Revision of Wind Farm Certification Onshore Wind Power Plant Edition (NKRE-GL-WFC01)

Comparison Table for Previous and New Versions

[After revision: Edition: March 2023 ← Before revision: July 2021 (October 2021 Error Correction Edition)]

March 31, 2023
NIPPON KAIJI KYOKAI (ClassNK)

- The underlined parts of the provisions listed in the "Before revision" column shall be amended to the underlined parts of the corresponding provisions listed in the "After revision" column.
- Where a provision is marked with double lines in the "Before revision" column and there is no corresponding provision in the "After revision" column, that provision shall be deleted.
- Where a provision is marked with double lines in the “After revision” column and there is no corresponding provision listed in the "Before revision" column, that provision shall be added.

< Main points of revision >

1) Reflection of 20140328 Bureau of Commerce No. 1 "Interpretation of Technical Standards for Wind Power Generation Facilities" (Revision 20230310 Bureau No. 2).
   - Action for amendment effective December 26, 2022, and amendment effective March 20, 2023.
2) Revisions to respond to the following items in accordance with the amendment of the Electricity Business Act executed on March 20, 2023.
   - In connection with the abolition of the “Implementation procedures for the examination of construction plans for the installation or modification of wind power plants” (Ministry of Economy, Trade and Industry, No.20210518, Bureau No. 1, May 24, 2021), from the viewpoint of ensuring the continuity of examinations, the contents written in those Implementation procedures were incorporated into this document.
   - In connection with the start of the system of registered conformity assessment bodies, as a response to this system, some items were added to address all of the requirements of Articles 4, 5 and 7 of the Ministerial Ordinance Prescribing Technical Standards for Wind Power Generation Facilities (Ministry of Economy, Trade and Industry Ordinance of the Ministry of International Trade and Industry No. 53, final revision: Ordinance of the Ministry of Economy, Trade and Industry No. 32 of March 31, 2017).
3) Incorporation of requirements that have been generalizable in the course of performing the individual examinations for wind farm certification to date.
   - Partial revision of contents of Annexes A, B, C and F.
   - Foundation design requirements were added in Chapters 2, 3, 4 and 6, and Annex G was newly added.
4) The items are specified as requirements, which were often commented in the individual evaluations for wind farm certification performed in the past.

End

Cover and revision history

<table>
<tr><th>After revision</th><th>Before revision</th></tr>
<tr><td>New issue NKRE-GL-WFC01, Edition: July 2021
July 31, 2021
Partial revision (document number unchanged) NKRE-GL-WFC01, Edition: July 2021
October 1, 2021
Partial revision NKRE-GL-WFC01, Edition: March 2023
March 31, 2023</td><td>New issue NKRE-GL-WFC01, Edition: July 2021
July 31, 2021
Partial revision (document number unchanged) NKRE-GL-WFC01, Edition: July 2021
October 1, 2021
(added)</td></tr>
<tr><td>Revision History

I. (Omitted)

II. New issue dated March 31, 2023 (Document No.: NKRE-GL-WFC01, Edition: March 2023)

EFFECTIVE DATE and APPLICATION
1. These guidelines shall be enforced from April 1, 2023.
2. Notwithstanding the provisions of these guidelines, the provisions then in force shall remain applicable to power plants other than those falling under any of the following.
(1) Power plants for which the application for examination pertaining to wind farm certification is accepted on or after June 1, 2023
(2) Power plants for which the initial certification document of wind farm certification is issued on or after September 1, 2023
3. Regardless of 1 and 2 above, it should be noted that for provisions, etc., based on the requirements shown below from Chapter 1, 1.1.1-3. of these Guidelines, the application shall be from the effective date of that provision, etc.
1) 20140328 Bureau of Commerce No. 1 "Interpretation of Technical Standards for Wind Power Generation Facilities" (revised 20230310 Bureau No. 2)</td><td>Revision History

I. (Omitted)

(added)</td></tr>
</table>

After revision	Before revision
2) Annotations to the Ministerial Ordinance Prescribing Technical Standards for Wind Power Generation Facilities and its Interpretation (Ministry of Economy, Trade and Industry, revised on March 20, 2023)	

Chapter 1 General

After revision	Before revision
1.1 General 1.1.1 to 1.1.3 *(Omitted)*	1.1 General 1.1.1 to 1.1.3 *(Omitted)*
1.2 Normative References 1.2.1 General -1. The following standards are the normative references for wind farm certification that are specified in the "Sector-specific guidelines for 'accreditation criteria' - Wind power generation systems: wind farms, projects -" (JAB PD366:2017) document produced by the Japan Accreditation Board, excluding those for offshore and small wind turbines. Where an anno domini year is written for these cited standards, the version of the year mentioned shall apply, and subsequent revised versions (including Supplements) shall not apply. If there is no anno domini year written for a cited standard, the most recent version (including Supplements) shall apply. [J-01] JIS C 1400-1:2017 : Wind Energy Generation Systems-Part 1: Design requirements [J-02] IEC 61400-1:2019 : Wind energy generation systems - Part 1: Design requirements [J-03] Ministerial Ordinance Prescribing Technical Standards for Wind Power Generation Facilities (Ministry of Economy, Trade and Industry, Ordinance of the Ministry of International Trade and Industry No. 53, final revision: Ordinance of the Ministry of Economy, Trade and Industry No. 32 of March 31, 2017) [J-04] 20140328 Bureau of Commerce No. 1 "Interpretation of Technical Standards for Wind Power Generation Facilities" (Revision 20230310 Bureau No. 2) [J-05] Guidelines for Design of Wind Turbine Support Structures and Foundation [2010 version] (Japan Society of Civil Engineers) [J-06] Germanischer Lloyd (GL) Guideline for the Certification of Wind Turbines 2010 -2. In order to meet the requirements of the standards listed in -1 above, the following standards referenced by these guidelines shall form part of the provisions. Where an anno domini year is written for these cited standards, the version of the year mentioned shall apply, and subsequent revised versions (including Supplements) shall not apply. If there is no anno domini year written for a cited standard, the most recent version (including Supplements) shall apply. [R-01] NKRE-SP-0003 Wind Farm Certification Procedures, Edition October 2021 [R-02] Annotations to the Ministerial Ordinance Prescribing Technical Standards for Wind Power Generation Facilities and its Interpretation (Ministry of Economy, Trade and	1.2 Normative References 1.2.1 General -1. The following standards are the normative references for wind farm certification that are specified in the "Sector-specific guidelines for 'accreditation criteria' - Wind power generation systems: wind farms, projects -" (JAB PD366:2017) document produced by the Japan Accreditation Board, excluding those for offshore and small wind turbines. Where an anno domini year is written for these cited standards, the version of the year mentioned shall apply, and subsequent revised versions (including Supplements) shall not apply. If there is no anno domini year written for a cited standard, the most recent version (including Supplements) shall apply. [J-01] JIS C 1400-1:2017 : Wind Energy Generation Systems-Part 1: Design requirements [J-02] IEC 61400-1:2019 : Wind energy generation systems - Part 1: Design requirements [J-03] Ministerial Ordinance Prescribing Technical Standards for Wind Power Generation Facilities (Ministry of Economy, Trade and Industry, Ordinance of the Ministry of International Trade and Industry No. 53 of March 27, 1997, final revision: Ordinance of the Ministry of Economy, Trade and Industry No. 32 of March 31, 2017) [J-04] Interpretation of Technical Standards for Wind Power Generation Facilities (Ministry of Economy, Trade and Industry, No. 20140328, Bureau of Commerce No. 1, April 1, 2014) [J-05] Guidelines for Design of Wind Turbine Support Structures and Foundation [2010 version] (Japan Society of Civil Engineers) [J-06] Germanischer Lloyd (GL) Guideline for the Certification of Wind Turbines 2010 -2. In order to meet the requirements of the standards listed in -1 above, the following standards referenced by these guidelines shall form part of the provisions. Where an anno domini year is written for these cited standards, the version of the year mentioned shall apply, and subsequent revised versions (including Supplements) shall not apply. If there is no anno domini year written for a cited standard, the most recent version (including Supplements) shall apply. [R-01] NKRE-SP-0003 Wind Farm Certification Procedures, Edition February 2021 [R-02] Annotations to the Ministerial Ordinance Prescribing Technical Standards for Wind Power Generation Facilities and its Interpretation (Ministry of Economy, Trade and

After revision	Before revision
Industry, revised on March 20, 2023) *(Deleted)* [R-03] Recommendations for Design of Building Foundations (Architectural Institute of Japan, 2019) [R-04] Guidebook on Design and Fabrication of High Strength Bolted Connections (Architectural Institute of Japan, 2003) [R-05] Structural Design Recommendation for Chimneys (Architectural Institute of Japan, 2007) [R-06] JIS C 1400-12-1:2010 : Wind turbines - Part 12-1: Power performance measurements of electricity producing wind turbines [R-07] JIS C 1400-24:2014 : Wind turbines - Part 24: Lightning protection [R-08] IEC 61400-6:2020 : Wind energy generation systems - Part 6: Tower and foundation design requirements [R-09] IEC 61400-13:2015 : Wind turbines - Part 13: Measurement of mechanical loads [R-10] ISO 273:1979 : Fasteners - Clearance holes for bolts and screws [R-11] ISO 4354:2009 : Wind actions on structures [R-12] EN 1993-1-9:2005 : Design of steel structures - Part 1-9: Fatigue [R-13] fib Model Code for Concrete Structures 2010(CEB-FIP Model Code 2010) [R-14] CEB-FIP Model Code 1990 [R-15] DNVGL-ST-0126 Support structures for wind turbines, Edition April 2016 [R-16] MEASNET Evaluation of Site-Specific Wind Conditions, Version 2, April 2016 [R-17] IEC 61400-12-1:2017 : Wind energy generation system - Part 12-1: Power performance measurements of electricity producing wind turbines	Industry, revised on June 21, 2021) [R-03] Implementation procedures for the examination of construction plans for the installation or modification of wind power plants (Ministry of Economy, Trade and Industry, No.20210518, Bureau No. 1, May 24, 2021) [R-04] Recommendations for Design of Building Foundations (Architectural Institute of Japan, 2019) [R-05] Guidebook on Design and Fabrication of High Strength Bolted Connections (Architectural Institute of Japan, 2003) [R-06] Structural Design Recommendation for Chimneys (Architectural Institute of Japan, 2007) [R-07] JIS C 1400-12-1:2010 : Wind turbines - Part 12-1: Power performance measurements of electricity producing wind turbines [R-08] JIS C 1400-24:2014 : Wind turbines - Part 24: Lightning protection [R-09] IEC 61400-6:2020 : Wind energy generation systems - Part 6: Tower and foundation design requirements [R-10] IEC 61400-13:2015 : Wind turbines - Part 13: Measurement of mechanical loads [R-11] ISO 273:1979 : Fasteners - Clearance holes for bolts and screws [R-12] ISO 4354:2009 : Wind actions on structures [R-13] EN 1993-1-9:2005 : Design of steel structures - Part 1-9: Fatigue [R-14] fib Model Code for Concrete Structures 2010 (CEB-FIP Model Code 2010) [R-15] CEB-FIP Model Code 1990 [R-16] DNVGL-ST-0126 Support structures for wind turbines, Edition April 2016 [R-17] MEASNET Evaluation of Site-Specific Wind Conditions, Version 2, April 2016 [R-18] IEC 61400-12-1:2017 : Wind energy generation system - Part 12-1: Power performance measurements of electricity producing wind turbines
1.3 Definitions and abbreviations 1.3.1 to 1.3.3 *(Omitted)*	1.3 Definitions and abbreviations 1.3.1 to 1.3.3 *(Omitted)*
1.4 Wind farm certification 1.4.1 General	1.4 Wind farm certification 1.4.1 General

<table>
<tr><th>After revision</th><th>Before revision</th></tr>
<tr><td>-1. to -2. (Omitted)
-3. The purpose of wind farm certification is to assess whether the design of type-certified wind turbines (RNA) and support structure (towers and foundations) are in conformity with the external conditions and the requirements under the Electricity Business Act, specifically, to confirm compliance with Articles 4, 5 and 7 of the Technical Standards for Wind Power Generation Facilities[J-03].
-4. The prerequisites for the issuance of wind farm certification are the conditions that the wind turbine (RNA) and tower must have obtained type certification, and that the manufacturing of the wind turbine (RNA) and tower and their main parts and components must have been carried out at a place specified in the type certification. The handling of deviations from these conditions is specified in Chapter 5 for the wind turbines (RNA) and in Chapter 6 for the towers.
-5. (Omitted)</td><td>-1. to -2. (Omitted)
-3. The purpose of wind farm certification is to assess whether the design of type-certified wind turbines (RNA) and support structure (towers and foundations) are in conformity with the external conditions and the requirements under the Electricity Business Act.
-4. In principle, wind farm certification is not permitted for power plants that use wind turbines (RNA) or towers that have not obtained type certification. However, in the case of a wind turbine which has acquired a design evaluation conformity statement and is carrying out type testing for the acquisition of type certification, the wind farm certification may be issued on the condition that the acquisition of the type certification is set as an outstanding issue and a time limit for the solution of that outstanding issue is established.
-5. (Omitted)</td></tr>
<tr><td>1.4.2 to 1.4.8 (Omitted)</td><td>1.4.2 to 1.4.8 (Omitted)</td></tr>
<tr><td>1.4.9 Certification subcommittee
-1. to -2. (Omitted)
(Deleted)
-3. In principle, the format when the Support Structure Certification Subcommittee Foundation and Ground Section Meeting is held shall be that the requester directly explains the contents related to the items to be examined to the members of the section meeting. The only language accepted for the materials used for explanation in the relevant section meeting shall be Japanese.

