Electric Power Industry Standard of the People's Republic of China

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DL/T 5409.4—2010

Technical Code for Engineering Investigation of Nuclear Power Plants Part 4: Surveying

核电厂工程勘测技术规程 第4部分：测量

（英文版）

Issue Date: May 24, 2010

Implementation Date: October 1, 2010

Issued by the National Energy Administration

ICS 27.140
P 59
Record No. J1040—2010

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图书在版编目（CIP）数据

DL/T 5409.4—2010 核电厂工程勘测技术规程. 第 4 部分. 测量= Technical Code for Engineering Investigation of Nuclear Power Plants Part 4: Surveying: 英文 / 国家能源局发布. —北京：中国电力出版社，2013.5

ISBN 978-7-5123-4105-0

Ⅰ. ①D… Ⅱ. ①国… Ⅲ. ①核电厂–勘测–技术规范–中国–英文 Ⅳ. ①TM623–65

中国版本图书馆 CIP 数据核字（2013）第 037294 号

中国电力出版社出版

（北京市东城区北京站西街 19 号 100005 http://www.cepp.sgcc.com.cn）

北京博图彩色印刷有限公司印刷

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2013 年 5 月第一版 2013 年 5 月北京第一次印刷

850 毫米×1168 毫米 32 开本 6.75 印张 171 千字

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Technical Code for Engineering Investigation of Nuclear Power Plants Part 4: Surveying

Translation sponsored by: China Electric Power Planning & Engineering Association
Translated by: SUNTHER Consulting Co., Ltd.
Reviewed by: Guangdong Electric Power Design and Research Institute, and East China Electric Power Design Institute

CHINA ELECTRIC POWER PRESS
BEIJING, 2013

Foreword

DL/T 5409 *Technical Code for Engineering Investigation of Nuclear Power Plants* consists of four parts below:

Part 1: Seismic Hazard

Part 2: Geotechnical Engineering

Part 3: Hydrological and Meteorological Survey

Part 4: Surveying

This is part 4 of DL/T 5409.

This part is prepared as arranged by the *Notice on Printing and Distributing Industrial Standards Project Plan 2005* (FGBGY [2005] 739) issued by the General Office of the National Development and Reform Commission.

Appendices A, B, E, F, K, L, and M herein are normative, whereas appendices C, D, G, H, and J are informative.

This part was proposed by China Electricity Council.

This part is under jurisdiction of the Technical Committee on Electric Power Planning and Engineering of Standardization Administration of Power Industry.

This part is mainly drafted by Guangdong Electric Power Design Institute and East China Electric Power Design Institute.

The organizations participating in drafting this part include China Power Engineering Consulting Group Corporation, Shandong Electric Power Engineering Consulting Institute Corp., Ltd., and Northeast Electric Power Design Institute.

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Any comments and suggestions proposed during the implementation of this code are to be referred to the Standardization Center of China Electricity Council at the address of No.1, Ertiao Lane, Baiguang Road, Xuanwu District Beijing 100761, China.

This code is translated by SUNTHER Translation & Solutions under the authority of China Electric Power Planning & Engineering Association.

Contents

1 Scope

This part of DL/T 5409 specifies the basic technical requirements for surveying nuclear power plants and their ancillary facilities.

This part is applicable to surveying nuclear power plants and their ancillary facilities at design and construction stage. It may also be used as a reference for surveying during operation management stage.

2 Normative References

The following normative references contain provisions which, through reference in the text, constitute provisions of this part. For dated references, all their subsequent amendments (excluding the contents of errata) or revisions shall not apply. However, parties to agreements based on this part are encouraged to investigate the possibility of using their most recent editions. For undated references, their latest edition shall apply to this part.

GB/T 20257.1 *Cartographic Symbols for National Fundamental Scale Maps — Part 1: Specifications for Cartographic Symbols — 1:500, 1:1000, and 1:2000 Topographic Maps*

GB/T 7931 *Specifications for Aerophotogrammetric Field Work of 1:500, 1:1000, and 1:2000 Topographic Maps*

GB 12319 *Symbols, Abbreviations and Terms Used on Chinese Charts*

GB/T 12897 *Specifications for the First and Second Order Leveling*

GB/T 12898 *Specifications for the Third and Forth Order Leveling*

GB/T 13977 *Specifications for Aerophotogrammetric Field Work — 1:5000 and 1:10 000 Topographic Maps*

GB/T 15967 *Specifications for Aerial Photogrammetric Digital Mapping of 1:500, 1:1000, and 1:2000 Topographic Maps*

GB/T 18316 *Specifications for Inspection and Acceptance of Quality of Digital Surveying and Mapping Achievements*

GB/T 20257.2 *Cartographic Symbols for National Fundamental*

Scale Maps — Part 2: Specifications for Cartographic Symbols — 1:5000 and 1:10 000 Topographic Maps

GB 50026 *Code for Engineering Surveying*

JGJ8 *Code for Deformation Measurements of Building and Structure*

DL/T 5001 *Technical Code for Engineering Survey of Fossil Fuel Power Plant*

3 General Provisions

3.0.1 This code is established to unify the technical requirements for surveying nuclear power plants and their ancillary facilities and provide surveying and mapping information for construction of nuclear power plants in a timely and accurate manner in order to achieve technical advancement, economical rationality and high quality and to accommodate the needs for construction and development of nuclear power plants.

3.0.2 The main contents of this part include horizontal and vertical control surveys, topographic surveys of lands and waters in a scale of 1:500–1:10 000, digital photography surveys, application of satellite remote sensing technique, construction surveys, and other surveys.

