requirements for signaling indication distance;
- 2 under normal circumstances, it shall be set to the left side of the train running direction; under special circumstances, it is allowed to be set to the right side of the train running direction or above the center line of its track;
- 3 AVOID setting to the location where the signal is easily mistaken for the adjacent signal;
- 4 AVOID setting to the location where the electric locomotives or EMUs cannot cross the catenary without electricity.

3.1.4 The distance between adjacent approach signals, home signals, route signals, starting signals or block signals in the same direction shall be calculated according to the train traction and meet the requirements for train braking distance. In case of in non-conformity with the requirements, the first signal shall be demoted or indicated repeatedly. In case of special sections failing to be demoted or indicated repeatedly due to conditional restrictions, speed limits shall be required.

3.1.5 Each mono-indication obstruction signal and approach mono-indication obstruction signal shall be equipped with a testing equipment for the integrity of the lighting circuit.

3.2 Setting principle

3.2.1 The home signals shall be set in accordance with the following requirements:

2) In case of EMU operation, it shall be set at a distance of not less than 5m from the direction of the fouling post along the track.

- 5 The marshalling-departure tracks in the shunting yard may be provided with the starting signals for group of tracks. A departure track indicator shall be set in place at an appropriate location in rear of fouling post on each marshalling-departure track.

3.2.3 The route signals shall be set in accordance with the following requirements:

- 1 The multi-yard stations should be provided with the route signals;
- 2 The single-yard stations may be provided with the route signals as required.

3.2.4 The block signals shall be set in accordance with the following requirements:

- 1 The automatic block section that uses ground signaling as the train running token and the boundary point of the interval block section shall be provided with the block signals;
- 2 The block post shall be provided with the block signal located at the block post, which shall be located at the outside of point of outermost facing-point switch or at an appropriate location in rear of fouling post at the trailing-point switch;
- 3 The block signals in the automatic block section shall not be set to the locations where trains might be decoupled after parking, and should not be set to the locations where it is difficult in train starting;
- 4 The home signals in the automatic block section or the first block signal in front of the block signals located at the block post shall be indicated with three black slash marks. In addition, the home signals in the four-aspect automatic block section or the second block signal in front of the block signals located at the block post shall also be indicated with a black slash mark.

3.2.5 The mono-indication obstruction signals shall be set in accordance with the following requirements:

- 1 The mono-indication obstruction signals shall be set in the train approach direction with guarded crossings;
- 2 The tracks with a design speed of below 120km/h, guarded bridge and tunnel constructions, and landslide sites that may endanger the traffic safety may be provided with the mono-indication obstruction signals;
- 3 The mono-indication obstruction signals shall not be less than 50m from the protection site; and it shall be set nearby according to the principle that drivers are able to clearly see the protection site.

- 3) the block signal that also serves as the mono-indication obstruction signal.

3.2.10 The shunting signals shall be set in accordance with the following requirements:

- 1 For the stations with shunting operation or MU depots and MU operation points, the shunting signals shall be set as required by the shunting operation;
- 2 The train route in the intermediate stations and overtaking stations of the high-speed railway and intercity railway should not be provided with the shunting signals.

3.2.11 The repeating signals shall be set in accordance with the following requirements:

- 1 Affected by the terrain and its features, in case of home signals, route signals, starting signals and block signals located at the block post in non-conformity with the requirements for the prescribed indication distance, the repeating signals shall be set up;
- 2 In the case that the shunting signals at the entrance of the branch lines in the stations fail to meet the requirements for indication distance, the repeating signals may be set up;
- 3 The repeating signals shall be set within the indication distance of the main signals, as far as possible from the main signals.

3.2.12 The signals shall not be set at the end of the safety siding and refuge siding.

3.2.13 The home signals or shunting signals shall be set at the entrance of the junction tracks connected to the branch lines in the stations.

3.2.14 The route indicators shall be set in accordance with the following requirements:

- 1 For the starting signals of normal lighting and the starting signals that also serve as the route signals for departure, in the case that there are two or more departure directions and signal indication is unable to respectively indicate the route direction, the route indicators should be set up;
- 2 The starting signals of normal lighting-off and the starting signals that also serve as the route signals for departure should not be provided with the route indicators.

3.2.15 In case of shunting yards occupied with operation and difficulty in lookout of the hand signaling of the shunting commanders, the shunting indicators shall be set up.

- 3) Other block signals are of normal lighting and indicate proceed signal for positioning.
- 3 The approach signals, home distant signals, and distant signals of the block signals located at the block post are of normal lighting, indicating caution signal for positioning;
- 4 The shunting signals are of normal lighting, indicating stop signal for positioning;
- 5 The mono-indication obstruction signals and approach mono-indication obstruction signals are of normal lighting-off, but shall have the conditions of automatically switching to lighting state or manually switching to lighting state; in case of switching to lighting state, the mono-indication obstruction signals shall indicate red light, while the approach mono-indication obstruction signals shall indicate yellow light;
- 6 The repeating signals shall be positioned with no indication.

3.3.3 The automatic signal at stop of the signals shall meet the following requirements:

- 1 In case of home signals, route signals, starting signals and block signals indicating the train permissive signal, automatically PUT the signal at stop at the time when the train's first wheel set crosses the track section boundary corresponding to the signal;
- 2 Automatically PUT the calling-on signal at stop at the time when the train's first wheel set crosses the track section boundary corresponding to the signal;
- 3 For the tracks that use onboard signaling as the train running token, in the case that the home signals, route signals, starting signals and block signals located at the block post in normal lighting-off state switch to lighting state and indicate the train permissive signal or calling-on signal, the timing of automatic stop of signals shall meet the requirements of Item 1 and Item 2 in this article;
- 4 Shunting signals (except for the shunting signals to hold route for shunting and those in the flat shunting and humping route)
 - 1) In case of track section equipped on the outside, when all shunting train consists cross the track section boundary corresponding to the signal and the track section on the outside of the signal becomes idle, automatically PUT the signal at stop;
 - 2) In case of track section equipped on the outside, when all shunting train consists cross the track section boundary corresponding to the signal, but the track section on the outside of the signal remains occupied, automatically PUT the signal at stop when all shunting train consists are out of the first track section in rear of the signal;

3.3.11 For the station equipped with centralized interlocking for shunting area on level tracks, the shunting signal on the rolling route shall indicate lunar white flash light as the permissive signal for rolling.

3.3.12 The route indicator shall be lightened when the main signal is open; and it shall be in line with the need to distinguish the departure direction.

3.4 Signaling mechanism and lighting configuration

3.4.1 In case of no lighting in the signal, the lighting position shall be closed.

3.4.2 In addition to the position light repeating signals, two basic light combined into a signal indication shall be on a vertical line, with an interval of at least one lighting position.

3.4.3 For high signals, do not use upper and lower lighting positions of a three-position lighting mechanism to indicate the light in the same color.

3.4.4 For the dwarf signal composed of two mechanisms, the lighting position that indicates most restrictive signal shall be set to the mechanism near the track side.

3.4.5 For the shunting signal that also serves as the high route signal for receiving and the shunting signal that also serves as the high route signal for receiving-departure, the shunting signal mechanism shall be set to the lower part of the signal column, or the dwarf shunting signal shall be set up, separately. In addition, the blue light shall be closed.

3.4.6 In the electric traction section, the mechanism of the high signal shall be set to the right of the signal column. In the non-electric traction section, the mechanism of the high signal in station should be set to the right of the signal column; the mechanism of the high signal in section should be set to the left of the signal column.

3.4.7 In the case that the track using onboard signaling as the train running token is connected to that using ground signaling as the train running token, the mechanism, lighting configuration and indication mode of the home signal, route signal, starting signal and block signal located at the block post in the station shall meet the requirements for running token during train operation.