Table 1-4 Certification subcommittee/section meeting
<table><tr><th>Certification subcommittee</th><th>Items to be examined</th></tr><tr><td>Large Wind Turbine Certification Subcommittee</td><td>(Omitted)</td></tr></table></td><td>1.4.9 Certification subcommittee
-1. to -2. (Omitted)
-3. In addition to -2. above, in cases where the requirements for general facilities do not apply as a result of the Implementation procedures for the examination of construction plans for the installation or modification of wind power plants[R-02], after the examination by ClassNK is completed, a place may be established where the requester directly explains the content of the construction plan to the subcommittee/section meeting members based on the results of the examination by ClassNK. The only language accepted for the materials used for explanation in the relevant subcommittee/section meeting shall be Japanese.
-4. In principle, the format when the Support Structure Certification Subcommittee Foundation and Ground Section Meeting is held shall be that the requester directly explains the contents related to the items to be examined to the members of the section meeting. The only language accepted for the materials used for explanation in the relevant section meeting shall be Japanese.

Table 1-4 Certification subcommittee
<table><tr><th>Certification subcommittee</th><th>Items to be examined</th></tr><tr><td>Large Wind Turbine Certification Subcommittee</td><td>(Omitted)</td></tr></table></td></tr>
</table>

After revision		Before revision	
Support Structure Certification Subcommittee Tower Section Meeting	[M3] The Support structure design evaluation (Tower) [including site conditions assessment, design basis evaluation and integrated load analysis] items that deviate from the Guidelines for Design of Wind Turbine Support Structures and Foundation[J-05] *Among the items to be examined by the Tower Section Meeting as deviations from the Guidelines for Design of Wind Turbine Support Structures and Foundation[J-05], the items for which the corresponding design methods have been established are summarized in Annex F. If there is deviation in an item not listed in Annex F, or if a method that is different to the methods listed in Annex F is to be applied, the requirements shall be determined separately by the Tower Section Meeting.	Support Structure Certification Subcommittee Tower Section Meeting	[M3] The Support structure design evaluation (Tower) [including site conditions assessment, design basis evaluation and integrated load analysis] items that deviate from the Guidelines for Design of Wind Turbine Support Structures and Foundation[J-05] *(added)*
Support Structure Certification Subcommittee Foundation and Ground Section Meeting	[M4] The Support structure design evaluation (Foundation) [including site conditions assessment, design basis evaluation and integrated load analysis] items that deviate from the Guidelines for Design of Wind Turbine Support Structures and Foundation[J-05] *Among the items to be reviewed by the Foundation and Ground Section Meeting as deviations from the Guidelines for Design of Wind Turbine Support Structures and Foundation[J-05] the items for which the corresponding design methods have been established are summarized in Annex G. If there is deviation in an item not listed in Annex G, or if a method that is different to the methods listed in Annex G is to be applied, the requirements shall be determined separately by the Foundation and Ground Section Meeting.	Support Structure Certification Subcommittee Foundation and Ground Section Meeting	[M4] The Support structure design evaluation (Foundation) [including site conditions assessment, design basis evaluation and integrated load analysis] items that deviate from the Guidelines for Design of Wind Turbine Support Structures and Foundation[J-05] *(addhed)*
1.5 Documents to be submitted 1.5.1 to 1.5.3 *(Omitted)*		1.5 Documents to be submitted 1.5.1 to 1.5.3 *(Omitted)*	
1.5.4 Materials related to wind turbine (RNA) design evaluation		1.5.4 Materials related to wind turbine (RNA) design evaluation	

After revision	Before revision
-1. *(Omitted)* (1) to (6) *(Omitted)* (7) Of the items among the wind turbine structural drawings and strength calculation documents (including details related to construction) to be attached to the construction plan notification based on the Electricity Business Act, the items which are not included in (1) to (6) above. (8) Materials summarizing the measures for safely stopping wind turbines specified in 5.5.2 and the results of the strength evaluation associated with those measures (It is acceptable for this to be the "Explanation of the measures for the safe and automatic stopping of the wind turbine when the rotational speed has increased significantly, or when the functioning of the control equipment for the wind turbine has significantly deteriorated," which is an explanation to be attached to the construction plan notification based on the Electricity Business Act) (9) Materials summarizing the measures taken to protect against lightning strikes specified in 5.5.3 (It is acceptable for this to be the "Explanation of the protection of the wind turbine against lightning strikes," which is to be attached to the construction plan notification based on the Electricity Business Act) (10) Explanation of the power generation method, which is to be attached to the construction plan notification based on the Electricity Business Act	-1. *(Omitted)* (1) to (6) *(Omitted)* *(added)* (7) Materials summarizing the measures for safely stopping the wind turbine as specified in 5.5.1, and the results of the strength evaluation associated with those measures *(added)* (8) Materials summarizing the measures taken to protect against lightning strikes as specified in 5.5.2 *(added)* *(added)*
1.5.5 Materials related to the support structure (Tower) design evaluation -1. *(Omitted)* (1) to (4) *(Omitted)* (5) Report including the results of consideration of the items specified in 6.2 (If there are items that deviate from the Guidelines for Design of Wind Turbine Support Structures and Foundation[J-05], it must include items for the contents of Annex F.) (6) *(Omitted)* (7) Of the items among the support structure structural drawings and strength calculation documents (including details related to construction) to be attached to the construction plan notification based on the Electricity Business Act, the items which are not included in (1) to (6) above. (8) Materials summarizing the details listed below for the tower manufacturing evaluation. 1) If a tower described in the type certification will be selected (including the selection of the manufacturing plant described in the type certification), then the expected timing of the decision on the manufacturing plant. 2) In cases other than 1) above, the policy related to the manufacturing evaluation, and the estimated	1.5.5 Materials related to the support structure (Tower) design evaluation -1. *(Omitted)* (1) to (4) *(Omitted)* (5) Report including the results of consideration of the items specified in 6.2 *(added)* (6) *(Omitted)* *(added)*

After revision	Before revision
timing of the decision on that policy. *(Deleted)*	-2. If no application for examination for the support structure (Foundation) design evaluation is made, the following documents shall be submitted to ClassNK from among the examination materials specified in 1.5.6-1. (1) Of the support structure strength calculation documents attached to the construction plan notification based on the Electricity Business Act, a report that corresponds to the following details - Geotechnical investigation - Seismic response analysis - Work execution plan - Special materials - Foundation drawings around tower anchorage zone
1.5.6 Materials related to the support structure (Foundation) design evaluation -1. *(Omitted)* (1) Support structure structural drawings and strength calculation documents (including details related to construction) to be attached to the construction plan notification based on the Electricity Business Act (2) Explanatory materials for the following items related to the support structure design (in case the Support Structure Certification Subcommittee Foundation and Ground Section Meeting specified in 1.4.9-3. is to be hold) - Overview of the power plant plan - Items that deviate from the Guidelines for Design of Wind Turbine Support Structures and Foundation[J-05] related to foundation design, and details of the handling policy and study items related to them (including the details related to the applicable items in Annex G.) - Overview of structural design of support structure	1.5.6 Materials related to the support structure (Foundation) design evaluation -1. *(Omitted)* (1) Support structure strength calculation documents attached to the construction plan notification based on the Electricity Business Act (2) Overview materials on the support structure design (in case the Support Structure Certification Subcommittee Foundation and Ground Section Meeting specified in 1.4.9-4. is to be hold) *(added)*
1.6 Correspondence to the Technical Standards for Wind Power Generation Facilities [Reference] 1.6.1 General -1. *(Omitted)* Table 1 -5 Correspondence between the Technical Standards for Wind Power Generation Facilities and	1.6 Correspondence to the Technical Standards for Wind Power Generation Facilities [Reference] 1.6.1 General -1. *(Omitted)* Table 1-5 Correspondence between the Technical Standards for Wind Power Generation Facilities and

After revision		Before revision	
the requirements of these guidelines		the requirements of these guidelines	
Technical Standards for Wind Power Generation Facilities (Excerpts from the original text, and temporary translation)	Related items in these guidelines	(As left)	(As left)
(Scope) *(Omitted)*	- *(Deleted)*	(Scope) *(Omitted)*	*(added)* Chapter 1. General
(Definitions) *(Omitted)*	*(Omitted)*	(Definitions) *(Omitted)*	*(Omitted)*
(Hazard prevention measures for persons other than operators) *(Omitted)*	*(Omitted)*	(Hazard prevention measures for persons other than operators) *(Omitted)*	*(Omitted)*
(Wind turbine) *(Omitted)*	*(Deleted)* < Item (i) > ▪ [Interpretation] Article 3 Paragraphs 1 to 3 - 1.4.1-3., 1.5.2 - 5.5.2 < Item (ii) > ▪ [Interpretation] Article 4 Paragraphs 1 to 2 - 2.1, 2.2, 2.3 - Annex A - Annex B - Annex C ▪ [Interpretation] Calculation of wind pressure in Article 4 Paragraph 1, and	(Wind turbine) *(Omitted)*	2.Site conditions assessment 3. Design basis evaluation 4. Integrated load analysis evaluation 5. Wind turbine (RNA) design evaluation *(added)*

After revision		Before revision	
	Paragraphs 3 and 4 - 3.2.2 - 4.2 - Chapter 5 ▪ [Interpretation] Article 4 Paragraph 5 - Not covered < Item (iii) > ▪ [Interpretation] Article 5 - 5.5.2-2. < Item (iv) > ▪ [Interpretation] Article 6 - 5.5.2-2. < Item (v) > - 5.5.1		
(Ensuring the safety of wind turbines) *(Omitted)*	*(Deleted)* < Paragraph 1 > ▪ [Interpretation] Article 7 Paragraphs 1 to 3 - 5.5.2-1. < Paragraph 2 > ▪ [Interpretation] Article 7 Paragraphs 4 to 5 - Not covered < Paragraph 3 > ▪ [Interpretation] Article 7 Paragraph 6	(Ensuring the safety of wind turbines) *(Omitted)*	2.Site conditions assessment 5. Wind turbine (RNA) design evaluation *(added)*