3.0.3 The surveys of nuclear power plants generally employ the national plane coordinate and elevation systems, such as Xi'an Geodetic Coordinate System 1980 (or Beijing Geodetic Coordinate System 1954), and National Vertical Datum 1985 (or Huanghai Vertical Datum 1956). Where relatively independent plane coordinate or elevation systems are used, they shall be correlated with the national plane coordinate or vertical system.

3.0.4 The control networks for surveying the main plant area and ancillary facility area shall be arranged at different stages and at different levels consisting of primary network, secondary network, and micro-grid control network.

3.0.5 The basic requirements for the accuracy of primary network are as follows: the root mean square error (RMSE) of the coordinates of the weakest horizontal control point (with respect to the starting

point for calculation of horizontal positions in surveyed area) shall not be more than 2 cm; and the RMSE of the elevation at the weakest elevation control point (with respect to the starting point for calculation of elevations in surveyed area) shall not be more than 1 cm.

3.0.6 The basic mapping scales used in the design stage shall be as specified in Table 3.0.6.

Table 3.0.6 Basic mapping scales

Design Stage	Basic Scale
Pre-feasibility study, and feasibility study	1:5000–1:10 000
Preliminary design	1:1000–1:2000
Construction drawing design	1:500–1:1000
Note1: During the pre-feasibility study and feasibility study stages, the personnel generally collect the existing topographic maps for use. Alternatively, they may remap the survey area using the techniques including digital photogrammetry and satellite remote sensing. Note2: The topographic maps used in different design stages may also be developed in the scales as required by specific projects.	

3.0.7 Cartographic symbols shall be as specified in GB/T 20257.1, GB/T 20257.2 and GB 12319.

3.0.8 The application software intended for surveying nuclear power plants, including those self-developed, introduced, and transferred surveying and mapping software, can only be used after they are tested and certified by the organizations at corresponding levels.

3.0.9 The state-of-the-art techniques, such as GPS, digital photogrammetry, and satellite remote sensing, shall be actively generalized for surveying nuclear power plants, as long as they can meet the requirements on accuracy specified herein.

3.0.10 The surveying and mapping instruments and tools must be inspected and calibrated in a timely manner, and shall be maintained, preserved and repaired regularly.

3.0.11 In this part, RMSE is taken as the criterion for assessing the surveying and mapping accuracy, whereas twice the RMSE as the limit error.

Note: Unless otherwise indicated, the plus or minus sign of RMSE, closing error, tolerance and discrepancy contained in the provisions herein are generally omitted.

3.0.12 The original records of various field surveys shall be filled completely, legibly, orderly, and neatly and any erasing, obliteration and transcription is prohibited.

3.0.13 The electronic versions of the relevant observations data, digital diagrams and technical documentation that are the outcome of various surveying and mapping activities and are valuable to maintain shall be sorted, backuped, and filed by categories and shall be maintained permanently along with their hard copies.

3.0.14 In addition to the requirements stipulated herein, the surveying of nuclear power plants shall comply with the applicable national and industrial standards in force.

4 Horizontal Control Survey

4.1 General Requirements

4.1.1 This chapter applies to the horizontal control survey of the main plant area and the ancillary facilities area. At early site selection stage, horizontal control survey performed within a larger range shall comply with the relevant national standards in force.

4.1.2 The horizontal control network may be established using the methods including satellite positioning survey, traverse survey, and triangulation survey.

4.1.3 In terms of accuracy classification of horizontal control network, the accuracy of satellite positioning control network, traverse, traverse network, and triangulation network are third-order, fourth-order, class Ⅰ, and class Ⅱ respectively.

4.1.4 The arrangement and calculation of primary control network shall comply with the following principles:

1 The primary control network shall be planned comprehensively according to the specific local conditions and shall be cost effective and accommodate the future development.

2 When carrying out connection survey with the national system, the connection survey scheme shall be taken into account as well, and the connection survey shall be established and calculated independently of the primary control network. The methods and accuracy indicators of coordinate connection survey may comply with the relevant provisions of GB 50026.

3 Prior to work, data collection and reconnaissance survey

shall be performed, the collected control data and topographic maps shall be analyzed comprehensively, and optimal design and accuracy estimation shall be made on the maps. On the premise of meeting the accuracy requirements, the order of accuracy of the network and the observation scheme shall be determined reasonably, nevertheless, the accuracy shall not be lower than the fourth order.

4 If the accuracy of the initial point cannot meet the requirements, the coordinates of a point and an azimuth shall be selected as the initial data.

5 Where satellite positioning survey method is used in primary control network, distance measuring instrument shall be used to test the side length of the control network after constraint adjustment. The number of tested sides shall not be less than three. The accuracy of the distance measuring instrument shall be less than or equal to 5 mm class. The relative error of discrepancy shall not exceed 1/60 000 as compared with the inversely calculated side length using GPS coordinates.

4.1.5 For the coordinate system of horizontal control networks, on condition that the deformation of projection length in the survey area is no more than 1/150 000, the personnel have the options below:

1 Use unified Gauss conformal projection 3° zone plane rectangular coordinate system.

2 Use arbitrary zone plane rectangular coordinate system, and the projection plane may employ Gauss projection plane, datum plane with compensation effect or mean height of survey area.

3 In areas where existing horizontal control networks are available, the original coordinate system may be used.

4 Use an independent coordinate system.

4.1.6 Where necessary, coordinate connection survey shall be