3.4.8 The signal mechanism and lighting configuration shall meet the requirements of Annex D.

4 Track occupancy inspection device

4.1 General requirements

4.1.1 The track circuit should be used in the track occupancy inspection. A track occupancy inspection device with axle counter may also be adopted.

4.1.2 In the case that there is a train occupied in the track section unit except for the dead section, the track occupancy inspection device shall output the track occupancy information.

4.1.3 In the case that any track section unit in the track section outputs the track occupancy information, the track section shall output the track occupancy information.

4.1.4 The following track sections shall be provided with the track occupancy inspection device:

- 1 each section in the train route and shunting route in the centralized interlocking section;
- 2 block section in the automatic block section;
- 3 section on the outside of the home signal and block signal located at the block post in the non-automatic block section;
- 4 adjacent station and block post sections in the automatic station block section;
- 5 section on the outside of the crossing mono-indication obstruction signal;
- 6 it is necessary to test other track sections occupied by the trains and the sections determined for specific purposes
 - 1) draw-out track, locomotive waiting track, outbound track and stub ended track in the centralized interlocking station;
 - 2) section on the outside of the signal at the entrance of the junction track in the branch line station.

4.1.5 The length of the track section shall not be less than the maximum value of the distance between adjacent wheel sets of all locomotives running on this track; where there is a dead section of track circuit in the track section unit, the interval between two adjacent dead sections shall not be less than the maximum value of the distance between adjacent wheel sets of all locomotives running on this track.

4.1.6 The length of the track section in station shall meet the following requirements:

- 1 Where it is necessary to provide the locking and release conditions for interlocking equipment, it shall not be less than the minimum length (L_{min1})

traction section on the outside of other stub-end shunting signals shall not be less than 25m.

4.1.10 In the case that the traction section located at the safety siding or refuge siding turnout is included into the centralized interlocking, the range of the track occupancy inspection shall include the safety siding or refuge siding.

4.1.11 The centralized interlocking track section shall be designed with power outage supervision for the power supply of the track occupancy inspection device. After power failure of the track occupancy inspection device, the release delay of the track section shall be greater than the maximum power-on recovery time of the track occupancy inspection device.

4.1.12 Except for the insulated overlapped section located at the crossover of double-working switches, other insulated overlapped sections that are related to the fouling post and used for separating adjacent track sections shall be located in rear of fouling post. The distance from the insulated overlapped section to the direction of the track where fouling post is located shall not be less than 3.5m with no EMU operation and 5m with EMU operation.

4.1.13 Except for the insulated overlapped section located at the crossover of double-working switches, other insulated overlapped sections that are related to the fouling post and used for separating adjacent track sections shall be designed as the insulated joints located within the clearance under the following circumstances:

- 1 located on the outside of fouling post;
- 2 juxtaposed with fouling post;
- 3 located in rear of fouling post, but the distance from the direction of the track where fouling post is located is less than the specified minimum value (3.5m with no EMU operation and 5m with EMU operation).

4.1.14 The mechanical insulated overlapped sections located at the approach signal, home signal, route signal, starting signal, block signal and shunting signal shall be juxtaposed with the signal. In the case that juxtaposition is impossible, the following requirements shall be complied with:

- 1 At the approach signal, home signal, route signal for receiving, route signal for receiving-departure, block signal located at the block post, and juxtaposed block signals in the automatic block section, the insulated overlapped section may be located within the range of 1m in front of to 1m in rear of the signals;
- 2 At the route signal for departure, route signal for departure that also serves as the starting signal, starting signal, and single block signal in the automatic block section, the insulated overlapped section may be located within the range of 1m in front of to 6.5m in rear of the signals;

- 2) ZPW-2000 series track circuits shall be used in the automatic block section.

4.2.2 During the railway signaling engineering design, the engineering design length of the track section unit shall be determined according to the standard shunt resistance, rail parameters, ballast resistivity and other parameters.

4.2.3 The standard shunt resistance values of the track circuits shall meet the following requirements:

- 1 The standard shunt resistance value of 25Hz phase modulated track circuit shall be taken as 0.06Ω ;
- 2 The standard shunt resistance value of asymmetrical high-voltage impulse track circuit shall be taken as 0.15Ω ;
- 3 ZPW-2000 series track circuits
 - 1) In case of ballast resistivity less than $3\Omega \cdot \text{km}$, the standard shunt resistance value shall be taken as 0.15Ω ;
 - 2) In case of ballast resistivity not less than $3\Omega \cdot \text{km}$, the standard shunt resistance value shall be taken as 0.25Ω .

4.2.4 The rail parameter values of various systems of track circuits in the ballasted track shall meet the requirements of relevant technical standards such as TB/T 1445 *Track circuit parameters*, TB/T 2853 *Technical specification for 25Hz phase sensitive track circuit*, TB/T 3206 *Technical specification for ZPW-2000 track circuit*, etc.

4.2.5 When determining the engineering design length of the track circuit, the minimum ballast resistivity value shall meet the following requirements:

- 1 Mixed passenger and freight railway
 - 1) For ballasted tracks in stations, it shall not be greater than $0.6\Omega \cdot \text{km}$;
 - 2) For ballasted tracks in sections, it shall not be greater than $1.0\Omega \cdot \text{km}$.
- 2 High-speed railway and intercity railway
 - 1) For ballasted tracks, it shall not be greater than $2.0\Omega \cdot \text{km}$;
 - 2) For ballastless tracks, it shall not be greater than $3.0\Omega \cdot \text{km}$.

4.2.6 In case of ballast resistivity less than $0.5\Omega \cdot \text{km}$, the track circuits should not be used alone.

4.2.7 The protection of the track circuits shall meet the following requirements:

- 1 The protective measures for occupancy inspection, such as setting different polarities, different phases or different carrier frequencies, shall be taken for insulation failure between adjacent track circuits;

- 1 The carrier frequency of the section and station track circuits shall adopt overall settings;
- 2 The track circuits on both sides of the boundary point of the block section shall use different carrier frequencies;
- 3 The carrier frequency of the downline in the section shall be alternately set at 1 700Hz, 2 300Hz ...; the carrier frequency of the up track in the section shall be alternately set at 2 000Hz, 2 600Hz ...;
- 4 The carrier frequencies of the downline in the station and the receiving-departure track on the down side should be 1 700Hz and 2 300Hz; the carrier frequencies of the up track in the station and the receiving-departure track on the up side should be 2 000Hz and 2 600Hz; for the station with multiple departure directions, the carrier frequency settings shall meet the requirements for train operation;
- 5 For other systems of track circuit sections in station adjacent to ZPW-2000 series track section, in case of using ZPW-2000 series frequency shift equipment to achieve coding, the carrier frequency of the coding equipment shall be different from that of the adjacent ZPW-2000 track section.

4.2.16 The tuning area of ZPW-2000 series jointless track circuit shall be designed according to the following requirements:

- 1 It shall not be set at the joints of different types of ballast beds and within the range of rail overlapping device;
- 2 It should not be set in the area with guard rail and the dead zone of the overhead contact system.

4.2.17 The transmitters and receivers of ZPW-2000 series track circuit and asymmetrical high-voltage impulse track circuit should be redundant settings.

4.2.18 In case of ZPW-2000 series track circuit applied to the parallel tracks in the same direction, the parallel track section shall take the following measures:

- 1 SET to different carrier frequencies;
- 2 SHORTEN the length of track circuit;
- 3 The track circuits with the same carrier frequency shall not be connected laterally.

4.2.19 Not only the requirements stipulated in this Code, but also those stipulated in the relevant technical standards such as TB/T 2852 *General technical specifications for track circuit*, TB/T 2853 *Technical specification for 25Hz phase sensitive track circuit*, TB/T 3206 *Technical specification for ZPW-2000 track circuit*, etc. shall be complied with, during the engineering design of track circuits.