After revision		Before revision	
	- 2.5 - 5.5.3		
(Prevention of dangers of oil pressure systems and compressed air devices) *(Omitted)*	*(Omitted)*	(Prevention of dangers of oil pressure systems and compressed air devices) *(Omitted)*	*(Omitted)*
(Structure to support the wind turbine) *(Omitted)*	*(Deleted)* < Paragraph 1 > ▪ [Interpretation] Article 9 Paragraph 1 - 2.1, 2.2, 2.3, 2.4, 2.6 - 3.2.3 - 4.3 ▪ [Interpretation] Article 9 Paragraph 2 - Chapter 6 ▪ [Interpretation] Article 9 Paragraph 3 - Chapter 6 ▪ [Interpretation] Article 10 - 3.2.3 ▪ [Interpretation] Article 11 - 3.2.3 ▪ [Interpretation] Article 12 - 2.4, 2.6 - 3.2.3 - 4.3	(Structure to support the wind turbine) *(Omitted)*	2.Site conditions assessment 3. Design basis evaluation 4. Integrated load analysis evaluation 6. Support structure design evaluation *(added)*

After revision		Before revision	
	- Chapter 6 ▪ [Interpretation] Article 13 - Chapter 6 ▪ [Interpretation] Article 14 - Chapter 6 ▪ [Interpretation] Article 15 - Chapter 6 ▪ [Interpretation] Article 16 Paragraph 1 - 1.2.2 ▪ [Interpretation] Article 16 Paragraph 2 - Not covered ▪ [Interpretation] Article 17 Paragraph 1 - Chapter 6 ▪ [Interpretation] Article 16 Paragraph 2 - Not covered < Paragraph 2 > - Not covered		
(Prevention of pollution, etc.) *(Omitted)*	*(Omitted)*	(Prevention of pollution, etc.) *(Omitted)*	*(Omitted)*

Chapter 2. Site conditions assessment

After revision	Before revision
2.1 General 2.1.1 General -1. to -2. *(Omitted)* -3. The wind conditions shall be summarized in accordance with Annex C.4.	2.1 General 2.1.1 General -1. to -2. *(Omitted)* *(added)*
2.2 Wind conditions during power production 2.2.1 Wind condition measurement -1. to -2. *(Omitted)* -3. As shown in Table 2.1, the observed height shall be not less than 2/3 of the planned hub height, regardless of the topography class. Also, in order to appropriately evaluate the wind shear, the principle shall be to perform observation at three altitudes or more. In addition, the distance between the measurement point and the wind turbine construction point must be within the representative radius corresponding to the topographic complexity as shown in Table 2.1. -4. to -5. *(Omitted)* -6. When measurement must be carried out in the vicinity of an existing wind turbine that is in operation, a point which is not affected by the wake of the existing wind turbine must be selected. In addition, Annex A.6 may be followed if observations are to be made at a point where the wake effect of an existing wind turbine cannot be excluded. -7. The results of the wind condition measurement must be summarized in accordance with Annex A.5.	2.2 Wind conditions during power production 2.2.1 Wind condition measurement -1. to -2. *(Omitted)* -3. As shown in Table 2.1, the observed height shall be not less than 2/3 of the planned hub height, regardless of the topography class. The distance between the measurement point and the wind turbine construction point must be within the representative radius corresponding to the topographic complexity as shown in Table 2.1. -4. to -5. *(Omitted)* *(added)*
2.2.2 Measurement data evaluation -1. to -4. *(Omitted)* -5. Regarding wind condition measurement data, comparison with normal year values must be carried out using reference data that have a correlation coefficient of 0.8 or higher with the wind condition measurement data, such as reanalysis data by a meteorological model and long-term measurement data from a meteorological observatory close to the site, and appropriate corrections must be made. -6. to -8. *(Omitted)* -9. For measurement data from remote sensing equipment, it shall be kept in mind that appropriate correction will be required according to the complexity of the topography and the characteristics of the observation methods of the equipment used.	2.2.2 Measurement data evaluation -1. to -4. *(Omitted)* -5. Regarding wind condition measurement data, comparison with normal year values must be carried out using appropriate reference data such as reanalysis data by a meteorological model and long-term measurement data from a meteorological observatory close to the site, and appropriate corrections must be made. -6. to -8. *(Omitted)* *(added)*
2.2.3 Evaluation of topographic complexity -1. In order to select a model for airflow analysis and to evaluate the number of wind direction sectors,	2.2.3 Evaluation of topographic complexity -1. In order to select a model for airflow analysis and to evaluate the number of wind direction sectors,

After revision	Before revision
the turbulence structure correction parameters (hereinafter, C_{CT}) must be calculated for the measurement position (measurement mast and remote sensing equipment) and the wind turbine position in order to judge the topographic complexity at each position. The specific method of judgment shall follow one of the following. (1) to (2) *(Omitted)* -2. *(Omitted)*	the turbulence structure correction parameters (hereinafter, C_{CT}) must be calculated for the measurement mast position and the wind turbine position in order to judge the topographic complexity at each position. The specific method of judgment shall follow one of the following. (1) to (2) *(Omitted)* -2. *(Omitted)*
2.2.4 Airflow analysis -1. to -3. *(Omitted)*	2.2.4 Airflow analysis -1. to -3. *(Omitted)*
2.2.5 Calculation of the wind speed appearance frequency distribution -1. *(Omitted)* *(Deleted)* -2. *(Omitted)*	2.2.5 Calculation of the wind speed appearance frequency distribution -1. *(Omitted)* -2. In addition to the appearance frequency by direction, the energy density by direction must also be calculated. -3. *(Omitted)*
2.2.6 Calculation of turbulence intensity -1. to -5. *(Omitted)*	2.2.6 Calculation of turbulence intensity -1. to -5. *(Omitted)*
2.2.7 Evaluation of wind turbine wake effect from adjacent wind turbines -1. to -2. (Omitted) -3. For the consideration of the effects of ambient turbulence and discrete turbulent wakes, it is possible to use the effective turbulence intensity (hereinafter, I_{eff}). This I_{eff} shall be calculated using the model given in either of the following. Also, for the extreme turbulence intensity including the wake effects, it is acceptable to use the maximum turbulence at the center of the wake in the most severe direction. (1) JIS C 1400-1:2017[J-01], Annex D (IEC 61400-1 Ed.3.1, Annex D) (2) IEC 61400-1:2019 [J-02], Annex E -4. *(Omitted)* *(Deleted)*	2.2.7 Evaluation of wind turbine wake effect from adjacent wind turbines -1. to -2. *(Omitted)* -3. For the consideration of the effects of ambient turbulence and discrete turbulent wakes, it is possible to use the effective turbulence intensity (hereinafter, I_{eff}). This I_{eff} shall be calculated using the model given in either of the following. *(added)* (1) JIS C 1400-1:2017[J-01], Annex D (IEC 61400-1 Ed.3.1, Annex D) (2) IEC 61400-1:2019 [J-02], Annex E -4. *(Omitted)* -5. For the extreme turbulence including the wake effects, it is possible to use the maximum turbulence at the center of the wake in the most severe direction.
2.2.8 Calculation of the wind shear exponent -1. to -3. *(Omitted)*	2.2.8 Calculation of the wind shear exponent -1. to -3. *(Omitted)*
2.2.9 Calculation of flow inclination angle -1. to -3. *(Omitted)*	2.2.9 Calculation of flow inclination angle -1. to -3. *(Omitted)*

After revision	Before revision
2.2.10 Calculation of atmospheric density -1. to -2. *(Omitted)*	2.2.10 Calculation of atmospheric density -1. to -2. *(Omitted)*
2.3 Wind conditions during parked by storm 2.3.1 Calculation of extreme wind speed and turbulence intensity -1. to -2. *(Omitted)* -3. If a typhoon simulation is used in the calculation in -1. above, the validity must be sufficiently confirmed by comparing the simulation results (upper air winds due to the hypothetical typhoon) with the measured values (upper air winds calculated from the atmospheric pressure in the typhoon database). If the result of the comparison of the simulation results and the measured values is that the simulation results are an underestimation, additional consideration must be given to the effects of uncertainty related to the number of years of analysis and the number of years of atmospheric pressure measurement. In addition, the validity of the setting of the wind direction to be verified must be sufficiently confirmed. -4. *(Omitted)* -5. *(Omitted)* -6. *(Omitted)*	2.3 Wind conditions during parked by storm 2.3.1 Calculation of extreme wind speed and turbulence intensity -1. to -2. *(Omitted)* *(added)* -3. *(Omitted)* -4. *(Omitted)* -5. *(Omitted)*
2.3.2 Calculation of atmospheric density -1. *(Omitted)*	2.3.2 Calculation of atmospheric density -1. *(Omitted)*
2.4 Geotechnical and earthquake conditions 2.4.1 General -1. *(Omitted)* (1) *(Omitted)* (2) Interpretation of Technical Standards for Wind Power Generation Facilities[J-04] (3) *(Omitted)* -2. The following points shall be taken into consideration when setting the conditions in accordance with -1. above. (1) *(Omitted)* (2) When setting the engineering base surface, as the conditions for applying one-dimensional wave theory, it must be confirmed that the shear wave velocity is 400 m/s or higher, the layer thickness is 5 m or higher, and the inclination is 5 degrees or less. If there is deviation from the above conditions, the effect must be examined, and the applicability of one-dimensional wave theory must be confirmed.	2.4 Geotechnical and earthquake conditions 2.4.1 General -1. *(Omitted)* (1) *(Omitted)* *(added)* (2) *(Omitted)* -2. The following points shall be taken into consideration when calculating the conditions in accordance with -1. above. (1) *(Omitted)* (2) When setting the engineering base surface, it must be confirmed that the shear wave velocity is 400 m/s or higher, the layer thickness is 5 m or higher, and the inclination is 5 degrees or less (conditions of application of one-dimensional wave theory). *(added)*

After revision	Before revision
(3) If the spread foundations are on sloping ground, the effect of the decreased ultimate bearing capacity must be considered.	*(added)*
(4) If the planned construction site is weak ground, it must be taken into consideration that negative frictional forces may become significant.	*(added)*
(5) If the planned construction site falls within the target area specified in the MLIT Housing Bureau Building Guidance Division Notice No. 1111 of June 24, 2016, the existence of effects from long-period ground motion must be examined.	*(added)*
(6) *(Omitted)*	(4) *(Omitted)*
(7) *(Omitted)*	(5) *(Omitted)*
(8) When making a liquefaction judgment, it should be noted that the simplified method can only be applied to a depth of up to 20 m. When making a liquefaction judgment when the liquefied layer is continuous beyond a depth of 20 m, the cyclic shear stress must be calculated using ground response analysis.	*(added)*
(9) When the planned construction site is near the edge of water line and there is a risk of liquefaction, the following points must be checked and the existence of effects from lateral flow must be checked. In addition, if there is a possibility of lateral flow occurring, the amount of lateral flow (flow power, residual deformation, etc.) must be appropriately considered. - The inclination of the ground surface and the thickness and inclination of the liquefied layer. (For the inclination, both the direction parallel to the edge of water line and the direction perpendicular to it must be checked.) - Distance to the edge of water line. - If the edge of water line has shore protection, the shape of it.	*(added)*
(10) *(Omitted)*	(3) *(Omitted)*
-3. *(Omitted)*	-3. *(Omitted)*
2.5 Lightning environment conditions 2.5.1 General -1. to -2. *(Omitted)*	2.5 Lightning environment conditions 2.5.1 General -1. to -2. *(Omitted)*
2.6 Other environmental conditions 2.6.1 General -1. *(Omitted)*	2.6 Other environmental conditions 2.6.1 General -1. *(Omitted)*

Chapter 3. Design basis evaluation

After revision	Before revision
3.1 General 3.1.1 General -1. *(Omitted)*	3.1 General 3.1.1 General -1. *(Omitted)*
3.2 Design basis requirements 3.2.1 General -1. to -2. *(Omitted)*	3.2 Design basis requirements 3.2.1 General -1. to -2. *(Omitted)*
3.2.2 Wind turbine (RNA) design basis -1. *(Omitted)* *(Omitted)* (2) Site conditions • Wind conditions during power production - Turbulence intensity correction parameter: C_{CT} (at measurement position / at wind turbine position) *(Omitted)* *(Omitted)* (10) Ultimate and fatigue design loads and response analysis *(Omitted)*	3.2.2 Wind turbine (RNA) design basis -1. *(Omitted)* *(Omitted)* (2) Site conditions • Wind conditions during power production - Turbulence intensity correction parameter: C_{CT} (at measurement mast position / at wind turbine position) *(Omitted)* *(Omitted)* (10) Extreme and fatigue design loads and response analysis *(Omitted)*
3.2.3 Support structure design basis -1. The document which shows the design basis for the support structure (tower) shall describe how the following matters were decided. For the design basis for the support structure (Tower), it should be noted that there must be compliance with Articles 10, 11 and 12 of the Interpretation of Technical Standards for Wind Power Generation Facilities[J-04]. *(Omitted)* -2. Regarding the design basis for the support structure (foundation), in principle, it is acceptable to follow the regulations in the Guidelines for Design of Wind Turbine Support Structures and Foundation[J-05]. For the design basis for the support structure (foundation), it should be noted that there must be compliance with Articles 10, 11 and 12 of the Interpretation of Technical Standards for Wind Power Generation Facilities[J-04].	3.2.3 Support structure design basis -1. The document which shows the design basis for the support structure (tower) shall describe how the following matters were decided. *(added)* *(Omitted)* -2. Regarding the design basis for the support structure (foundation), in principle, it is acceptable to follow the regulations in the Guidelines for Design of Wind Turbine Support Structures and Foundation[J-05]. *(added)*

Chapter 4. Integrated load analysis evaluation

After revision	Before revision
4.1 General 4.1.1 General -1. *(Omitted)*	4.1 General 4.1.1 General -1. *(Omitted)*
4.2 Requirements for load analysis for RNA and tower evaluation 4.2.1 Comparison of the site conditions and the design values set in the type certification -1. to -3. *(Omitted)*	4.2 Requirements for load analysis for RNA and tower evaluation 4.2.1 Comparison of the site conditions and the design values set in the type certification -1. to -3. *(Omitted)*
4.2.2 Load analysis -1. *(Omitted)* -2. In the case of a wind turbine with a power back-up as a measure for use in the event of a loss of the electrical power network, evaluation must be carried out according to 5.4, and a design load case to be applied in the ultimate load analysis must be decided. -3. *(Omitted)* -4. The definition of the site load to be calculated shall be clearly indicated, and the coordinate definition applied in that site load calculation shall be clearly indicated in a diagram. In principle, the definition specified in IEC 61400-13:2015[R-09] shall be used for the coordinate definition. -5. to -7. *(Omitted)*	4.2.2 Load analysis -1. *(Omitted)* -2. In the case of a wind turbine with a backup power supply as a measure for use in the event of a loss of the electrical power network, evaluation must be carried out according to 5.3, and a design load case to be applied in the ultimate load analysis must be decided. -3. *(Omitted)* -4. The definition of the site load to be calculated shall be clearly indicated, and the coordinate definition applied in that site load calculation shall be clearly indicated in a diagram. In principle, the definition specified in IEC 61400-13:2015[R-16] shall be used for the coordinate definition. -5. to -7. *(Omitted)*
4.3 Requirements for load analysis for support structure evaluation 4.3.1 General -1. *(Omitted)* (1) *(Omitted)* (2) Interpretation of Technical Standards for Wind Power Generation Facilities[J-04] (3) *(Omitted)*	4.3 Requirements for load analysis for support structure evaluation 4.3.1 General -1. *(Omitted)* (1) *(Omitted)* *(added)* (2) *(Omitted)*
4.3.2 Support structure load analysis -1. In addition to the load calculated in 4.3.1-1., the loading data for the foundation and the tower design load at the site shall be set with appropriate consideration of the load applied to the tower at the time of the type certification, and the site load on the tower that was calculated based on the site conditions specified in 4.2.2. -2. to -4. *(Omitted)* -5. The handling of wind and wind turbine control loads combined with the seismic loads obtained from	4.3.2 Support structure load analysis -1. In addition to the load calculated in 4.3.1-1., the loading data for the foundation and the tower design load at the site shall be set by following the provisions of Paragraphs 2.2 and 4.1.2 of the Guidelines for Design of Wind Turbine Support Structures and Foundation[J-05], and appropriately considering the load applied to the tower at the time of the type certification, and the site load on the tower that was calculated based on the site conditions specified in 4.2.2. -2. to -4. *(Omitted)* *(added)*

After revision	Before revision
the results of seismic response analysis must follow the Appended Table 3 of the Interpretation of Technical Standards for Wind Power Generation Facilities[J-04]. Although the handling of the wind and wind turbine control loads shall be as described above, the specific method for combining the seismic load and the wind and wind turbine control loads may be carried out in accordance with Paragraph 5.5.4 of the Guidelines for Design of Wind Turbine Support Structures and Foundation[J-05]. When coupled analysis simultaneously considering both the seismic and the wind and wind turbine control loads is performed, this shall be approved as appropriate by ClassNK. -6. In the case of pile foundations, if ground springs and attenuation are set using the thin layer method, etc., and not by following the provisions of the Guidelines for Design of Wind Turbine Support Structures and Foundation[J-05], the validity of the setting should be appropriately indicated in accordance with Annex G.4.	-5. In the case of pile foundations, if ground springs are set using the thin layer method, etc., and not by following the provisions of the Guidelines for Design of Wind Turbine Support Structures and Foundation[J-05], the validity of the setting should be appropriately indicated.

Chapter 5. Wind turbine (RNA) design evaluation

After revision	Before revision
5.1 General 5.1.1 General -1. The structural integrity of the wind turbine for the site conditions shall be indicated by comparing the site-specific loads obtained by the integrated load analysis with the design loads used in the type certification. <u>It is also a prerequisite that the main components of the RNA are composed of components specified in the type certificate, and that they are manufactured at a manufacturing site specified in the certification documents pertaining to the type certification.</u> -2. *(Omitted)* -3. However, in the case of a wind turbine that has not obtained type certification, <u>where the wind turbine has acquired a design evaluation conformity statement and is carrying out type testing for the acquisition of type certification, the wind farm certification may be issued on the condition that the acquisition of the type certification is set as an outstanding issue and a time limit for the solution of that outstanding issue is established. (However, it should be noted that conditional issuance is not acceptable in an examination by a registered conformity assessment body.) In other cases,</u> the handling shall be as judged appropriate by ClassNK.	5.1 General 5.1.1 General -1. The structural integrity of the wind turbine for the site conditions shall be indicated by comparing the site-specific loads obtained by the integrated load analysis with the design loads used in the type certification. -2. *(Omitted)* -3. <u>In the case of</u> a wind turbine which has not acquired type certification, the handling shall be as judged appropriate by ClassNK.
5.2 Wind turbine (RNA) design evaluation 5.2.1 Comparison of site loads with design loads at type certification -1. to -3. *(Omitted)*	5.2 Wind turbine (RNA) design evaluation 5.2.1 Comparison of site loads with design loads at type certification -1. to -3. *(Omitted)*
5.2.2 Strength evaluation of the components of the RNA based on the site load -1. If the site load exceeds the certified design load, the integrity of the affected components against the site load must be verified. <u>For the value obtained by dividing the site load by the certified design load in the load comparison, when it can be confirmed that the value after the third decimal place does not affect the checking value as a strength evaluation result, then if the value does not exceed 1.00 after rounding off the third decimal place, it may be considered that the integrity against the site load has been confirmed.</u> -2. to -4. *(Omitted)*	5.2.2 Strength evaluation of the components of the RNA based on the site load -1. If the site load exceeds the certified design load, the integrity of the affected components against the site load must be verified. *(added)* -2. to -4. *(Omitted)*
5.3 Nacelle cover strength evaluation 5.3.1 General -1. *(Omitted)*	5.3 Nacelle cover strength evaluation 5.3.1 General -1. *(Omitted)*

After revision	Before revision
5.3.2 Wind load on the nacelle cover -1. to -3. *(Omitted)*	5.3.2 Wind load on the nacelle cover -1. to -3. *(Omitted)*
5.3.3 Load cases -1. to -2. *(Omitted)*	5.3.3 Load cases -1. to -2. *(Omitted)*
5.3.4 Strength evaluation -1. to -2. *(Omitted)*	5.3.4 Strength evaluation -1. to -2. *(Omitted)*
5.4 Evaluation in the event of the electrical power network loss 5.4.1 General -1. to -3. *(Omitted)* -4. When DLC6.2 is omitted from the design load cases applied to the integrated load analysis in accordance with -3. above, a test showing that the system using a power back-up operates as assumed in the design must be conducted before the start of operation, and a report must be made to ClassNK using time-series data on the operation of related equipment such as the yaw control equipment and power back-up. The test plan for this testing must be submitted to ClassNK for approval before the test is conducted.	5.4 Evaluation in the event of the electrical power network loss 5.4.1 General -1. to -3. *(Omitted)* *(added)*
5.4.2 Backup power supply -1. *(Omitted)* -2. When setting design values for yaw misalignment, the following items (1) to (8) must be evaluated and confirmed under site-specific extreme wind speed conditions. In addition, the validity of the evaluation and confirmation of these items must be shown by measured data. If no measured data under conditions corresponding to the site-specific extreme wind speed have been obtained at the time of the design, then in order to confirm after the start of operations that the operation control assumed in the design can be appropriately performed under conditions corresponding to the site-specific extreme wind speed, an environment should be prepared to enable the collection of measured data (the history of the wind conditions (wind speed and wind direction) near the wind turbine and the history of the wind turbine operation control (nacelle orientation) and operating conditions corresponding to those wind conditions), and when this data has been obtained, it must be reported to ClassNK. *(Omitted)*	5.4.2 Backup power supply -1. *(Omitted)* -2. When setting design values for yaw misalignment, the following items (1) to (8) must be evaluated and confirmed under site-specific extreme wind speed conditions. In addition, the validity of the evaluation and confirmation of these items must be shown by measured data. *(added)* *(Omitted)*

After revision	Before revision
5.5 Evaluation to secure a safe state on the wind turbine 5.5.1 General -1. A wind turbine must be equipped so as not to come into contact with other structures, plants, etc., during operation.	5.5 Evaluation to secure a safe state on the wind turbine *(added)*
5.5.2 Safe and automatic shutdown of wind turbines -1. Even in the following cases, there shall be a function to stop safely and automatically, and also the safe state after stopping shall be maintained. It should be noted that for these items, it is necessary to conform to Article 7 of the Interpretation of Technical Standards for Wind Power Generation Facilities[J-04]. *(Omitted)* -2. *(Omitted)*	5.5.1 Safe and automatic shutdown of wind turbines -1. Even in the following cases, there shall be a function to stop safely and automatically, and also the safe state after stopping shall be maintained. *(added)* *(Omitted)* -2. *(Omitted)*
5.5.3 Protection against lightning strikes -1. to -3. *(Omitted)* -4. *(Omitted)* (1) The lightning protection through which the current generated by a lightning strike can flow safely into the ground without damaging the structures that support the wind turbine must conform to JIS C 1400-24:2014[R-07]. (2) *(Omitted)* -5. *(Omitted)*	5.5.2 Protection against lightning strikes -1. to -3. *(Omitted)* -4. *(Omitted)* (1) The lightning protection through which the current generated by a lightning strike can flow safely into the ground without damaging the structures that support the wind turbine must conform to JIS C 1400-24:2014[R-08]. (2) *(Omitted)* -5. *(Omitted)*