6 Interlocking

6.1 General requirements

6.1.1 The centralized interlocking shall be applied to the stations and tracks as well as MU depots and MU operation points.

6.1.2 The block posts should be provided with the independent centralized interlocking equipment. Each yard in the station, which is relatively independent of operation, should be provided with the independent centralized interlocking equipment.

6.1.3 For high-speed railway, intercity railway, heavy-haul railway and other Level I and Level II railways, the centralized interlocking shall use CBI. For other railways, the centralized interlocking should use CBI.

6.1.4 Except for the switches in front of the starting signal of group of tracks, all the switches related to receiving route and departure route, and the additional temporary switches in the centralized interlocking section shall be included in the centralized interlocking. The switches on the non-receiving route and non-departure route may be included in the centralized interlocking.

6.1.5 In case of using the relay interfaces, for the conditions forming the switch transition, route release, signal at clear on the dangerous side, the interlocking system shall collect and use the front contact of the relay. The relays that indicate the switch location, switch release, route release, idle section, conflicting check and other related traffic safety information shall be in normal excited state.

6.1.6 For the effects of relay operation differences and different component states, measures shall be taken to prevent the wrong circuit operation from endangering the traffic safety.

6.1.7 The compilation of the interlocking chart shall meet the relevant requirements of TB/T 1123 *Compilation principle of railway signaling interlocking chart*.

6.1.8 Not only the requirements stipulated in this Code, but also those stipulated in TB/T 3027 *Computer based interlocking technical specifications* shall be complied with, during the CBI engineering design.

6.2 Interlocking relationship

6.2.1 The interlocking relationship of the switches, routes and signals included in the centralized interlocking shall meet the following requirements:

- 2 For the switches under traction of multiple switch machines, the control circuits should be designed according to the principle of avoiding the starting current peak; and it shall meet the requirements for switch transition;
- 3 Individual maneuvering takes precedence over route selection;
- 4 Multiple switch or multi-point traction single switch should be designed as possible transition of each traction point after an effective operation;
- 5 The three-phase AC switch machine shall be provided with the open-phase protection device.

6.2.5 The starting circuit of the centralized interlocking switch shall be designed in accordance with the following requirements:

- 1 The switch cannot be opened during locking;
- 2 Switch transition shall be able to continue after starting; the switch locking conditions may no longer be checked;
- 3 After switch transition, the starting circuit will be cut off automatically;
- 4 In the case that the switch transition cannot be performed to the end and the track section is idle, the switches maneuvered by the non-CTC system shall be switched to its original position after being maneuvered; the switches maneuvered by the CTC system shall cut off the power supply circuit automatically and stop the transition after transition timeout;
- 5 In the case that CBI is designed with the storage route and switch to accept the remote control, the switch shall take protective measures for automatically cutting off the power supply circuit and stopping transition during startup, and for instantaneous shunt loss in the switch section.

6.2.6 The indication circuit of the centralized interlocking switch shall be designed in accordance with the following requirements:

- 1 During switch startup, the switch indication circuit shall be cut off first, and can only be turned on only after switch transition;
- 2 The switch indication shall check whether two rows of contact groups of the automatic switch circuit controller and relevant indication equipment are in the prescribed positions;
- 3 For multi-point traction switch, each traction point shall be checked in the correct position;
- 4 For double switch or multiple switch, each group of switches must be checked in the correct position; and it shall be in the locating position or reverse position;
- 5 During manual locking, it shall not affect the position indication of switches.

6.2.7 In case of not in prescribed locating or reverse position and exceeding the time limit, the centralized interlocking switch shall have the trail alarm information.

- 1 The train route and shunting route shall be provided with the approach locking;
- 2 Train route
 - 1) For CTCS-3 level section, the length of approach locking section shall not be less than the sum of the distance when the train is running at a design speed within the maximum allowable communication interruption time of the train control onboard equipment and RBC, and the maximum common braking distance of the train;
 - 2) For CTCS-2 level section, the length of approach locking section shall not be less than the maximum common braking distance when the train is running at a design speed;
 - 3) For other sections, it shall not be less than the emergency braking distance when the train is running at a design speed.
- 3 The approach locking section of the shunting route should be the track section on the outside of the shunting signal; where necessary, the length of approach locking section shall be determined according to the principle of Item 2 in this article; or the approach locking shall be formed immediately after the shunting signal is open;
- 4 In the case that the length of the non-approach section or approach section of the protective signal in the route does not meet the requirements for approach locking, the approach locking shall be formed immediately after signal at clear.

6.2.14 The calling-on locking shall be designed in accordance with the following requirements:

- 1 During calling-on route locking, the relevant switch locking of the route shall be checked in the correct position, and the conflicting signaling shall be closed;
- 2 During calling-on total locking, all the switches in the throat area and the branch switches on the receiving-departure track shall be locked.

6.2.15 Release in the route or track section shall meet the following requirements:

- 1 Route must be released after signal at stop;
- 2 Route should be designed according to the release by section; any conditional track section shall meet the requirements for release by checking three sections; route may also be designed according to the release at once;
- 3 The calling-on route shall not be automatically released after locking; other locked routes shall be able to be automatically released along the train and normal operation of the train consist;
- 4 After the signaling is closed abnormally, the locked routes cannot be automatically released;

- 3** switchless section between the yards
 - 1) facing-point train route;
 - 2) facing-point train route and shunting route;
 - 3) facing-point shunting route.
- 4** In case of the signal set at the insulated joints located within the clearance, the routes opened at the same time shall be prohibited;
- 5** In case of train route for receiving is provided with the successive route, other routes that are overlapped with the successive route and successive routes, except for the facing-point train route at the beginning of the successive route.

6.2.17 The conflicting routes must be checked against each other; and it is forbidden to open at the same time.

6.2.18 During normal route setting, the protective signal in the route shall be checked before opening to ensure that the following conditions are met:

- 1** Basic conditions
 - 1) The route is idle;
 - 2) In the case that the boundary of adjacent track section in the route is the insulated joint located within the clearance, the adjacent track section is idle or the switch in the adjacent track section is not opened to this route;
 - 3) The relevant switches are in the correct positions;
 - 4) The routes have been locked;
 - 5) Manual release has not been implemented;
 - 6) The conflicting route has not been established.
- 2** In case of having check relationship with relevant areas, the interlocking check conditions are correct;
- 3** The blocking conditions of the starting signal and block signal located at the block post are correct.

6.2.19 The opened home signal, route signal, starting signal, block signal located at the block post and shunting signal shall be closed under the following circumstances:

- 1** manually shut down the signaling;
- 2** changes in interlocking relationship;
- 3** permissive signal lighting goes out;
- 4** loss or error of switch position indication;
- 5** incorrect blocking conditions of the starting signal and block signal located at the block post.

7 Blocking

7.1 General requirements

7.1.1 The section block system shall be selected in accordance with the following requirements:

- 1** The single track section shall use semi-automatic block or automatic station block, and may also use automatic block;
- 2** Double track section
 - 1) The high-speed railway, intercity railway, heavy-haul railway and other Level I and Level II railways shall use automatic block;
 - 2) Other railways should use automatic block.
- 3** Same type of blocking mode should be used in one section;
- 4** The CTC section shall use automatic block or automatic station block.

7.1.2 The interval block should be designed to run in both directions. For the automatic block section running in both tracks and both directions, automatic station block may be used in case of running in reverse direction. Automatic block may also be used as required.

7.1.3 It is strictly forbidden for two adjacent stations or tracks to clear the departure signaling to the track in the same section at the same time. Adjacent stations or block posts on both switchless ends shall not clear the departure signaling to the same switchless track at the same time.