Chapter 6. Support structure design evaluation

After revision	Before revision
6.1 General 6.1.1 General -1. The structural integrity of the support structure for the site conditions is confirmed by using integrated load analysis to indicate that there is sufficient strength against the site-specific loads. In addition, for the tower part of the support structures, the prerequisites are that the design has obtained type certification, and that the tower has been manufactured at a manufacturing site specified in the certification documents pertaining to the type certification. -2. The design of the support structure (tower and foundation) shall comply with the following ministerial ordinances and guidelines, etc. (1) *(Omitted)* (2) Interpretation of Technical Standards for Wind Power Generation Facilities[J-04] (3) *(Omitted)* (4) *(Omitted)* -3. *(Omitted)* -4. *(Omitted)* -5. It should be noted that if -3. and -4. above apply, then it is necessary to conduct a separate manufacturing evaluation for the tower in light of the prerequisites of -1. above.	6.1 General 6.1.1 General *(added)* -1. The design of the support structure (tower and foundation) shall comply with the following ministerial ordinances and guidelines. (1) *(Omitted)* *(added)* (2) *(Omitted)* (3) *(Omitted)* -2. *(Omitted)* -3. *(Omitted)* *(added)*
6.2 Support structure (Tower) 6.2.1 General -1. In the design of the support structure (tower), if any item does not satisfy the provisions in 6.1.1-2., then it shall be shown that the item satisfies the required criteria regarding safety that are defined by the provisions in 6.1.1-2. -2. In the case of -1. above, if the design is based on the method shown in Annex F, and it is confirmed by the Support Structure Certification Subcommittee/Tower Section Meeting that the contents of it are satisfied, then it may be considered that the required criteria regarding safety that are defined by the provisions in 6.1.1-2 are satisfied for the item. -3. If it is necessary to conduct a manufacturing evaluation for the tower, ClassNK will individually specify when and how the results of the manufacturing evaluation shall be confirmed, based on the content indicated in 1.5.5-1. (8).	6.2 Support structure (Tower) 6.2.1 General -1. In the design of the support structure (tower), if any item does not satisfy the provisions in 6.1.1-1., then it shall be shown that the item satisfies the required criteria regarding safety that are defined by the provisions in 6.1.1-1. -2. In the case of -1. above, if the design is based on the method shown in Annex F, and it is confirmed by ClassNK that the contents of it are satisfied, then it may be considered that the required criteria regarding safety that are defined by the provisions in 6.1.1-1 are satisfied for the item. *(added)*

After revision	Before revision
6.3 Support structure (Foundation) 6.3.1 General -1. In the design of the support structure (foundation), if any item does not satisfy the provisions in 6.1.1-2., then it shall be shown that the item satisfies the required criteria regarding safety that are defined by the provisions in 6.1.1-2. -2. In the case of -1. above, if the design is based on the method shown in Annex G, and it is confirmed by the Support Structure Certification Subcommittee/Foundation and Ground Section Meeting that the contents of it are satisfied, then it may be considered that the requirements regarding safety that are defined by the provisions in 6.1.1-2 are satisfied for the item.	6.3 Support structure (Foundation) 6.3.1 General -1. In the design of the support structure (foundation), if any item does not satisfy the provisions in 6.1.1-1., then it shall be shown that the item satisfies the required criteria regarding safety that are defined by the provisions in 6.1.1-1. *(added)*
6.3.2 Strength evaluation for support structure (foundation) -1. *(Omitted)* (1) The bearing capacity of piles must be additionally evaluated by the formula prescribed in the Recommendations for Design of Building Foundations[R-03]. (2) *(Omitted)* (3) The horizontal resistance of piles must be additionally evaluated by a method using the group pile frame model specified in the Recommendations for Design of Building Foundations[R-03]. (4) to (5) *(Omitted)* (6) When applying certified construction methods in the field of architecture, etc., it is necessary to sufficiently confirm that the application of those methods is acceptable. (In particular, it may be that the scope of certification is limited to the primary design, so it must be checked whether it can be applied to the secondary design, etc.)	6.3.2 Strength evaluation for support structure (foundation) -1. *(Omitted)* (1) The bearing capacity of piles must be additionally evaluated by the formula prescribed in the Recommendations for Design of Building Foundations[R-06]. (2) *(Omitted)* (3) The horizontal resistance of piles must be additionally evaluated by a method using the group pile frame model specified in the Recommendations for Design of Building Foundations[R-06]. (4) to (5) *(Omitted)* *(added)*
6.3.3 Items to be considered in the design -1. *(Omitted)*	6.3.3 Items to be considered in the design -1. *(Omitted)*

Annex A. Measurement data evaluation methods [normative]

After revision	Before revision
A.1 Selection of measurement points -1. to -3. *(Omitted)* *(Deleted)*	A.1 Selection of measurement points -1. to -3. *(Omitted)* -4. When measurement must be carried out in the vicinity of an existing wind turbine that is in operation, a point which is not affected by the wake of that wind turbine must be selected. If the separation distance from that wind turbine is 10D or more (D: Rotor diameter of the wind turbine in operation), the wind turbine may be treated as one that is not affected by the wake.
A.2 Wind speed measurement by measurement mast -1. *(Omitted)* -2. The cup type anemometer is calibrated before the measurement period, and the calibration value is used in the wind condition evaluation. The calibration of the cup-type anemometer shall be performed in accordance with the procedure described in Annex F of JIS C 1400-12-1:2010[R-06] or in a procedure judged to be equivalent, and the calibration results shall be attached to the report. -3. *(Omitted)* -4. The installation of a wind speed anemometer on a measurement mast shall be in a manner that minimizes the effect on the anemometer from the mast and boom. It is desirable that the installation of a wind speed anemometer on a measurement mast follows Annex G of JIS C 1400-12-1:2010[R-06]. It is desirable that the boom installation is at an orientation that is 45° from the principal wind direction in the case of a cylindrical mast, and 90° from the principal wind direction in the case of a truss structure. When a lightning rod is installed, it is installed at a position where it will not affect the anemometer. -5. The 10 minute average and standard deviation of the wind speed are measured. It is desirable that the sampling frequency is 1 Hz or higher. In addition, MEASNET[R-16], [A1] can be used as a reference for the calibration, installation method, equipment configuration, and test method, etc. -6. *(Omitted)*	A.2 Wind speed measurement by measurement mast -1. *(Omitted)* -2. The cup type anemometer is calibrated before the measurement period, and the calibration value is used in the wind condition evaluation. The calibration of the cup-type anemometer shall be performed in accordance with the procedure described in Annex F of JIS C 1400-12-1:2010[R-07] or in a procedure judged to be equivalent, and the calibration results shall be attached to the report. -3. *(Omitted)* -4. The installation of a wind speed anemometer on a measurement mast shall be in a manner that minimizes the effect on the anemometer from the mast and boom. It is desirable that the installation of a wind speed anemometer on a measurement mast follows Annex G of JIS C 1400-12-1:2010[R-07]. It is desirable that the boom installation is at an orientation that is 45° from the principal wind direction in the case of a cylindrical mast, and 90° from the principal wind direction in the case of a truss structure. When a lightning rod is installed, it is installed at a position where it will not affect the anemometer. -5. The 10 minute average and standard deviation of the wind speed are measured. It is desirable that the sampling frequency is 1 Hz or higher. In addition, MEASNET[R-17], [A1] can be used as a reference for the calibration, installation method, equipment configuration, and test method, etc. -6. *(Omitted)*
A.3 Wind direction measurement by measurement mast -1. The wind direction measurement is carried out by using a vane type anemometer. It is desirable to install one at each altitude to form pairs with the wind speed anemometers described in A.2. The installation of a wind direction anemometer on a measurement mast shall be in a manner that minimizes the effect on the anemometer from the mast and boom. It is desirable that the installation of a wind direction anemometer on a measurement mast follows Annex G of JIS C 1400-12-1:2010[R-06]. -2. *(Omitted)*	A.3 Wind direction measurement by measurement mast -1. The wind direction measurement is carried out by using a vane type anemometer. It is desirable to install one at each altitude to form pairs with the wind speed anemometers described in A.2. The installation of a wind direction anemometer on a measurement mast shall be in a manner that minimizes the effect on the anemometer from the mast and boom. It is desirable that the installation of a wind direction anemometer on a measurement mast follows Annex G of JIS C 1400-12-1:2010[R-07]. -2. *(Omitted)*

After revision	Before revision
A.4 Measurement using remote sensing devices -1. *(Omitted)* -2. For the measurement heights, the essential measurement heights shall be the height of the anemometer on the measurement mast with which the correlation is being confirmed, and the hub height of the planned wind turbine. Other heights shall be set appropriately up to close to the top of the rotor plane, with one every 10 m as the standard setting. -3. *(Omitted)* -4. If the correlation between the measurement data of the remote sensing equipment and of the measurement mast does not satisfy the requirements, the effect of the topographic complexity, and of the characteristics of the measurement method of the using equipment may be corrected using the results of airflow analysis, etc.	A.4 Measurement using remote sensing devices -1. *(Omitted)* -2. For the measurement heights, the essential measurement heights shall be the height of the anemometer on the measurement mast with which the correlation is being confirmed, and the hub height of the planned wind turbine. Other heights shall be set appropriately, with one every 10 m as the standard setting. -3. *(Omitted)* *(added)*
A.5 Measurements and evaluation report of measurement results -1. *(Omitted)* -2. *(Omitted)* (1) to (2) *(Omitted)* (3) Wind shear exponent: a. The average value of the wind shear exponent, described in tabular form with a wind direction sector width of 30° or less. (4) *(Omitted)* (5) *(Omitted)* (6) *(Omitted)* (7) *(Omitted)*	A.5 Measurements and evaluation report of measurement results -1. *(Omitted)* -2. *(Omitted)* (1) to (2) *(Omitted)* *(added)* (3) *(Omitted)* (4) *(Omitted)* (5) *(Omitted)* (6) *(Omitted)*
A.6 Measurement at a point affected by the wake of an existing wind turbine -1. When measurement must be carried out in the vicinity of an existing wind turbine that is in operation, a point which is not affected by the wake of the existing wind turbine should be selected, but, due to various constraints, there are cases where measurement must be carried out at a point where the wake effect of an existing wind turbine cannot be eliminated. This paragraph summarizes the items that should be considered in such cases. -2. If the separation distance between the measurement mast and the existing wind turbine is 10D or more (D: Rotor diameter of the existing wind turbine), the measurement data may be treated as data that is not affected by the wake.	*(added)*

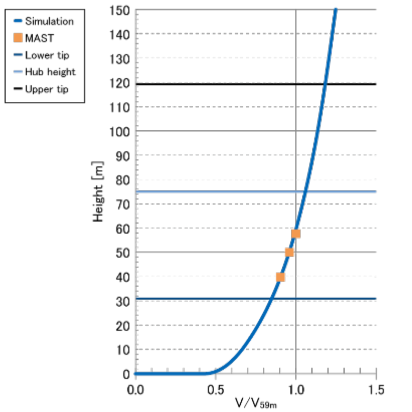
After revision	Before revision
-3. If the measurement data within the disturbed sector specified in IEC61400-12-1: 2017[R-17] is rejected and the effective data rate of the remaining data satisfies the provisions of 2.2.2-2., the measurement data may be treated as data that is not affected by the wake. -4. If neither of the items -2. and -3. above is satisfied, consider performing simultaneous measurement using a wind condition measurement mast and remote sensing equipment and then performing correction for the wake effect of the existing wind turbine. [A2]	
A.7 Reference documents [A1] *(Omitted)* [A2] Yoshida et al., Study on the method of wind turbine wake effect exclusion from wind condition measurement data in an existing wind farm, Proceedings of the 44th Wind Energy Symposium, pp. 199-201, 2022.	A.6 Reference documents [A1] *(Omitted)* *(added)*

Annex B Airflow analysis and verification of its validity [normative]

After revision	Before revision
B.1 Airflow analysis B.1.1 Topographic data and ground surface roughness data -1. to -3. *(Omitted)*	B.1 Airflow analysis B.1.1 Topographic data and ground surface roughness data -1. to -3. *(Omitted)*
B.1.2 Measurement region -1. to -3. *(Omitted)*	B.1.2 Measurement region -1. to -3. *(Omitted)*
B.1.3 Calculation grid and resolution -1. to -2. *(Omitted)*	B.1.3 Calculation grid and resolution -1. to -2. *(Omitted)*
B.1.4 Boundary conditions -1. to -2. *(Omitted)*	B.1.4 Boundary conditions -1. to -2. *(Omitted)*
B.1.5 Direction division -1. to -2. *(Omitted)*	B.1.5 Direction division -1. to -2. *(Omitted)*
B.2 Verification of airflow analysis validity B.2.1 Verification of validity of airflow analysis applied to the calculation of wind conditions during power production -1. to -2. *(Omitted)* -3. The vertical profiles of the wind shear by wind direction are normalized by the wind speed at the highest point on the measurement mast, and then the comparison of the measurement data with the airflow analysis results must be conducted in a format following the example shown in Figure B.2. However, if there is measurement data by a vertical lidar, it should be normalized by the wind speed at hub height in a format following the example shown in Figure B.3. The following points should be kept in mind when preparing figures. − In all cases, the horizontal axis should start at 0. − The airflow analysis results should be displayed to the horizontal axis 0 position. − An auxiliary line should be inserted at the position where the horizontal axis is 1.0. − If displacement height is taken into account, it should be clarified that the value is consistent with the figure. -4. With regard to the turbulence intensity by wind direction, use the turbulence energy *k* of the *k-epsilon* model, etc., in the airflow analysis and obtain the standard deviation of the wind speed fluctuation in the principal wind direction that arises due to the terrain and surface roughness σ_u^{surf} by using equation (B.1). Also, the wind speed U obtained from the airflow analysis and equation (B.2) must be used to	B.2 Verification of airflow analysis validity B.2.1 Verification of validity of airflow analysis applied to the calculation of wind conditions during power production -1. to -2. *(Omitted)* -3. The vertical profiles of the wind shear by wind direction are normalized by the wind speed at the highest point on the measurement mast, and then the comparison of the measurement data with the airflow analysis results must be conducted in a format following the example shown in Figure B.2. However, if there is measurement data by a vertical lidar, it should be normalized by the wind speed at hub height in a format following the example shown in Figure B.3. *(added)* -4. With regard to the turbulence intensity by wind direction, use the turbulence energy *k* of the *k-epsilon* model, etc., in the airflow analysis and obtain the standard deviation of the wind speed fluctuation in the principal wind direction that arises due to the terrain and surface roughness σ_u^{surf} by using equation (B.1). Also, the wind speed U obtained from the airflow analysis and equation (B.2) must be used to

<table>
<tr><th>After revision</th><th>Before revision</th></tr>
<tr><td>calculate I_{sim} and then compare the result with the turbulence intensity obtained from measurement data. In this case, in principle, the wind speed bin corresponding to 15 m/s shall be applied, but the wind speed bin may be changed depending on the measurement data (the number of measurement points per wind speed bin, etc.). However, the wind speed bin selected should be appropriately stated.

(Omitted)



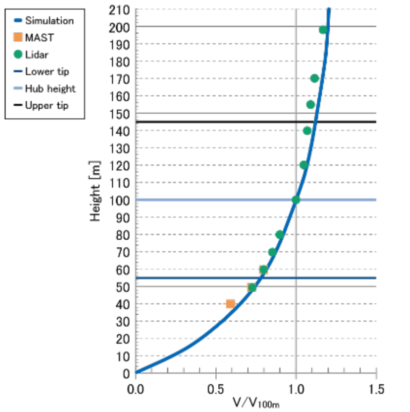
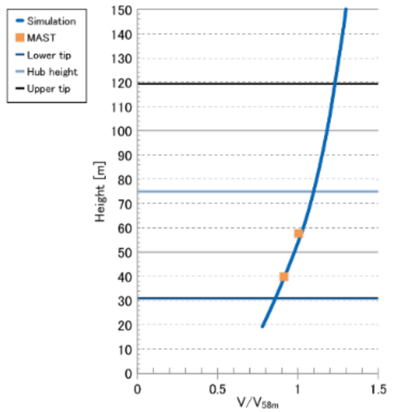


Figure B.2 Measurement mast only (Displacement height not set)
Figure B.3 Measurement mast + vertical lidar (Displacement height not set)</td><td>calculate I_{sim} and then compare the result with the turbulence intensity obtained from measurement data. In this case, in principle, the wind speed bin corresponding to 15 m/s shall be applied, but the wind speed bin may be changed depending on the measurement data (the number of measurement points per wind speed bin, etc.). *(added)*

(Omitted)



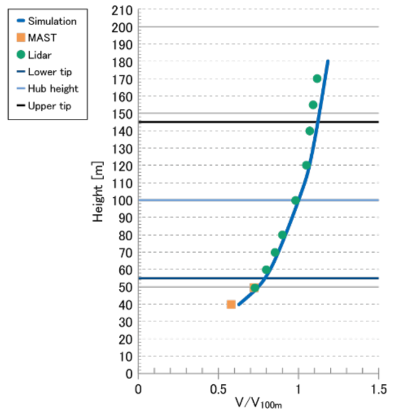


Figure B.2 Measurement mast only *(added)*
Figure B.3 Measurement mast + vertical lidar *(added)*</td></tr>
<tr><td>B.2.2 Verification of validity of airflow analysis applied to the calculation of wind conditions during parked by storm
-1. *(Omitted)*</td><td>B.2.2 Verification of validity of airflow analysis applied to the calculation of wind conditions during parked by storm
-1. *(Omitted)*</td></tr>
<tr><td>B.3 Report on airflow analysis and its validity
B.3.1 Report on the airflow analysis applied to the wind conditions during power production and its validity
-1. *(Omitted)*</td><td>B.3 Report on airflow analysis and its validity
B.3.1 Report on the airflow analysis applied to the wind conditions during power production and its validity
-1. *(Omitted)*</td></tr>
<tr><td>B.3.2 Report on the airflow analysis applied to the wind conditions during parked by storm and its validity
-1. Reports on the airflow analysis applied to the calculation of the wind conditions during parked by storm and on the verification of the validity of that analysis shall include at least the following items.</td><td>B.3.2 Report on the airflow analysis applied to the wind conditions during parked by storm and its validity
-1. Reports on the airflow analysis applied to the calculation of the wind conditions during parked by storm and on the verification of the validity of that analysis shall include at least the following items.</td></tr>
</table>

After revision	Before revision
(1) Details of the airflow analysis (including the following content): a. to c. *(Omitted)* d. The following items when a method that considers the wind directional characteristics shown in C.3.1-4. (2) is applied 1) Probability distribution function for typhoon parameters 2) Probability distribution chart for typhoon parameters from analysis results	(1) Details of the airflow analysis (including the following content): a. to c. *(Omitted)* *(added)*
(2) Results of validity verification (including the following content): a. Results of comparison of the airflow analysis with the measurement data regarding the average wind speed by wind direction b. Results of comparison of the airflow analysis with the measurement data regarding the vertical profiles of wind shear by wind direction c. Results of comparison of the airflow analysis with the measurement data regarding the turbulence intensity by wind direction d. The following items when a method that considers the wind directional characteristics shown in C.3.1-4. (2) is applied 1) Figure comparing the typhoon simulation results (upper air winds due to the hypothetical typhoon) with the measured values (upper air winds calculated from the atmospheric pressure in the typhoon database) 2) Figure showing the non-exceedance probability distribution of the annual maximum wind speed due to typhoons on flat terrain and on the actual terrain 3) Figure showing the validity of the setting of the wind direction to be verified e. When the simulation results are an underestimation in d. above, the results of consideration of the effects of uncertainty related to the number of years of analysis and the number of years of atmospheric pressure measurement	(3) Results of validity verification (including the following content): a. Results of comparison of the airflow analysis with the measurement data regarding the average wind speed by wind direction b. Results of comparison of the airflow analysis with the measurement data regarding the vertical profiles of wind shear by wind direction c. Results of comparison of the airflow analysis with the measurement data regarding the turbulence intensity by wind direction *(added)*

Annex C Evaluation method for wind conditions [informative /partially normative]

After revision	Before revision
C.1 General -1. to -2. *(Omitted)*	C.1 General -1. to -2. *(Omitted)*
C.2 Wind conditions during power production C.2.1 Wind speed appearance frequency distribution and average wind speed -1. to -3. *(Omitted)*	C.2 Wind conditions during power production C.2.1 Wind speed appearance frequency distribution and average wind speed -1. to -3. *(Omitted)*
C.2.2 Calculation method for turbulence intensity -1. to -3. *(Omitted)*	C.2.2 Calculation method for turbulence intensity -1. to -3. *(Omitted)*
C.2.3 Calculation method for wind shear exponent -1. to -2. *(Omitted)*	C.2.3 Calculation method for wind shear exponent -1. to -2. *(Omitted)*
C.2.4 Calculation method for flow inclination angle -1. to -2. *(Omitted)*	C.2.4 Calculation method for flow inclination angle -1. to -2. *(Omitted)*
C.2.5 Calculation method for atmospheric density -1. to -2. *(Omitted)*	C.2.5 Calculation method for atmospheric density -1. to -2. *(Omitted)*
C.3 Wind conditions during parked by storm C.3.1 Calculation method for extreme wind speed (10 minutes average wind speed with a return period of 50 years) -1. *(Omitted)* -2. The ground surface roughness classification at the wind turbine position is determined according to the Ministry of Construction Notification No. 1454 in 2000 (Ministry of Land, Infrastructure, Transport and Tourism Notification No. 1437) according to Table C.1.	C.3 Wind conditions during parked by storm C.3.1 Calculation method for extreme wind speed (10 minutes average wind speed with a return period of 50 years) -1. *(Omitted)* -2. The ground surface roughness classification at the wind turbine position is determined according to the Building Standards Act or by the situation of the ground surface around the wind power generation facility support according to Table C.1.

After revision	Before revision
Table C.1 Categorization of ground surface roughness classifications Roughness class / Ground surface conditions around the construction site I: Areas specified in a regulation by a Designated Administrative Agency as being extremely flat and having no obstacles II: Of the areas other than the areas in the ground roughness classes I and IV, the areas where the distance to the shoreline or lake shoreline (This is limited to cases where the distance to the opposite shore is 1,500 m or more. The same shall apply hereafter.) is 500 m or less (Excluding in cases where the height of the building is 13 m or less, or the distance to the shoreline or lake shoreline exceeds 200 m and the height of the building is 31 m or less.), or areas other than such areas which are specified in a regulation by a Designated Administrative Agency as being extremely flat and interspersed with obstacles. III: Areas other than roughness class I, II or IV IV: Areas specified in a regulation by a Designated Administrative Agency as being extremely urbanized	Table C.1 Categorization of ground surface roughness classifications Roughness class / Ground surface conditions around the construction site I: Areas with few obstacles, such as the surface of a sea or lake II: Areas where the obstacles are only around the level of farm products, such as pastoral areas and grasslands, areas where trees and low-rise buildings, etc., are scattered III: Areas with many trees and low-rise buildings, or areas where medium-rise buildings (4 to 9 floors) are scattered IV: Urban areas mainly consisting of medium-rise buildings
-3. *(Omitted)*	-3. *(Omitted)*
Table C.2 Parameters to determine the altitude correction coefficient for average wind speed Roughness class: I, II, III, IV Z_b: 5, 5, 5, 10 Z_G: 250, 350, 450, 550 α: 0.10, 0.15, 0.20, 0.27	Table C.2 Parameters to determine the altitude correction coefficient for average wind speed Roughness class: I, II, III, IV Z_b: 5, 5, 10, 20 Z_G: 250, 350, 450, 550 α: 0.1, 0.15, 0.2, 0.27
-4. The topographic multiplier for the average wind speed E_{tV} and the wind direction to be verified θ_d are determined by either of the following methods (1) and (2). (1) Method that does not consider the wind directional characteristics *(Omitted)*	-4. The topographic multiplier for the average wind speed E_{tV} and the wind direction to be verified θ_d are determined by either of the following methods (1) and (2). (1) Method that does not consider the wind directional characteristics *(Omitted)*