7.2 Semi-automatic blocking

7.2.1 After departure blocking, it shall be able to cancel blocking before clearing the starting signaling. Where the departure blocking is canceled after clearing the starting signaling and before the train crosses the starting signal, the departure route shall be checked for release.

7.2.2 After train departure, prior to block release, the starting signaling in the section of two adjacent stations or block posts shall not be cleared.

7.2.3 Before the train crosses the starting signal, it shall be able to put the cleared starting signaling at stop. In case of changing the departure route, it is unnecessary to reset the blocking.

7.2.4 The semi-automatic blocking equipment shall have the following indications and audios:

- 1** section block indication for receiving and block indication for departure;
- 2** section occupied indication;
- 3** train notification audio for receiving-departure.

8 Not only the requirements stipulated in this Code, but also those stipulated in TB/T 3439 *Technical specification for train control center* shall be complied with, during the TCC engineering design.

8.2.2 The TSRS engineering design shall meet the following requirements:

- 1** Each TSRS should correspond to a single CTC dispatching desk; each CTC dispatching desk may correspond to multiple TSRSs;
- 2** TSRS should be set in the station on this track; and it shall be set in the computer room of the signaling equipment;
- 3** TSRS should be set up at the same site as the RBC and CCS;
- 4** The TSRS and CTC dispatching station system equipment shall be interconnected by redundant transmission links.

8.2.3 The balise settings shall meet the following requirements:

- 1** The balise group that shall be set in the CTCS-2 level section
 - 1) section balise group;
 - 2) forward inbound balise group, reverse inbound balise group;
 - 3) forward outbound balise group, reverse outbound balise group;
 - 4) balise group for relay station;
 - 5) route balise group;
 - 6) positioning balise group;
 - 7) balise group for turnout with frog number more than 18;
 - 8) balise group for CTCS level transition;
 - 9) balise group for reverse section.
- 2** In addition to the balise group required by the CTCS-2 level, the CTCS-2 level + ATO section shall also include the balise group required by the ATO;
- 3** The balise group that shall be set in the CTCS-3 level section
 - 1) In addition to the balise group that is set in the CTCS-2 level section, RBC connection balise group and RBC switching balise group shall also be included;
 - 2) In case of the distance between two adjacent balise groups in the section is greater than 1 500m, an additional positioning balise group shall be set at an appropriate location between two balise groups;
 - 3) In case of the distance between two adjacent balise groups on the track in the station is greater than 400m, an additional positioning balise group shall be set at an appropriate location between two balise groups.
- 4** The balise groups with different functions in the same area should be combined; however, the reverse relay balise groups should not be combined with the section balise groups;
- 5** The dead zone of the overhead contact system should not be provided with the balise groups.

8.2.4 The LEU design shall meet the following requirements:

T_{track} - Number of the tracks where CTCS-3 level MUs are able to be stored within this RBC control range;

L_i - Main line length (km) of the i^{th} track within this RBC control range;

L_1 - Running interval (km) between adjacent trains on the i^{th} track within this RBC control range;

n - Number of main lines within this RBC control range;

$T_{\text{RBC-RBC}}$ - Number of adjacent RBC switching positions within this RBC control range;

$T_{\text{C2/C3}}$ - Number of CTCS-2 to CTCS-3 level transition locations within this RBC control range;

T_{others} - Number of trains linked to this RBC at the same time in special sections such as CTCS testing lines in the MU depots and MU operation points, etc. within this RBC control range;

T_{system} - Number of trains that the RBC itself allows to link at the same time;

T_{reserve} - Number of trains that are allowed to be linked at the same time after reservation within this RBC control range.

3 Adjacent RBC switching position

- 1) It shall be set at the boundary point of the interval block section;
 - 2) It should be consistent with the centralized area of station interlocking;
 - 3) It should avoid the MSC or BSC switching area of GSM-R network.
- 4 The system equipment of the RBC and CTC dispatching stations shall be connected through redundant transmission links;
- 5 RBC shall be connected to the corresponding MSC within its control range through redundant transmission links;
- 6 Not only the requirements stipulated in this Code, but also those stipulated in TB/T 3330 shall be complied with, during the RBC engineering design.

8.2.6 The CCS engineering design of CTCS-2 level + ATO shall meet the following requirements:

- 1 CCS should be set in the station on this track; and it shall be centrally set in a dedicated computer room of the signaling equipment;
- 2 CCS should be individually set according to the tracks;
- 3 The number of CCS settings shall be determined according to the control ability and train density;
- 4 CCS shall be connected to the system equipment of the CTC dispatching station through redundant transmission links;

9 Coding

9.0.1 The lineside coding design of coding shall meet the following requirements:

- 1 The automatic block section shall meet the requirements for normal operation of continuous cab signaling;
- 2 The non-automatic block section shall meet the requirements for normal operation of approach continuous cab signaling;
- 3 The CTCS-2 and CTCS-3 level sections shall meet the requirements for operation in full monitoring mode of the train control onboard equipment.

9.0.2 The coding information of the track section shall be consistent with the indication meanings of the approach signal that closes to the train or train consist on the track, home signal, route signal, starting signal, block signal, shunting signal that obstructs the train, shunting signal at the entrance of the dedicated track, and mono-indication obstruction signal or the establishment state of the protective route.

9.0.3 In case of using the track coding in station, the following track sections shall send codes continuously:

- 1 all track sections in the receiving route through turnout by straight track;
- 2 track section in the receiving route through turnout by lateral track;
- 3 all track sections in the departure route through turnout by straight track for automatic blocking;
- 4 straight tracks in the track sections outside the route signal and starting signal;
- 5 approach locking section of the home signal and block signal located at the block post in the non-automatic block section;
- 6 track section on the outside of the signal at the entrance of the branch line connected with the exclusive railway;
- 7 track section on the outside of the shunting signal that obstructs the train operation.

9.0.4 In case of using a track occupancy inspection device overlapped with separate coding equipment to achieve coding, the following requirements shall be met:

- 1 The main line shall adopt pre-overlapped coding;
- 2 The siding shall adopt overlapped coding; and it may also adopt pre-overlapped coding.

- 2) The tracking codes for the route through turnout by lateral track are L5 code, L4 code, L3 code, L2 code, L code, LU code, U2 code / U2S code, UU code / UUS code successively in descending order;
- 3) The tracking codes for calling-on receiving are L5 code, L4 code, L3 code, L2 code, L code, LU code, U code and HB code successively in descending order;
- 4) The protection code for foreign matter intrusion are L5 code, L4 code, L3 code, L2 code, L code, LU code, U code, HU code and H code;
- 5) The highest message code of the tracking code order may be selected according to the actual situation of the track.

9.0.8 For the section with automatic blocking in forward direction and automatic station blocking in reverse direction, in case of opening the reverse direction in the section, the coding of the block section shall meet the following requirements:

- 1 CTCS-0 level section or CTCS-2 level section using the relay code
 - 1) The approach locking section on the outside of the home signal and block signal located at the block post shall send the cab signaling message code that is consistent with the indication meaning of the lineside signal;
 - 2) The remaining track sections in the section should send the JC code.
- 2 For the CTCS-2 and CTCS-3 level sections using the TCC code, the codes should be sent according to the tracking code order specified in Item 3 of Article 9.0.7. The coding principle shall be the same as the forward direction.

9.0.9 In the automatic block section, the coding of each track section in the section should not check the filament burnout conditions for the permissive signaling of the block signal (except for the block signal located at the block post).

9.0.10 In the case that the block section and the first departure section for starting are composed of multiple track section units, the forward-direction coding of each track section unit shall meet the following requirements:

- 1 Where the block section is idle, the cab signaling message code that is consistent with the indication meaning of the block signal or home signal in front of the train operation or the establishment state of the protective route shall be sent;
- 2 Where the block section is occupied, each track section unit in front of the train operation shall send the cab signaling message code that is consistent with the indication meaning of the block signal or home signal in front of the train operation or the establishment state of the protective route; each track section unit in rear of the train operation shall send the stop code or no code.

10 Train dispatching and commanding (TDC) & centralized traffic control (CTC)

10.0.1 The high-speed railway and intercity railway shall use CTC. Other tracks may use CTC or TDCS as required.

10.0.2 The TDCS shall be set by classification according to the management needs; and it shall meet the following requirements:

- 1** The station system and dispatching station system shall be set up; the dispatching center system may be set up as required;
- 2** The station system shall be equipped with the integrated processor, station server, operation terminal, maintenance terminal, etc.;
- 3** The dispatching station system shall be equipped with the database server, application server, communication front server, interface server, external clock server, operation terminal, maintenance terminal, etc.;
- 4** The dispatching center system equipment shall be set up according to the dispatching and commanding needs of the transport enterprise.

10.0.3 The CTC system shall be set by classification according to the management needs; and it shall meet the following requirements:

- 1** It shall be equipped with the station system and dispatching station system;
- 2** The station system shall be equipped with the station autonomous controlling machine, station server, operation terminal, maintenance terminal, etc.;
- 3** The dispatching station system shall be equipped with the database server, application server, communication front server, interface server, external clock server, operation terminal, maintenance terminal, etc.

10.0.4 In the case that TDCS and CTC share a platform, the system equipment with the same functions should be set up in combination.

10.0.5 The following equipment of the TDCS / CTC system should adopt redundant settings:

- 1** database server;
- 2** application server;
- 3** communication front server;
- 4** integrated processor or station autonomous controlling machine;
- 5** station server;
- 6** train operation terminal in the station.

11 Centralized signaling monitoring (CSM)

11.0.1 For the high-speed railway, intercity railway, heavy-haul railway and other Level I and Level II railways, the CSM system shall be used for the monitoring of signaling equipment. For other railways, the CSM system should be used for the monitoring of signaling equipment.

11.0.2 The monitoring range of the CSM system shall include:

- 1 interlocking equipment;
- 2 blocking equipment;
- 3 train control lineside equipment;
- 4 TDCS / CTC equipment;
- 5 electrical power unit;
- 6 interface with the disaster prevention and environmental monitoring systems.

11.0.3 The CSM system shall directly collect the information on the analog quantity and switching value of the signaling equipment with no self-monitoring function and the combination thereof, mainly including the external power grid, power screen, track circuit, switch machine, home signal, route signal, starting signal, block signal, switch, frequency shift equipment, semi-automatic blocking equipment, interface relay for foreign matter intrusion and signaling system, connecting circuit between stations (yards), cable-to-ground insulation, power-to-ground leakage current, button state, console indication state, key relay state, key breaker state, etc.

11.0.4 The CSM system shall be able to obtain the equipment monitoring information, through the data communication and the interfaces of the power screen with the self-monitoring function, TDCS / CTC, ZPW-2000 series track circuit, axle counter, CBI, TCC, TSRS, RBC, CCS and other equipment.

11.0.5 During online information acquisition, the CSM system is strictly forbidden to affect the normal operation of the monitored signaling equipment.

11.0.6 The functions of the CSM system shall meet the following requirements:

- 1 The system shall have the early warning or alarming function by classification;
- 2 It shall be able to perform classification, storage, query, indication, statistics, analysis, playback, etc. on the monitoring data;
- 3 It should have the remote monitoring function.

11.0.7 The CSM system shall adopt a hierarchical structure as required for equipment maintenance and management.

13 Crossing signaling

13.0.1 The guarded railway crossings and crossing signaling shall be designed in accordance with the following requirements:

- 1 Section crossings (including the section crossings in the adjacent stations) shall be provided with the crossing automatic announcement and crossing automatic signaling;
- 2 Crossings within the station
 - 1) In case of located in the throat area with train operation, the crossing automatic announcement and crossing automatic signaling shall be set up;
 - 2) In case of crossing with the receiving-departure track, the crossing automatic announcement for train receiving may be set up; under special circumstances, the crossing announcement information shall be terminated manually;
 - 3) In case of only shunting operation, the crossing automatic announcement and crossing automatic signaling should not be set up.

13.0.2 For the railway crossings equipped with the crossing automatic signaling, after the train approaches the announcement, the railway direction and the road direction shall not be opened at the same time.

13.0.3 In the case that the train approaches the crossings from any direction of the track, the crossing signaling equipment shall give an announcement, which shall meet the following requirements:

- 1 Announcement objects
 - 1) In case of using the crossing automatic announcement equipment, an announcement shall be sent to the crossing keeper;
 - 2) In case of using the crossing automatic signaling equipment, an announcement shall be sent to the road direction;
 - 3) In case of using the crossing automatic announcement and crossing automatic signaling equipment, an announcement shall be sent to the crossing keeper and the road direction, respectively.
- 2 Announcement modes
 - 1) The mode of fixed-point alarm should be adopted;
 - 2) The mode of train approach announcement at once should be adopted;
 - 3) The mode of audio and lighting alarm announcement should be adopted.
- 3 The train approach announcement time shall not be less than the sum of the time required by the road vehicle passing through the crossing, the closing time of the crossing railing, and the acknowledging time required by

14 Shunting train protection (STP)

14.0.1 In case of the centralized interlocking station equipped with special shunting locomotives, the STP system shall be set up.

14.0.2 The control area of the STP system shall be located in the centralized interlocking section; and it shall be reasonably determined according to the shunting operation area.

14.0.3 The STP system shall not affect the normal operation of the CBI, TDCS / CTC or train operation monitoring device (LKJ).

14.0.4 The STP system shall be provided with the following equipment:

1 Lineside equipment

- 1) lineside host;
- 2) balise locator;
- 3) lineside radio communication equipment;
- 4) electrical maintenance terminal;
- 5) traffic terminal;
- 6) interface equipment.

2 Onboard equipment

- 1) onboard host;
- 2) onboard radio communication equipment.

14.0.5 The lineside host of the STP system shall meet the following requirements:

- 1 It shall be set in the computer room of the signaling equipment;
- 2 The scope of jurisdiction shall be determined according to the shunting operation scale and the control ability of the lineside host;
- 3 The hot standby redundancy structure should be adopted.

14.0.6 The STP system shall transmit the signaling, switch and track section information related to the shunting operation to the shunting locomotive in train-ground radio communication mode. The settings of radio communication equipment shall meet the relevant requirements for national radio management. Radio coverage shall meet the requirements for shunting operation commanding.

14.0.7 The balise locator shall be set in accordance with the following requirements:

- 1 The balise locator shall be set at the entrance of the station centralized interlocking section and the boundary point of the yards, respectively;

16 Electrical power unit (EPU)

16.0.1 The signaling equipment (except for the electric heating elements of the switch snow-melting device) should be powered by the intelligent power supply panel. The power supply panel shall meet the relevant requirements of TB/T 1528 *Railway signal power supply panel*.

16.0.2 The type of power output from the signaling power supply panel shall be determined based on the electricity type of the signaling equipment.

16.0.3 The capacity of the signaling power supply panel shall be determined after the calculation based on the electricity consumption of the signaling equipment.

16.0.4 The power supply circuit of the signaling power supply panel shall be reasonably designed according to the purpose of the signaling equipment as well as the regional division of the stations, yards and tracks.

16.0.5 The signaling power supply panel should provide dual independent power supply circuit for the TDCS, CTC, CBI, TCC, TSRS, RBC, CCS, signaling safety data network, and signaling equipment such as outdoor LEU, etc.