After revision	Before revision
$$E_{tV} = max(E'_{tV}(\theta_d),\ 1),\ E'_{tV}(\theta_d) = max\left(E'_{tV}(\theta)\right),\ E'_{tV}(\theta) = \frac{U\ (x,\ y,\ H_h,\ \theta)}{U^P(x,\ y,\ H_h)} \quad (\text{C}.16)$$ (2) Method that considers the wind directional characteristics The topographic multiplier for the average wind speed E_{tV} is decided by the equation (C.17) based on the results of typhoon simulations for the wind turbine construction site. Here, $U_{50}(x,\ y,\ H_h)$ is the expected annual maximum wind speed with a return period of 50 years at the hub height H_h at the wind turbine construction site, which is obtained by statistical analysis from the result of the typhoon simulation, and $U_{50}^P(x,\ y,\ H_h)$ is the expected annual maximum wind speed with a return period of 50 years at the hub height above flat terrain of the ground surface roughness classification. In addition, the wind direction to be verified θ_d shall be the wind direction corresponding to $U_{50}(x,\ y,\ H_h)$. The validity of the simulation results must be sufficiently confirmed by comparing them with the measured values. Further, if the comparison of the typhoon simulation results (upper air winds due to the hypothetical typhoon) with the measured values (upper air winds calculated from the atmospheric pressure in the typhoon database) indicates that the simulation results are an underestimation, additional consideration must be given to the effects of uncertainty related to the number of years of analysis and the number of years of atmospheric pressure measurement. In addition, the validity of the setting of the wind direction to be verified must be sufficiently confirmed.	$$E_{tV} = max(E'_{tV},\ 1), \qquad E'_{tV} = \max_{\theta}\left(\frac{U\ (x,\ y,\ H_h,\ \theta)}{U^P(x,\ y,\ H_h)}\right) \quad (\text{C}.16)$$ (2) Method that considers the wind directional characteristics The topographic multiplier for the average wind speed E_{tV} is decided by the equation (C.17) based on the results of typhoon simulations for the wind turbine construction site. Here, $U_{50}(x,\ y,\ H_h)$ is the expected annual maximum wind speed with a return period of 50 years at the hub height H_h at the wind turbine construction site, which is obtained by statistical analysis from the result of the typhoon simulation, and $U_{50}^P(x,\ y,\ H_h)$ is the expected annual maximum wind speed with a return period of 50 years at the hub height above flat terrain of the ground surface roughness classification. In addition, the wind direction to be verified θ_d shall be the wind direction corresponding to $U_{50}(x,\ y,\ H_h)$. Furthermore, it must be sufficiently confirmed that there is no problem with the application of the typhoon simulation by conducting a comparison with measurement values, etc., in addition to checking the validity of the simulation itself.
C.3.2 Extreme wind speed (Calculation method for 3 seconds average wind speed) C.3.2.1 Calculation method for turbulence intensity -1. to -2. *(Omitted)* -3. The correction coefficient for the turbulence intensity due to the terrain E_{tI} is determined by the equation (C.20). Of the methods shown in C.3.1-4., if the method selected is (1) Method that does not consider the wind directional characteristics, then $E'_{tV}(\theta_d)$ is obtained by equation (C.16), and if the method selected is (2) Method that considers the wind directional characteristics, then it is obtained by equation (C.21). Here, $U\ (x, y, H_h, \theta)$ is the average wind speed obtained by airflow analysis for wind direction θ at hub height H_h at the wind turbine construction site on the actual terrain, and $U^P(x, y, H_h)$ is the average wind speed at the hub height H_h at the wind turbine construction site that was obtained by airflow analysis for flat terrain of ground surface roughness classification P.	C.3.2 Extreme wind speed (Calculation method for 3 seconds average wind speed) C.3.2.1 Calculation method for turbulence intensity -1. to -2. *(Omitted)* -3. The correction coefficient for the turbulence intensity due to the terrain E_{tI} is determined by the equation (C.20). Here, the topographic multiplier for the average wind speed E'_{tV} is obtained by using equation (C.21) based on the results of airflow analysis by wind direction on the actual terrain and on flat terrain. Here, $U\ (x, y, H_h, \theta)$ is the average wind speed obtained by airflow analysis for wind direction θ at hub height H_h at the wind turbine construction site on the actual terrain, and $U^P(x, y, H_h)$ is the average wind speed at the hub height H_h at the wind turbine construction site that was obtained by airflow analysis for flat terrain of ground surface roughness classification P.

After revision	Before revision
$$E_{tI}=max(E_{tS}(\theta_d)/E'_{tV}(\theta_d),\ 1) \quad (C.20)$$ $$E'_{tV}(\theta_d)=\frac{U\,(x,\ y,\ H_h,\ \theta_d)}{U^P(x,\ y,\ H_h)} \quad (C.21)$$ -4. The correction coefficient for the fluctuating wind speed due to the terrain E_{tS} is determined by equation (C.22) <u>regardless of whether the method selected is (1) Method that does not consider the wind directional characteristics or (2) Method that considers the wind directional characteristics in C.3.1-4</u>. Here, $\sigma_u(x,y,H_h,\theta_d)$ is the standard deviation of the wind speed fluctuation in the principal wind direction at the hub height H_h in the wind direction to be verified on the actual terrain θ_d, and $\sigma_u^P(x,y,H_h)$ is the standard deviation of the wind speed fluctuation in the principal wind direction at the hub height H_h on flat terrain with a ground surface roughness classification P, which are obtained from airflow analysis. $$E_{tS}(\theta_d)=\frac{\sigma_u(x,y,H_h,\theta_d)}{\sigma_u^P(x,y,H_h)} \quad (C.22)$$ -5. *(Omitted)*	$$E_{tI}=max(E_{tS}/E'_{tV},\ 1) \quad (C.20)$$ $$E'_{tV}=\max_{\theta}\left(\frac{U\,(x,y,H_h,\theta)}{U^P(x,y,H_h)}\right) \quad (C.21)$$ -4. The correction coefficient for the fluctuating wind speed due to the terrain E_{tS} is determined by the equation (C.22). Here, $\sigma_u(x,y,H_h,\theta_d)$ is the standard deviation of the wind speed fluctuation in the principal wind direction at the hub height H_h in the wind direction to be verified on the actual terrain θ_d, and $\sigma_u^P(x,y,H_h)$ is the standard deviation of the wind speed fluctuation in the principal wind direction at the hub height H_h on flat terrain with a ground surface roughness classification P, which are obtained from airflow analysis. $$E_{tS}=\frac{\sigma_u(x,y,H_h,\theta_d)}{\sigma_u^P(x,y,H_h)} \quad (C.22)$$ -5. *(Omitted)*
C.3.2.2 Calculation method for 3 seconds average wind speed -1. *(Omitted)*	C.3.2.2 Calculation method for 3 seconds average wind speed -1. *(Omitted)*
C.3.2.3 Calculation method for wind shear for extreme wind speed -1. *(Omitted)*	C.3.2.3 Calculation method for wind shear for extreme wind speed -1. *(Omitted)*
C.3.3 Calculation method for U_{e50} using wind condition measurement data [informative] -1. to -2. *(Omitted)*	C.3.3 Calculation method for U_{e50} using wind condition measurement data [informative] -1. to -2. *(Omitted)*
C.4 Reports on wind conditions C.4.1 Report on wind conditions during power production -1. *(Omitted)*	C.4 Reports on wind conditions C.4.1 Report on wind conditions during power production -1. *(Omitted)*
C.4.2 Report on wind conditions during parked by storm -1. to -2. *(Omitted)*	C.4.2 Report on wind conditions during parked by storm -1. to -2. *(Omitted)*
C.4.3 Other conditions	C.4.3 Other conditions

After revision	Before revision
-1. to -2. *(Omitted)*	-1. to -2. *(Omitted)*
C.5 Reference documents *(Omitted)*	C.5 Reference documents *(Omitted)*

Annex D Equivalent wind pressure coefficient for the nacelle cover [informative]

After revision	Before revision
D.1 General -1. to -2. *(Omitted)*	D.1 General -1. to -2. *(Omitted)*
D.2 Equivalent wind pressure coefficient [Wind direction: -15° to +15°] -1. to -2. *(Omitted)*	D.2 Equivalent wind pressure coefficient [Wind direction: -15° to +15°] -1. to -2. *(Omitted)*
D.3 Equivalent wind pressure coefficient [Wind direction: All wind directions] -1. to -2. *(Omitted)*	D.3 Equivalent wind pressure coefficient [Wind direction: All wind directions] -1. to -2. *(Omitted)*
D.4 Reference documents *(Omitted)*	D.4 Reference documents *(Omitted)*

Annex E Measurement testing for fluctuating pressure characteristics acting on a nacelle surface [informative]

After revision	Before revision
E.1 General -1. *(Omitted)*	E.1 General -1. *(Omitted)*
E.2 Selection of wind tunnel -1. *(Omitted)*	E.2 Selection of wind tunnel -1. *(Omitted)*
E.3 Model and test conditions E.3.1 Model -1. *(Omitted)*	E.3 Model and test conditions E.3.1 Model -1. *(Omitted)*
E.3.2 Airflow similarity -1. *(Omitted)*	E.3.2 Airflow similarity -1. *(Omitted)*
E.3.3 Wind speed and wind direction in test implementation -1. *(Omitted)*	E.3.3 Wind speed and wind direction in test implementation -1. *(Omitted)*
E.3.4 Pressure measurement instrument -1. *(Omitted)*	E.3.4 Pressure measurement instrument -1. *(Omitted)*
E.3.5 Data processing and recording -1. to -2. *(Omitted)*	E.3.5 Data processing and recording -1. to -2. *(Omitted)*
E.3.6 Maximum/minimum peak wind pressure coefficient -1. to -2. *(Omitted)*	E.3.6 Maximum/minimum peak wind pressure coefficient -1. to -2. *(Omitted)*
E.4 Reference documents *(Omitted)*	E.4 Reference documents *(Omitted)*

Annex F Design methodologies for tower structures [normative]

After revision	Before revision
F.1 General -1. This Annex summarizes the tower structure-related items where the method has been established for items that deviate from the Guidelines for Design of Wind Turbine Support Structures and Foundation[J-05]. -2. This Annex presents examples of methods based on past examination cases and does not deny the application of other methods.	F.1 General -1. This Annex summarizes the methods that meet the requirements for general facility, in 2. (3) [2] specified in the Implementation procedures for the examination of construction plans for the installation or modification of wind power plants[R-03]. *(added)*
F.2 Attenuation -1. For the first and second mode structural damping ratios for cylindrical steel structures, the values obtained from equation (F.1) and equation (F.2)[R-08] [R-11] [F1] may be applied. When using values other than this, it is necessary to explain the validity of the values. In addition, for the modal damping ratio that consists of the structural damping and ground damping, evaluation is possible in the method shown in the reference document[F2]. Furthermore, in the time history response analysis using the SR model, the soil damping is considered as a dashpot[F2]. *(Omitted)*	F.2 Attenuation -1. For the first and second mode structural damping ratios for cylindrical steel structures, the values obtained from equation (F.1) and equation (F.2)[R-09] [R-12] [F1] may be applied. When using values other than this, it is necessary to explain the validity of the values. In addition, for the modal damping ratio that consists of the structural damping and ground damping, evaluation is possible in the method shown in the reference document[F2]. Furthermore, in the time history response analysis using the SR model, the soil damping is considered as a dashpot[F2]. *(Omitted)*
F.3 Anchor bolt hole diameter -1. *(Omitted)* [1] The hole diameter of anchor bolts shall not exceed the clearance based on the nominal bolt diameter specified in ISO273[R-10]. [2] Following the Guidebook on Design and Fabrication of High Strength Bolted Connections[R-04], if the nominal bolt diameter exceeds 24 mm, the hole diameter may be the bolt diameter + 8 mm on the premise that the slip resistance is reduced (reduction factor: 0.85). Therefore, in the most severer loading conditions based on the site conditions, the horizontal force due to the shear force and torsional moment acting on the tower base, and the frictional force (resistance friction force) on the underside of the base plate should be compared considering the reduction factor of 0.85, and it must be confirmed that the "Resistance friction force considering horizontal force/reduction factor" is less than 1.0.	F.3 Anchor bolt hole diameter -1. *(Omitted)* [1] The hole diameter of anchor bolts shall not exceed the clearance based on the nominal bolt diameter specified in ISO273[R-11]. [2] Following the Guidebook on Design and Fabrication of High Strength Bolted Connections[R-05], if the nominal bolt diameter exceeds 24 mm, the hole diameter may be the bolt diameter + 8 mm on the premise that the slip resistance is reduced (reduction factor: 0.85). Therefore, in the most severer loading conditions based on the site conditions, the horizontal force due to the shear force and torsional moment acting on the tower base, and the frictional force (resistance friction force) on the underside of the base plate should be compared considering the reduction factor of 0.85, and it must be confirmed that the "Resistance friction force considering horizontal force/reduction factor" is less than 1.0.
F.4 Design applying the fatigue equivalent design method in structural calculations for anchor bolts -1. *(Omitted)* (1) *(Omitted)* (2) *(Omitted)* 1) Principle for conducting fatigue strength evaluation	F.4 Design applying the fatigue equivalent design method in structural calculations for anchor bolts -1. *(Omitted)* (1) *(Omitted)* (2) *(Omitted)* 1) Principle for conducting fatigue strength evaluation

After revision	Before revision

After revision

- According to the requirement by 7.4.1 in the Guidelines for Design of Wind Turbine Support Structures and Foundation[J-05], the degree of fatigue damage shall be determined by the cumulative fatigue damage rule.