16.0.6 In the case that the AC electrical equipment is powered by the signaling power supply panel via a three-phase power supply, balanced allocation of three-phase loads shall be performed.

16.0.7 In case of powered by using a three-phase AC power supply, it shall be designed with the power supply sequence error and phase failure supervision alarm.

16.0.8 The UPS design shall meet the following requirements:

- 1 TDCS, CTC, CBI, TCC, TSRS, RBC, CCS, signaling safety data network, CSM, STP system's lineside equipment shall be powered by the UPS;
- 2 The track occupancy inspection device with axle counter, which is applied to the train occupancy inspection in the sections, shall meet the requirements for the train under normal operation from departing from the departure station to arriving at the receiving station intact;
- 3 Online UPSs shall be used in the CTCS-2 and CTCS-3 level sections;
- 4 The UPSs used in the dispatching stations / dispatching centers, stations, block posts, section signaling relay stations, MU depots and MU operation points should be designed with redundant settings;
- 5 The UPS capacity shall meet the electricity consumption requirements of the loads.

17 Optical cables

17.0.1 The outdoor signaling cables shall be selected in accordance with the following requirements:

- 1 The situations where signaling cables shall be used between the signaling equipment housing and the outdoor signaling equipment housing
 - 1) control line and indication line of the turnout switching device;
 - 2) signal lighting control line;
 - 3) transmitting line and receiving line of the track circuit;
 - 4) coding control line;
 - 5) information transmission line of the switch snow-melting device.
- 2 The outdoor signaling cables shall use armored integrated sheathed signaling cables or armored aluminum-sheathed signaling cables;
- 3 The cables of ZPW-2000 series track circuits and coding shall use the railway digital signaling cables; other signaling equipment should not use the digital signaling cables;
- 4 The signaling cables shall meet the requirements of relevant technical standards such as TB/T 1472 *Technical conditions of integrated sheathed and aluminum-sheathed signal cables*, TB/T 2476 *Railway signal cables*, TB/T 3100 *Railway digital signaling cable*, etc.

17.0.2 The paths of outdoor signaling optical cables shall be located within the railway land area. The paths shall be selected in accordance with the following requirements:

- 1 Better soil and terrain conditions;
- 2 Less through tracks and obstacles;
- 3 Closer distance between the equipment;
- 4 Outside of the toe of ballast bed;
- 5 To avoid soil shoulder and slope;
- 6 To avoid gravel blockage sites;
- 7 To avoid ponds and sewage pits;
- 8 To avoid soft soil sites where collapse may occur;
- 9 To avoid areas with chemical substances such as acids and alkalis and other areas that are liable to cause corrosion;
- 10 To avoid point of switch, frog center and rail joints;
- 11 To avoid the strut foundation of the overhead contact system and other constructions.

17.0.3 The laying and protection of outdoor signaling cables shall meet the following requirements:

- 1) where the actual length between the equipment is less than 20m, it shall be counted as 1m;
- 2) where the actual length between the equipment is up to or greater than 20m, it shall be counted as 2m.
- 5 The cross-track length through a single track shall be counted as 5.5m; in case of crossing multiple tracks with a spacing of greater than 5m, it shall also include the parts with a distance between tracks of exceeding 5m;
- 6 The margin introduced to indoors shall be counted as not less than 5m;
- 7 The bending coefficient of the sum of the above lengths shall be counted as not less than 2%;
- 8 The length margins for other special sections.

17.0.12 The stone markers and warning signs of the optical cables for direct burial shall be set in accordance with the following requirements:

- 1 Stone marker sites set in the optical cables
 - 1) connecting points and remaining points of the optical cables, including the divergent optical cable terminals;
 - 2) turning points of the optical cables;
 - 3) in case of crossing the river, railway and highway, on both sides of the river, railway and highway;
 - 4) in case of crossing the obstacles, use two laying marks in the front and rear to search for the sites with difficulties in optical cables;
 - 5) in case of ordinary straight-track sections in the optical cables, a stone marker should be set every 50m.
- 2 In case of available fixed markers on the above sites, the optical cables may not be equipped with any stone markers.
- 3 Warning sign sites set in the optical cables
 - 1) in case of crossing the railway and highway, on both sides of the railway and highway;
 - 2) densely populated premises that pass through or are adjacent to the farmlands;
 - 3) other sites that need to be provided with the warning signs.
- 4 The materials and information sign contents of the stone markers and warning signs for the optical cables shall meet the relevant requirements of TB/T 2493 *Sign board for railway track and signal*.

17.0.13 The signaling cables shall be introduced into a cable draw-in chamber or a cable draw-in pit to combine into a terminal. Then, the terminal is connected to a branching cabinet for lightning protection. Where the signaling cables are introduced into the signaling equipment housing, preventive measures against lightning, water, fire and rats shall be taken.

17.0.14 In case of using optical transmission channels, the signaling equipment shall give priority to the use of communication optical cables. In case

18 Operating environment

18.1 External power supply

18.1.1 The AC power supply with a rated voltage of 220V / 380V and a frequency of 50Hz shall be used as the external signaling power supply.

18.1.2 The external power supply of the signaling equipment shall meet the following requirements:

- 1** Signaling equipment that shall be powered by Level 1 load
 - 1) equipment in the dispatching station and dispatching center;
 - 2) equipment in the CSM center;
 - 3) signaling equipment (except for the crossing signaling equipment) in the automatic block section;
 - 4) signaling equipment in the non-automatic block section and large station.
- 2** Signaling equipment that should be powered by Level 2 load
 - 1) signaling equipment in the medium and small stations in the non-automatic block section;
 - 2) crossing signaling equipment;
 - 3) switch snow-melting device.

18.1.3 The switching time of the two external power supplies of the signaling power screen shall not be greater than 0.15s.

18.1.4 The power draw-in site shall be equipped with a breaker. The capacity shall be determined according to the principle of grading protection.

18.1.5 Not only the requirements stipulated in this Code, but also those stipulated in the TB 10008 *Code for design of railway electric power* shall be complied with, during the engineering design of the external power supply.

18.2 Signaling production housings

18.2.1 The signaling production housings shall include the signaling equipment housing and signaling maintenance housing. The settings thereof shall include the following requirements:

- 1** Signaling equipment housing
 - 1) Each station should be provided with the signaling equipment housing and cable draw-in chamber;
 - 2) Each section signaling relay station shall be provided with the signaling equipment housing;

relevant technical standards such as GB 50174 *Code for design of electronic information system room*, GB 50343 *Technical code for protection of building electronic information system against lightning*, TB 10180 *Technical code for lightning protection and earthing of railway*, etc. and railway building design standards. The computer room of the TDCS / CTC dispatching station and dispatching center shall meet the Class A criteria specified in GB 50174 *Code for design of electronic information system room*. The computer room of other signaling equipment shall meet the Class C criteria specified in GB 50174 *Code for design of electronic information system room*.

18.3 Interference protection, lightning protection and earthing

18.3.1 In the electric traction section, the choke transformer settings, traction return current and equipotential connection or earthing of the track circuit shall meet the requirements for realizing the occupancy inspection function of the track circuit.

18.3.2 In the electric traction section, the connection of the choke transformer at the mechanical insulated overlapped section of the track circuit shall meet the following requirements:

- 1** Traction current shall be returned through the midpoint of the choke transformer at the mechanical insulated overlapped section;
- 2** Double-wire connection shall be applied to the bond between rail and transformer for the choke transformer to be connected to two rails; the plug bond between rail and transformer should apply;
- 3** In case of a choke transformer is separately equipped on both sides of the insulated overlapped section, with traction current passing through, the midpoints of two choke transformers shall be connected with the midpoint connectors; in case of using the midpoint connectors for connection only, double-wire connection shall apply;
- 4** The track lead and midpoint connectors of the choke transformer shall meet the relevant requirements of TB/T 3205 *Track lead, midpoint connectors for impedance bond*.