2) The requirements for each item to be considered shall be as shown in Table F.1.

Table F.1 Items to be considered for fatigue strength evaluation and their requirements

Items to be considered	Applicable specifications and standards	Requirements
Anchor bolts	EN 1993-1-9: 2005[R-12]	*(Omitted)*
Grout/Concrete	MC2010[R-13] (MC1990[R-14] is also possible)	*(Omitted)*

*1: See the column of requirements for DC50 on Table 8.1 of EN 1993-1-9: 2005[R-12].

(In addition, refer to the Guidance note in Paragraph 4.12.3.6 of DNVGL-ST-0126[R-15].)

(Omitted)

Before revision

- This shall follow item 7.4.1 in the Guidelines for Design of Wind Turbine Support Structures and Foundation[J-05], and the degree of fatigue damage shall be determined by the cumulative fatigue damage rule.

2) The requirements for each item to be considered shall be as shown in Table F.1.

Table F.1 Items to be considered for fatigue strength evaluation and their requirements

Items to be considered	Applicable specifications and standards	Requirements
Anchor bolts	EN 1993-1-9: 2005[R-13]	*(Omitted)*
Grout/Concrete	MC2010[R-14] (MC1990[R-15] is also possible)	*(Omitted)*

*1: See the column of requirements for DC50 on Table 8.1 of EN 1993-1-9: 2005[R-13].

(In addition, refer to the Guidance note in Paragraph 4.12.3.6 of DNVGL-ST-0126[R-12].)

(Omitted)

After revision

F.5 Lever ratio of flange joint

-1. *(Omitted)*

Before revision

F.5 Lever ratio of flange joint

-1. *(Omitted)*

After revision

F.6 Design applying the fatigue equivalent design method in structural calculations for flange joints

-1. *(Omitted)*

(1) *(Omitted)*

(2) *(Omitted)*

1) Principle for conducting fatigue strength evaluation

- According to the requirement by 7.4.1 in the Guidelines for Design of Wind Turbine Support Structures and Foundation[J-05], the degree of fatigue damage shall be determined by the cumulative fatigue damage rule.

2) The requirements for each item to be considered shall be as shown in Table F.2.

Table F.2 Items to be considered for fatigue strength evaluation and their requirements

Items to be considered	Applicable specifications and standards	Requirements
Flange bolt	EN 1993-1-9: 2005[R-12]	• When considering only the axial force on the flange bolt and not bending, apply

Before revision

F.6 Design applying the fatigue equivalent design method in structural calculations for flange joints

-1. *(Omitted)*

(1) *(Omitted)*

(2) *(Omitted)*

1) Principle for conducting fatigue strength evaluation

- This shall follow item 7.4.1 in the Guidelines for Design of Wind Turbine Support Structures and Foundation[J-05], and the degree of fatigue damage shall be determined by the cumulative fatigue damage rule.

2) The requirements for each item to be considered shall be as shown in Table F.2.

Table F.2 Items to be considered for fatigue strength evaluation and their requirements

Items to be considered	Applicable specifications and standards	Requirements
Flange bolt	EN 1993-1-9: 2005[R-13]	• When considering only the axial force on the anchor bolt and not bending, apply

<table>
<tr><th>After revision</th><th>Before revision</th></tr>
<tr><td>

		DC36* as the S-N diagram. *1 • The size effect reduction factor: ks shall be considered.

*1: See the column of requirements for DC50 on Table 8.1 of EN 1993-1-9: 2005[R-12].
(In addition, refer to the Guidance note in Paragraph 4.12.3.6 of DNVGL-ST-0126[R-15].)
</td><td>

		DC36* as the S-N diagram. *1 • The size effect reduction factor: ks shall be considered.

*1: See the column of requirements for DC50 on Table 8.1 of EN 1993-1-9: 2005[R-13].
(In addition, refer to the Guidance note in Paragraph 4.12.3.6 of DNVGL-ST-0126[R-12].)
</td></tr>
<tr><td>F.7 Distance between flange bolt centers in circumferential direction
-1. If the distance between the centers of the flange bolts in the circumferential direction does not satisfy the dimensional specifications in 7.3.3 (1) 2) of the Guidelines for Design of Wind Turbine Support Structures and Foundation[J-05], the following must be satisfied.
(1) For the tower flange connection, perform finite element analysis for each case where the distance between the centers of the flange bolts in the circumferential direction is 1) and 2) below, and indicate the effect that the difference in the center-to-center distance has on bolt tension, stress, etc., against the site ultimate load (short-term, extremely rare earthquake, IEC load). In the case of 2), also confirm from the results of the finite element analysis that the tower flange connection is structurally safe.
1) In the case of 2.0D (D: nominal bolt diameter), which is the dimensional specification in 7.3.3 (1) 2) of the Guidelines for Design of Wind Turbine Support Structures and Foundation[J-05]
2) In the case where the planned distance between the centers of the flange bolts in the circumferential direction is (< 2.0D)
(2) The validity of the model and analysis method for the finite element analysis used in (1) above must be verified by comparison with the results of structural experiments, or by reproducing the contents of previous literature.</td><td>(added)</td></tr>
<tr><td>F.8 Tower opening
-1. For the tower opening, in a case where the tower opening is not provided with a reinforcing material that satisfies the dimensional provisions of 7.3.5 (2) 1) of the Guidelines for Design of Wind Turbine Support Structures and Foundation[J-05], and the plate thickness around the opening is increased, the following details must be satisfied in accordance with the provisions of 7.3.5 (2) 2) of those Guidelines.
(1) In accordance with 7.3.3 of the Structural Design Recommendation for Chimneys[R-05], the checking of the strength of the opening in terms of bending moment and shear force must be performed for each load of the site ultimate load (long-term, short-term, rare earthquake, extremely rare earthquake and IEC load) calculated based on the site conditions. For the position of the cross-section check,</td><td>(added)</td></tr>
</table>

After revision	Before revision
perform finite element analysis for the opening and then the cross-section where the stress concentration is confirmed to be the most severe must be selected and appropriate consideration must be given to the stress concentration factor. (2) Fatigue strength checks against the site fatigue loads calculated based on the site conditions must be performed for the welds at the opening end and around the opening.	
F.9 Reference documents *(Omitted)*	F.7 Reference documents *(Omitted)*

Annex G Design methodologies for foundations [normative]

After revision	Before revision
G.1 General -1. This Annex summarizes the foundation-related items where the method has been established for items that deviate from the Guidelines for Design of Wind Turbine Support Structures and Foundation[J-05]. -2. This Annex presents examples of methods based on past examination cases and does not deny the application of other methods.	*(added)*
G.2 Special earthwork such as ground improvement -1. When ground improvement is carried out, in principle, the Foundation and Ground Section Meeting of the Support Structure Certification Subcommittee must conduct an examination according to the situation of each site. -2. When strength correction using rubble concrete is performed for the foundation floor, the item -1. above shall not apply if the depth of that concrete is less than 3 m.	*(added)*
G.3 Handling of seismic response analysis for the ground -1. If the shearing strain exceeds 1% in the results of the seismic response analysis for the ground, then it is not permitted to follow the response calculation flow for liquefied ground that is described in the Guidelines for Design of Wind Turbine Support Structures and Foundation[J-05] (p. 170, Illustration 5.11), so at the subject point, it is not permitted to apply equivalent linear analysis or simplified liquefaction analysis in which the equivalent stiffness of the liquefied layer multiplied by the stiffness reduction rate is set. -2. In the case of -1. above, the following analyses must be performed, depending on whether liquefaction is considered or not. (1) When liquefaction is not considered: Sequential nonlinear - Total stress analysis (2) When liquefaction is considered: Sequential nonlinear - Effective stress analysis (Time-history nonlinear analysis considering the soil nonlinearity accompanying the increase in the shear strain and the increase in the excess pore water pressure) -3. In a case where sequential nonlinear - effective stress analysis is performed in -2. above, the basis for setting the ground model (stress-strain model) and its validity must be shown. -4. If the shearing strain does not exceed 1% in the results of the seismic response analysis for the ground, but the response calculation flow for liquefied ground that is described in the Guidelines for Design of Wind Turbine Support Structures and Foundation[J-05] (p. 170, Illustration 5.11) is not followed and sequential nonlinear - effective stress analysis is applied, then the validity of the analysis results must be shown. (Example: For representative cases, perform comparisons of the equivalent linear analysis and simplified liquefaction analysis in which the equivalent stiffness of the liquefied layer multiplied by the stiffness reduction rate is set.)	*(added)*

After revision	Before revision
-5. When the inclination of the engineering base surface is 5 degrees or more, the existence of effects from the inclination of the engineering base surface must be checked. (Example: Perform seismic response analysis using the ground response at the wind turbine site that was evaluated by finite element analysis (2-D), and then perform a comparison with the seismic response analysis results evaluated using the ground response of a 1-D parallel stratified ground at the time of design.)	
G.4 Handling related to time history response analysis -1. When setting ground springs and attenuation by using the thin layer method, the basis for that setting and its validity must be shown. In particular, for attenuation, it must be clearly stated how the attenuation coefficient C was set in the form shown in Illustration 5.19 of the Guidelines for Design of Wind Turbine Support Structures and Foundation[J-05].	*(added)*
G.5 Pile design -1. When the pile response is calculated using a separated model in which the wind turbine and foundation response analysis is performed separately to the pile response analysis, the value of the ultimate bending strength Mu of the pile divided by the maximum bending moment M during extremely rare earthquakes should not be less than 1.2. However, this does not apply when coupled analysis of the pile response is performed in an integrated model of the wind turbine/foundation and pile, and it has been confirmed that the analysis is valid. -2. For the shear checks for piles during extremely rare earthquakes, the evaluation may be performed using the ultimate strength rather than the short-term allowable value if the following items are satisfied. (1) The ultimate shear capacity of piles is evaluated based on each of the Pile Foundation Design Manual[G1] and Strength and Deformation Capacity of Foundation Structural Members[G2], and it is confirmed to be within the allowable value. (2) The tolerance to shear based on the allowable value evaluated in (1) above exceeds the tolerance to bending, and it has been confirmed that it is a failure mode where bending failure will occur first.	*(added)*
G.6 Reference documents [G1] Pile Foundation Design Manual (Japan Road Association, September 2020) [G2] Strength and Deformation Capacity of Foundation Structural Members (Architectural Institute of Japan, 2022)	*(added)*