18.3.3 In the electric traction section, in case of traction current passing through the straight track of the scissors crossing turnout, additional rail insulation shall be provided on the crossover.

18.3.4 In the electric traction section, the rails of track circuits and the choke transformers as well as the electric traction power supply equipment and the earthing cables of buildings shall be connected in accordance with the following requirements:

protectors should be centrally set in the interior branching plate for lightning protection or branching cabinet for lightning protection;

- 3 A separate lightning protection box for signaling power supply shall be set in the power cable draw-in position of the signaling equipment housing.

18.3.10 The distance from the outer edge of the outdoor signaling equipment to the live part of the overhead contact system shall not be less than 2m. The metal structural members of the signaling equipment within 5m from the live part of the overhead contact system must be grounded.

18.3.11 In the electric traction section, the total return point returned to the traction substation via the track circuit shall be grounded through the midpoint of the choke transformer.

18.3.12 In the electric traction section, the earthing and shielding connections of the outdoor signaling cables shall meet the following requirements:

- 1 Metal sheaths shall be grounded;
- 2 The shield connection shall be used between the sheaths for multiple cables laid in the same trench or trough;
- 3 The aluminum sheaths, steel strips and inner shielding sheaths shall be conducted with single-end earthing in segments.

18.3.13 The earthing of the trackside signaling equipment shall meet the following requirements:

- 1 The power cable or signaling cable entering and leaving the box shall be laid underground by passing a shielded cable or unshielded cable through the steel pipe; the metal shielding layer or steel pipe of the shielded cable shall be grounded;
- 2 In the track circuit section, it is strictly forbidden to replace the earthing cables with rails.

18.3.14 The ZPW-2000 automatic block section shall be provided with the run-through earthing cable.

18.3.15 The earthing of the outdoor signaling equipment shall meet the following requirements:

- 1 For the tracks equipped with no run-through earthing cable, the separated earthing resistance shall not be greater than 4Ω ; it shall not be greater than 10Ω at need;
- 2 For the tracks equipped with run-through earthing cables, the earthing resistance shall not be greater than 1Ω ;
- 3 In case of earthing resistance in non-conformity with the requirements, resistance reduction measures shall be taken.

19 Interface design

19.0.1 The interface design for the signaling field and traffic field shall meet the following requirements:

- 1 PROPOSE the special design schemes for major signaling systems, such as interlocking, blocking, train operation control, etc.;
- 2 ACCESS to the design schemes for the blocking system;
- 3 Jointly VALIDATE the set positions of the home signal, block signal and block section signal marker, the division of the train dispatching sections, etc.

19.0.2 The signaling field shall obtain the track type, track mileage, track design speed, track curve, track gradient and other information from the track field.

19.0.3 The interface design for the signaling field and yard field shall meet the following requirements:

- 1 PROPOSE
 - 1) installation space requirements of the turnout switching devices and signals;
 - 2) design requirements of the signal cable troughs, cable pits, cable hand holes, track-crossing protective tube grooves and cable protection facilities;
 - 3) the requirements of the train control system for the effective length of station tracks and the platform setting;
 - 4) design requirements for the integrated earthing engineering of the signaling equipment and facilities.
- 2 ACCESS to the station-yard information of the stations, yards, block posts, MU depots and MU operation points;
- 3 Jointly VALIDATE
 - 1) centralized control range of signaling;
 - 2) setting requirements of the rail overlapping devices, special sleepers for track circuits, insulated gauge rods, etc.

19.0.4 The interface design for the signaling field and track field shall meet the following requirements:

- 1 PROPOSE
 - 1) design requirements of the mechanical insulated overlapped sections within the stations;
 - 2) set position requirements for the compensation capacitor of the track circuits;
 - 3) insulation requirements of the gauge rods;

- 3 signal cable troughs, cable pits, cable hand holes, track-crossing protective tube grooves, cable protection facilities, etc.;
- 4 integrated earthing engineering of the signaling equipment and facilities.

19.0.9 The signaling field shall propose the design requirements of the HVAC fire protection facilities for the signaling equipment housing to the HVAC field.

19.0.10 The signaling field shall propose the electrical load requirements of the signaling equipment to the electricity field; and it shall validate the breaker settings and other relevant parameters at the interface jointly with the electricity field.

19.0.11 The interface design for the signaling field and electric traction power supply field shall meet the following requirements:

- 1 PROPOSE the design principle of the choke transformer in the track circuit;
- 2 ACCESS to the traction power supply mode, traction current parameters, etc.;
- 3 Jointly VALIDATE
 - 1) set position of the high signal;
 - 2) set positions of the boosting cable and the horizontal cable of the track circuit;
 - 3) set position of the dead zone, in case of using a balise to provide the information on passing neutral section of electrical sectioning in the overhead contact system or the overlapping section information.

19.0.12 The interface design for the signaling field and communication field shall meet the following requirements:

- 1 PROPOSE
 - 1) requirements for special optical fibers for signaling and transmission links;
 - 2) wireless network requirements of the TDCS / CTC, RBC, CCS, STP and other systems;
 - 3) requirements for the environmental monitoring system of signaling power supply and equipment housing.
- 2 ACCESS to the telephone numbers and other information corresponding to the approved RBC and CCS.

19.0.13 The interface design for the signaling field and MU field shall meet the following requirements:

- 1 ACCESS to the MU routing design information;
- 2 ACCESS to the information on the parking requirements of the tracks in the MU depots and MU operation points;

Annex A

Naming rules for the signals, indicators and block section signal markers

A.0.1 The naming format of the signals, indicators and block section signal markers

- 1 using letters, numerals or the combination of letters and numerals;
- 2 “letters” shall use the capital English letters “A, B, C ...”;
- 3 “numerals” include the capital Roman numerals “I, II, III ...” and Arabic numerals.

A.0.2 Within the jurisdiction of the same station, the names of signals and indicators shall not be repeated. In the same automatic block section, the names of other block signals, except for the block signal located at the block post, and block section signal markers shall not be repeated.

A.0.3 The home signals shall be expressed in the letters “X and S”. For further distinction, the suffix to the letters “X and S” shall be expressed in “letter” or “letter + number” and other auxiliary information, as shown in Table A.0.3.

Table A.0.3 -- Naming of the home signals

Serial No.	Scenario	Expression	Example
1	Down throat	X, or suffix to auxiliary information	X, X _D
2	Up throat	S, or suffix to auxiliary information	S, S _D
3	Throat area connected to multiple directions in the section	On the basis of Item 1 and Item 2 in this table, suffix to the first Chinese phonetic alphabet that represents the track name; main track may omit the suffix	1. Down throat in Beijing and eastern suburb: X _B , X _D ; 2. In case of main track in Beijing, “X _B ” may be simplified as “X”
4	Multiple tracks in one direction of the section connected with the throat area	On the basis of Item 3 in this table, suffix to the Arabic numerals (odd number for the down throat, even number for the up throat)	Multiple tracks of the down throat in Beijing: X _{B1} , X _{B3} , X _{B5} ...
5	Throat area connected to the double-track section,	Suffix the name of the forward home signal to “F”	Down throat in Beijing is double-track automatic

		number for the down direction, even number for the up direction)	2. Multiple signals in the up direction: Zs2, Zs4 ...
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A.0.10 The distant signal shall be expressed in the letter “Y” suffixed with the name of the main signal. For instance:

- 1 The distant signal of the home signal expressed in “X” is named as “Y_X”;
- 2 The distant signal of the mono-indication obstruction signal expressed in “Z_{X1}” is named as “Y_{ZX1}”.

A.0.11 The repeating signal shall be expressed in the letter “F” suffixed with the name of the main signal.

- 1 In the case that some signal has only one repeating signal, for instance:
 - 1) The repeating signal of the home signal expressed in “X” is named as “F_X”;
 - 2) The repeating signal of the starting signal expressed in “S_{II}” is named as “F_{S II}”;
 - 3) The repeating signal of the shunting signal expressed in “D₁” is named as “F_{D1}”.
- 2 If a signal has multiple repeating signals, PREFIX to the Arabic numerals on the basis of the above names. The numeric serial numbers shall be numbered in the ascending order according to the operating direction. For instance, in the case that the home signal expressed in X_D has two repeating signals, NAME as “1F_{XD} and 2F_{XD}” successively according to the train operating direction.

A.0.12 The approach signal shall be expressed in the letter “J” suffixed with the name of the main signal. For instance, the approach signal in front of the home signal expressed in “X_D” is named as “J_{XD}”.

A.0.13 The hump signal shall be expressed in the letter “T”. For further distinction, the suffix to the letter “T” shall be expressed in the sequence number of the pushing track. For instance:

- 1 In case of only one hump signal in the hump yard, it shall be named as “T”;
- 2 In case of multiple hump signals in the hump yard, it shall be named as “T₁, T₂ ...” according to the pushing track of each signal, respectively.

A.0.14 The hump auxiliary signal shall be expressed in the letters “TF” suffixed with the number of its track. For instance, the hump auxiliary signal of IG is named as “TF₁”.

A.0.15 The departure route indicator shall be expressed in the letters “XB” suffixed with the name of the corresponding starting signal, or the letters “XB”

Annex B

Naming rules for the track section and track section unit

B.0.1 The naming format of the track sections and track section units

- 1 using the combination of numerals and letters;
- 2 “numerals” include the capital Roman numerals “I, II, III ...” and Arabic numerals;
- 3 “letters” shall use the capital English letter “G”, or be prefixed with other letters “A, B, C ...” or “D, W” that indicate the auxiliary information.

B.0.2 In the case that one track section only includes one track section unit, the naming of the two shall be the same. In the case that one track section includes multiple track section units, the naming of the track section unit shall be expressed in the name of the track section suffixed with capital English letters “A, B, C ...”.

B.0.3 Within the same centralized jurisdiction, the names of the track sections shall not be repeated.

B.0.4 The switch section in the station throat area shall be expressed in the “number” of the switch in the track section, with additional letters “DG”. In the case that one switch section includes multiple groups of switches, the switches shall be numbered in the format of “minimum switch number - maximum switch number”. For instance, the switch section with No. 1 switch, No. 7 switch and No. 9 switch is named as “1-9DG”.

B.0.5 The naming of the track section shall be expressed as the “number” of the track, with an additional letter “G”

- 1 The numbers of the tracks on the main line shall use capital Roman numerals; the numbers of the tracks on the non-main line shall use the Arabic numerals;
- 2 In case of track composed of multiple track sections
 - 1) The naming of the switch sections shall meet the requirements of Article B.0.4 in this Code; for instance, when the track 3 is equipped with a group of switches numbered 15, the switch section is named as “15DG”;
 - 2) Each switchless section shall be expressed in the track number suffixed with the Arabic numerals, such as “3G1 and 3G2”.

B.0.6 The switchless section that is adjacent to the section at the station receiving-departure crossing shall be expressed in the “number” of its connected track, followed by the letter “A” or “B”, then followed by the letter “G”.

	front of train operation.		
9	<p>Starting signal (VII): To indicate whether the train is able to depart from the station to the section, the departure directions and the operating conditions of the section.</p> <p>Route signal for starting and departure (V): To indicate whether the train is able to depart from the station to the section, the departure directions and the operating conditions of the section, and to indicate the operating conditions of the departure route in front of train operation.</p>		<ol style="list-style-type: none"> 1. Normal lighting; 2. It has two departure directions.
10	<p>Starting signal (VIII): To indicate whether the train is able to depart from the station to the section, the departure directions and the operating conditions of the section, and to indicate whether the shunting train consist is able to perform shunting.</p> <p>Route signal for starting and departure (VI): To indicate whether the train is able to depart from the station to the section, the departure directions and the operating conditions of the section, to indicate the operating conditions of the departure route in front of train operation, and to indicate whether the shunting train consist is able to perform shunting.</p>		<ol style="list-style-type: none"> 1. Normal lighting 2. It has two departure directions; 3. It is equipped with the shunting signaling.
11	<p>Starting signal (IX): To indicate whether the train is able to depart from the station to the section, and to indicate whether the shunting train consist is able to perform shunting.</p> <p>Route signal for departure (V): To indicate the operating conditions of the departure route in front of train operation, and to indicate whether the shunting train consist is able to perform</p>		<ol style="list-style-type: none"> 1. Normal lighting; 2. In case of used in the MU depots and MU operation points: <ol style="list-style-type: none"> 1) It is equipped with the calling-on signaling mechanism; 2) It is not applicable to high signals. 3. In case of used in other

List of quoted standards

1. GB/T 50262 *Standard for fundamental terms of railway engineering*
2. GB 50174 *Code for design of electronic information system room*
3. GB 50343 *Technical code for protection of building electronic information system against lightning*
4. GB 10493 *Technical specification for crossing signal equipment within the station*
5. GB 10494 *Technical specification for crossing signal equipment in wayside*
6. GB/T 21562 / IEC 62278 *Railway applications - Specification and demonstration of reliability, availability, maintainability and safety (RAMS)*
7. TB 10006 *Code for design of railway communication*
8. TB 10008 *Code for design of railway electric power*
9. TB/T 10058 *Drawing standards of railway engineering*
10. TB/T 10059 *Standard for graphical symbol of railway engineering*
11. TB 10063 *Code for design of fire prevention for railway engineering*
12. TB 10069 *Code for design of railway hump signaling and automation system for marshalling station*
13. TB 10088 *Code for design of railway digital mobile communication system (GSM-R)*
14. TB 10180 *Technical code for lightning protection and earthing of railway*
15. TB 454 *Terminology for railway signaling*
16. TB/T 1123 *Compilation principle of railway signaling interlocking chart*
17. TB/T 1445 *Track circuit parameters*
18. TB/T 1472 *Technical conditions of integrated sheathed and aluminum-sheathed signal cables*
19. TB/T 1528 *Railway signal power supply panel*

20. TB/T 1567 *Technical specification for railway automatic blocking*
21. TB/T 2296 *General technical specification for railway axle counters*
22. TB/T 2307 *Technical conditions for electrical device centralized various combination circuit*
23. TB/T 2465 *Technical specification on coding for railway station*
24. TB/T 2476 *Railway signal cables*
25. TB/T 2493 *Sign board for railway track and signal*
26. TB/T 2497 *Technical specification for railway semi-automatic blocking*
27. TB/T 2668 *Specification for railway automatic station block*
28. TB/T 2852 *General technical specifications for track circuit*
29. TB/T 2853 *Technical specification for 25Hz phase sensitive track circuit*
30. TB/T 3027 *Computer based interlocking technical specifications*
31. TB/T 3060 *Cab signaling message definition and allocation*
32. TB/T 3100 *Railway digital signaling cable*
33. TB/T 3189 *Specification of railway signal axle counter application system*
34. TB/T 3203 *WAN technology specification of train operation dispatching command system and centralized traffic control system*
35. TB/T 3205 *Track lead, midpoint connectors for impedance bond*
36. TB/T 3206 *Technical specification for ZPW-2000 track circuit*
37. TB/T 3324 *Overall technical requirements for railway digital mobile communication system (GSM-R)*
38. TB/T 3330 *Technical specification for radio block center*
39. TB/T 3439 *Technical specification for train control center*

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